Module I

POPULATION WELFARE PROGRAM

An Essential Element of Universal Health Coverage

World Health Organization

CONTENT

SECTION ONE
ORIENTATION 1

1.1 OVERVIEW OPF THE CURRICULUM 3
1.2 A ORGANOGRAM OF REGIONAL INSTITUTE....................9
1.3 PAKISTAN NURSING COUNCIL (PNC) LICENSING PROCESS....................11
1.4 PAKISTAN POPULATION SCENARIO....................15
1.5 DEMOGRAPHY....................24
1.6 POPULATION DYNAMICS....................38
1.7 CONCEPT OF FAMILY IN ISLAM....................42
1.8 POPULATION WELFARE PORAGRAM....................44
1.9 ORGANIZATIONAL SET UP OF DISTRICT....................52
1.10 REPRODUCTIVE HEALTH SERVICES CENTRE....................55
1.11 JOB DESCRIPTION FOR FWWs....................59

SECTION TWO
LIFE SCIENCES 66

2.1 BODY FLUIDS....................68
2.2 SOLUTIONS....................76
2.3 FLUID, ELECTROLYTE AND ACID BASE BALANCE....................83
2.4 WATER BALANCE FLUID AND ELECTROLYTE REPLACEMENT....................90
2.5 UNDERSTANDING ELECTROLYTE DISORDERS....................95
2.6 MACRONUTRIENTS, ENZYMES AND HORMONES....................103

SECTION THREE
IMMUNITY AND INFECTION PREVENTION 127

3.1 MICROBIOLOGY....................129
3.2 CLASSIFICATION OF MICRO-ORGANISMS:....................135
3.3 USEFUL MICRO-ORGANISMS....................140
3.4 IMMUNITY....................146
3.5 HYPERSENSITIVITY / HYPER IMMUNE REACTIONS....................151
3.6 INFECTION....................157
3.7 COMMONLY USED TERMS IN INFECTION PREVENTION....................172
3.8 INFECTION PREVENTION....................178
3.9 INFECTION PREVENTION PRACTICES....................182
3.10 INFECTION PREVENTION PRACTICE FOR INSTRUMENT PROCESSING..205
3.11 MEDICAL WASTE MANAGEMENT....................217
3.12 HEALTH-CARE FACILITY RECOMMENDATIONS FOR STANDARD PRECAUTIONS BY WHO **....................229**
3.13 THE CONCEPT OF DISEASE....................233
3.14 HAND WASHING....................239

SECTION FOUR

NUTRITION **249**

4.1 NUTRITION AND NUTRIENTS 251
4.2 ENERGY CONTENT OF NUTRIENTS 257
4.3 BASAL METABOLISM 263
4.4 ROLE OF NUTRITION IN HEALTH MAINTENANCE 268
4.5 NUTRITIONAL REQUIREMENTS THROUGHOUT THE LIFE CYCLE 274
4.6 ACCESSORY ORGANS FOR DIGESTION: 281
4.7 BASIC FOOD GROUPS 286
4.8 BALANCED DIET 292
4.9 NEED FOR A BALANCED DIET 299
4.10 MALNUTRITION 305
4.11 FOOD HYGIENE 328
4.12 EFFECT OF COOKING ON THE NUTRITIVE VALUE OF FOOD: 337

SECTION ONE

ORIENTATION

1.1 OVERVIEW OF THE CURRICULUM

1.1 OVERVIEW OF THE CURRICULUM

RATIONALE FOR REVISION OF CURRICULUM

The future role of FWW has been expanded considering urgent need for reducing population growth, reducing morbidity and mortality rate of women and children. The FWWs are now expected to provide safe and quality RH, FP and midwifery services at individual, family, and community level

Current evidence suggests that a 10% increase in deliveries by skilled health workers can lead to a reduction of 5% in maternal deaths (State of World Midwifery, 2014). Major changes in the FWW curriculum will include adding of midwifery services including preconception and antenatal care, conducting normal deliveries, care of new-born, and post-natal care of women and children.

The revision of FWW curriculum has been according to Pakistan Nursing Council (PNC) guidelines, Higher Education (HEC) policies and ICM Essential Competencies for Basic Midwifery Practice (2018) to meet national needs and keep up with international trends. The FWW education program is of three years integrating theoretical with clinical component. For FWWs to function effectively and provide safe and quality services they need to conform to a professional and ethical framework. The preparation of competent and proficient FWW is primarily dependent on provision of high-quality robust education program. The FWW program has been designed to educate females who can provide competent RH and FP care including midwifery preventive and curative care to individuals, families and communities.

Overview of FWW curriculum

To facilitate expanded role of FWW the revised curriculum is spread over three years of competency-based education. This 36-month course of study will enable FWWs to practice all components of RH & FP as well as basic midwifery services. Moreover, some courses are added to enable her for admission in higher education and to equip her to perform her duties at health facility efficiently in accordance with her revised job description. The extended curriculum includes basic computer learning, public health principles & practice, communication skills, health education, leadership, and data management.

The sequence and content of the FWW curriculum is hoped to enable the student to acquire essential competencies for safe and quality care for all components of Reproductive Health and Family Planning services, and midwifery practice. The curriculum is compliant to PNC standards and to deliver WHO (World Health Organization) Basic EmNOC(emergency obstetrics and new born care course) protocols. More emphasis is placed on practical training sessions and students are expected to gain clinical experience of RH & FP components, Maternal New born and Child Health (MNCH) services in hospitals, communities in rural and urban settings including primary health care facilities.

Goals of FWW program

- To provide Reproductive Health and Family Planning (RH & FP) services to the population across the life span, including preventive, curative, and rehabilitative health care services to individuals, families, and communities.

- Address different dimensions of population growth and associated health care within national laws, ethical considerations and development priorities while adhering to social and cultural norms
- Understand the aspects of working with community and characteristics of family in the community and manage their problems and needs
- Develop an understanding of the components of RH package for delivering comprehensive safe and quality services that will enable an individual to make healthy choices and to receive appropriate care
- Provide effective and safe care to women during all stages of pregnancy for healthy outcome.
- Conduct spontaneous normal vaginal delivery of a healthy baby
- Identify obstetrical disorders/complications and refer to appropriate health facilities
- Counsel couples on various contraceptive methods based on evidence-based practices to ensure safe and effective outcomes.
- Develop adequate knowledge, skills, and attitudes to identify and treat selected minor ailments and gynecological disorders and refer complicated cases to appropriate health facilities
- Apply infection control practices to provide safe, effective, and ethical practices to individual, family and community.
- Develop an understanding of sexual and reproductive health of adolescents, identify their health problems and their management.
- Appreciate the factors that contribute to gender-based issues and the impact on health status and access to health.

Learning outcomes

After completion of the updated education program the FWWs should be able to:

- Integrate theoretical and clinical knowledge into delivering comprehensive safe and quality care related to all components of RH, FP and midwifery services to individuals, family and community at all levels of care.
- Manage Family Welfare Centers and maintain an inventory, registers, records and periodic reports
- Conduct health education sessions to individuals, family and community based on need related to RH, FP and Midwifery services and within socio-cultural context
- Counsel women, adolescents, infertile couples, families and communities based on identified needs and within the scope of practice of FWWs
- Collaborate and network with communities and other health care providers to maximize the delivery of cost efficient and effective care and build strong referral system
- Utilize critical thinking and decision-making skills to solve individual, family and

community health problems.

Academic Calendar

The curriculum includes both theory and clinical elements with ratio of 40% theory and 60% clinical (practice) component.

The training course is organized in six Semesters and each semester will be of 18 weeks with 16 weeks of teaching and two weeks of review and examinations according to HEC guidelines.

Total credit hours of FWW Associate degree program will be 101 credits, maximum 18 credits per semester average credits per course will be 3 credits and last semester will largely comprise internship on the clinical area to strengthen RH & FP and midwifery competencies.

This follows National Qualifications Framework of Pakistan 2015 Ordinary Bachelor/ Associate Degree 3 years/90-108 credit hours (page 13).

One year = two semesters = 18 weeks per semester =18 weeks classes, 2 weeks examinations.

The program is 36 months over three years two semesters per year 52 weeks per year (52 weeks per year in which 36 weeks are Academic and 4 weeks' vacation, and 4 weeks for Final Assessment. 8 weeks remaining can be utilized for remedial work (self-study, library and revision hours) or clinical experience as per guidelines of HEC.

One credit hour = one hour of theory class per week or 18 hours per semester

One credit hour = three hours of clinical learning per week or 54 hours per semester

Total hours available per semester 6 hours per day = 36 hours per week

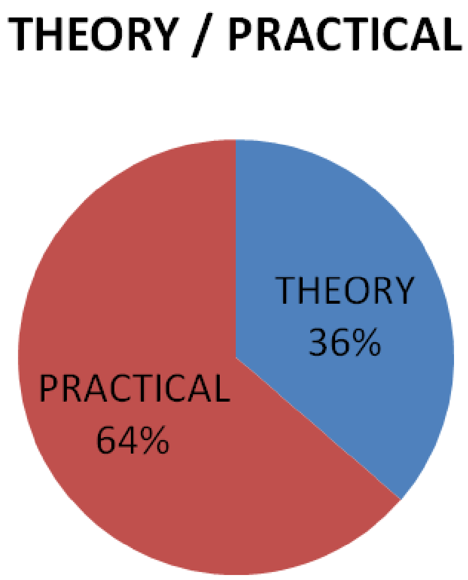
36 x 18 weeks= 648 (2 weeks' vacation, 2 weeks Final Assessment, 4 Weeks Remedial work/clinical experience)36x8=288

Hours per semester 36x26=936 (648 + 288)

1872 per year x 3 = 5616 hours

For this program 5616 hours have been scheduled.

DESCRIPTION	HOURS
Theory	1089
Practical	1863
Total Academic Hours (Excluding Hours of Vacation, Final Assessment and Remedial/ Clinical Experience)	2952
Total Program Hours	36 *156 weeks = 5616 hours
Total curriculum hours (details below)	5616 hours



The Curriculum

Semester- I

- Orientation (Population Demographics)
- Life Sciences/ Midwifery Sciences
- Microbiology (Infection Control)
- Nutrition Across Lifecycle
- Computer and Information Technology (Tele-health)
- Pakistan Studies
- English (Functional) (1st Year)

Semester- II

- Introduction to RH Package

- Drug Dosage Calculation and Pharmacology
- Health Education, Communication (VCAT) & Counseling (E learning)
- Basic Anatomy and Physiology

Semester- III

- Family Planning and Contraceptive Technology
- Human Rights approach to FP, RH & MCH (Ethical and Legal Considerations)
- Common Ailment and Gynecological Disorders
- First Aid and Handling Emergencies
- English (2nd Year)

Semester- IV

- Embryology, Preconception Care and Antenatal Care
- Normal Labour and its Complications
- Post-natal Care
- Abortion, Post abortion care (PAC), Healthy Timing and Spacing of Pregnancy (HTSP) and Post Abortion Family Planning (PPFP)

Semester-V

- English (3rd Year)
- Care of New-born and Complications
- Early Childhood Development and Growth Milestones
- Leadership and Management (Professionalism, Management of FWC)
- Entrepreneurship
- Working with Community (PHC)
- Islamic Studies / Ethics

Semester-IV

- Clinical Internship including Clinical Seminar

1.2 A SAMPLE ORGANOGRAM OF REGIONAL TRAINING INSTITUTE, LARKANA

1.2 A SAMPLE ORGANOGRAM OF REGIONAL TRAINING INSTITUTE, LARKANA

PRINCIPAL (BS- 19)

ADMINISTRATIVE SECTION

1	Administrative Officer (BS-16)	(1)
2	Accountant (BS-16)	(1)
3	LDC (BS-14)	(1)
4	Driver (BS-05)	(3)
5	Naib Qasid (BS-02)	(3)
6	Chowkidar (BS-02)	(1)
7	Mali (BS-2)	(1)
8	Sweeper	(1)

TRAINING SECTION

1	Deputy Principal (BS-18)	(1)
2	Senior Instructor (BS-18)	(2)
3	Instructor (BS-17)	(2)
4	Assistant Sister Tutor (BS-14)	(2)
5	Assistant Sister Tutor (BS-14)	(2)
6	Projectionist (BS-12)	(1)
7	Family Welfare Counsellor (BS-11)	(1)
8	Family Welfare Worker (BS-8)	(2)
9	Family Welfare Assistant M/F (BS-5)	(2)
10	Aya (BS-02)	(1)

HOSTELS

11	Warden (BS-11)	(1)
12	Aya (BS-02)	(1)
13	Chowkidar (BS-02)	(1)
14	Sweeper (BS-02)	(1)

1.3 PAKISTAN NURSING COUNCIL LICENSURE FOR FWW

1.3 Pakistan Nursing Council (PNC) Licensing Process

Introduction to PNC:

The PNC is an autonomous, regulatory body constituted under the Pakistan Nursing Council Act (1952, 1973) and empowered to register (license) Nurses, Midwives, Lady Health Visitors (LHVs) and Nursing Auxiliaries to practice in Pakistan and was established in 1948.

What is a License?

Generally, a "license" is permission granted by a qualified authority permitting a licensee to do something that would otherwise be prohibited. "License" may also refer to a physical document granting such permission, sometimes referred to as a permit.

Significance of license:

- Nursing regulation is designed to protect public safety; therefore, effective regulation is essential to promote better patient safety and improved health outcomes.
- Nursing practice is governed by state and territorial nurse practice act and regulatory procedures.

Benefits of PNC license

- To provide safe care to patient.
- Professional nurses reduce the chance of error.
- Legal Protection to the registered professional
- To improve health outcomes.

Current process /Requirement of Pakistan Nursing Council License:

There are two modes of PNC registration

- Online mode
- Offline mode

ONLINE MODE:

- Registration can be processed through PNC online portal. This is completely paperless process for registration. PNC accepts all online applications and send their registration to the professionals on their home/work address. (https://online.pnc.org.pk/login)

OFFLINE MODE:

- This is another option for professionals to apply for registration/renewal. Registration form and other requirements can be downloaded from PNC website (http://pnc.org.pk/PNC_Registration.htm). Registration form required document and fee can be sent PNC by post or can submit on PNC counter by hand.

Documents Required for Initial Registration:

- PNC processing fee slip. 02 Nos. Fresh Photograph (Passport size, white background and attested on back side
- Attested Photocopy of CNIC
- Attested Photocopies of all Diplomas / Degrees (Professional Diploma/Degrees i.e. Nurse, Midwife, LHV, FWW, BSN etc.)
- Internship Certificate for GBSN Graduates (Successful completion of one-year internship is a mandatory requirement for GBSN graduated to get PNC Registration.)
- Attested Photocopy of Matric Certificate
- Attested Photocopy of Domicile Certificate.

Note: Documents should be made attested from Gazettes officer (Nursing Professionals only).

Documents Required for Renewal:

- PNC processing fee slip.
- Original Registration Card
- 02 Nos. Fresh Photograph (Passport size, white background and attested on back side)
- Attested Photocopy of CNIC
- Attested Photocopies of all Diplomas / Degrees (Professional Diploma/Degrees i.e. Nurse, Midwife, LHV, FWW, BSN etc).
- Attested Photocopies of Matric certificate.
- Attested Photocopy of Domicile Certificate.

Role of PNC bodies:

- Attested Photocopy of Domicile Certificate.
- PNC sets the curriculum for the education of Nurses, Midwives, LHVs and Nursing Auxiliaries.
- PNC provides registration (license) to practice.
- PNC maintains standards of education and practice.
- PNC plays an advisory role for the overall benefit of Nurses, Midwives, LHVs, FWW and Nursing Auxiliaries in the country.

Functions of PNC:

- PNC plays an advisory role for the overall benefit of Nurses, Midwives, LHVs, FWW and Nursing Auxiliaries in the country.
- Issue licenses and manage renewal process.
- Establish nursing practice nursing.

- Regulate advanced practice nursing.
- Approve operation of nursing education programs.
- Investigate complaints against licensed practitioners.
- Hold disciplinary hearings, suspending or revoking licensure if necessary.
- Promulgate all rules related to the regulation of nursing practice.

Future Recommendations:

- Promulgate all rules related to the regulation of nursing practice.
- All Nursing professionals are expected to maintain continued competency to practice through various means of continue education.
- Institution must create a criterion for renewal of license examination.
- Ranging from 20 to 40 continue education hours over two to three - year period required for renewal of license should be compulsory.

1.4 PAKISTAN POPULATION SCENARIO

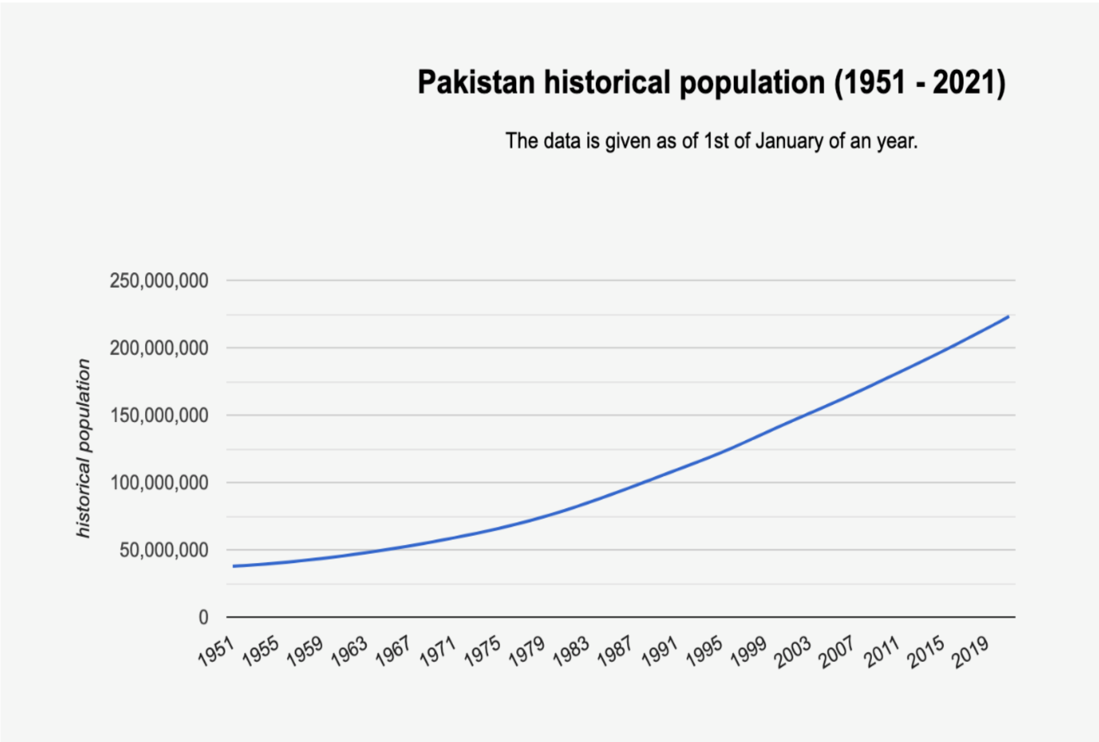
1.4 Pakistan Population Scenario

During 2021 Pakistan population is projected to increase by 4,696,856 people and reach 228,037,618 in the beginning of 2022. The natural increase is expected to be positive, as the number of births will exceed the number of deaths by 4,967,099. If external migration will remain on the previous year level, the population will be declined by 270,242 due to the migration reasons. It means that the number of people who leave Pakistan to settle permanently in another country (emigrants) will prevail over the number of people who move into the country (to which they are not native) to settle there as permanent residents (immigrants).

Population Changes Rates In 2021

According to estimations, daily change rates of Pakistan population in 2021 will be as follows:

- 18,210 live births average per day (758.75 in an hour)
- 4,601 deaths average per day (191.73 in an hour)
- -740 emigrants average per day (-30.85 in an hour)



The population of Pakistan will be increasing by 12,868 persons daily in 2021.

Quick facts about the population of Pakistan

Current population (as of Thursday, March 25, 2021)	224,408,814
Population rank	5 (2.85% of world population)
Total area	796,100 km^2 (307,376 mi^2)
Population density	281.9 per km^2 (730.1 people/mi^2)
Sex ratio	1.03 (114,027,437 men to 110,382,603 women)
Median age	22.5 years
Life expectancy	66.0 years (64.2 - men, 67.9 - women)
Literacy	58.7 %

(Population figures are estimates by Countrymeters based on the latest United Nations data)

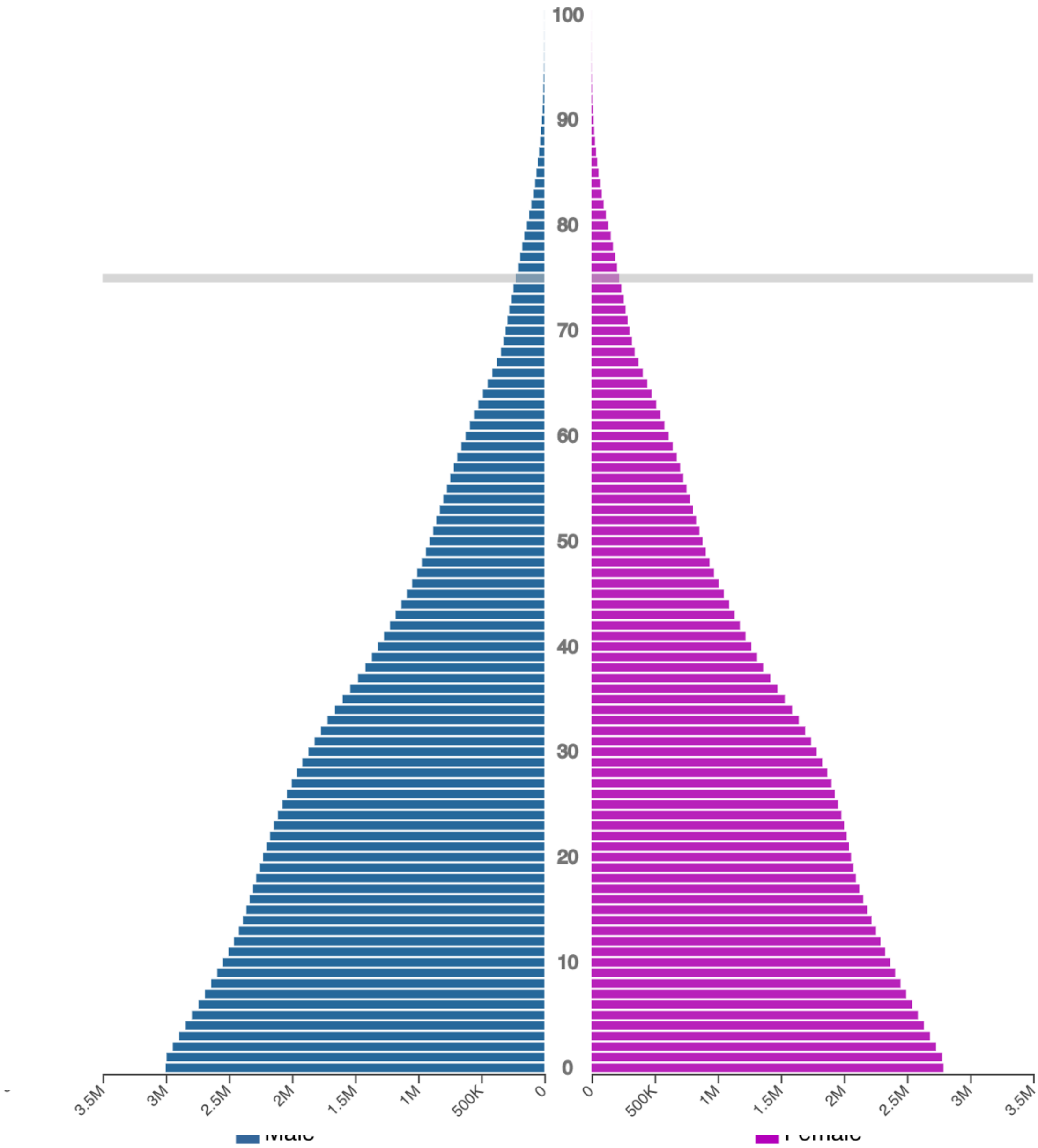
Demographics of Pakistan 2020

As of 1 January 2021, the population of Pakistan was estimated to be 223,340,762 people. This is an increase of 2.10 % (4,600,116 people) compared to population of 218,740,646 the year before. In 2020 the natural increase was positive, as the number of births exceeded the number of deaths by 4,864,792. Due to external migration, the population declined by 264,676. The sex ratio of the total population was 1.033 (1,033 males per 1,000 females) which is higher than global sex ratio. The global sex ratio in the world was approximately 1,016 males to 1,000 females as of 2020.

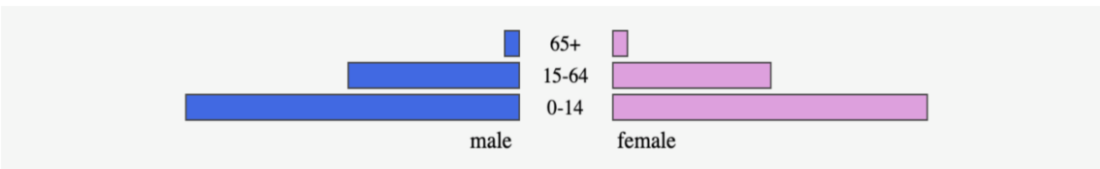
Below are the key figures for Pakistan population in 2020:

- 6,509,722 live births
- 1,644,930 deaths
- Natural increase: 4,864,792 people
- Net migration: -264,676 people
- 113,320,682 males as of 31 December 2020
- 110,020,080 females as of 31 December 2020

Pakistan Population Pyramid 2021



A simplified model of the population distribution pyramid is made which is broken down into 3 main age groups. The groups are the same as were used above: population under 15, between 15 and 64 and population which is over 65-year-old.

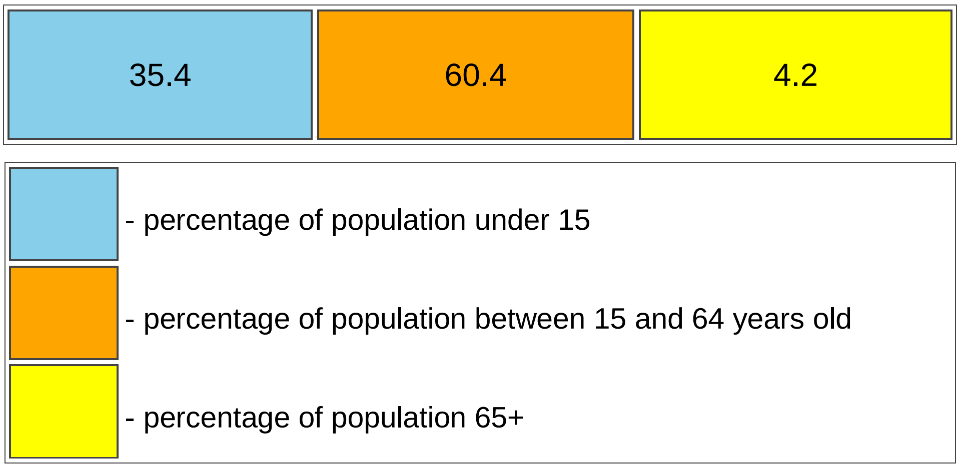


As we can see the Pakistan population pyramid has an expanding type. This type of pyramid is common for developing countries with high birth and death rates. Relatively short life expectancy, as well as low level of education and poor health care are also describing such kind of population age distribution model.

Source: The estimation data for section "Pakistan age structure" is based on the latest demographic and social statistics by United Nations Statistics Division

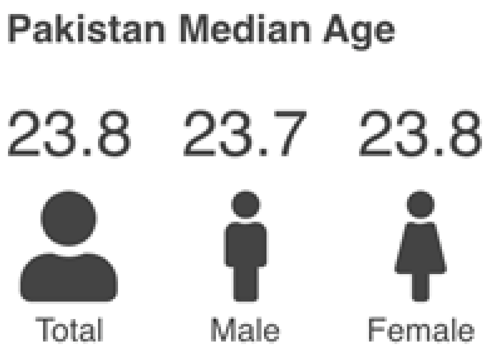
Pakistan Age Structure

As of the beginning of 2021 according to our estimates Pakistan had the following population age distribution:



In absolute figures (estimate):

- 79,125,165 young people under 15 years old (40,645,785 males / 38,481,613 females)
- 134,799,550 persons between 15 and 64 years old (69,622,016 males / 65,177,535 females)
- 9,416,047 persons above 64 years old (4,457,882 males / 4,955,932 females



Age Dependency Ratio

Dependency ratio of population is a ratio of people who are generally not in the labor force (the dependents) to workforce of a country (the productive part of population). The dependent part includes the population under 15 years old and people aged 65 and over. The productive part of population accordingly consists of population between 15 and 64 years. This ratio shows the pressure on productive population produced by the dependent part of population.

The total dependency ratio of population in Pakistan is 65.7 %.

What does this value mean? It shows that the dependent part of population is more than a half of the working part. It means that the working population (labor force) in Pakistan must provide goods for itself and cover expenditure on children and aged persons (this population is more than a half of working population). The value of more than 50% shows that the pressure on productive population in Pakistan is relatively high.

Child dependency ratio

Child dependency ratio is a ratio of people below working age (under 15) to workforce of a country. Child dependency ratio in Pakistan is 58.7 %.

Aged dependency ratio

Aged dependency ratio is a ratio of people above working age (65+) to workforce of a country. Aged dependency ratio in Pakistan is 7 %.

Source: The estimation data for section "Pakistan age dependency ratio" is based on the latest demographic and social statistics by United Nations Statistics Division

Life Expectancy

Life expectancy at birth is one of the most important demographic indicators. It shows the number of years a new born infant would live if birth and death rates will remain at the same level during the whole lifetime.

Total life expectancy (both sexes) at birth for Pakistan is 66 years.

This is below the average life expectancy at birth of the global population which is about 71 years (according to Population Division of the Department of Economic and Social Affairs of the United Nations).

Male life expectancy at birth is 64.2 years. Female life expectancy at birth is 67.9 years.

Literacy Of Population

According to our estimates 84,732,056 persons or 58.75% of adult population (aged 15 years and above) in Pakistan can read and write. Accordingly, about 59,481,309 adults are illiterate.

Literacy rate for adult male population is 71.5% (52,968,609 persons). 21,111,289 are illiterate.
Literacy rate for adult female population is 45.29% (31,763,447 persons). 38,370,020 are illiterate.

Youth literacy rates are 81.46% and 69.33% for males and females accordingly.

The overall youth literacy rate is 75.59%. Youth literacy rate definition covers the population between the ages of 15 to 24 years.

Source: The estimation data for section "Pakistan population literacy" is based on the latest data published by UNESCO Institute for Statistics (retrieved March 13, 2016)

Pakistan - A Profile

The country of Pakistan has a history that dates to almost 2,500 years B.C. It is one of the most highly advanced and highly developed civilizations of those ancient times. Finally becoming a sovereign state (and eventually recognized as an official mark on the map of the world) on August 14, 1947, this country is known for having deep roots in the Islamic religion. The country's capital is Islamabad, and the country features four different provinces: North West Frontier Province, Sindh, Baluchistan, and Punjab.

Pakistan Demographics

Pakistan is going through a new era of urbanization and the creation of a couple of megacities within the country. As of 2003, the country became one of the most urbanized cities in all of South Asia, mainly because city dwellers made up about 36 percent of its entire population at that point. About 50 percent of Pakistani citizens live in a place where at least 5,000 other citizens reside as well.

Most Pakistani people come from the ancestral group known as the Indo-Iranians. The largest ethnic group in Pakistan consists of those of Punjabi ethnicity, while Pashtuns and Sindhies are the second and third largest ethnic groups in the country, respectively. There is a special mixed ethnic group between the Punjabi ethnicity and the Sindhi ethnicity, and this group makes up about 10 percent of the entire Pakistani population.

The most popular language in Pakistan is Punjabi, a language in which 88 percent of the population speaks. Second is the language Saraiki, which is spoken by 10 percent of the population; and coming in third is the language Pashto, spoken by 15 percent of the population.

English is widely spoken throughout the government of Pakistan, mainly because it is the official language of the government of the country. Many government officials, civil servants, and members of the military speak English in their daily conversations and their meetings.

Pakistan Religion, Economy, and Politics

In the year 1984, the life expectancy of a Pakistani citizen was only at 56.9 years. As of the year 2002, the life expectancy has jumped up to 63 years of age. The improvement was a direct result of improved medical facilities and better educated health professionals available in the country. The downside, unfortunately, is that doctors and nurses are still in short number for the citizens that need them. There is only 1 nurse for every 3,700 people in the country. There are approximately 6 beds per thousand residing in Pakistan as well. If the country is looking to improve health among its citizens and continue to grow their life expectancy rate, then the number of available doctors and nurses needs to continue to grow. If these numbers do not improve, then the people of Pakistan will see their life expectancy rate dip back down to the numbers of the mid 1990's (59 years of age).

The life expectancies of males and females are generally the same in Pakistan. As of 2002, men were expected to live around 63.7 years, while women were expected to live 63.4 years. (These numbers are according to the National Institute of Population Studies.) In addition, the median age is only 23.8 years of age.

The access to clean drinking water and improved sanitation services are also important factors to consider in terms of quality of life. 91.4% of the population has improved access to clean drinking water while 8.6% still have unimproved access. When it comes to sanitation access, only 63.5% of the population has this available, while 36.5% still struggle.

Pakistan Population History

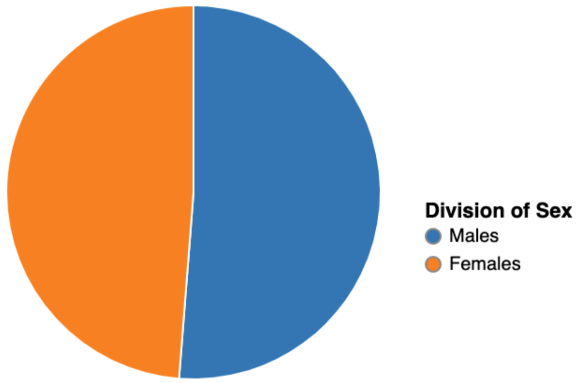
To break this down even more specifically, the population of Pakistan grew, on average, at a rate of 3 percent per year from 1951 until the middle of the 1980's decade. From the mid 1980's until the year 2000, the growth of the population slowed down to about 2.6 percent per year; and from 2000 to 2012, to about 2 percent per year. The reason for this slow population increase may be that the country spent a lot of time and effort to slow down the population growth. As a result of these efforts, it is a lot poorer than what is was a long time ago. If it did not make any effort to slow down its population increase, then there would be 49.13 million MORE people in the country than the current reports. But on the other end, they would also be a lot richer as a country. In other words, Pakistan, had it not slowed down its population increase, would be 52 percent richer than it is right now. Obviously, history cannot be changed, so the efforts have been switched to educating its population instead.

Census 2017

The 2017 Census of Pakistan was a detailed enumeration of the Pakistani population which began on 15 March 2017 and ended on 25 May 2017. The census was conducted by the Pakistan Bureau of Statistics for the first time in 21st century, after 19 years. Initial estimates estimated the population at 210–220 million. The provisional results were finally presented to the Council of Common Interests on 25 August 2017, and then approved and released to the public. The results showed a total population of Pakistan at 207,774,520 people. It didn't include the population of Pakistan's dependent territories Azad Kashmir and Baltistan. As of December 2020, the complete and results of the census had still not been published. On 22 December 2020, Pakistan government finally approved the 6th National Census-2017.

Results

The provisional results of the 2017 Census were presented to the Council of Common Interests on 25 August 2017. According to the results, the total population in Pakistan was 207,774,520, representing a 57% increase in 19 years The provisional results exclude data from Gilgit-Baltistan and Jammu & Kashmir, which was to be included in the final report in 2018. The urban population in Pakistan stood at 75,580,000 or 36.4% of the total population



Cites

The population of 10 major cities of the country has increased by 74.4 percent since 1998, when the last census was conducted, according to the data of recently concluded 6th Population and Housing Census 2017.The total population of the 10 cities surged to 40,956,232 individuals as per the 2017 census from 23,475,067 registered during the 1998 census, the data revealed

1.5 DEMOGRAPHY

1.5 DEMOGRAPHY

Demography is the scientific study of human population. It focuses its attention on three readily observable human phenomena:

a) Changes in population size (growth or decline)

b) Composition of the population

c) Distribution of population in space.

It deals with five demographic processes namely, fertility, mortality, marriage, migration, and social mobility. These five processes are continually at work within a population and determine its size, composition, and distribution.

Demographic Cycle:

The history of world population since 1650 suggests that there is a demographic cycle of 5 stages through which a nation passes, and these are:

First stage (High Stationary):

This stage is characterized by a high birth rate and a high death rate which cancel each other, and the population remains stationary.

Second stage (Early Expanding):

The death rate begins to decline, while the birth rate remains unchanged.

Third stage (Late Expanding):

The death rate declines still further, and the birth rate tends to fall. The population continues to grow because birth rate exceeds death rate.

Fourth stage (Low Stationary):

This stage is characterized by a low birth and low death rate with the result the population becomes stationary.

Fifth stage (Declining):

The population begins to decline because birth rate is lower than the death rate.

Demographic Indicators

The basic information regarding demographic studies is obtained through specific demographic indicators. The population indicators usually considered are rates and ratios.

A rate measures the occurrence of some event e.g., occurrence of disease in a population during a given time period. It is a statement of the risk of developing a condition. The rate is expressed per 1000 or some other round figure (10,000; 100,000) selected according to convenience or convention to avoid fractions.

Ratios express a relation in size between two random quantities broadly, ratio is the result of dividing one quantity by another e.g., female to male. 100:105.

Importance:

These indicators are needed to increase focus on certain issues and to assist decision makers at all levels to adopt sound and sustainable policies. It is important to take population trends and factors into account when building policies and programs. Wide adoption and use of these indicators would help improve information consistency at the national level.

- A specific set of indicators must be adapted to the area-specific conditions and needs.
- Indicators need to be revised and updated over a time, as new experience is gained, and new approaches and methodologies become available.
- Indicators help in specifying a number of selected priority issues identified at the local level as the local indicators may vary from those at the national level.

Crude Birth Rate (CBR)

CBR is defined as number of live births per thousand population per given year and is also known as birth rate

$$\text{CBR} = \frac{\text{Number of live births per given year}}{\text{Total Mid-year Population per given year}} \times 1000$$

Crude Death Rate (CDR)

CDR is defined as number of deaths per thousand population per given year.

$$\text{CDR} = \frac{\text{Number of deaths per given year}}{\text{Total Mid-year Population per given year}} \times 1000$$

Population Growth Rate (PGR)

It is defined as the percentage of population increased per given year as a result of natural events (births and deaths).

$$\text{Population Growth Rate} = \frac{\text{Total births per given year} - \text{Total deaths per given year}}{\text{Total Population}} \times 100$$

Doubling Time

It is the time taken for the population of a specific area to double. The formula used is called the Law of Seventy.

$$\text{Doubling Time} = \frac{\text{70 years}}{\text{Population Growth Rate}}$$

Infant Mortality Rate (IMR)

IMR is defined as deaths of infants (under one year of age) per thousand live births per given year.

$$\text{IMR} = \frac{\text{Number of deaths of infants per given year}}{\text{Total number of live births per given year}} \times 1000$$

Under-5 Mortality Rate

It is defined as deaths of children under 5 years of age per thousand live births per given year

$$\text{Under- 5 mortality Rate} = \frac{\text{Number of deaths of children under 5 years of age}}{\text{Total number of live births per given year}} \times 1000$$

Maternal Mortality Ratio (MMR)

MMR is defined as number of maternal deaths due to complications related to childbirth and pregnancy per 100,000 live births per given year.

$$\text{MMR} = \frac{\text{Number of maternal deaths caused by pregnancy and childbirth per given year}}{\text{Total births per given year}} \times 100{,}000$$

Total Fertility Rate (TFR)

TFR is defined as average number of children born to a woman during her entire reproductive life.

$$\text{TFR} = \frac{\text{Total number of births}}{\text{Total number of married women aged 15 to 49 years}}$$

Contraceptive Prevalence Rate (CPR)

CPR is defined as percentage of married couples of reproductive age using a contraceptive method.

Total married couples of reproductive age currently using any

$$CPR = \frac{\text{contraceptive method}}{\text{Total number of married eligible couples in reproductive age}} \times 100$$

PDHS 2018-19

Adverse Effects of Over Population In Pakistan

Unchecked Growth of Population in Cities:

In past 30 years the population has multiplied itself three times. When people live in congested areas, there is lack of fresh air, environmental sanitation, proper refuse / disposal of garbage and sewage. This leads to low living standards, unhygienic living conditions and increased incidence of diseases.

When people leave a village in search of better jobs, work etc and go to the cities which are already overcrowded, the cities grow bigger and bigger. Thus, increasing population puts an extra burden on the living standards of the people, like lack of water supply, fuel, transport, health, housing and educational facilities.

Neonatal mortality rate	**41.2** deaths per thousand live births
Infant mortality rate	**55.7** deaths per thousand live births
Female child mortality rate	**62.7** deaths per thousand live births
Male child mortality rate	**71.6** deaths per thousand live births
Female adult mortality rate	**137.5** deaths per 1,000 female adults
Male adult mortality rate	**172.9** deaths per 1,000 male adults
Life expectancy	**67.1** years
Male life expectancy	**66.2** years
Female life expectancy	**68.1** years
Survival to age 65, female	**72.9** %
Survival to age 65, male	**68.6** %
Maternal mortality ratio	**140** deaths per 100,000 live births
Maternal deaths	**8,300** number
Lifetime risk of maternal death	**0.5** %
Healthy life expectancy	**56.9** years
Female healthy life expectancy	**56.8** years
Male healthy life expectancy	**56.9** years

Lack of Housing Facilities:

The larger the number of people, the lesser will be the housing facilities. At the present rate of growth, we need to build about 116,000 houses in urban areas and 173,000 houses in rural areas every year, which is not possible. This will lead to overcrowding and slums will spring up.

Low Agricultural productivity:

Rapidly growing population has an adverse effect on agriculture as it leads to subdivision of the farms, hence there is low productivity. If a man has many children, especially sons, the cultivated land will be fragmented, which will lead to poverty. The landowner will not have enough money to cultivate the land or purchase modern agricultural equipment, which will lead to low food production.

Lack of Health Services:

It is difficult and very expensive to train medical and paramedical personnel to provide health care to the rapidly growing population. Other health facilities like medicines, hospitals and medical equipment cannot cope with the over increasing demand. Repeated pregnancies, overcrowding and unhygienic living conditions lead to diseases, epidemics, and high death rate.

Deficient Food and Nutrition:

The larger the number of people in Pakistan, the lesser is the food to eat. This will lead to malnutrition and the health of the people will therefore suffer.

Lack of Educational Facilities:

The literacy rate of Pakistan is 52% (1998 Census) because of lack of educational facilities. Rapidly growing population will lead further to lack of educational facilities like teaching staff, schools and equipment etc, and this in turn would increase the illiteracy ratio.

Unemployment:

The rapidly growing population leads to high increase in the labour class. This will lead to unemployment. When people do not find jobs and remain unemployed, they become frustrated. They start looking for easy ways of earning money which leads to increase in crime rate.

Over Crowding:

In the past 30 years the population has multiplied itself three times. In 1972 the density of population was 82 persons per square kilometer and in 1981 it was 106 people per sq. km.

High Dependency Rate:

Rapidly growing population leads to high increase in the number of dependent populations. According to 1998 census, the number of dependent people in our country was 68%.

Effects on Ecology:

Rapid population growth has an adverse effect on the ecology. All types of pollution take place in the environment which results in deterioration of the health of the population.

Some of the implications of overpopulation on the environment are as follow:

Home environment

- Homes are overcrowded
- More people sleeping in one room thus having less air to breathe
- Air-borne diseases spread rapidly
- More noise results in irritability of temperament
- Tolerance decreases which is harmful for the society
- More refuse / garbage / excreta is produced

Village environment

- A specific set of indicators must be adapted to the area-specific conditions and needs.
- Villages become congested by construction of more houses
- Houses become smaller & smaller
- Lack of sunshine and fresh air (lack of well-ventilated housing)
- Lack of safe drinking water
- Unsatisfactory disposal of refuse / garbage
- Unsatisfactory disposal of excreta / sewerage
- Water borne diseases spread rapidly
- Incidence of diseases transmitted by vectors (flies, mosquitoes etc) increases
- More street refuse is produced

Towns and Cities

- Towns and cities grow bigger and bigger
- Community feeling and cohesion decreases
- Unemployment increases
- Street crime rate increases
- Health facilities decrease
- Incidence of diseases / epidemics increases
- Educational facilities decrease

- Slums / shanty towns increase due to influx of rural population
- Sanitation / waste disposal is unsatisfactory
- Poverty leading to poor living standards
- More traffic results in overcrowding of roads and traffic jams
- Noise / air pollution increases, leading to irritability and mood changes of people

Country's environment

- Country's resources are gradually depleted
- Increasing Industrial waste pollutes the air, water and seacoasts
- Poor health indicators as compared to the developed countries
- Wildlife is threatened
- Sea life is endangered
- Forestation decreases due to increased wood consumption
- Lack of rainfall due to deforestation and atmospheric temperature rises with passage of time
- Water shortage / scarcity occurs
- Cultivated land decreases due to fragmentation
- Shortage/scarcity of food leading to malnutrition
- Increase in population below the poverty line due to inflation

Global environment

- Depletion of all resources
- Increase in pollution of air, water and noise
- Shortage of water
- Change in climate
- Global warming
- Depletion of ozone layer

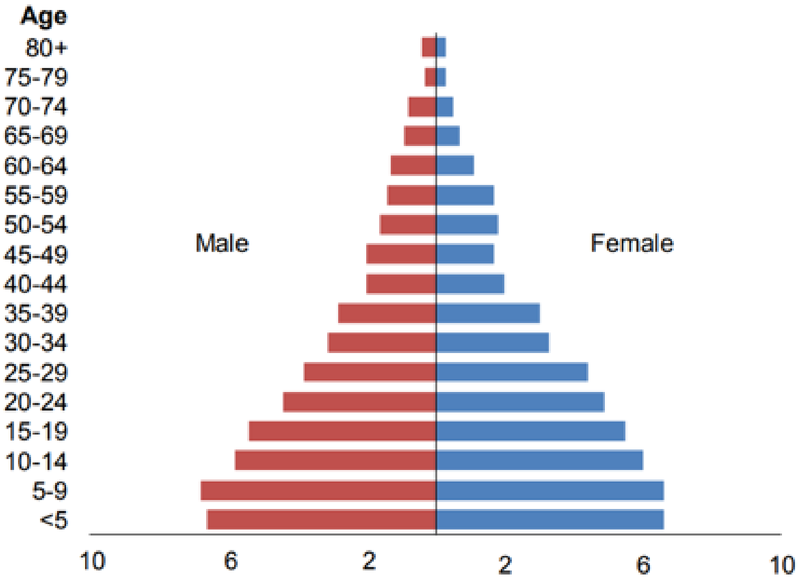
Summary implications of unchecked population growth:

SHORTAGE OF	
Educational facilities	Living space
Health services	Arable land
Housing units	Clean water
Food	
INCREASE IN	
Unemployment	Overcrowding
Land fragmentation	Katchi abadis
Import of food etc.	Poverty
Environmental problems	Unrest
Congestion in households	Crime

Data from Pakistan Demographic Health Survey 2018-2019

Figure 2.4 **Population pyramid**

Percent distribution of the household population



Note: Excludes Azad Jammu and Kashmir and Gilgit Baltistan

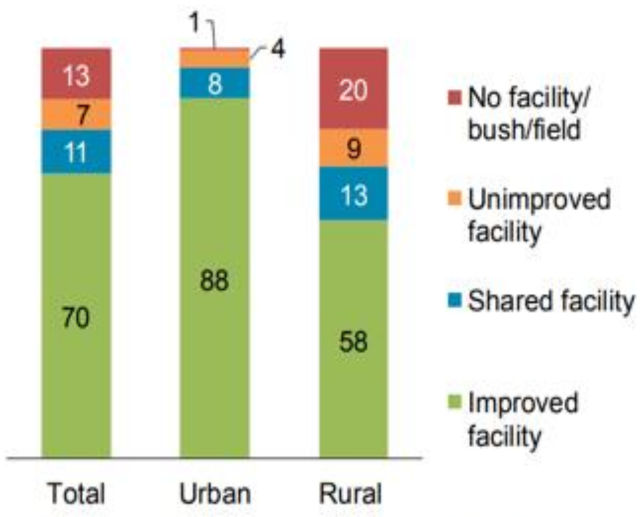
Key Findings

- ***Modern contraceptive use:*** Modern contraceptive use by currently married women has stagnated over the last 5 years, with 26% of women using a modern method in 2012-13 and 25% in 2017-18. The most popular modern methods among women are female sterilisation and male condoms (9% each).
- ***Sources of modern methods:*** Women choose almost equally the public (44%) and private (43%) sectors in their use of sources of modern contraception. Lady health workers play a major role in dispensing injectables, oral pills, and condoms to women (18%, 26%, and 15% respectively).
- ***Informed choice:*** Only 19% of women are informed about all three quality-of-service indicators (side effects, what to do in case of side effects, and other methods).
- ***Contraceptive discontinuation:*** In the 5 years preceding the survey, 3 out of 10 contraceptive users (30%) discontinued use within 12 months. The most common reason for stopping a method was the desire to become pregnant (44%), followed by method-related health concerns or side effects (19%).
- ***Unmet need for family planning:*** 17% of currently married women have an unmet need for family planning.
- ***Future use of contraception:*** One-third (33%) of currently married women who are not using contraception intend to use family planning at some future time. Forty-six percent do not.

Housing characteristics

Key Findings

- ***Drinking water:*** 95% of all households have access to an improved drinking water source. Only 7% of the households use an appropriate water treatment method.
- ***Sanitation:*** 70% have an improved sanitation facility that is not shared with the other households; however, 25% have flush toilet linked to the septic tank.
- ***Electricity:*** 93% of the households have electricity.
- ***Indoor smoke:*** 49% of the households use solid fuel for cooking.
- ***Birth registration:*** 42% of children under age 5 are registered, and 36% have a birth certificate; 84% of adults age 18 and above have a National Identity Card.
- ***Education:*** 50% of women have no education compared with 34% of men.
- ***School attendance:*** Net attendance ratio (NAR) is 59% at the primary level and 38% at the middle/secondary level.



Note: Excludes Azad Jammu and Kashmir and Gilgit Baltistan

Household toilet facilities by residence

Maternal health

Key Findings

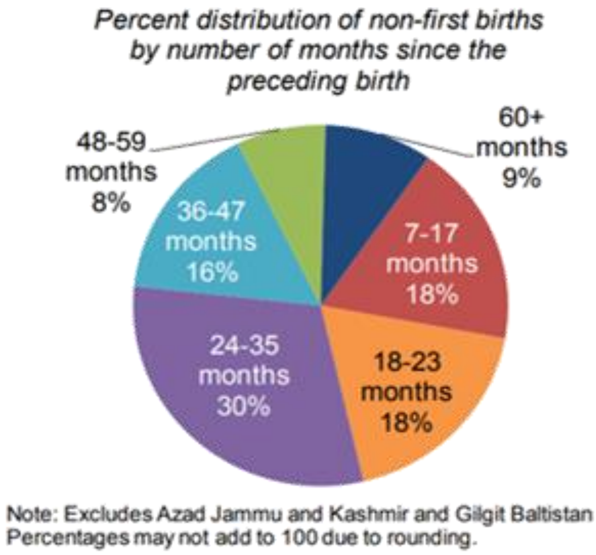
- ***Antenatal care:*** 86% of women who gave birth in the 5 years before the survey received antenatal care (ANC) from a skilled provider, a 13-percentage-point increase from 2012-13. Fifty-one percent of women had at least four antenatal care visits.
- ***Components of antenatal care:*** 89% of women receiving ANC reported that they had their blood pressure checked; urine and blood samples were taken from 7 in 10 women.
- ***Counselling during antenatal care:*** 52% of women received counselling during ANC on early initiation of breastfeeding; 54% received information on exclusive breastfeeding, and 70% reported counselling on having a balanced diet.
- ***Protection against neonatal tetanus:*** 69% percent of the most recent births to women in the 5 years before the survey were protected against neonatal tetanus.
- ***Delivery:*** 69% of deliveries are conducted by skilled birth attendants, and 66% of deliveries take place in a health facility.
- ***Postnatal checks:*** Only 6 in 10 mothers and newborns received a postnatal care check within 2 days of delivery.
- ***Problems in accessing health care:*** Nearly 7 in 10 women reported at least one problem in accessing health care for themselves.

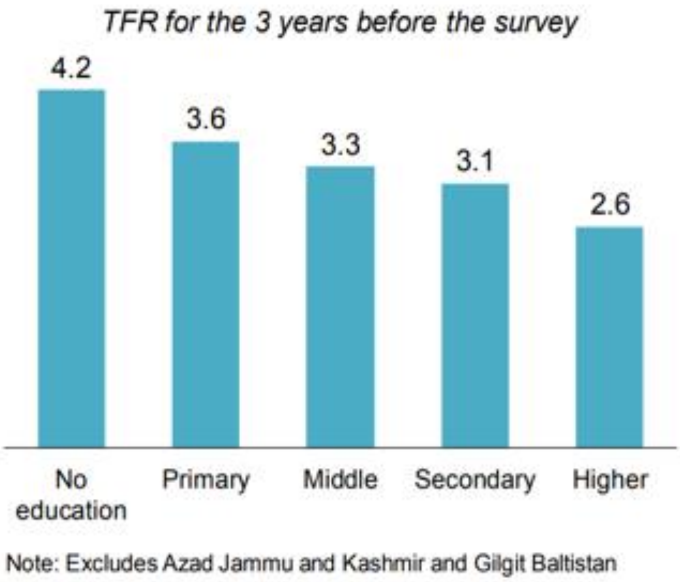
Infant mortality

Key Findings

- ***Current levels:*** Neonatal mortality is 42 deaths per 1,000 live births, infant mortality is 62 deaths per 1,000 live births, and under-5 mortality is 74 deaths per 1,000 live births.
- ***Trends:*** Under-5 mortality has declined from 112 deaths per 1,000 live births in 1990-91 to 74 deaths in 2017-18—a 34% decrease over the last 3 decades. Infant mortality declined from 86 to 62 deaths per 1,000 live births. The neonatal mortality that stagnated at roughly 55 deaths per 1,000 live births for a decade has declined to 42 deaths per 1,000 live births in the most recent 5-year period.
- ***Regional differences:*** There are large variations by regions in childhood mortality. For example, childhood mortality is highest in Punjab, where neonatal, infant, and under-5 mortality rates are 51, 73, and 85 deaths per 1,000 live births. FATA has the lowest at 18, 29, and 33, respectively.
- ***Short birth intervals:*** The under-5 mortality rate is 122 deaths per 1,000 live births for children born within 2 years of a previous birth. The rate is much lower—44 deaths per 1,000 live births—for children born at least 4 years after a previous birth.
- ***Perinatal mortality:*** The perinatal mortality rate is 57 deaths per 1,000 pregnancies.

Birth intervals





Fertility by education

Infant and Child Mortality

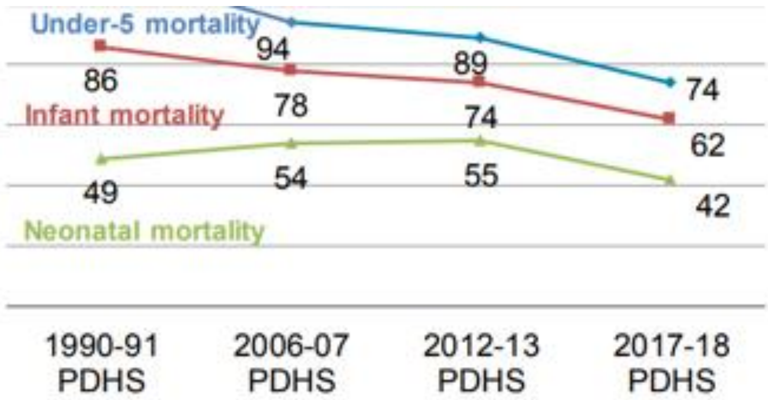
Neonatal mortality: The probability of dying within the first month of life.

Postneonatal mortality: The probability of dying between the first month of life and the first birthday (computed as the difference between infant and neonatal mortality).

Infant mortality: The probability of dying between birth and the first birthday.

Child mortality: The probability of dying between the first and fifth birthday.

Under-5 mortality: The probability of dying between birth and the fifth birthday.



Note: Excludes Azad Jammu and Kashmir and Gilgit Baltistan

EARLY CHILDHOOD MORTALITY RATES

Deaths per 1000 live births in the 5-year period before the survey

1.6 POPULATION DYNAMICS

1.6 Population Dynamics

According to the United Nations Population Division, Pakistan will be ranked number three among the largest countries in terms of population size by 2050. Pakistan's population is expected to grow from an estimated 181 million in 2009 to 335 million by 2050 unless fertility rates drop faster than those currently projected. At present, women in Pakistan have an average of four children – the best strategy for achieving ambitious population targets are two births per woman by 2025.

As a result of the rapid population growth from 1950 – 2010, Pakistan is far behind other developing countries in terms of educational development and provision of employment. Education has mostly failed so far in terms of provision and quality because of the poor performance of the state machinery.

Yet, Pakistan's development and hope for the provision of high standard of living is highly dependent on its capacity to educate its teeming population, which is estimated to rise to 300 million in 2050. Consequently, the country will have to adopt transformative development strategies to meet these challenges.

Human development index

Pakistan's Human Development Index (HDI) value for 2018 is in the medium human development category with a score of 0.560 (152nd rank out of 189 countries and territories

Many factors contribute to these problems:

Rural-Urban Migration

The rural-urban migration is peaking in Pakistan even though the rural population still exceeds that of the urban in absolute estimates. The awareness of those living in the rural areas regarding issues such as family planning, and sexual and reproductive health is undermined by regressive traditions, customs and religious considerations.

Around 37 per cent of Pakistan's population lives in urban areas – growing urbanization is increasing the pressure on provision of qualitative services. An equitable access to high-quality social services, including basic health, reproductive health, nutrition, water and sanitation, hygiene promotion and education, is constrained by the multiple dimensions of disparities. For example, the lack of investment in the health sector has caused gaps in the access to primary health care services, especially in preventive health care.

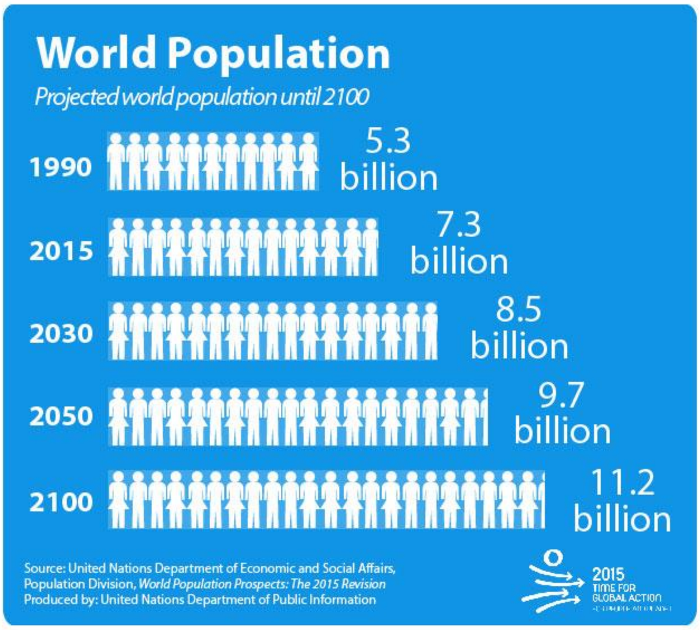
Dramatic social changes have led to rapid urbanization and the emergence of megacities.
Furthermore, 50% of Pakistanis now reside in towns of 5,000 people or more

The youth bulge

According to the United Nations Population Fund estimates, 28 per cent of Pakistan's population is between the ages of 15 and 29 years. There is obviously a significant demographic dividend associated with this, but the challenge is to translate this youth bulge into an asset. The country's labour force is increasing at 3.2 per cent per annum and, by 2030, the working- age population is expected to be around 67 per cent of the total, compared to the current 55 per cent, with corresponding demand for employment. However, 32 per cent of the youth are uneducated and most of them lack vocational or life skills.

World Population Trends

It took hundreds of thousands of years for the world population to grow to 1 billion – then in just another 200 years or so, it grew sevenfold. In 2011, the global population reached the 7 billion mark, and today, it stands at about 7.6 billion. This dramatic growth has been driven largely by increasing numbers of people surviving to reproductive age and has been accompanied by major changes in fertility rates, increasing urbanization and accelerating migration.



Why is the population growing so quickly?

The huge growth in the world population over the past two centuries is largely the result of advances in modern medicines and improvements in living standards. These have significantly reduced infant, child and maternal mortality, contributing to an increase in life expectancy. Although fertility levels have declined, they have not fallen at the same pace as mortality levels.

Megatrends

The recent past has seen enormous changes in fertility rates and life expectancy. In the early 1970s, women had on average 4.5 children each; by 2015, total fertility for the world had fallen to below 2.5 children per woman. Meanwhile, average global lifespans have risen, from 64.6 years in the early 1990s to 70.8 years today.

In addition, the world is seeing high levels of urbanization and accelerating migration. 2007 was the first year in which more people lived in urban areas than in rural areas, and by 2050 about 66 per cent of the world population will be living in cities.

These megatrends have far-reaching implications. They affect economic development, employment, income distribution, poverty, and social protections. They also affect efforts to ensure universal access to health care, education, housing, sanitation, water, food and energy. To address the needs of individuals, policymakers must understand how many people are living more sustainably on the planet, where they are, how old they are, and how many people will come after them.

1.7CONCEPT OF FAMILY IN ISLAM

1.7 CONCEPT OF FAMILY IN ISLAM

Allah Almighty, the Lord of the Worlds, has created man as the "Ashraf-ul-Makhlookat" or the best creation, and granted him pure livelihood which enables him to lead a clean and pure livelihood and to worship Allah. With the possession of such independence, man has got superiority over all other living beings. Allah says in the Holy Qur'an.

"Verily we have honored the children of Adam. We carry them on the land and the sea, and have made provision of good things for them, and have preferred them above many of those whom we created with a marked preferment".

(Sura Al-Isra; verse no.70)

'I created the jinn and humankind only that they might worship me. I seek no livelihood from them, nor do I ask that they should feed me. Lo Allah He it is who giveth livelihood, the lord of unbreakable might'.

(Sura Al-Zariyat; verse no.56-58)

Some people may ask if it is so that Allah has created us only to worship Him, then is it wrong for us to work and earn to feed ourselves. The answer to this question is quite simple. If a Muslim works honestly and takes the right steps to feed and clothe himself and his family, then all his efforts in this regard will be conceded as 'Ibadat'.

We can realize from the above two verses of the Holy Qur'an that Allah has made mankind the best of his creations. He has not made the dirty and rotten things as the food for men, like he did for the birds and the beasts. But due to poverty and want, a man is forced today to eat things from the dust bins. In this way the elevated status of the man is being damaged and dishonoured. Hence, we shall have to consider how man can save himself from eating dirty food, and be able to live and eat good food and devote his time to worship Allah

'Walk about its (earth's) regions and His provisions'

(Sura Al-Mulk; verse no.16)

It is not enough for man to look for his own food only; he has to look and find food and clothing for his family also.

It has been said in the Holy Qur'an.

'The (mother and child) must be maintained and clothed in a reasonable manner by the father of the child'.

(Sura Al-Baqara; verse no.234)

Allah has instructed the husbands as follows:

'Consort with them (wives) in kindness'

(Sura Al-Nisa; verse no.19)

When we go through all these verses of the Holy Qur'an, we can easily understand that Allah has urged that we form happy and prosperous families. Hence it is our duty to look after the happiness and prosperity of each member of our family. It is also necessary to ensure that the family members do not suffer even in case the father dies.

In a hadith of the Holy Prophet (PBUH), as narrated by Hadhrat Saeed (RA) that Holy Prophet (PBUH) has said, “It would be very good for you if you leave your inheritors not in want, but in prosperity”.

The Foundation of Conjugal Life:

A husband and a wife, bound in matrimony, are known as a couple. Conjugal life or matrimonial life will also include children (when they are born). Hence the conjugal life is the combined name given to the life and welfare of the husband, the wife and the children. Man is Ashraf-ul-Makhlooqat (best of creations) and a social animal. That is why the system of marriage is limited to man only. Other animals do not have such system although they also have the same biological needs. This is because they are not rational, they do not have a conscience and they are not social living beings.

To let us know how conjugal life started on earth, Allah, the Lord of the Worlds, tells in the Holy Qur’an:

‘Men, have fear of your Lord, who created you from a single soul. From the soul He created its mate, and through them He bestowed the earth with countless men and women’

(Sura Al-Nisa; verse no.1)

Allah has given you wives from among yourselves, and through them he granted you sons and grandsons. He has provided you with good things’

(Sura Al-Nahl; verse no.72)

‘Creator of the heavens and the earth, He has given you spouses from among yourselves’

(Sura Al-Shura; verse no.11)

‘It was He who created you from a single being. From that being He created his mate, so that he might find comfort in her’

(Sura Al-Araf; verse no.189)

‘And of His (Allah’s) sign is that He gave you wives from among yourselves, that you might live in tranquillity with them, and put love and kindness in your hearts’

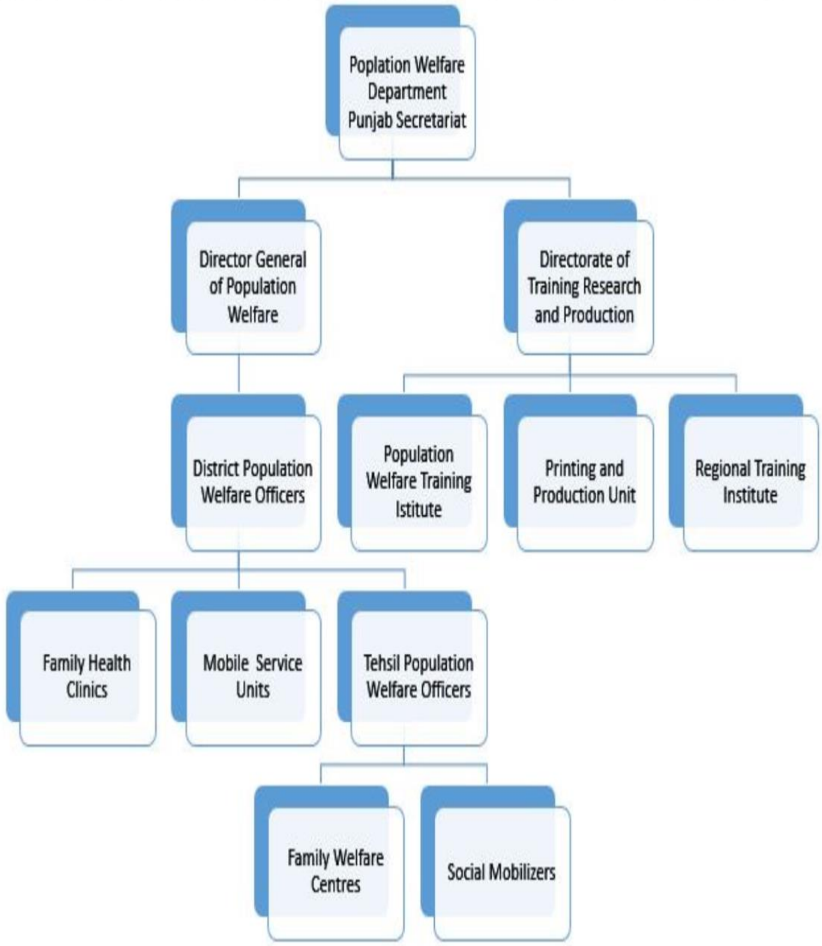
(Sura Al-Ruom; verse no.21)

This makes it clear that peace lies in conjugal life, and love and kindness make the conjugal life happy and sweet.

Almighty Allah has laid the foundation of conjugal life for the happiness of mankind. Now it is man’s duty to make conjugal life neat, disciplined, and well planned. Man can make his fortune smile by dint of his own efforts.

1.8 POPULATION WELFARE PORAGRAM

Organogram



- Directorate General Population Welfare
- Directorate of Training Research and Production
- District Population Welfare Office
- Regional Training Institutes
- Population Welfare Training Institute

- Family Health Clinics
- Family Welfare Centers
- Mobile Service Units
- Men Advisory Centers

POPULATION WELFARE PROGRAM

Population Welfare Program is an ongoing social development effort encouraging voluntary adoption of family planning methods. The consensus reached at the International Conference on Population and Development (ICPD) in Cairo, in 1994, stressed that early stabilization of population would make crucial contribution towards achievement of sustainable development and poverty reduction.

Population Welfare Program was started in 1952 by NGOs named FPAP and APWA with two clinics based in Karachi & Dhaka. In 1960-65 it was taken up by Ministry of Health and was run through health outlets. Then it was transferred as autonomous bodies to Federal, Provincial & District level. Later, it was governmentalized & initially run by Population Welfare Division under Ministry of Planning & Development. Then it was given the status of a full-fledged Ministry. Recently, the Ministry has decentralized the program, giving more power to the provinces and autonomy at the district level.

PAKISTAN POPULATION POLICY - 2002

Vision

To achieve population stabilization by 2070 through:

1) Universal coverage of population welfare program by 2010
2) Achieving replacement level fertility by 2020

Policy Goals

1) Attain a balance between resources and population growth within the broad parameters of the ICPD paradigm.
2) Address various dimensions of the population issue within national laws, development priorities while remaining within the national, social and cultural norms.
3) Increase awareness of the adverse consequences of rapid population growth at the national, provincial, district and community levels.
4) Promote family planning as an entitlement based on informed and voluntary choice.
5) Attain a reduction in fertility through improvement in access and quality of reproductive health services.
6) Promotion of research: Neural Information Processing Systems (NIPS) has been mandated to do research “Covering all aspects of population and development such as education, health, women empowerment, labour force, ageing, adolescent and urbanization”.

Policy Objectives

Attain Population Stabilization through:

1) Reduction in TFR to 2.1 by 2020
2) Increase CPR to 60% by 2020

3) Reduction in PGR to 1.3% by 2020
4) Universal access to modern family planning methods by 2010

Strategies

1) Launch advocacy campaigns for all segments of the society
2) Ensure ownership and participation of communities and stakeholders in service delivery
3) Reduce unmet need for quality Family Planning (FP) and Reproductive Health (RH) services
4) Adopt a shift from target oriented to people-centred approach
5) Create a comprehensive network of FP/RH services
6) Expand Social Marketing of contraceptives to make them accessible and affordable in rural and under-served areas
7) Bring attitudinal change in men to adopt small family norms and responsible parenthood
8) Involvement views of leaders and religious scholars.

Functions of Population Welfare Department:

In line with its vision and goals, the department carries out the following functions:

1) Population policy formulation, implementation, monitoring, and evaluation
2) Demographic statistics and analysis
3) Mainstreaming population factor in the development planning process
4) Provision of family welfare services including family planning and general medical care
5) Preparation of budget and development schemes
6) Coordination with the federal government, international agencies, NGOs, and donors
7) Procurement and distribution of contraceptives
8) Training research and development of professional standards
9) Information, education, and communication services
10) Promotion of population planning activities through private and other public sector institutions
11) Budget, accounts, and audit matters
12) Purchase of stores and capital goods
13) Service matters except those entrusted to the Services and General Administration Department

14) Matters incidental and ancillary to the above subjects

GOALS OF POPULATION WELFARE DEPARTMENT :

The Population Welfare Department Punjab has outlined its goals as follows:

1) Stabilize population growth as an essential requirement for promoting sustainable development with equitable distribution through vigorous implementation of inter-sectoral strategies
2) Reduce fertility to contain population momentum by improving access to quality of reproductive health care through integrated service delivery
3) Facilitate and guide relevant sectors to achieve SDG objectives related to universal access to reproductive health care services aimed at promoting general welfare of population

OBJECTIVES OF POPULATION WELFARE DEPARTMENT :

1) Lower wanted family size to 2.5 by 2020 through an effective population communication and education program focusing on small family size and its relationship with human welfare and environmental security
2) Actively promote three Healthy Timing and Spacing of Pregnancy messages to reach out to all women by 2020
3) Ensure necessary contraceptive security at all service delivery outlets for 2015-2020
4) Achieve a fertility level of 3.3 births per woman by 2020
5) Universal access to safe and quality family planning and reproductive health services to the most remote and far-flung areas of the Province by 2025
6) Raise contraceptive prevalence rate to 60 percent by 2030
7) Strive expeditiously to attain replacement level fertility of 2.1 births by 2030

STRATEGIES

To attain maximum results, precise and decisive strategies have been coined by the department. The department strives to:

1) Develop and launch advocacy campaigns to address special groups, such as policymakers, opinion leaders, youth, and adolescents
2) Increase ownership of population issues by the stakeholders and strengthen their participation in the processes of service delivery and program design
3) Reduce unmet need for family planning services by making available quality family planning and RH services to all married couples who want to limit or space their children
4) Adopt a shift from target-oriented to people-centered needs and services
5) Ensure provision of quality services especially to the poor, under-served, and un-served populations in rural areas and urban slums

6) Coordinate and monitor a comprehensive network of family planning and reproductive health services
7) Build strong partnerships with concerned line ministries, provincial line departments particularly health, non-governmental organizations, and the private sector including the industrial sector to maintain standards in family planning by providing assistance and guidance through advocacy, training, monitoring ,and other means of participation and quality assurance
8) Strengthen contribution to population activities by civil society players, particularly NGOs and media
9) Expand the role of the private sector by making contraceptives accessible and affordable through social marketing of contraceptives
10) Decentralize program management and service delivery to provincial and district levels
11) Punjab Population Policy 2017, specifically tailored as per the needs of the population of Punjab, has been drafted and is in process of approval

SERVICES

The Population Welfare Programme, Punjab provides Reproductive Health Services, mainly family planning information and services, maternal and child health (MCH) care services. Since the International Conference on Population and Development (ICPD), the Programme has expanded its focus to include more components related to Reproductive Health such as Reproductive Tract Infections (RTIs), Sexually Transmitted Infections (STIs), Infertility, Adolescent Health problems, etc. as per the 9 essential components of the Reproductive Health Package for Pakistan, which are as follows:

1) Screening/early detection of breast and cervical cancers
2) Management of infertility
3) Management of RH-related issues of men, including male involvement and prostate cancer
4) Management of other RH-related issues of elderly women
5) Management of RH-related issues of adolescents
6) Prevention and management of RTIs/STIs and HIV/AIDS
7) Infant health care (newborn to children up to 1 year old)
8) Maternal health care, including safe motherhood and pre and post-abortion care to avoid complications
9) Comprehensive FP services for females and males

STRUCTURE

The main structure of the Population Welfare Department Punjab comprises the Secretariat, the Directorate General, Population Welfare Training Institute (PWTI), Regional Training Institutes (RTIs), Printing and Production Unit. T

District offices are directly under the control of the Directorate General Population Welfare. Tehsil Offices, the Service Delivery Outlets, namely Family Health Clinics, Men Advisory Centers, Mobile Service Units, Family Welfare Centers, and the training centers located in the Family Health Clinics and the Men Advisory Centers, i.e. the Family Health Training Centers and the Men Advisory Training Centers are under the administrative control of the District offices.

INSTITUTES

The Population Welfare Department offers a broad range of clinical and non-clinical, administrative and management trainings. Basic and refresher, short and long courses are arranged for the PWD employees as well as for staff of the Health and Line Departments, NGOs, ulema, public representatives and people from the civil society including teachers. The institutes which conduct these trainings are:

- Population Welfare Training Institute
- Regional Training Institutes
- Men Advisory Training Center
- Family Health Clinic (FHC) Training Centers

FAMILY PLANNING 2020

Family Planning 2020 (FP2020) is a global partnership that supports the rights of women to enable 120 Million more women in 69 poorest countries to use contraceptives by 2020.

In London Summit on Family Planning, 2012 where more than 20 governments made commitments to address the policy, financing, delivery, and socio-cultural barriers to women accessing contraceptive information, services, and supplies, Pakistan specifically committed to achieve universal access to reproductive health and raise contraceptive prevalence rate (CPR) to 55% by the year 2020. Given the ground realities in provinces, the CPR was rationalized and reduced from 55% to 50% by 2020. The Provincial Health and Population Welfare Departments of the four provinces-together with some federal representatives, formally announced their target goals for 2020: Punjab 55%, Sindh 45%, KP 42%, Balochistan 32%. The commitments made by the government of Pakistan cover the realm of policy, finance, and service delivery.

The Government of Pakistan acknowledges that all citizens are entitled to high quality FP information and services. Therefore all provincial Chief Ministers pledge to personally monitor and oversee their respective provincial FP2020 goals through regular stock takes. This will ensure that services are optimally provided by all public and private health sector facilities to meet the reproductive health needs of both men and women and also reach out to the marginalized so that no one is left behind.

COMMITMENTS FOR FP 2020

Objective

Achieve universal access to Reproductive Health and raise CPR by 55% (revised to 50%)

Policy and Political

1) Provincial Population Policy and Health Sector Strategy will be developed
2) Financial
3) Annual public spending for FP services will be increased to ensure universal access by 2020
4) Provinces will raise additional resources to access quality services by training staff in client-centered services and ensuring the availability of contraceptive commodities

Programme and Service Delivery

1) Contraceptive services will be included in the Essential Health Services Package
2) FP will be made a priority for Lady Health Workers (LHWs)
3) Supply chain management, training, and communication campaigns will be strengthened. There will be an increased focus on men for FP

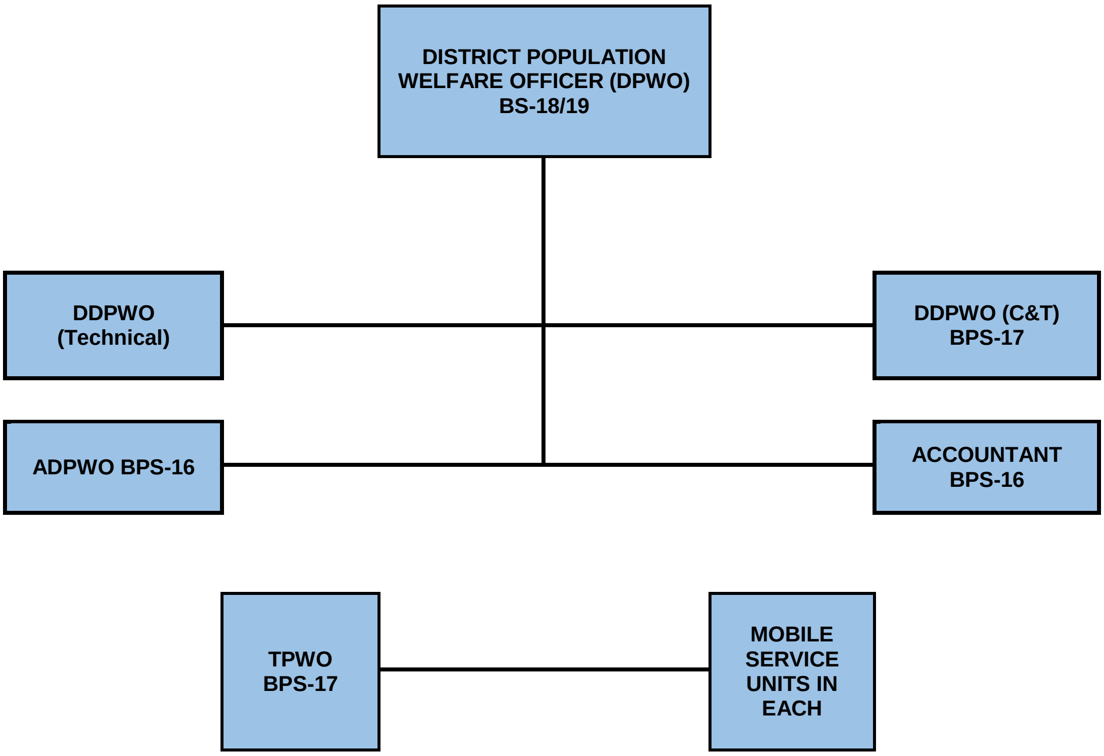
1.9 ORGANIZATIONAL SET UP OF DISTRICT

SERVICE DELIVERY COMPONENTS

PROGRAMME:	Islamabad	Punjab	Sindh	Baluchistan	KP	AJK
Family Welfare Centres (FWC)	29	1500	628	170	422	182
Reproductive Health Services "A" Centres	3	119	70	11	26	15
Mobile Service Units	1	117	72	55	30	10
Male Mobilizers	20	1855	1250	-	-	182
NON-PROGRAMME:						
RHS – B Centres	8	50	39	4	-	-
Registered Medical Practitioners	145	4199	3334	1200	-	250
Lady Health Workers of National Program for FP and Primary Health Care	353	57187	23185	7200	15796	2998
RESEARCH AND TRAINING:						
Regional Training Institutes	1	4	4	1	2	1

Source: Provincial Welfare Departments 2013, Ministry of Health 2011

ORGANIZATIONAL CHART OF DISTRICT SET-UP



KEY	
DPWO=	DISTRICT POPULATION WELFARE OFFICER
DDPWO=	DEPUTY DISTRICT POPULATION WELFARE OFFICER
C&T=	COMMUNICATION AND TRAINING
ADPWO=	ASSISTANT DISTRICT POPULATION WELFARE
OFFICER MSU=	MOBILE SERVICE UNITS
WMO=	WOMAN MEDICAL OFFICER
TPWO=	TEHSIL POPULATION WELFARE OFFICER
F.W.C=	FAMILY WELFARE COUNSELLOR
F.W.W=	FAMILY WELFARE WORKER
F.W.A (M/F)=	FAMILY WELFARE ASSISTANT (MALE/FEMALE)

1.10 REPRODUCTIVE HEALTH SERVICES CENTRE

Differences between RHS A and B centers and FWC

Under this project two types of Reproductive Health Service Centers (RHS Centers) are available:

- RHS – A CENTRES
- RHS – B CENTRES

RHS – A Centres

Generally, a surgical unit is constructed by the Ministry of Population Welfare in Teaching Hospitals & District Head Quarter Hospitals. The lady doctor in charge of the centre is trained in contraceptive surgical procedures. She performs the operations independently in the operation theatre of this unit.

Staff

- Medical Officer
- Theatre Nurse
- Family Welfare Counsellor
- Family Welfare Worker
- Theatre Technician
- Family Welfare Assistant (M/F)
- Accounts Assistant / LDC
- Driver
- Aya

Services Offered

- Contraceptive Surgery
  - Tubal Ligation
  - Vasectomy
- Provision of other Contraceptives
  - Implants
  - IUCD
  - Injectables
  - Pills
  - Condoms
- Supporting services
  - MCH services
  - Comprehensive RH Package services

- C/S Extension camp services
  - Monitoring of Family Welfare Centers
  - Training of Doctors and Paramedics (only in RHS'A' Training Centers)
    - Program personnel
    - Non-Program personnel

RHS – B Centres

Hospitals having operating facilities and trained manpower interested to perform contraceptive surgery are designated as "B" type RHS Centres. These include district and tehsil level hospitals, surgical centres of the Non-Governmental Organizations (NGOs) and private hospitals etc.

1.11 JOB DESCRIPTION FOR FWWs

1.11 JOB DESCRIPTION FOR FWWs

Definition of FWW

A Family Welfare Worker is a qualified person having legal license to practice as FWW to provide competency-based RH & FP, MCH services including preventive, curative, health care services to individuals, families, and communities.

General Scope of Practice for FWW

The FWW may practice at health facility, home, community, clinic or health unit, hospital, and FWW education institution. The FWW is a professional who works to provide Reproductive Health, Family Planning and Midwifery Services to the population across the life span at all levels of health care.

The FWW will ensure universal access to safe and quality care in relation to components of Reproductive Health, Family Planning and Midwifery Services such as safe motherhood, and maternal health, contraception, sexually transmitted infections, and post abortion care.

The FWW has an important task to promote and deliver family planning services in the urban and rural areas, health counselling and education, not only for the woman, but also within the family and the community. The FWW works within community to address population growth issues within socio cultural norms. She will increase awareness of impact of population growth on development.

Her education program will equip her to provide the necessary support, care and advice during pregnancy, labor, postpartum period, conduct births and provide care for the newborn and the infant. This care includes preventative measures, the promotion of normal birth, the detection of complications in mother and child, carrying out emergency measures and referring of pregnancy related complications to the appropriate health care providers/institutions.

Role of FWW based on PNC recommended guidelines

FWW works with the community to implement components of RH & FP to provide safe and quality care to the individual, family and community at all level of health care including preventive and rehabilitative care.

Assess and address socio-cultural, economical, and psychological status of clients/patients and community. Maintain fundamental human rights of individuals when providing care. Maintain legal and ethical consideration in caring for individuals Demonstrate effective interpersonal communication with women and families, health care teams, and community groups. Assess the health status, screen for health risks, and promote general health and well-being of individual and family. Identify, assess, refer, and manage care of individuals with RTIs, STIs, HIV and AIDS Counsel individuals, families and community regarding prevention of RTIS, STIs, HIV and AIDS.

Recognize conditions outside FWW scope of practice and refer appropriately

Care for women who experience physical and sexual violence and abuse

Care for adolescents in the community by identifying and managing their problems

Provide treatment of minor ailments and provision of First Aid treatment.

Counsel and refer women with menopausal problems

Counsel and refer infertile couples

Provide health education sessions on several RH problems such as conducting Self-Examination of Breast, self-care guidance in line with WHO guidelines

FWW Competencies

Be ethical

Be professional

Critical thinking skills

Communication skills

Networking, and collaboration with other health care providers

Record keeping

Contextual care

Value based care

Effective communicator

Community mobilizer

Clinical expert

Detailed Job description of FWW

Family Planning Services

- Educate and provide family planning (short-term and long-term methods) to mothers and husbands
- Provide women centered post abortion care and postpartum family planning services to their clients according to the laws and policies
- To promote and provide child spacing and FP services by educating communities on importance of Healthy Time Spacing of Pregnancy (HTSP)
- Counsel, administer or generate referral for short term methods/ Long-Acting Reversible Contraceptives (LARCs) or surgical or permanent methods of contraception as applicable in different situations.
- Identify and bring eligible couples in the community for contraception

- Assist eligible couples in making free and informed choices of contraception through behavior change communication
- Conduct and ensure follow-up of all the cases of contraceptive users
- Manage/counsel for side effects of contraceptives
- Refer for surgical methods and Implants
- Identify and refer complications of FP methods

Pregnancy (Antenatal Period)

- To identify and register pregnant women and refer high risk cases to higher level health care facility
- Provide guidance related to pregnancy, birth, breastfeeding, and parenthood.
- Diagnose and monitor normal pregnancies and manage minor disorders in pregnancy
- Responsible for determining pregnancy status during gestation, foetal heart rate, and presentation and position of fetus
- Responsible for carrying out complete physical examinations, including breast examination, abdominal examination, pelvic examination, clinical pelvimetry and Pap smear.
- Diagnose, provide first line management and monitor abnormal and high-risk pregnancies and refer
- Prescribe appropriate medicines (approved) as per protocols and administer, prescribed (approved) drugs safely during pregnancy Identify health risk factors and manage or refer to appropriate facility
- To prepare the woman for safe motherhood
- Advice mother about nutrition requirement during pregnancy and lactation period.
- Prevent and treat common health problems related to reproduction and early life.
- Identify pregnant and lactating women in the community, Counsel for maternal nutrition; prepare pregnant women for breast feeding and HTSP
- Refer pregnant women for TT immunization
- Identify danger signs of pregnancy and postpartum complications for giving obstetric first aid and prompt referral
- Provide information and refer pregnant women for safe delivery to trained personnel/facility

Labour and delivery (Natal period)

- Performs procedures such as abdominal palpation and ultrasound examinations to evaluate fetal status; estimate fetal weight, presentation and position, and fetal heart rate.

- Provide care to the mother during labour and monitor the condition of the foetus
- Identify abnormal labour and refer
- Ensure the safe and aseptic normal spontaneous vaginal deliveries independently/ and to deal with minor complications relevant to normal vaginal delivery.
- Ensure that entire placenta is expelled
- To ensure partograph maintenance for each delivery.

Care of the newborn

- APGAR Scoring
- Provide immediate care for newborn (warming perform, skin to skin care, Kangaroo Mother Care) including resuscitation where necessary
- Conduct newborn assessment and provide first line management of abnormal newborn conditions and refer complicated cases
- Ensure the establishment of breast feeding for the newborn.
- Educate on and initiate immunizations
- Refer infants for immunization

Postnatal Care

- Provide postnatal care for the healthy woman and healthy newborn infant
- To examine the women during puerperal duration and refer in case of complications
- Promote, support and sustain breast feeding and active discouragement of formula milk
- Conduct care during 4th stage of labour; advocate and teach mothers regarding nutrition, vitamins, minerals, adequate rest, and postnatal services, where necessary.

Infant care (up to one year of age)

- To immunize children according to the schedule of EPI and booster doses for any vaccine needed.
- To monitor and record the growth and development of the children on the basis of milestones.
- To promote early initiation, exclusive breast feeding and complementary feeding up to age of two years and discourage bottle feeding.
- To advise and encourage proper weaning practices after six months of age

Care of the Pre-school Child

- To supervise the health of child from 2 to 5 years of age by regular examination.
- To monitor the weight, height and mid upper arm circumference (MUAC) of the children in accordance with the WHO Growth Chart up to the age of 5 years and to

fill up specially designed growth monitoring/charts (children's cards).

- Identification of malnourished child from 0-59 months.
- Referral of identified malnourished child to stabilization center.
- Registration and provision of therapeutic food and dietary guidelines to identified malnourished child.
- To advise the mothers for the care of the child's health and provision of balanced diet.
- Immunize as per EPI Schedule.
- Identify danger signs of childhood illnesses to provide first aid /refer

Management of Adolescent Problems

- Identify health problems of adolescents related to sexual and reproductive health.
- Counsel and manage health problems of adolescents such as physiological changes, nutrition and personal hygiene
- Counsel and /or refer adolescents with development problems

Prevention and Management of RTIs/STIs and HIV&AIDS

- Counsel women for prevention of RTIs and STIs
- Provide syndromic management/refer STI case
- Referral of HIV/AIDS to appropriate facility

Management of other RH problems

- Management of infertility, counsel/refer infertile couples
- Management of RH Issues of Elderly, counsel/refer women with menopausal problems.
- Management of RH related issues of men and women
- Detection of breast and cervical cancers, counsel/refer women with Breast lump and cervical cancer.

Health Care Services

- Treat minor ailments
- Provide first aid for minor injuries
- Management of minor emergencies and referral to appropriate facility.

Health Education

- To provide health education to mothers in groups or in person using effective communication skills and aids through involvement of family and community
- To educate and provide guidance to mothers on clean cord care, eye care, warmth,

immunization, nutrition, breast feeding, clothing and hygiene practices.

- Balanced diet for mothers and children.
- Educate about signs of malnutrition in their children.
- Educate pregnant and lactation mothers for initiation of breastfeeding, breastfeeding positions, problems, expressing breast milk and storage.
- Educate about the concept of 1000 days and importance of 1000 days window period.
- Educates the mother in preventing and dealing with common accidents of the children

Community Mobilization

- Conduct base line survey for assessing the RH, FP and midwifery needs of the community
- Compile and tabulate all data collected
- Create awareness and build capacity of the community for preventive activities, health promotion and adoption of small family norm
- Develop working relationship with community leaders (influential people) and other health delivery facilities
- Maintain a list and hold meetings with the members of the community like local influential, community volunteers, health services providers, hakims/ homeopaths, and satisfied clients
- Develop linkages with other service delivery outlets for referral/management

Counselling

The counsellor offers counselling, support, and reassurance

Conduct pre-marriage counseling, contraception and matters relating to adolescent health.

Counsel infertile couple and refer appropriately to health facility/consultant Raise awareness of the community of the adverse impact of rapid population growth at community level, district, and provincial level.

Record Keeping

- To maintain all necessary family record e.g. Antenatal care, labour, postnatal, immunization, growth and development of child and family planning
- Collect, analyze and keep health Record/Health Management Information System (HMIS) records
- Follow all recording and reporting as provided in the duty roster or assignment chart from time to time by managing committee.
- Provide information about morbidity and mortality of infants, children and mothers to the health authority with situation analysis and recommendations for the purpose of

evaluation and planning in future.

- Maintain Clinical Registers and Performance reports
- Maintain logbooks:
  - Contraceptives
  - Antenatal & postnatal
  - Infant and childcare
  - Gynaecological disorders

Management and Administration

- Ensure availability of all necessary equipment and commodities at workplace
- Supervise and train community-based workers such as community health workers and volunteers.
- Supervise human and material resources
- Ensure proper documentation and timely reporting
- Hold staff meetings to supervise and organize center activities according to work schedule.
- Maintain a basic community profile and display activities on wall charts
- Participate in refresher trainings
- Supervise and maintain hygiene/clean lines in the centre
- Ensure infection prevention practices during FP and RH services
- Maintain an inventory, registers, records and periodic reports
- Maintain imprest money to meet day to day expenditure (petty cash)

SECTION TWO

LIFE SCIENCES

2.1 BODY FLUIDS

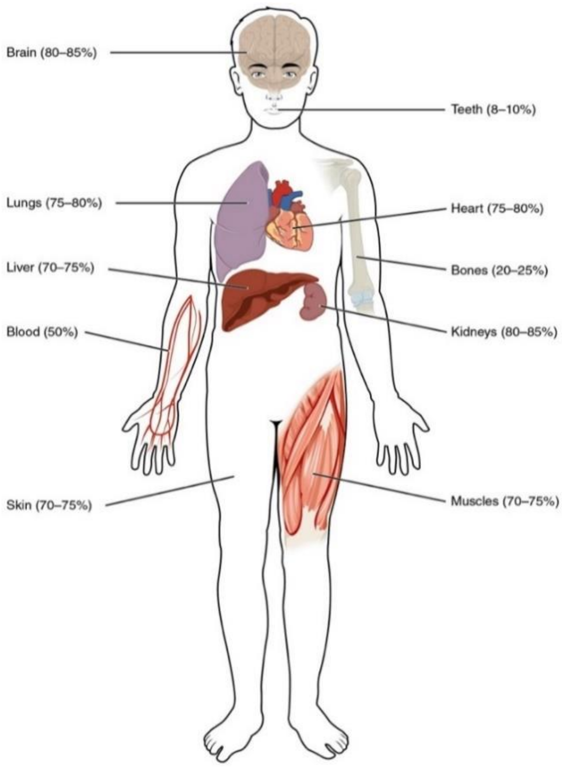
2.1 BODY FLUIDS

The chemical reactions of life take place in aqueous solutions. The dissolved substances in a solution are called solutes. In the human body, solutes vary in different parts of the body, but may include proteins—including those that transport lipids, carbohydrates, and, very importantly, electrolytes. Often in medicine, a mineral dissociated from a salt that carries an electrical charge (an ion) is called and electrolyte. For instance, sodium ions (Na^+) and chloride ions ($Cl^–$) are often referred to as electrolytes.

In the body, water moves through semi-permeable membranes of cells and from one compartment of the body to another by a process called osmosis. Osmosis is the diffusion of water from regions of higher concentration to regions of lower concentration, along an osmotic gradient across a semi-permeable membrane. As a result, water will move into and out of cells and tissues, depending on the relative concentrations of the water and solutes found there. An appropriate balance of solutes inside and outside of cells must be maintained to ensure normal function.

BODY WATER CONTENT

Human body is mostly water, ranging from about 75 percent of body mass in infants to about 50–60 percent in adult men and women, to as low as 45 percent in old age. The percent of body water changes with development, because the proportions of the body given over to each organ and to muscles, fat, bone, and other tissues change from infancy to adulthood (Figure 1). The brain and kidneys have the highest proportions of water, which composes 80–85 percent of their masses. In contrast, teeth have the lowest proportion of water, at 8–10



percent.

Water Content of the Body's Organs and Tissues. Water content varies in different body organs and tissues, from as little as 8 percent in the teeth to as much as 85 percent in the *brain.*

BODY FLUIDS

- A typical adult body contains about 40 L of body fluids.
- 25 L of fluids (or 63%) are located inside body cells, called intracellular fluid (ICF).
- 15 L of fluids (or 37%) are located outside of body cells, called extracellular fluid (ECF).
- 80% of ECF is interstitial fluid (which includes lymph, synovial fluid, cerebrospinal fluid, GI tract fluids, and fluids in the eyes and ears), and 20% of ECF is blood plasma.
- ICF is mostly water and is rich in K+, Mg++, HPO4--, SO4--, and protein anions.
- ECF contains more Na+, Cl-, HCO3-, and Ca++.

Water Balance

Water is the most abundant constituent in the body, varying from 45% to 75% of body weight. Water balance occurs when water intake equals water output. A normal adult consumes about 2,500 ml of water daily 1,500 ml in beverages, 750 ml in food, and 250 ml from cellular respiration and anabolic metabolism. At the same time, this adult is releasing about 2,500 ml of water daily -- 1,500 ml in urine, 700 ml by evaporation (through the skin and lungs), 100 ml in the faeces, and 200 ml in sweating.

Regulation of Water intake

The body loses as little as 1% of its water.

An increase in osmotic pressure of extracellular fluid due to water loss stimulates osmoreceptors in the thirst center (hypothalamus).

Activity in the hypothalamus causes the person to be thirsty and to seek water.

Drinking ends because resulting distension of the stomach by water stimulants nerve impulses that inhibit the thirst center.

Water is absorbed through the wall of the stomach, small intestine, and large intestine.

The osmotic pressure of extracellular fluid returns to normal.

Events In Regulation Of Water Output

Dehydration:

- Extracellular fluid becomes osmotically more concentrated.
- Osmoreceptors in the hypothalamus are stimulated by the increase in the osmotic pressure of body fluids.
- The Hypothalamus signals the posterior pituitary gland to release ADH into the blood.
- Blood carries ADH to the kidneys.

- ADH causes the distal convoluted tubules & collecting ducts to increase water reabsorption.
- Urine output decreases, and further water loss is minimized.

Excess water intake

- Extracellular fluid becomes osmotically less concentrated.
- This change stimulates osmoreceptors in the hypothalamus.
- The posterior Pituitary gland decrease ADH release.
- Renal tubules decrease water reabsorption.
- Urine output, increases and excess water is excreted

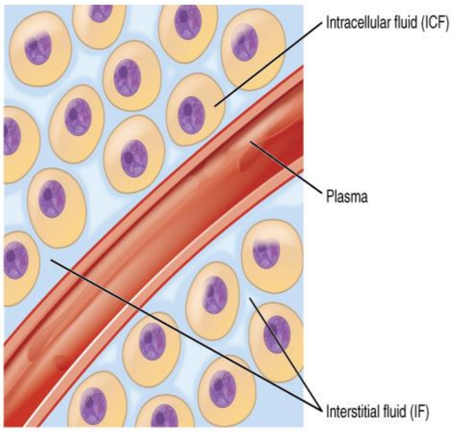
Functions Of Water

- Necessary for cellular metabolism and building materials
- Regulation of internal body temperature, through respiration and sweating
- Transport of protein and carbohydrates
- Elimination of waste through urine and feces
- Shock absorber for the brain and spinal cord Joint lubrication

When fluid is lost for any reason, electrolytes become imbalanced, body systems are stressed, and cognitive function in the brain is impaired. Blood becomes concentrated, signaling the kidneys to retain water. As a result, urine output is decreased. When blood is “thicker,” the heart must work harder, causing the pulse to increase to maintain blood pressure. All these compensatory actions by the body put an already-compromised patient at risk. Replacement of fluids intravenously resolves the imbalance and restores normal body functions. Which IV solution to administer is related to the reason for the fluid loss.

FLUID COMPARTMENTS

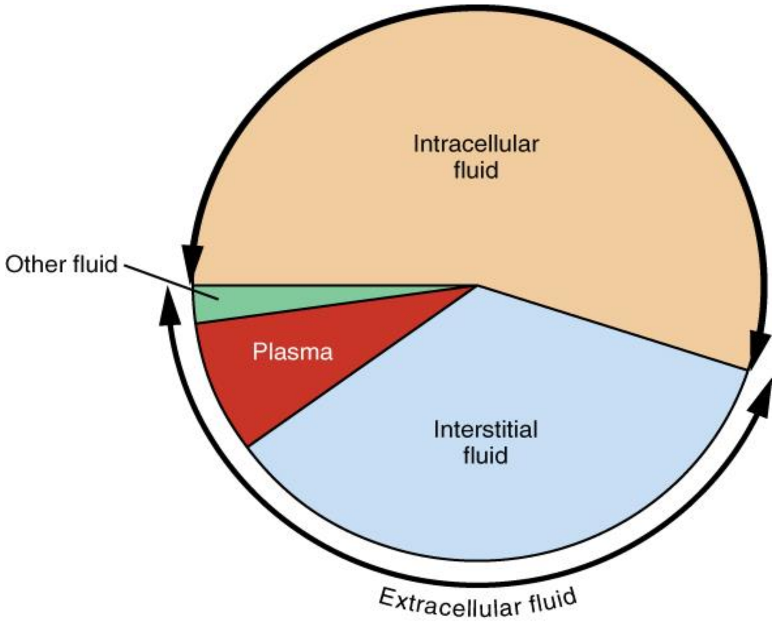
Body fluids can be discussed in terms of their specific fluid compartment, a location that is largely separate from another compartment by some form of a physical barrier. The intracellular fluid (ICF) compartment is the system that includes all fluid enclosed in cells by their plasma membranes. Extracellular fluid (ECF) surrounds all cells in the body. Extracellular fluid has two primary constituents: the fluid component of the blood (called plasma) and the interstitial fluid (IF) that surrounds all cells not in the blood.



Fluid Compartments in the Human Body. The intracellular fluid (ICF) is the fluid within cells. The interstitial fluid (IF) is part of the extracellular fluid (ECF) between the cells. Blood plasma is the second part of the ECF. Materials travel between cells and the plasma in capillaries through the IF.

INTRACELLULAR FLUID

The ICF lies within cells and is the principal component of the cytosol/cytoplasm. The ICF makes up about 60 percent of the total water in the human body, and in an average-size adult male, the ICF accounts for about 25 liters (seven gallons) of fluid (Figure 3). This fluid volume tends to be very stable because the amount of water in living cells is closely regulated. If the amount of water inside a cell falls to a value that is too low, the cytosol becomes too concentrated with solutes to carry on normal cellular activities; if too much water enters a cell, the cell may burst and be destroyed.



A Pie Graph Showing the Proportion of Total Body Fluid in Each of the Body's Fluid Compartments. Most of the water in the body is intracellular fluid. The second largest volume is the interstitial fluid, which surrounds cells that are not blood cells.

EXTRACELLULAR FLUID

The ECF accounts for the other one-third of the body's water content. Approximately 20 percent of the ECF is found in plasma. Plasma travels through the body in blood vessels and transports a range of materials, including blood cells, proteins (including clotting factors and antibodies), electrolytes, nutrients, gases, and wastes. Gases, nutrients, and waste materials travel between capillaries and cells through the IF.

The body has other water based ECF. These include the cerebrospinal fluid that bathes the brain and spinal cord, lymph, the synovial fluid in joints, the pleural fluid in the pleural cavities, the pericardial fluid in the cardiac sac, the peritoneal fluid in the peritoneal cavity, and the aqueous humor of the eye. Because these fluids are outside of cells, these fluids are also considered components of the ECF compartment.

FLUID MOVEMENT BETWEEN COMPARTMENTS

Hydrostatic pressure, the force exerted by a fluid against a wall, causes movement of fluid between compartments. The hydrostatic pressure of blood is the pressure exerted by blood against the walls of the blood vessels by the pumping action of the heart. In capillaries, hydrostatic pressure (also known as capillary blood pressure) is higher than the opposing "colloid osmotic pressure" in blood—a "constant" pressure primarily produced by circulating albumin—at the arteriolar end of the capillary.

This pressure forces plasma and nutrients out of the capillaries and into surrounding tissues. Fluid and the cellular wastes in the tissues enter the capillaries at the venule end, where the hydrostatic pressure is less than the osmotic pressure in the vessel. Filtration pressure squeezes fluid from the plasma in the blood to the IF surrounding the tissue cells. The surplus fluid in the interstitial space that is not returned directly back to the capillaries is drained from tissues by the lymphatic system, and then re-enters the vascular system at the subclavian veins.

Hydrostatic pressure is especially important in governing the movement of water in the nephrons of the kidneys to ensure proper filtering of the blood to form urine. As hydrostatic pressure in the kidneys increases, the amount of water leaving the capillaries also increases, and more urine filtrate is formed. If hydrostatic pressure in the kidneys drops too low, as can happen in dehydration, the functions of the kidneys will be impaired, and less nitrogenous wastes will be removed from the bloodstream. Extreme dehydration can result in kidney failure.

When people have excessive sweating, they will lose water through the skin. Sweating depletes our tissues of water and increases the solute concentration in those tissues. As this happens, water diffuses from our blood into sweat glands and surrounding skin tissues that have become dehydrated because of the osmotic gradient. When a dehydrated person drinks water and rehydrates, the water is redistributed by the same gradient, but in the opposite direction, replenishing water in all the tissues.

OEDEMA

Oedema is the accumulation of excess water in the tissues. It is most common in the soft tissues of the extremities. The physiological causes of edema include water leakage from blood capillaries. Edema is almost always caused by an underlying medical condition, using certain therapeutic drugs, by pregnancy, by localized injury, or by an allergic reaction. In the limbs, the symptoms of oedema include swelling of the subcutaneous tissues, an increase in the normal size of the limb, and stretched, tight skin. One quick way to check for subcutaneous oedema localized in a limb is to press a finger into the suspected area. oedema is likely if the depression persists for several seconds after the finger is removed (which is called “pitting”).

Other causes of edema include damage to blood vessels and/or lymphatic vessels, or a decrease in osmotic pressure in chronic and severe liver disease, where the liver is unable to manufacture plasma proteins. A decrease in the normal levels of plasma proteins results in a decrease of colloid osmotic pressure (which counterbalances the hydrostatic pressure) in the capillaries. This process causes loss of water from the blood to the surrounding tissues, resulting in edema.

Pulmonary oedema is excess fluid in the air sacs of the lungs, a common symptom of heart and/or kidney failure. People with pulmonary edema likely will have trouble breathing, and they may experience chest pain. Pulmonary oedema can be life threatening, because it compromises gas exchange in the lungs, and anyone having symptoms should immediately seek medical care.

In pulmonary oedema resulting from heart failure, excessive leakage of water occurs because fluids get “backed up” in the pulmonary capillaries of the lungs when the left ventricle of the heart is unable to pump sufficient blood into the systemic circulation. Because the left side of the heart is unable to pump out its normal volume of blood, the blood in the pulmonary circulation gets “backed up,” starting with the left atrium, then into the pulmonary veins, and then into pulmonary capillaries.

The resulting increased hydrostatic pressure within pulmonary capillaries, as blood is still coming in from the pulmonary arteries, causes fluid to be pushed out of them and into lung tissues.

Edema. An allergic reaction can cause capillaries in the hand to leak excess fluid that accumulates in the tissues.

Mild, transient oedema of the feet and legs may be caused by sitting or standing in the same position for long periods of time, as in the work of a toll collector or a supermarket cashier. This is because deep veins in the lower limbs rely on skeletal muscle contractions to push on the veins and thus “pump” blood back to the heart. Otherwise, the venous blood pools in the lower limbs and can leak into surrounding tissues.

Medications that can result in oedema include vasodilators, calcium channel blockers used to treat hypertension, non-steroidal anti-inflammatory drugs, estrogen therapies, and some diabetes medications. Underlying medical conditions that can contribute to oedema include congestive heart failure, kidney damage and kidney disease, disorders that affect the veins of the legs, and cirrhosis and other liver disorders.

Therapy for oedema usually focuses on elimination of the cause. Activities that can reduce the effects of the condition include appropriate exercises to keep the blood and lymph flowing through the affected areas. Other therapies include elevation of the affected part to assist drainage, massage and compression of the areas to move the fluid out of the tissues, and decreased salt intake to decrease sodium and water retention.

2.2 SOLUTIONS

2.2 SOLUTIONS

Solutions, suspensions, colloids, and other dispersions are similar but have characteristics that set each one apart from the others.

Solutions

A solution is a homogeneous mixture of two or more components. The dissolving agent is the solvent. The substance that is dissolved is the solute. A solution is always transparent light passes through with no scattering from solute particles which are molecule in size. The solution is homogeneous and does not settle out. A solution cannot be filtered but can be separated using the process of distillation. The components of a solution are atoms, ions, or molecules, making them 10-9 m or smaller in diameter.

Example: Sugar and water

Suspensions

The particles in suspensions are larger than those found in solutions. A suspension is cloudy and heterogeneous. The particles are larger than 10,000 Angstroms which allows them to be filtered. If a suspension is allowed to stand the particles will separate out Components of a suspension can be evenly distributed by mechanical means, like by shaking the contents but the components will eventually settle out.

Example: Oil and water

Colloids

Particles intermediate in size between those found in solutions and suspensions can be mixed in such a way that they remain evenly distributed without settling out. These particles range in size from 10^{-8} to 10^{-6} m in size and are termed colloidal particles or colloids. The mixture they form is called a **colloidal dispersion**. A colloidal dispersion consists of **colloids** in a dispersing medium. A **colloid** is intermediate between a solution and a suspension. While a suspension will separate out a colloid will not.

Other Dispersions

Liquids, solids, and gasses all may be mixed to form colloidal dispersions.

Aerosols: Solid or liquid particles in a gas.

Examples: Smoke is solid in a gas. Fog is a liquid in a gas.

Sols: Solid particles in a liquid.

Example: Milk of Magnesia is a sol with solid magnesium hydroxide in water.

Emulsions: Liquid particles in a liquid

Example: Mayonnaise is oil in water.

Gels: Liquids in solid.

Examples: Gelatin is protein in water. Quicksand is sand in water

Differences Between Solutions Crystalloids And Colloids

The suspensions can be differentiated from colloids and solutions because the components of suspensions will eventually separate. Colloids can be distinguished from solutions using the Tyndall effect. A beam of light passing through a true solution, such as air, is not visible. Light passing through a colloidal dispersion, such as smoky or foggy air, will be reflected by the larger particles and the light beam will be visible.

Isotonic, Hypotonic, & Hypertonic Fluids

The cell is divided into two parts: (intracellular & extracellular). Each part is made up of a solution and depending on the tonicity of the fluid you can having shifting of fluids from outside of the cell to the inside via osmosis. The cell loves to be in an isotonic state and when something happens to make it unequal (like with hypotonic or hypertonic conditions) it will use osmosis to try to equal it out.

Osmosis allows molecules of the solvent to pass through a semipermeable membrane from a less concentrated solution to a higher concentrated solution. The key thing to remember here is that everything will move from a LOW concentration to a HIGH concentration.

Isotonic, Hypotonic, & Hypertonic Solutions

1) ISOTONIC

Iso: same/equal

Tonic: concentration of a solution

The cell has the same concentration on the inside and outside which in normal conditions the cell’s intracellular and extracellular are both isotonic.

It is important to be familiar with what fluids are isotonic and when they are given.

ISOTONIC FLUIDS

- 0.9% Saline
- 5% dextrose in water (D5W
- 5% Dextrose in 0.225% saline (D5W1/4NS)
- Lactated Ringer’s

Isotonic solutions are used: to increase the extracellular fluid volume due to blood loss, surgery, dehydration, fluid loss that has been loss extracellularly.

2) HYPOTONIC

Hypo: “under/beneath”

Tonic: concentration of a solution

The cell has a low amount of solute extracellularly and it wants to shift inside the cell to get everything back to normal via osmosis. This will cause CELL SWELLING which can cause the cell to burst or lyses.

Hypotonic solutions

- 0.45% Saline (1/2 NS)
- 0.225% Saline (1/4 NS)
- 0.33% saline (1/3 NS)

Hypotonic solutions are used when the cell is dehydrated, and fluids need to be put back intracellularly. This happens when patients develop diabetic ketoacidosis (DKA) or hyperosmolar hyperglycemia.

Important: Never give hypotonic solutions to patient who are at risk for increased cranial pressure (can cause fluid to shift to brain tissue), extensive burns, trauma (already hypovolemic) etc. because you can deplete their fluid volume.

3) HYPERTONIC

Hyper: excessive

Tonic: concentration of a solution

The cell has an excessive amount of solute extracellularly and osmosis is causing water to rush out of the cell intracellularly to the extracellular area which will cause the cells to shrink.

Hypertonic solutions

- 3% Saline
- 5% Saline
- 10% Dextrose in Water (D10W)
- 5% Dextrose in 0.9% Saline
- 5% Dextrose in 0.45% saline
- 5% Dextrose in Lactated Ringer’s

When hypertonic solutions are used (very cautiously…. most likely to be given in the ICU due to quickly arising side effects of pulmonary edema/fluid overload). In addition, it is preferred to give hypertonic solutions via a central line due to the hypertonic solution being vesicant on the veins and the risk of infiltration.

When Water Is Lost, IV Solutions Restore Fluid Balance

The human body is made up of about 60% water, with two-thirds of it stored intracellularly. The rest is found in blood vessels and between the cells. Water makes up 73% of the brain and heart; 83% of the lungs; 79% of the muscles and kidneys; and 64% of the skin.

Crystalloid Solutions

Most used crystalloid solutions contain small particles that pass easily from the bloodstream to cells and tissues. There are three types of crystalloids, given according to their tonicity, the ability to make water move into or out of a cell by osmosis. Tonicity is related to the concentration of all the solute particles in a solution, called the osmolarity. A solution with few particles has a low osmolarity, while a solution with a high number of particles has a high osmolarity. Water moves through the semipermeable membranes of the body from low-to-high osmolarity, to create a balance of water and solutes.

The three types of crystalloids are:

- Hypotonic: When the extracellular fluid has fewer solutes (osmolarity) than the fluid in the cells. Water will move from extracellular space into the cells.
- Hypertonic: When the extracellular fluid has more solutes (osmolarity) than within the cells, water flows out of the cells.
- Isotonic: Both the extracellular and intracellular fluids have the same osmolarity, so there is no movement of water between them.

Which Crystalloid Solution to Administer?

Although crystalloids are administered routinely, which solution is ordered depends on the patient’s condition. Four solutions are the most administered. Here is a brief description of each:

1) 0.9% NORMAL SALINE (NS, 0.9 NACL, OR NSS)

Normal saline is the chemical name for salt. The generic name is sodium chloride. It is a sterile, nonpyrogenic crystalloid fluid administered via an intravenous solution. Normal saline infusion is used for extracellular fluid replacement (e.g., dehydration, hypovolemia, haemorrhage, sepsis), treatment of metabolic alkalosis in the presence of fluid loss, and for mild sodium depletion. Normal saline can also be used as a flush -- to clean out an intravenous (IV) catheter. This helps prevent blockage and removes any medicine left in the catheter area after the patient has received an IV infusion. Dosage is dependent upon the age, weight, and clinical condition of the patient as well as laboratory determinations. Normal saline solution can be administered only via intravenous (IV) access.

0.9% Normal Saline (NS, 0.9NaCl, or NSS) is one of the most common IV fluids, it is administered for most hydration needs: haemorrhage, vomiting, diarrhea, haemorrhage, drainage from GI suction, metabolic acidosis, or shock.

It is an isotonic crystalloid that contains 0.9% sodium chloride (salt) that is dissolved in sterile water. It's the fluid of choice for resuscitation efforts as well. It is sometimes used with caution or even avoided in patients with cardiac or renal compromise because of the sodium causing fluid retention or volume overload.

IMPORTANT: NS is also the only fluid used in conjunction with blood product administration.

2) LACTATED RINGERS (LR, RINGERS LACTATE, OR RL)

The IV solution most like blood plasma concentration, it is the fluid of choice for burn and trauma patients. It used for acute blood loss; hypovolemia from third-space fluid shifts; electrolyte imbalance; and metabolic acidosis. LR is an isotonic crystalloid containing sodium chloride, potassium chloride, calcium chloride, and sodium lactate in sterile water. It is contraindicated in patients with a pH > 7.5, patients with liver disease who are unable to metabolize lactate, or for any patient with lactic acidosis. Use with extreme caution in cases of renal failure.

3) DEXTROSE 5% IN WATER (DW 5%)

A crystalloid that is both isotonic and hypotonic, administered for hypernatremia and to provide free water for the kidneys. Initially hypotonic, D5 dilutes the osmolarity of the extracellular fluid. Once the cells have absorbed the dextrose, the remaining water and electrolytes become an isotonic solution. D5 should not be used as the sole treatment of fluid volume deficit, because it dilutes plasma electrolyte concentrations. It is contraindicated in resuscitation, early post-op recovery, cardiac and renal conditions, and in any case of suspected increased intracranial pressure. Because the solution contains calories, due to dextrose (a form of glucose) as the solute, it does provide very limited nutrition.

4) 0.45% NORMAL SALINE (HALF NORMAL SALINE, 0.45NACL)

A hypotonic crystalloid solution of sodium chloride dissolved in sterile water, administered to treat hypernatremia or diabetic ketoacidosis. It is contraindicated in patients with burns, trauma, or liver disease due to depletion of intravascular fluid volumes. Half normal saline may result in fluid overload and subsequent decreased electrolyte concentrations or pulmonary oedema. Infusing too quickly can cause hemolysis of red blood cells.

Colloids: Less Frequent, but Important!

Colloids have large molecules that are unable to pass through semipermeable membranes. They remain in the blood vessels. They're also called volume or plasma expanders because they draw fluid from the interstitial space back into the blood vessels with oncotic pressure. Because colloids require less volume than crystalloid solutions, they are used for patients who are unable to tolerate large fluid volumes or are malnourished. Some of the uses for colloids are shock, external burns, pancreatitis, peritonitis, and post-op albumin loss. Common colloids are Albumin and Hespan. As a nurse, learn the types of IV solutions, and the reasons they are administered. Be aware of contraindications, and notify the prescribing provider if you know any reasons the patient should not receive fluid replacement with the

Factors Associated with Oedema

- Low plasma protein concentration: cause is liver disease, kidney disease, loss of protein in urine, lack of protein in diet due to starvation.

Effect: plasma osmotic pressure decreases, less fluid enters venular end of capillaries by osmosis.

Obstruction of lymph vessels: causes are surgical removal of portions of lymphatic pathways and parasitic infections.

Effect: back pressure in lymph vessels, interferes with movement of fluid from interstitial spaces into lymph capillaries.

Increased venous pressure: venous obstruction or faulty valves.

Effect: back pressure in veins increases capillary filtration and interferes with return of fluid from interstitial spaces into venular end of capillaries

Inflammation: cause is tissue damage.

Effect: capillaries become abnormally permeable and fluid leaks from plasma into the interstitial spaces

2.3 FLUID, ELECTROLYTE AND ACID BASE BALANCE

2.3 FLUID, ELECTROLYTE and ACID BASE BALANCE

The kidneys are essential for regulating the volume and composition of bodily fluids. A most critical concept to understand is how water and sodium regulation are integrated to defend the body against all possible disturbances in the volume and osmolarity of bodily fluids. Simple examples of such disturbances include dehydration, blood loss, salt ingestion, and plain water ingestion.

Water balance

Water balance is achieved in the body by ensuring that the amount of water consumed in food and drink (and generated by metabolism) equals the amount of water excreted. The consumption side is regulated by behavioural mechanisms, including thirst and salt cravings. While almost a liter of water per day is lost through the skin, lungs, and faeces, the kidneys are the major site of regulated excretion of water.

One way the the kidneys can directly control the volume of bodily fluids is by the amount of water excreted in the urine. Either the kidneys can conserve water by producing urine that is concentrated relative to plasma, or they can rid the body of excess water by producing urine that is dilute relative to plasma.

Direct control of water excretion in the kidneys is exercised by vasopressin, or anti-diuretic hormone (ADH), a peptide hormone secreted by the hypothalamus. ADH causes the insertion of water channels into the membranes of cells lining the collecting ducts, allowing water reabsorption to occur. Without ADH, little water is reabsorbed in the collecting ducts and dilute urine is excreted.

ADH secretion is influenced by several factors (note that anything that stimulates ADH secretion also stimulates thirst):

- By special receptors in the hypothalamus that are sensitive to increasing plasma osmolarity (when the plasma gets too concentrated). These stimulate ADH secretion.
- By stretch receptors in the atria of the heart, which are activated by a larger than normal volume of blood returning to the heart from the veins. These inhibit ADH secretion because the body wants to rid itself of the excess fluid volume.
- By stretch receptors in the aorta and carotid arteries, which are stimulated when blood pressure falls. These stimulate ADH secretion, because the body wants to maintain enough volume to generate the blood pressure necessary to deliver blood to the tissues.

Electrolytes

Electrolytes are elements and compounds that occur naturally in the body. They control important physiologic functions and are the minerals with an electric charge. They are in your blood, urine, tissues, and other body fluids. Electrolytes are important because they help

- Balance the amount of water in your body

- Balance your body's acid/base (pH) level
- Move nutrients into your cells
- Move wastes out of your cells
- Make sure that your nerves, muscles, the heart, and the brain work the way they should

Examples of electrolytes include

- calcium
- chloride
- magnesium
- phosphate
- potassium
- sodium

The levels of electrolytes in the body can become too low or too high. This can happen when the amount of water in the body changes. The amount of water that we take in should equal the amount we lose. If something upsets this balance, we may have too little water (dehydration) or too much water (overhydration). Some medicines, vomiting, diarrhea, sweating, and liver or kidney problems can all upset the water balance. An electrolyte disorder occurs when the levels of electrolytes in body are either too high or too low. Electrolytes need to be maintained in an even balance for your body to function properly. Otherwise, vital body systems can be affected.

Severe electrolyte imbalances can cause serious problems such as coma, seizures, and cardiac arrest

Normal Fluid and Electrolyte Physiology

A variety of key electrolytes are dissolved in body fluids to maintain organ function and fluid balance. The gastrointestinal (GI) tract, the kidneys and the endocrine system (pituitary-thyroid-adrenals) orchestrate precise fluid electrolyte balance. In addition, the respiratory system helps to maintain the body’s acid base balance.

In the average adult, intracellular fluid is about 40 percent of body weight and extracellular fluid is about 20 percent of body weight. The electrolytes within these fluid compartments are strikingly different. Within the extracellular fluid, sodium chloride predominates, while potassium with phosphates and negatively charged proteins is the major intracellular electrolyte. Sodium and potassium gradients are essential for muscle and nerve function. Numerous other electrolytes, including bicarbonate, magnesium, calcium, etc., are involved with a variety of essential metabolic functions.

The normal GI tract processes about 9 liters of fluid each day: approximately 2 to 3 liters of fluid are consumed orally, and about 6 to 7 liters of fluid are secreted by various parts of the GI tract. As these 9 liters passes along a normal GI tract, almost all of it is absorbed: the upper small bowel (duodenum and jejunum) absorbs 4 to 5 liters; the ileum, 2 to 3 liters; and the colon, 1 to 2 liters. Only 100 to 200 ml of this fluid is lost in the stool.

Fluid and Electrolyte Disorders

Fluid and electrolyte balance is upset when there is inadequate fluid and electrolyte intake, or dysfunction of key fluid and electrolyte balance organs:

- the GI tract,
- kidneys, or
- endocrine system.

For example, with various forms of short bowel syndrome the normal 200 ml of daily GI loss can exceed 5 liters and be accompanied by large electrolyte losses! The kidneys cannot maintain FEB under such circumstances. A variety of medications such as diuretics or cathartics (sorbitol, magnesium, caffeine, etc.) may also contribute to fluid and electrolyte imbalance.

Sodium losses are manifested by dehydration and muscle weakness. Potassium losses result in muscle weakness and cardiac arrhythmias. If more water is lost than sodium, hypernatremia occurs which may lead to confusion and impaired consciousness.

Symptoms of Dehydration

Dehydration produces symptoms and can be expressed as a fraction of total body water deficit. A 2 percent (1 liter) fluid loss is associated with thirst and increased drinking, and a decrease in tearing. In addition, the mouth and tongue become increasingly dry, and the skin loses its elasticity. With 5 percent or greater fluid loss, the eyes become sunken. It is not unusual for a person to experience up to 5 percent (2 liters) dehydration from time to time, but it is rare for a person to lose more than this. Very severe dehydration is life threatening and occurs when 10 percent or more (about 4 liters) body water is lost. When this level of dehydration is approached, the symptoms of dehydration mentioned above increase, excessive drinking finally stops, the individual becomes lethargic and his/her level of consciousness decreases.

Urine flow begins to decrease as soon as fluid intake lessens or fluid losses increase. Therefore, measuring the amount of urine flow in 12 or 24 hours is an excellent measure of adequate hydration. The volume can be measured at home and should be at least 1500 ml in a 24-hour period for most adults. Much less than this suggests some degree of dehydration.

The fluids lost by an abnormal GI tract depend on the actual disease process, the part of the bowel involved, and how long the bowel has recuperated from the initial insult. Loss of fluid may be due to infection such as infectious diarrhea (viral, bacterial, or parasitic), inflammation (Crohn’s disease), loss of bowel length (short bowel syndrome) or certain drugs (magnesium, drugs suspensions with sorbitol).

Acid-Base Balance

Acids are electrolytes that release hydrogen ions (H+) when they are dissolved in water.

Bases are electrolytes that release hydroxide ions (OH-) when they are dissolved in water.

Acid-base balance is primarily regulated by the concentration of H+ (or the pH level) in body fluids, especially ECF

Normal pH range of ECF is from 7.35 to 7.45.

Acid base balance

Most H+ comes from metabolism -- glycolysis, oxidation of fatty acids and amino acids, and hydrolysis of proteins. Homeostasis of pH in body fluids is regulated by acid-base buffer systems (primary control), respiratory centers in brain stem, and by kidney tubule secretion of H+.Acid-base buffer systems are chemical reactions that consist of a weak acid and a weak base, to prevent rapid, drastic changes in body fluid pH. One of the most carefully regulated concentration in the body is that of H+ ion.

When acid (H+) is added to the blood, the pH decreases. Then increased acidity (decreased pH) is minimized by buffers which bind some of the added H+. When acid is taken away, blood becomes more alkaline (pH increases). This change is minimized by buffers, which release H+ and replace some of the acid that was lost

The pair bicarbonate / carbonic acid forms an important buffer system. H_2CO_3 (carbonic acid)- is the acid member of the pair because it can release H+.

HCO_3^- is the base member of the pair because it can accept H+.

This system is important because two of its components are rigorously controlled by the body:

- the lungs control CO_2 and
- the kidneys control HCO_3

Chemical Acid-Base buffer systems

1) Bicarbonate buffer system

Bicarbonate ion (HCO_3^-) – converts a strong acid into a weak acid. Carbonic acid (H_2CO_3) – converts a strong base into a weak base.

Bicarbonate buffer system produces carbonic acid (H_2CO_3) and sodium bicarbonate ($NaHCO_3$) to minimize H+ increase, mainly in the blood:

2) Phosphate buffer system

Produces sodium hydrogen phosphates (NaH_2PO_4 and Na_2HPO_4) to regulate H+ levels, mainly in kidney tubules and erythrocytes:

3) Protein buffer system

Relies on the carboxylic acid group of amino acids to release H+, and the amino group to accept H+, mainly inside body cells and in blood plasma.

Central Regulation

Respiratory centers in the pons and medulla oblongata regulate the rate and depth of breathing, which controls the amount of carbon dioxide

gas (CO_2) remained in the blood and body fluid –

e.g., slower breathing rate an increase in blood CO_2 level

an increase in carbonic acid (H_2CO_3) in blood

more H+ is released into body fluids

pH of blood and body fluids drops.

Nephrons react to the pH of body fluids and regulate the secretion of H+ into urine -- e.g., a diet high in proteins causes more H+ to be produced in body fluids (which lowers body fluid pH), as a result the nephrons will secrete more H+ into the urine.

Compensation

Compensation is a series of physiological responses that react to acid-base imbalances, by returning blood pH to the normal range (7.35 – 7.45).

Respiratory acidosis

Respiratory acidosis (due to deficiency of CO_2 expiration) **and respiratory alkalosis** (due to abnormally high CO_2 expiration) are primary disorders of CO_2 pressure in the lungs. These may be compensated by renal mechanisms where nephrons will secrete more H+ to correct acidosis and secrete less H+ to correct alkalosis.It is due to increased CO_2 retention (due to hypoventilation), which can result in the accumulation of carbonic acid and thus a fall in

blood pH to below normal.

Metabolic Acidosis

An increased production of acids such as lactic acid, fatty acids, and ketone bodies, or loss of blood bicarbonate (such as by diarrhea), resulting in a fall in blood pH to below normal.

Metabolic alkalosis

A rise in blood pH produced by loss of acids (such as excessive vomiting) or by excessive accumulation of bicarbonate base.

Respiratory Excretion Of CO_2

The respiratory center is located in the brain stem. It helps control pH by regulating the rate and depth of breathing.

- Increasing CO_2 and H^+ ions concentration stimulates chemo receptors associated with the respiratory center.

breathing rate and depth increase, and

CO_2 concentration decreases.

- If the CO_2 and H^+ ion concentrations are low; the respiratory center inhibits breathing.

Renal excretion of H^+

- Nephrons secrete hydrogen ions to regulate the ph. Phosphate buffers hydrogen ions in urine.
- Ammonia produced by renal cells help transport H^+ to the outside of the body.
- The chemical buffer system (Bicarbonate buffer system, phosphate buffer, and protein buffer system) act rapidly and are the first line of defense against pH shift.
- The physiological buffer (respiratory mechanism CO_2 excretion), renal mechanism (H^+ excretion) act slowly and are the 2nd line of defense against pH shift.

Source of H^+

1) Aerobic respiration of glucose produces CO_2, which reacts with water to form carbonic acid, which then dissociates to release H^+ and bicarbonate ions.
2) Anaerobic respiration of glucose produces lactic acid.
3) Incomplete oxidation of fatty acids releases acidic ketone bodies.
4) Oxidation of sulfur-containing amino acid produce H ions
5) Hydrolysis of phosphoproteins and nucleic acids gives rise to phosphoric acid.

2.4 WATER BALANCE FLUID AND ELECTROLYTE REPLACEMENT

2.4 WATER BALANCE FLUID AND ELECTROLYTE REPLACEMENT

On a typical day, the average adult should take in about 2500 mL of fluids.. Most water intake comes through the digestive tract via liquids and food, but roughly 10 percent of water available to the body is generated at the end of aerobic respiration during cellular metabolism

Additionally, each day about the same volume (2500 mL) of water leaves the body by different routes; most of this lost water is removed as urine. Urine produced by the kidneys accounts for the largest amount of water leaving the body. The kidneys can adjust the concentration of the urine to reflect the body's water needs, conserving water if the body is dehydrated or making urine more dilute to expel excess water when necessary.

Water is lost through the skin through evaporation from the skin surface without overt sweating and from air expelled from the lungs. This type of water loss is called insensible water loss because a person is usually unaware of it.

Homeostasis requires that water intake and output be balanced ADH is a hormone that helps the body to retain water by increasing water reabsorption by the kidneys

Body fluid volume and electrolyte concentration are normally maintained within very narrow limits despite wide variations in dietary intake, metabolic activity, and environmental stresses. Homeostasis of body fluids is preserved primarily by the kidneys.

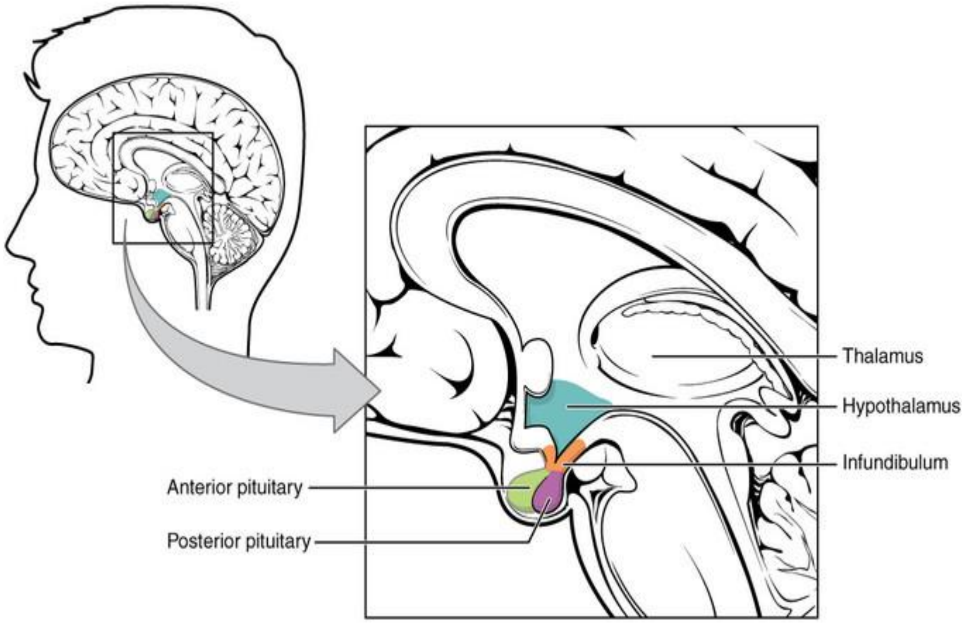
Water and sodium balance are closely interdependent. Total body water (TBW) is about 60% of body weight in men (ranging from about 50% in obese people to 70% in lean people) and about 50% in women. Almost two thirds of TBW is in the intracellular compartment (intracellular fluid, or ICF); the other one third is extracellular (extracellular fluid, or ECF). Normally, about 25% of the ECF is in the intravascular compartment; the other 75% is interstitial fluid

Regulation of Water Intake

Osmolality is the ratio of solutes in a solution to a volume of solvent in a solution. **Plasma osmolality** is thus the ratio of solutes to water in blood plasma. A person's plasma osmolality value reflects his or her state of hydration. A healthy body maintains plasma osmolality within a narrow range, by employing several mechanisms that regulate both water intake and output.

Drinking water is considered voluntary. The water that leaves the body, as exhaled air, sweat, or urine, is ultimately extracted from blood plasma. As the blood becomes more concentrated, the thirst response—a sequence of physiological processes—is triggered. Osmoreceptors are sensory receptors in the thirst center in the hypothalamus that monitor the concentration of solutes (osmolality) of the blood. If blood osmolality increases above its ideal value, the hypothalamus transmits signals that result in a conscious awareness of thirst.

The person should (and normally does) respond by drinking water. The hypothalamus of a dehydrated person also releases antidiuretic hormone (ADH) through the posterior pituitary gland. ADH signals the kidneys to recover water from urine, effectively diluting the blood plasma.



To conserve water, the hypothalamus of a dehydrated person also sends signals via the sympathetic nervous system to the salivary glands in the mouth. The signals result in a decrease in watery, serous output (and an increase in stickier, thicker mucus output). These changes in secretions result in a “dry mouth” and the sensation of thirst.

Decreased blood volume resulting from water loss has two additional effects. First, baroreceptors, blood-pressure receptors in the arch of the aorta and the carotid arteries in the neck, detect a decrease in blood pressure that results from decreased blood volume. The heart is ultimately signaled to increase its rate and/or strength of contractions to compensate for the lowered blood pressure.

Second, the kidneys have a renin-angiotensin hormonal system that increases the production of the active form of the hormone angiotensin II, which helps stimulate thirst, but also stimulates the release of the hormone aldosterone from the adrenal glands. Aldosterone increases the reabsorption of sodium in the distal tubules of the nephrons in the kidneys, and water follows this reabsorbed sodium back into the blood.

If adequate fluids are not consumed, dehydration results and a person’s body contains too little water to function correctly. A person who repeatedly vomits or who has diarrhea may become dehydrated, and infants, because their body mass is so low, can become dangerously dehydrated very quickly. Endurance athletes such as distance runners often become dehydrated during long races. Dehydration can be a medical emergency, and a dehydrated person may lose consciousness, become comatose, or die, if his or her body is not rehydrated quickly.

Regulation of Water Output

Water loss from the body occurs predominantly through the renal system. A person produces an average of 1.5 liters of urine per day. Although the volume of urine varies in response to hydration levels, there is a minimum volume of urine production required for proper bodily functions. The minimum level of urine production necessary to maintain normal function is about 0.47 liters per day.The kidneys also must make adjustments in the event of ingestion of too much fluid. **Diuresis**, which is the production of urine in excess of normal levels, begins about 30 minutes after drinking a large quantity of fluid. Diuresis reaches a peak after about 1 hour, and normal urine production is reestablished after about 3 hours.

Body water homeostasis is regulated mainly through ingested fluids, which, in turn, depends on thirst. Thirst is the basic instinct or urge that drives an organism to ingest water.

Thirst is a sensation created by the hypothalamus, the thirst center of the human body. Thirst is an important component of blood volume regulation, which is slowly regulated by homeostasis.

Water Balance Disorders

Dehydration (hypohydration) is defined as the excessive loss of body fluid. It is literally the removal of water from an object. However, in physiological terms, it entails a deficiency of fluid within an organism. Much of the physiological effects of dehydration is due to the changes in ion concentration that may occur because of the dehydration. Alternatively, hypovolemia may occur due to loss of blood volume itself.

Dehydration

There are three types of dehydration that differ based on the type of change in ion concentrations:

1) Hypotonic—primarily a loss of electrolytes, sodium. Hypotonic dehydration causes decreased plasma osmolarity.
2) Hypertonic—primarily a loss of water. Hypertonic dehydration causes increased plasma osmolarity.
3) Isotonic—an equal loss of water and electrolytes. Isotonic dehydration will not change plasma osmolarity, but it will reduce overall plasma volume. Isotonic dehydration is the most common type of dehydration.

Further complications may also occur. In hypotonic dehydration, intravascular water shifts to the extravascular space and exaggerates intravascular volume depletion for a given amount of total body water loss. Neurological complications can occur in hypotonic and hypertonic states. The former can lead to seizures, while the latter can lead to osmotic cerebral oedema upon rapid rehydration.

Hypovolemia

Hypovolemia is specifically a decrease in the volume of blood plasma. Furthermore, hypovolemia defines water deficiency in terms of blood volume rather than the overall water content of the body.

To treat minor dehydration water intake must be increased, while the source of fluid loss must be reduced or stopped altogether. Plain water restores only the volume of the blood plasma and inhibits the thirst mechanism before solute levels can be replenished.

Solid foods can contribute to fluid loss from vomiting and diarrhea. In more severe cases, correction of a dehydrated state is accomplished by the replenishment of necessary water and electrolytes through oral rehydration therapy or fluid replacement by intravenous therapy (an IV drip).

As oral rehydration is easier to provide, it is the treatment of choice for mild dehydration. Solutions used for intravenous rehydration must be isotonic or hypotonic.

2.5 UNDERSTANDING ELECTROLYTE DISORDERS

2.5 UNDERSTANDING ELECTROLYTE DISORDERS

Symptoms

Mild forms of electrolyte disorders may not cause any symptoms. Such disorders can go undetected until they're discovered during a routine blood test. Symptoms usually start to appear once a particular disorder becomes more severe.

Not all electrolyte imbalances cause the same symptoms, but many share similar symptoms.

Common symptoms of an electrolyte disorder include:

- irregular heartbeat
- fast heart rate
- fatigue
- lethargy
- convulsions or seizures
- nausea
- vomiting
- diarrhea or constipation
- abdominal cramping
- muscle cramping
- muscle weakness
- irritability
- confusion
- headaches
- numbness and tingling

Electrolyte disturbances can become life-threatening if left untreated.

Causes of electrolyte disorders

Electrolyte disorders are most often caused by a loss of bodily fluids through prolonged vomiting, diarrhea, or sweating. They may also develop due to fluid loss related to burns. Certain medications can cause electrolyte disorders as well. In some cases, underlying diseases, such as acute or chronic kidney disease, are to blame. The exact cause may vary depending on the specific type of electrolyte disorder.

Types of electrolyte disorders

Elevated levels of an electrolyte are indicated with the prefix "hyper-." Lowered levels of an electrolyte are indicated with "hypo-."

Conditions caused by electrolyte level imbalances include:

- calcium: hypercalcemia and hypocalcemia
- chloride: hyperchloremia and hypochloremia
- magnesium: hypermagnesemia and hypomagnesemia
- phosphate: hyperphosphatemia or hypophosphatemia
- potassium: hyperkalemia and hypokalemia
- sodium: hypernatremia and hyponatremia

Calcium

Calcium is a vital mineral that your body uses to stabilize blood pressure and control skeletal muscle contraction. It's also used to build strong bones and teeth.

Hypercalcemia occurs when you have too much calcium in the blood. This is usually caused by:

- kidney disease
- thyroid disorders, including hyperparathyroidism
- lung diseases, such as tuberculosis or sarcoidosis
- certain types of cancer, including lung and breast cancers
- excessive use of antacids and calcium or vitamin D supplements
- medications such as lithium, theophylline, or certain water pills

Hypocalcemia occurs due to a lack of adequate calcium in the bloodstream. Causes can include:

- kidney failure
- hypoparathyroidism
- vitamin D deficiency
- pancreatitis
- prostate cancer
- malabsorption
- certain medications, including heparin, osteoporosis drugs, and antiepileptic drugs

Chloride

Chloride is necessary for maintaining the proper balance of bodily fluids.

Hyperchloremia occurs when there's too much chloride in the body. It can happen because of:

- severe dehydration

- kidney failure
- dialysis

Hypochloremia develops when there's too little chloride in the body. It's often caused by sodium or potassium problems.

Other causes can include:

- cystic fibrosis
- eating disorders, such as anorexia nervosa
- scorpion stings
- acute kidney failure

Magnesium

Magnesium is a critical mineral that regulates many important functions, such as:

- muscle contraction
- heart rhythm
- nerve function

Hypermagnesemia means excess amounts of magnesium. This disorder primarily affects people with Addison's disease and end-stage kidney disease.

Hypomagnesemia means having too little magnesium in the body. Common causes include:

- alcohol use disorder
- malnutrition
- malabsorption
- chronic diarrhea
- excessive sweating
- heart failure
- certain medications, including some diuretics and antibiotics

Phosphate

The kidneys, bones, and intestines work to balance phosphate levels in the body. Phosphate is necessary for a wide variety of functions and interacts closely with calcium.

Hyperphosphatemia can occur due to:

- low calcium levels
- chronic kidney disease

- severe breathing difficulties
- underactive parathyroid glands
- severe muscle injury
- tumor lysis syndrome, a complication of cancer treatment
- excessive use of phosphate-containing laxatives

Low levels of phosphate, or hypophosphatemia, can be seen in:

- acute alcohol abuse
- severe burns
- starvation
- vitamin D deficiency
- overactive parathyroid glands
- certain medications, such as intravenous (IV) iron treatment, niacin (Niacor, Niaspan), and some antacids

Potassium

Potassium is particularly important for regulating heart function. It also helps maintain healthy nerves and muscles.

Hyperkalemia may develop due to high levels of potassium. This condition can be fatal if left undiagnosed and untreated.

It is typically triggered by:

- severe dehydration
- kidney failure
- severe acidosis, including diabetic ketoacidosis
- certain medications, including some blood pressure medications and diuretics
- adrenal insufficiency, which is when your cortisol levels are too low

Hypokalemia occurs when potassium levels are too low. This often happens because of:

- eating disorders
- severe vomiting or diarrhea
- dehydration
- certain medications, including laxatives, diuretics, and corticosteroids

Sodium

Sodium is necessary for the body to maintain fluid balance and is critical for normal body function. It also helps to regulate nerve function and muscle contraction.

Hypernatremia occurs when there's too much sodium in the blood.

Abnormally high levels of sodium may be caused by:

- inadequate water consumption
- severe dehydration
- excessive loss of bodily fluids because of prolonged vomiting, diarrhea, sweating, or respiratory illness
- certain medications, including corticosteroids

Hyponatremia develops when there's too little sodium.

Common causes of low sodium levels include:

- excessive fluid loss through the skin from sweating or burns
- vomiting or diarrhea
- poor nutrition
- alcohol use disorder
- overhydration
- thyroid, hypothalamic, or adrenal disorders
- liver, heart, or kidney failure
- certain medications, including diuretics and seizure medications
- syndrome of inappropriate secretion of antidiuretic hormone (SIADH)

Risk factors for electrolyte disorders

Conditions that increase risk for an electrolyte disorder include:

- alcohol use disorder
- cirrhosis
- congestive heart failure
- kidney disease
- eating disorders, such as anorexia and bulimia
- trauma, such as severe burns or broken bones
- thyroid disorders
- adrenal gland disorders

Diagnosing Electrolyte Disorders

Clinical features and history are helpful. A simple blood test can measure the levels of electrolytes in the body. A blood test for kidney function is important as well.

For example, hypernatremia (too much sodium) can cause loss of elasticity in the skin due to significant dehydration. Your doctor can perform a pinch test to determine whether dehydration is affecting you.

They may also test your reflexes, as both increased and depleted levels of some electrolytes can affect reflexes.

Electrocardiogram (ECG) may be useful to check for any irregular heartbeats, rhythms, or changes brought on by electrolyte problems.

Treatment:

Varies depending on the type of electrolyte disorder and on the underlying condition that's causing it. In general, certain treatments are used to restore the proper balance of minerals in the body.

The term applied is “oral rehydration therapy.” If there is sufficient functioning GI tract to absorb fluid, oral rehydration therapy can be accomplished despite ongoing diarrheal losses.

Oral rehydration therapy solutions are specifically designed to promote water and sodium absorption. Water by itself is not effective because the GI tract requires sodium, sugar and/or amino acids to absorb the water. “Sport drinks” (see Table 2) promote water absorption by providing sodium and sugar, but in the face of major GI losses, their sodium content is too low for them to be used for oral rehydration therapy. Water containing appropriate sodium, sugar and amino acids must be given in specific amounts for optimal absorption.

Simple ingredients available in the grocery store can be used. For example, the World Health Organization (WHO) formula can be mixed using 1 liter of water, 3/4 tsp. table salt, 1/2 tsp. baking soda, 1 cup orange juice, 4 Tbs. table sugar or 2 Tbs. honey; sugar free flavourings may be added to make this salty drink more palatable

The WHO formula and several other hydration products are available commercially However, before choosing a commercial hydration product, be sure to check the sodium concentration. This should approach or exceed 90 mEq/L. The sugar concentration should exceed 20 gm sugar/L, preferably around 40 gm/L. Rice-based formulas may have additional absorption advantages because they contain amino acids in addition to sugar and sodium

Intravenous (IV) fluids

Intravenous (IV) fluids, typically sodium chloride, can help rehydrate the body. This treatment is commonly used in cases of dehydration resulting from vomiting or diarrhea. Electrolyte supplements can be added to IV fluids to correct deficiencies.

Certain IV medications can help our body restore electrolyte balance quickly.The medication will depend on the electrolyte disorder you have. Medications that may be administered include calcium gluconate, magnesium chloride, and potassium chloride.

Oral medications and supplements

Oral medications and supplements are often used to correct chronic mineral abnormalities in your body.

Depending on the electrolyte disorder, the patient may receive medications or supplements such as:

- calcium (gluconate, carbonate, citrate, or lactate
- magnesium oxide
- potassium chloride
- phosphate binders, which include sevelamer hydrochloride and calcium-based treatments such as calcium carbonate

They can help replace depleted electrolytes on a short- or long-term basis, depending on the underlying cause of your disorder. Once the imbalance has been corrected, the doctor will treat the underlying cause. Although some of the supplements can be purchased over the counter, most people with electrolyte disorders get a prescription for supplements from their doctor.

IV fluid and electrolyte administration:

Intravenous administration of fluid is one effective treatment of dehydration. Hypovolemia is a cause of hypovolemic shock. Shock is any condition in which the body's fluids are unable to properly circulate and oxygenate the major organs of the human body; this causes compensatory mechanisms to activate that cause further bodily harm as the body's metabolism is maintained for a while longer.

In the case of hypovolemic shock, the tissue metabolism is impaired due to a lack of blood volume and makes it difficult for red blood cells to reach all of the tissues of the body. It is most often caused by severe vomiting, diarrhea, blood loss, or haemorrhage. Other forms of shock with similar symptoms may be due to problems in the heart (cardiogenic) or bacterial infection (septic).

Role of FWWs in preventing electrolyte disorders

The following general advice can help prevent electrolyte disorders:

- stay hydrated if you're experiencing prolonged vomiting, diarrhea, or sweating
- visit your doctor if you're experiencing common symptoms of an electrolyte disorder

If the electrolyte disorder is caused by medications or underlying conditions, refer the patient to the doctor so the prescription may be reviewed.

2.6 MACRONUTRIENTS, ENZYMES AND HORMONES

2.6 Macronutrients, Enzymes and Hormones

Carbohydrates

Carbohydrates are molecules that contain carbon, hydrogen and oxygen atoms in specific ratios.

Chemical classification of carbohydrates

Carbohydrates, also called Carbs, are defined as aldehydic or ketonic compounds with some number of oxydrilic groups (so polyhydroxy aldehydes or ketones as well). On the basis of the number of forming units,there are three major classes of carbohydrates: monosaccharides, oligosaccharides and polysaccharides. The term “saccharide” derives from the greek word “sakcharon”, which means sugar.

- **Monosaccharides** or simply sugars are formed by only one polyhydroxy aldehydic or ketonic unit.The most abundant monosaccharide is D-glucose, also called dextrose.
- **Oligosaccharides** are formed by short chains of monosaccharidic units (from 2 to 20) linked one to the next by chemical bounds, called glycosidic bounds.The most abundant oligosaccharides are disaccharides, formed by two monosaccharides, and especially in the human diet the most important are sucrose (common table sugar), lactose and maltose. Within cells many oligosaccharides formed by three or more units do not find themselves as free molecules but linked to other ones, lipids or proteins, to form glycoconjugates.
- Polysaccharides are polymers consisting of 20 to 107 monosaccharidic units; they differ each other for the monosaccharides recurring in the structure, for the length and the degree of branching of chains or for the type of links between units. Whereas in the plant kingdom several types of polysaccharides are present, in vertebrates there are only a small number.

Physiological classification of carbs

Based on their degree of polymerization, they can be classified as:

- simple: mono- and disaccharides (also known as “sugars”) and tri- and tetrasaccharides (oligosaccharides).
- complex: the polysaccharides.
- The common sources include rice, wheat, jowaar and baajra. Their storage or reserved food forms include sugar and starch
- The carbohydrates are water soluble and crystalline in nature, with a sweet taste

Role Of Carbohydrates In The Body

One of the primary functions of carbohydrates is to provide s body with energy. Most of the carbohydrates in the foods are digested and broken down into glucose before entering the bloodstream. Glucose in the blood is taken up into the body’s cells and used to produce a fuel molecule called adenosine triphosphate (ATP) through a series of complex processes known as cellular respiration. Cells can then use ATP to power a variety of metabolic tasks.

Most cells in the body can produce ATP from several sources, including dietary carbohydrates and fats. But when consuming a diet with a mix of these nutrients, most of the body's cells will prefer to use carbs as their primary energy source.

If the body has enough glucose to fulfill its current needs, excess glucose can be stored for later use. This stored form of glucose is called glycogen and is primarily found in the liver and muscle. The liver contains approximately 100 grams of glycogen. These stored glucose molecules can be released into the blood to provide energy throughout the body and help maintain normal blood sugar levels between meals. Unlike liver glycogen, the glycogen in the muscles can only be used by muscle cells. It is vital for use during long periods of high-intensity exercise. Muscle glycogen content varies from person to person, but it's approximately 500 grams.

When a person has all the glucose our body needs and the glycogen stores are full, the body converts excess carbohydrates into triglyceride molecules and store them as fat. Glycogen storage is just one of several ways our body makes sure it has enough glucose for all its functions. When glucose from diet is lacking, muscle can also be broken down into amino acids and converted into glucose or other compounds to generate energy.

However, this is one way the body provides adequate energy for the brain, which requires some glucose for energy even during periods of prolonged starvation. Consuming at least some carbohydrates is one way to prevent this starvation-related loss of muscle mass. These carbs will reduce muscle breakdown and provide glucose as energy for the brain.

Eating excessive amounts of refined carbs is detrimental to heart health and may increase the risk of diabetes. Excess refined carbohydrates can increase the risk of heart disease and diabetes. Fiber is a type of carbohydrate that is associated with reduced "bad" LDL cholesterol levels, a lower risk of heart disease and increased glycemic control. Nearly every cell in your body can generate the fuel molecule ATP from fat. In fact, the body's largest form of stored energy is not glycogen — its triglyceride molecules stored in fat tissue.

Carbohydrates serve several key functions in our body. They provide us with energy for daily tasks and are the primary fuel source for your brain's high energy demands. Fiber is a special type of carb that helps to promote good digestive health and may lower your risk of heart disease and diabetes.

Proteins

Protein is crucial to good health and the name comes from the Greek word *proteos*, meaning "primary" or "first place. "Proteins are made up of amino acids that join together to form long chains. Protein molecule can be thought of as a string of beads in which each bead is an amino acid. There are 20 amino acids that help to form the thousands of different proteins in the body.

Functions of proteins

Proteins do most of their work in the cell and perform various jobs. It helps repair and build our body tissues, allows metabolic reactions to take place and coordinates bodily functions. Proteins are the main building blocks of our body. They're used to make muscles, tendons, organs, and skin, as well as enzymes, hormones, neurotransmitters, and various molecules that serve many important functions. In addition to providing our body with a structural framework, proteins also maintain proper pH and fluid balance. Finally, they keep immune system strong, transport and store nutrients and can act as an energy source, if needed.

How much protein intake is optimal?

Not getting enough protein in your diet can lead to health issues. For example, tissue can break down and lead to muscle loss. But more isn't necessarily better. While it can help build muscle, if you take in too much your body may store the excess as fat. The DRI (Dietary Reference Intake) is 0.36 grams of protein per pound (0.8 grams per kg) of body weight.

This amounts to:

- 56 grams per day for the average sedentary man
- 46 grams per day for the average sedentary woman
- Children under 4: 13 grams
- Children age 4 to 8: 19 grams
- Children age 9 to 13: 34 grams
- Women and girls ages 14 and over: 46 grams
- Boys age 14 to 18: 52 grams
- Men age 19 and over: 56 grams

After age 40, one can start to lose muscle mass, a condition known as sarcopenia, and the person will need more protein. Simply put, everyone should get 10% to 35% of their calories each day in the form of protein. More calories are needed for activities like biking, lifting weights

What Are the Best Sources of Protein?

High-quality sources of protein include:

- Fish
- Poultry
- Lean beef
- Eggs
- Dairy products

Proteins can be provided from plant-based sources. These include:

- Nuts
- Seeds
- Legumes like beans, peas, or lentils

Grains, like wheat, rice, or corn. Fish and seafood are also good sources. In some cases, your healthcare provider may recommend supplements. However, there are no guidelines for supplementing with protein during pregnancy. It’s not just the quantity of protein that matters. It’s also important to eat a variety of protein sources because different proteins provide different amino acids. Eating a variety of protein sources will also provide a variety of vitamins and minerals.

What “grams of protein” really means?

This is a very common area of misunderstanding. In nutrition science, “grams of protein” refers to the number of grams of the macronutrient protein, not the number of grams of a protein-containing food like meat or eggs. An 8-ounce serving of beef weighs 226 grams but only contains 61 grams of protein. Similarly, a large egg weighs 46 grams but only packs 6 grams of protein.

Here are 9 important functions of protein in our body.

1) Growth and Maintenance

The body needs protein for growth and maintenance of tissues. Yet, the body’s proteins are in a constant state of turnover. Under normal circumstances, body breaks down the same amount of protein that it uses to build and repair tissues. Other times, it breaks down more protein than it can create, thus increasing your body’s needs. This typically happens in periods of illness, during pregnancy and while breastfeeding People recovering from an injury or surgery, older adults and athletes require more protein as well. The body’s protein needs are dependent upon your health and activity level.

2) Causes Biochemical Reactions

Enzymes are proteins that aid the thousands of biochemical reactions that take place within and outside of the cells The structure of enzymes allows them to combine with other molecules inside the cell called substrates, which catalyze reactions that are essential to metabolism. Enzymes may also function outside the cell, such as digestive enzymes like lactase and sucrase, which help to digest sugar. Some enzymes require other molecules, such as vitamins or minerals, for a reaction to take place. Bodily functions that depend on enzymes include

- Digestion
- Energy production
- Blood clotting
- Muscle contraction

Lack or improper function of these enzymes can result in disease. Enzymes are proteins that allow key chemical reactions to take place within your body.

3) Acts as a Messenger

Some proteins are hormones, which are chemical messengers that aid communication between your cells, tissues and organs. They're made and secreted by endocrine tissues or glands and then transported in your blood to their target tissues or organs where they bind to protein receptors on the cell surface. Hormones can be grouped into three main categories:

- **Protein and peptides:** These are made from chains of amino acids, ranging from a few to several hundred.
- **Steroids:** These are made from the fat cholesterol. The sex hormones, testosterone and estrogen, are steroid-based.
- **Amines:** These are made from the individual amino acids tryptophan or tyrosine, which help make hormones related to sleep and metabolism.

Protein and polypeptides make up most of body's hormones. Some examples include:

- **Insulin:** Signals the uptake of glucose or sugar into the cell.
- **Glucagon:** Signals the breakdown of stored glucose in the liver.
- **HGH (human growth hormone):** Stimulates the growth of various tissues, including bone.
- **ADH (antidiuretic hormone):** Signals the kidneys to reabsorb water.
- **ACTH (adrenocorticotropic hormone):** Stimulates the release of cortisol, a key factor in metabolism.

4) Provides Structure

Some proteins are fibrous and provide cells and tissues with stiffness and rigidity. These proteins include keratin, collagen and elastin, which help to form the connective framework of certain structures in your body. Keratin is a structural protein that is found in skin, hair and nails. Collagen is the most abundant protein in your body and is the structural protein of your bones, tendons, ligaments and skin. Elastin is several hundred times more flexible than collagen. Its high elasticity allows many tissues in body to return to their original shape after stretching or contracting, such as your uterus, lungs and arteries

5) Proper pH

Protein plays a vital role in regulating the concentrations of acids and bases in your blood and other bodily fluids. Proteins act as a buffer system, helping your body to maintain proper pH values of the blood and other bodily fluids. The balance between acids and bases is measured using the pH scale. It ranges from 0 to 14, with 0 being the most acidic, 7 neutral and 14 the most alkaline.

Examples of the pH value of common substances include:

- **pH 2:** Stomach acid

- **pH 4:** Tomato juice
- **pH 5:** Black coffee
- **pH 7.4:** Human blood
- **pH 10:** Milk of magnesia
- **pH 12:** Soapy water

A variety of buffering systems allows your bodily fluids to maintain normal pH ranges. A constant pH is necessary, as even a slight change in pH can be harmful or potentially deadly

6) Balances Fluids

Proteins regulate body processes to maintain fluid balance. Albumin and globulin are proteins in the blood that help to maintain the body's fluid balance by attracting and retaining water. Proteins in your blood maintain the fluid balance between your blood and the surrounding tissues.

If one doesn't eat enough protein, the levels of albumin and globulin eventually decrease. Consequently, these proteins can no longer keep blood in blood vessels, and the fluid is forced into the spaces between the cells. As the fluid continues to build up in the spaces between cells, swelling or edema occurs, particularly in the stomach region. This is a form of severe protein malnutrition called kwashiorkor that develops when a person is consuming enough calories but does not consume enough protein.

7) Bolsters Immune Health

Proteins help to form immunoglobulins, or antibodies, to fight infection Antibodies are proteins in the blood that help to protect our body from harmful invaders like bacteria and viruses. When these foreign invaders enter the cells, our body produces antibodies that tag them for elimination. Without these antibodies, bacteria and viruses would be free to multiply and overwhelm the body with the disease they cause. Once the body has produced antibodies against a particular bacteria or virus, the cells never forget how to make them. This allows the antibodies to respond quickly the next time a particular disease agent invades your body. As a result, our body develops immunity against the diseases to which it is expose

8) Transport and Stores Nutrients

Transport proteins carry substances throughout your bloodstream — into cells, out of cells or within cells. The substances transported by these proteins include nutrients like vitamins or minerals, blood sugar and cholesterol. For example, haemoglobin is a protein that carries oxygen from your lungs to body tissues. Glucose transporters (GLUT) move glucose to your cells, while lipoproteins transport cholesterol and other fats in your blood. Protein transporters are specific, meaning they will only bind to specific substances. In other words, a protein transporter that moves glucose will not move cholesterol. Proteins also have storage roles. Ferritin is a storage protein that stores iron. Another storage protein is casein, which is the principal protein in milk that helps babies grow.

9) Provides Energy

Proteins supply our body with energy. Protein contains four calories per gram, the same amount of energy that carbs provide. Fats supply the most energy, at nine calories per gram. However, the last thing our body wants to use for energy is protein since this valuable nutrient is widely used throughout the body.

Carbs and fats are much better suited for providing energy, as body maintains reserves for use as fuel. Moreover, they're metabolized more efficiently compared to protein. In fact, protein supplies your body with very little of its energy needs under normal circumstances. However, in a state of fasting (18–48 hours of no food intake), body breaks down skeletal muscle so that the amino acids can supply us with energy .The body also uses amino acids from broken-down skeletal muscle if carbohydrate storage is low. This can occur after exhaustive exercise or if we don't consume enough calories in general.

The Role Of Protein During Pregnancy

During pregnancy, an exceptional stage of life defined by rapid growth and development, adequate dietary protein is crucial to ensure a healthy outcome. Protein deposition in maternal and fetal tissues increases throughout pregnancy, with most occurring during the third trimester. Proteins are found in every cell of the body, making up skin, muscles, hair, fingernails and all other tissues. They provide structure to cells and help them function properly, as well as helping cells repair themselves.

During pregnancy, the body needs more protein for tissue development and growth. Protein benefits both the mother and baby. You require a slightly higher intake of protein during pregnancy to help with the various changes your body goes through to support your baby's growth.

The Reference Nutrient Intake (RNI) of protein for adults is 0.75g per kg of bodyweight per day, plus an additional 6g per day for pregnant women. So, for a woman weighing 60 kg, they will need: 60 x 0.75g/d = 45g of protein a day and 51g during pregnancy.

A good rule of thumb is to include a portion of protein at every meal so that you're getting 2-3 portions per day. A portion is generally equivalent to the size of your palm. It is recommended that women consume 0.55–0.69 grams per pound (1.2–1.52 grams per kg) of protein daily during pregnancy. The recommended daily allowance for protein during breastfeeding is 0.59 grams per pound (1.3 grams per kg) per day, plus 25 additional grams Adequate dietary intake is essential as it helps your baby grow normally while contributing to other important areas of their development, including:

- Growth and repair of new and damaged tissues.
- Making antibodies for their immune system.
- Making hormones and enzymes.
- Helping muscles function properly.
- Transporting oxygen through their blood.

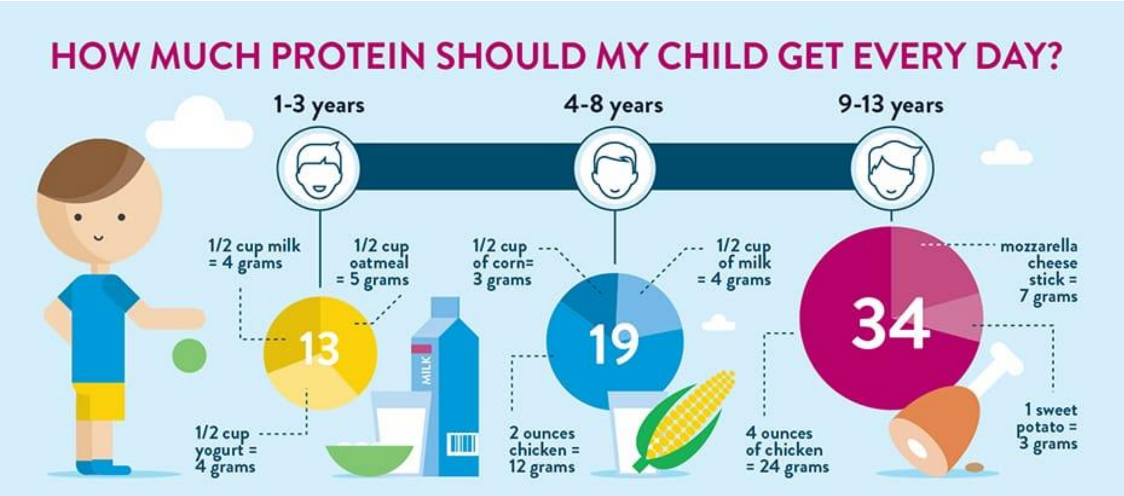
Getting the recommended amount of protein may also help to promote a healthy birthweight. A baby with a healthy birthweight has a reduced risk for developing diabetes or becoming overweight later in life. The role of protein during pregnancy enables your baby's cells to function well from the start. All future growth and development then has a strong foundation to build upon, throughout infancy, childhood and beyond.

Role Of Protein In Kids' Growth

Protein is a macronutrient that is vital for child growth and development, yet research shows that one in seven school-aged children do not meet their daily protein intake goals. If a child is growing slowly or is small for their age they may not be getting all the protein and nutrients needed for healthy growth. The good news is that with a few changes you can help your child get on track.

Protein plays an essential role in many bodily functions, including recovery and repair of tissues in the muscles, skin, organs, blood, hair and nails. Of the 20 amino acids that make up protein, the body can produce 11 — the other nine must come from food. The children who don't get enough protein may experience health issues, including fatigue, poor concentration, slowed growth, bone and joint pain, delayed wound healing and decreased immune response. But with small changes they can be protected against protein deficiency.

The minimum amounts needed to prevent protein deficiency are given below.



Protein sources for kids

Kids can be picky eaters, but luckily there are plenty of great options for adding protein to their diets outside of meals. Milk is an easy source of protein to give to kids, and it provides calcium and vitamin D, which are important nutrients for bone growth. For kids without food allergies, it is also recommended to add nut butters to smoothies, toast and snacks. Boiled eggs, mixed nuts and daals are good sources too. Meeting daily protein intake goals is an essential part of child growth and development. When kids get the nutrition they need, they're in the best position to begin long, healthy lives.

The FWW can help kids learn to balance nutrients at meals by using the 'plate' and the parents can also teach them to follow these same principles at snack time.

Lipids

Despite the broad use of the word "fat" to describe all body fat, there are several different types of fat in your body. Some types of fat can have a negative effect on your health and contribute to disease. Others are beneficial and necessary for your health. The main types of fat cells are white, brown, and beige cells. They can be stored as essential, subcutaneous, or visceral fat. Each type of fat serves a different role. Some promote healthy metabolism and hormone levels, while others contribute to life-threatening diseases, including:

- type 2 diabetes
- heart disease
- high blood pressure
- cancer

White

White fat is the type of fat that most people immediately think of. It's made up of large, white cells that are stored under the skin or around the organs in the belly, arms, buttocks, and thighs. These fat cells are the body's way of storing energy for later use. This type of fat also plays a large role in the function of hormones such as:

- estrogen
- leptin (one of the hormones that stimulates hunger)
- insulin
- cortisol (a stress hormone)
- growth hormone

While some white fat is necessary for good health, too much white fat is very harmful. Healthy body fat percentages range depending on your level of fitness or physical activity. A body fat percentage higher than recommended can put us at risk for the following health issues:

- type 2 diabetes
- coronary artery disease
- high blood pressure
- stroke
- hormone imbalances
- pregnancy complications
- kidney disease
- liver disease
- cancer

Brown

Brown fat is a type of fat primarily found in babies, although adults do still retain a very small amount of brown fat, typically in the neck and shoulders. This type of fat burns fatty acids to keep us warm.

Essential fat

Essential fat is exactly that — essential for your life and a healthy body. This fat is found in our:

- brain
- bone marrow
- nerves
- membranes that protect your organs

Essential fat plays a major role in hormone regulation, including the hormones that control fertility, vitamin absorption, and temperature regulation. Women need at least 10 to 13 percent of their body composition to come from essential fat to be in good health, while men require at least 2 to 5 percent.

Subcutaneous

Subcutaneous fat refers to the fat stored under the skin. It's a combination of brown, beige, and white fat cells. The majority of our body fat is subcutaneous. It's the fat that you can squeeze or pinch on your arms, belly, thighs, and buttocks. Fitness professionals use calipers to measure subcutaneous fat as a way of estimating total body fat percentage. A certain amount of subcutaneous fat is normal and healthy, but too much can lead to imbalanced hormone levels and sensitivity.

Visceral

Visceral fat, also known as "belly fat," is the white fat that's stored in your abdomen and around all of your major organs, such as the liver, kidneys, pancreas, intestines, and heart. High visceral fat levels can increase your risk for diabetes, heart disease, stroke, artery disease, and some cancers.

Benefits

Body composition is very important. Your body will function best with an appropriate overall fat percentage. Having a healthy body fat percentage provides many benefits, such as:

- temperature regulation
- balanced hormone levels
- better reproductive health
- adequate vitamin storage
- good neurological function

- healthy metabolism
- balanced blood sugar

Risks

Having too much white fat, particularly visceral fat, can be harmful to your health. Visceral fat can increase your risk for the following health conditions:

- heart disease
- stroke
- coronary artery disease
- atherosclerosis
- pregnancy complications
- type 2 diabetes
- hormone disturbances
- some cancers

Body fat percentage

Body composition can be measured using methods. One common method of estimating body fat percentage is skinfold measurements. A trained technician can use calipers, a tong-like instrument, to pinch and measure folds of skin on your arms, waist, and thighs to estimate total body fat percentage. This method measures primarily subcutaneous fat.

Body mass index (BMI) and waist circumference test is helpful. While they don't provide a specific percentage of body fat, they do provide an estimate based on your height and weight. BMI is calculated as a ratio of weight to height, while waist circumference is a measurement of the smallest part of the waist. A BMI greater than 25 is considered overweight, while a BMI over 30 is considered obese. A waist circumference greater than 35 inches in women and 40 inches in men is considered higher risk for disease, as increased waist circumference can indicate the presence of visceral fat.

Diet and fat

A common assumption is that a high-fat diet is what causes a person to have too much body fat. While fat is higher in calories than carbohydrates or protein, people need a certain amount of dietary fat for good health.

Refined, processed foods that are high in carbohydrates and low in fiber can also cause weight gain. People with diets that are high in refined sugars and processed foods are often more prone to visceral fat, which is more dangerous as a predictor of disease than subcutaneous fat.

Calories consumed that aren't needed by the body will be stored as fat reserves. In terms of gaining or losing weight, the total number of calories you take in versus the calories that you burn every day is what matters, rather than whether those calories are from fat, carbs, or protein. Most experts recommend a diet high in protein, complex carbohydrates, and fiber with moderate portion sizes. A healthy diet is most effective when combined with a regular exercise program.

Enzymes

An enzyme is a type of protein found within a cell. Enzymes create chemical reactions in the body. They speed up the rate of a chemical reaction to help support life. Enzymes are biological molecules (typically proteins) that significantly speed up the rate of virtually all the chemical reactions that take place within cells.

They are vital for life and serve a wide range of important functions in the body, such as aiding in digestion and metabolism.

Some enzymes help break large molecules into smaller pieces that are more easily absorbed by the body. Other enzymes help bind two molecules together to produce a new molecule. Enzymes are highly selective catalysts, meaning that each enzyme only speeds up a specific reaction

The enzymes in your body help to perform very important tasks. These include building muscle, destroying toxins, and breaking down food particles during digestion. Like all proteins they are produced by **ribosomes**, which are in the cytoplasm (the part of the cell that is outside the cell nucleus). After an enzyme is synthesized it may be modified in the Golgi apparatus or elsewhere in the cytoplasm.

An enzyme’s shape is tied to its function. Heat, disease, or harsh chemical conditions can damage enzymes and change their shape. When this happens, an enzyme doesn’t work anymore. This affects the body processes the enzyme helped support.

Key Terms

Term	Meaning
Catalyst	A substance that speeds up a chemical reaction without being changed
Enzyme	A biological catalyst (usually a protein)
Substrate	The reactant molecule that an enzyme works on
Active site	The part of the enzyme where the substrate binds

Types of enzymes

There are three main types of digestive enzymes. They’re categorized based on the reactions they help catalyze:

- **Amylase** breaks down starches and carbohydrates into sugars.
- **Protease** breaks down proteins into amino acids.
- **Lipase** breaks down lipids, which are fats and oils, into glycerol and fatty acids.

Why are enzymes important for digestion?

Enzymes are essential for healthy digestion and a healthy body. They work with other chemicals in the body, such as stomach acid and bile, to help break down food into molecules for a wide range of bodily functions.

Carbohydrates, for instance, are needed for energy, while protein is necessary to build and repair muscle, among other functions. But they must be converted into forms that can be absorbed and utilized by your body.

How enzymes work in your digestive system?

Amylase is produced in the salivary glands, pancreas, and small intestine. One type of amylase, called ptyalin, is made in the salivary glands and starts to act on starches while food is still in your mouth. It remains active even after you swallow.

Pancreatic amylase is made in the pancreas and delivered to the small intestine. Here it continues to break down starch molecules to sugars, which are ultimately digested into glucose by other enzymes. This is then absorbed into the body's blood circulation through the wall of the small intestine.

Protease is produced in the stomach, pancreas, and small intestine. Most of the chemical reactions occur in the stomach and small intestine. In the stomach, pepsin is the main digestive enzyme attacking proteins. Several other pancreatic enzymes go to work when protein molecules reach the small intestine.

Lipase is produced in the pancreas and small intestine. A type of lipase is also found in breast milk to help a baby more easily digest fat molecules when nursing. Lipids play many roles, including long-term energy storage and supporting cellular health.

What affects enzymes?

Enzymes work best at your normal body temperature. The average body temperature is 98.6°F (37°C), but normal body temperatures can range from 97°F to 99°F (36.1°C to 37.2°C).If you run a fever and your temperature increases too much, the structure of enzymes breaks down. They no longer function properly. Restoring our body temperature to its optimal range will help restore enzyme health.

Certain health conditions, such as pancreatitis, which is inflammation of the pancreas, hurts the pancreas and can also reduce the number and effectiveness of certain digestive enzymes.

The pH level of our stomach or intestines can also affect enzyme activi ty.A low pH means something is very acidic. A high pH means it's basic, also known as alkaline. Enzymes work best in a narrow pH range. If the environment surrounding an enzyme becomes too acidic or too basic, the enzyme's shape and function will suffer.

Hormones

Hormones are defined as chemicals synthesized and produced by the specialized glands to control and regulate the activity of certain cells and organs. These specialized glands are known as endocrine glands.

Hormones control and regulate the activity of certain cells or organs. These messengers control many physiological functions as well as psychological health. They are also quite important in maintaining homeostasis in the body. Many hormones are secreted by special glands, such as thyroid hormone produced by the thyroid gland. Hormones are essential for every activity of life, including the processes of digestion, metabolism, growth, reproduction, and mood control. Many hormones, such as neurotransmitters, are active in more than one physical process.

Why are Hormones called Chemical Messengers?

The prominent role of hormones is that of a messenger. Hypothalamus is a part of forebrain where a numerous number of neurosecretory cells are present. These neurosecretory cells are specialized in the secretion of a hormone called neurohormones. They stimulate the anterior lobe of the pituitary to produce various other hormones.

Sometimes, hormones act more than a regulator than a messenger. The changes in the level of hormone production lead to certain changes in the body. Thus, hormone as a regulator maintains the homeostasis of the body. Once the hormones meet their target, their production needs to be controlled and this is attained by a mechanism called feedback control mechanism. The feedback mechanism could either be positive or negative.

Cell Signaling

The effects of hormones depend on how they are released. Hence, signaling effects can be classified into the following:

- **Autocrine:** The hormone act on the cell that secreted it.
- **Paracrine:** The hormone act on a nearby cell without having to enter the blood circulation.
- **Intracrine:** The hormone is produced in the cell and acts intracellularly means inside the cell.
- **Endocrine:** The hormone act on the target cells once it is released from the respective glands into the bloodstream.

Types of Hormones

To regulate various functions, different types of hormones are produced in the body. They are classified as follows:

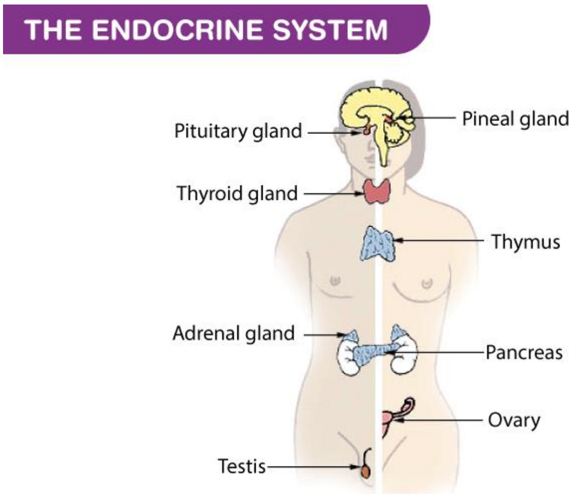
- Peptide Hormones
- Steroid Hormones

Peptide Hormones

Peptide hormones are composed of **amino acids** and are soluble in water. Peptide hormones are unable to pass through the cell membrane as it contains a phospholipid bilayer that stops any fat-insoluble molecules from diffusing into the cell. Insulin is an important peptide hormone produced by the pancreas.

Steroid Hormones

Unlike peptide hormones, steroid hormones are fat-soluble and can pass through a cell membrane. Sex hormones such as testosterone, estrogen and progesterone are examples of steroid hormones.



Hypothalamus: It controls the body temperature, regulates emotions, hunger, thirst, sleep, moods and allow the production of hormones.

Pineal: Pineal is also known as the thalamus. It produces serotonin derivatives of melatonin, which affects sleep patterns.

Parathyroid: This gland helps in controlling the amount of calcium present in the body.

Thymus: It helps in the production of T-cells, functioning of the adaptive immune system and maturity of the thymus.

Thyroid: It produces hormones that affect the heart rate and how calories are burnt.

Adrenal: This gland produces the hormones that control the sex drive, cortisol and stress hormone.

Pituitary: It is also termed as the “master control gland,”. This is because the pituitary gland helps in controlling other glands. Moreover, it develops the hormones that trigger growth and development.

Pancreas: This gland is involved in the production of insulin hormones, which plays a crucial role in maintaining blood sugar levels.

Testes: In men, the testes secrete the male sex hormone, testosterone. It also produces sperm.

Ovaries: In the female reproductive system, the ovaries release estrogen, progesterone, testosterone and other female sex hormones.

All these glands work together to produce and manage the hormones of the body.

Hypothalamus Pitutary Axis

The hypothalamus–pituitary complex can be thought of as the “command center” of the endocrine system. This complex secretes several hormones that directly produce responses in target tissues, as well as hormones that regulate the synthesis and secretion of hormones of other glands

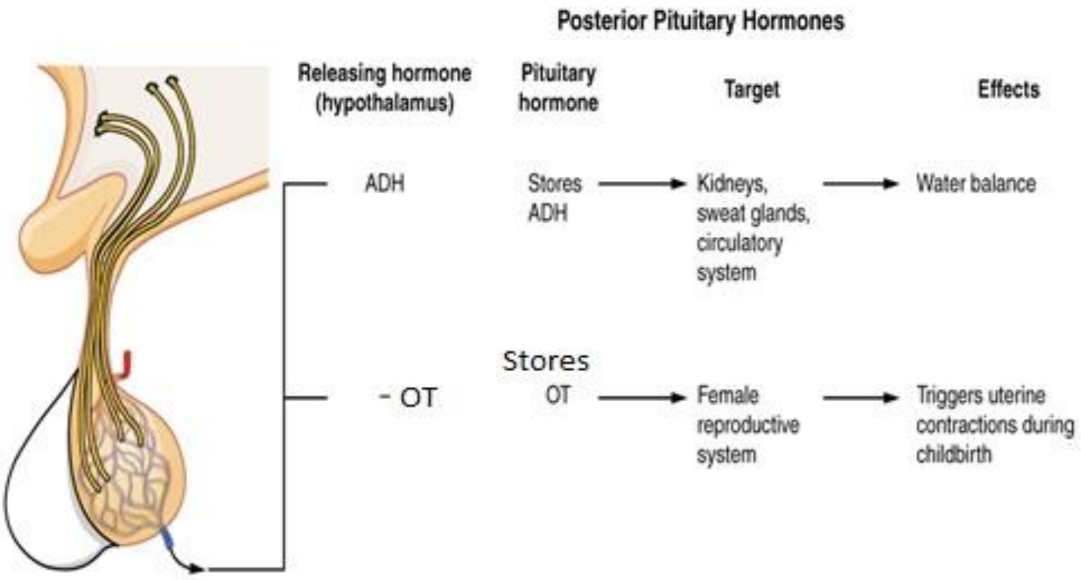
The pituitary gland is cradled within the Sella turcica of the sphenoid bone of the skull. It consists of two lobes that arise from distinct parts of embryonic tissue: the posterior pituitary (neurohypophysis) is neural tissue, whereas the anterior pituitary (also known as the adenohypophysis) is glandular tissue that develops from the primitive digestive tract. The hormones secreted by the posterior and anterior pituitary, and the intermediate zone between the lobes are summarized in Table

Pituitary Hormones			
Pituitary lobe	**Associated hormones**	**Chemical class**	**Effect**
Anterior	Growth hormone (GH)	Protein	Promotes growth of body tissues
Anterior	Prolactin (PRL)	Peptide	Promotes milk production from mammary glands
Anterior	Thyroid-stimulating hormone (TSH)	Glycoprotein	Stimulates thyroid hormone release from thyroid
Anterior	Adrenocorticotropic hormone (ACTH)	Peptide	Stimulates hormone release by adrenal cortex
Anterior	Follicle-stimulating hormone (FSH)	Glycoprotein	Stimulates gamete production in gonads
Anterior	Luteinizing hormone (LH)	Glycoprotein	Stimulates androgen production by gonads
Posterior	Antidiuretic hormone (ADH)	Peptide	Stimulates water reabsorption by kidneys
Posterior	Oxytocin	Peptide	Stimulates uterine contractions during childbirth
Intermediate zone	Melanocyte-stimulating hormone	Peptide	Stimulates melanin formation in melanocytes

Posterior Pituitary

The posterior pituitary is an extension of the neurons of the paraventricular and supraoptic nuclei of the hypothalamus. The cell bodies of these regions rest in the hypothalamus, but their axons descend as the hypothalamic – hypophyseal tract within the infundibulum, and end in axon terminals that comprise the posterior pituitary.

Neurosecretory cells in the hypothalamus release oxytocin (OT) or ADH into the posterior lobe of the pituitary gland. These hormones are stored or released into the blood via the capillary plexus.



The posterior pituitary gland does not produce hormones, but rather stores and secretes hormones produced by the hypothalamus. The paraventricular nuclei produce the hormone oxytocin, whereas the supraoptic nuclei produce ADH. These hormones travel along the axons into storage sites in the axon terminals of the posterior pituitary. In response to signals from the same hypothalamic neurons, the hormones are released from the axon terminals into the bloodstream.

Oxytocin

When fetal development is complete, the peptide-derived hormone **oxytocin** (tocia- = "childbirth") stimulates uterine contractions and dilation of the cervix. Towards the end of pregnancy, the synthesis of oxytocin receptors in the uterus increases, and the smooth muscle cells of the uterus become more sensitive to its effects. Oxytocin is continually released throughout childbirth through a positive feedback mechanism.

Oxytocin prompts uterine contractions that push the fetal head toward the cervix. In response, cervical stretching stimulates additional oxytocin to be synthesized by the hypothalamus and released from the pituitary. This increases the intensity and effectiveness of uterine contractions and prompts additional dilation of the cervix. The feedback loop continues until birth.

Although the mother's high blood levels of oxytocin begin to decrease immediately following birth, oxytocin continues to play a role in maternal and newborn health. First, oxytocin is necessary for the milk ejection reflex (commonly referred to as "let-down") in breastfeeding women. As the newborn begins suckling, sensory receptors in the nipples transmit signals to the hypothalamus. In response, oxytocin is secreted and released into the bloodstream. Within seconds, cells in the mother's milk ducts contract, ejecting milk into the infant's mouth. Secondly, in both males and females, oxytocin is thought to contribute to parent–newborn bonding, known as attachment. Oxytocin is also thought to be involved in feelings of love and closeness, as well as in the sexual response.

Antidiuretic Hormone (Adh)

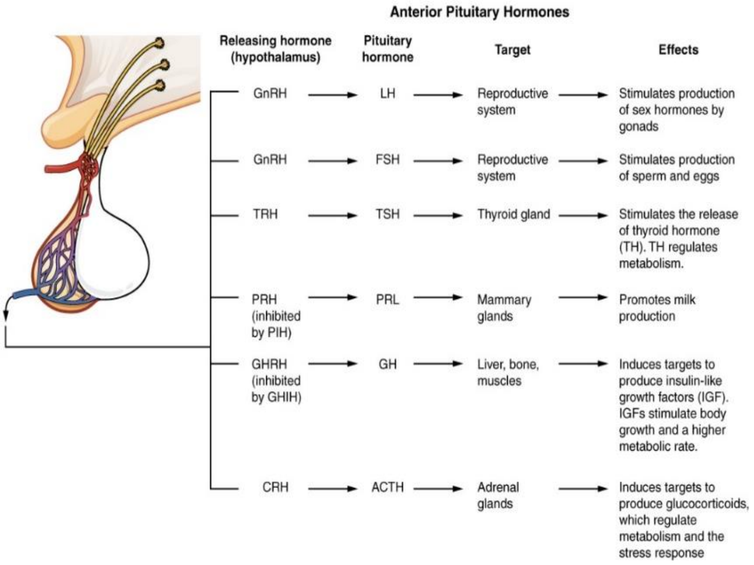
The solute concentration of the blood, or blood osmolarity, may change in response to the consumption of certain foods and fluids, as well as in response to disease, injury, medications, or other factors. Blood osmolarity is constantly monitored by **osmoreceptors**—specialized cells within the hypothalamus that are particularly sensitive to the concentration of sodium ions and other solutes.

Anterior Pituitary

The anterior pituitary originates from the digestive tract in the embryo and migrates toward the brain during fetal development. There are three regions: the pars distalis is the most anterior, the pars intermedia is adjacent to the posterior pituitary, and the pars tuberalis is a slender "tube" that wraps the infundibulum.

Recall that the posterior pituitary does not synthesize hormones, but merely stores them. In contrast, the anterior pituitary does manufacture hormones. However, the secretion of hormones from the anterior pituitary is regulated by two classes of hormones. These hormones—secreted by the hypothalamus—are the releasing hormones that stimulate the secretion of hormones from the anterior pituitary and the inhibiting hormones that inhibit secretion.

Hypothalamic hormones are secreted by neurons but enter the anterior pituitary through blood vessels. Within the infundibulum is a bridge of capillaries that connects the hypothalamus to the anterior pituitary. This network, called the **hypophyseal portal system**, allows hypothalamic hormones to be transported to the anterior pituitary without first entering the systemic circulation. Hypothalamic releasing and inhibiting hormones travel through a primary capillary plexus to the portal veins, which carry them into the anterior pituitary. Hormones produced by the anterior pituitary (in response to releasing hormones) enter a secondary capillary plexus, and from there drain into the circulation.



Anterior Pituitary. The anterior pituitary manufactures seven hormones. Hormones from the hypothalamus reach the anterior pituitary via the hypophyseal portal system.

The anterior pituitary produces seven hormones. These are the growth hormone (GH), thyroid-stimulating hormone (TSH), adrenocorticotropic hormone (ACTH), follicle-stimulating hormone (FSH), luteinizing hormone (LH), beta endorphin, and prolactin. Of the hormones of the anterior pituitary, TSH, ACTH, FSH, and LH are collectively referred to as tropic hormones (trope- = “turning”) because they turn on or off the function of other endocrine glands.

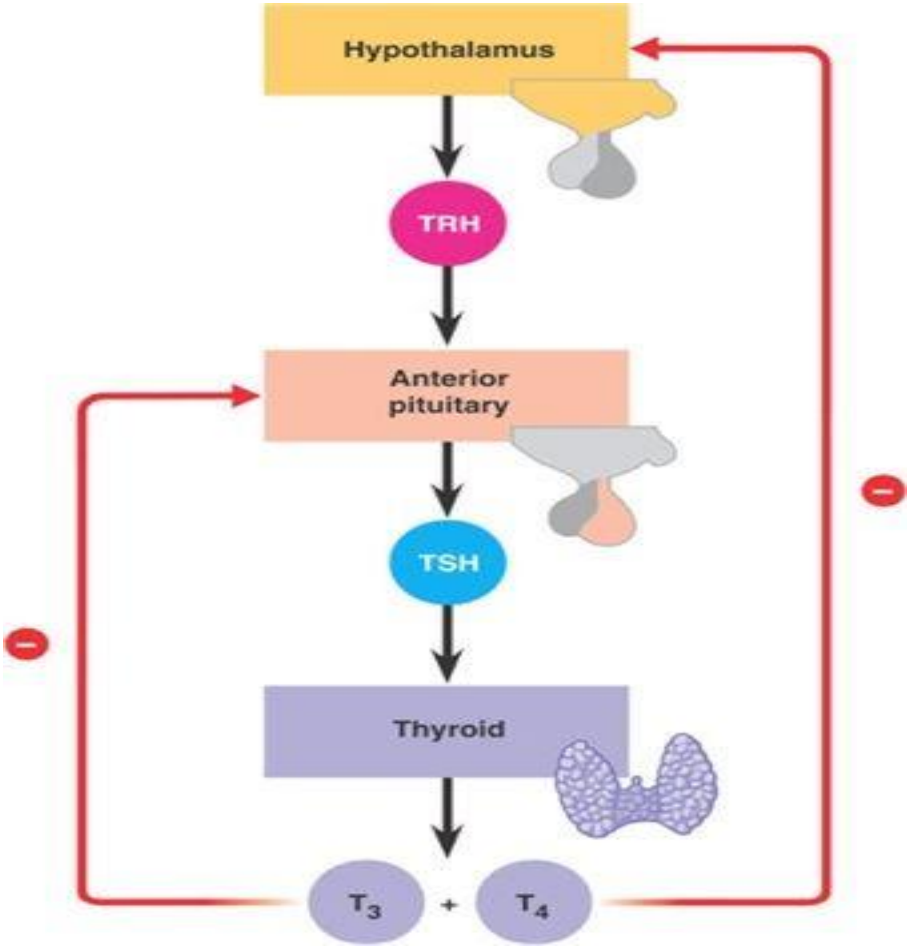
Growth Hormone

The endocrine system regulates the growth of the human body, protein synthesis, and cellular replication. A major hormone involved in this process is **growth hormone (GH)**, also called somatotropin—a protein hormone produced and secreted by the anterior pituitary gland. It is also known as somatotropin hormone. It is basically a protein hormone having 190 amino acids which are synthesized and secreted by the cells called somatotrophs in the anterior pituitary. It stimulates growth, cell reproduction cell regeneration and in boosting metabolism. It is important in human development.

Its primary function is anabolic; it promotes protein synthesis and tissue building through direct and indirect mechanism.

Thyroid-Stimulating Hormone

Feedback Mechanism – Thyroid



The thyroid gland produces a hormone called thyroxine, and its secretion is controlled by the Thyrotropin Releasing Hormone (TRH) from the hypothalamus and the Thyroid Stimulating Hormone (TSH) from the anterior pituitary. Thyroid gland basically releases two hormones Triiodothyronine (T3) and Thyroxine (T4), which helps in controlling the metabolism of our body. Further, these hormones regulate weight, determines energy levels, internal body temperature, skin, hair etc. When the level of thyroxine in the blood reduces, the hypothalamus stimulates the thyroxine secretion by stimulating TSH secretion. This represents a positive feedback mechanism.

If the hypothalamus continues to stimulate thyroxine production, it could result in a high level of thyroxine in the blood. This sends negative feedback to the hypothalamus to reduce or stop the TRH and TSH secretion which regulates the thyroxine level in the body. This is a negative feedback mechanism.

Other important hormones and their functions.

Insulin

This hormone is released by the pancreas, a leaf-like gland located in the abdominal cavity behind the stomach. It allows the body to use glucose or sugar from carbohydrates in the food for energy or to store glucose for future use. It helps in keeping blood sugar level from getting too high i.e. hyperglycemia or too low i.e. hypoglycemia

Estrogen

It is a female sex hormone released by the ovaries. It is responsible for the reproduction, menstruation and menopause. Excess of estrogen in the female body increases the risk of breast cancer, uterine cancer, depression, moodiness etc. If the estrogen level is less in female body then it leads to acne, skin lesions, thinning skin, hair loss etc.

Progesterone

Progesterone hormone is produced in the ovaries, the placenta when a woman gets pregnant and the adrenal glands. It stimulates and regulates various functions. It plays an important role in maintaining pregnancy. It helps body to prepare for conception, pregnancy and regulates the monthly cycle. When pregnancy doesn't occur, progesterone levels drop and menstrual cycle occurs. It also plays a role in sexual desire.

Testosterone

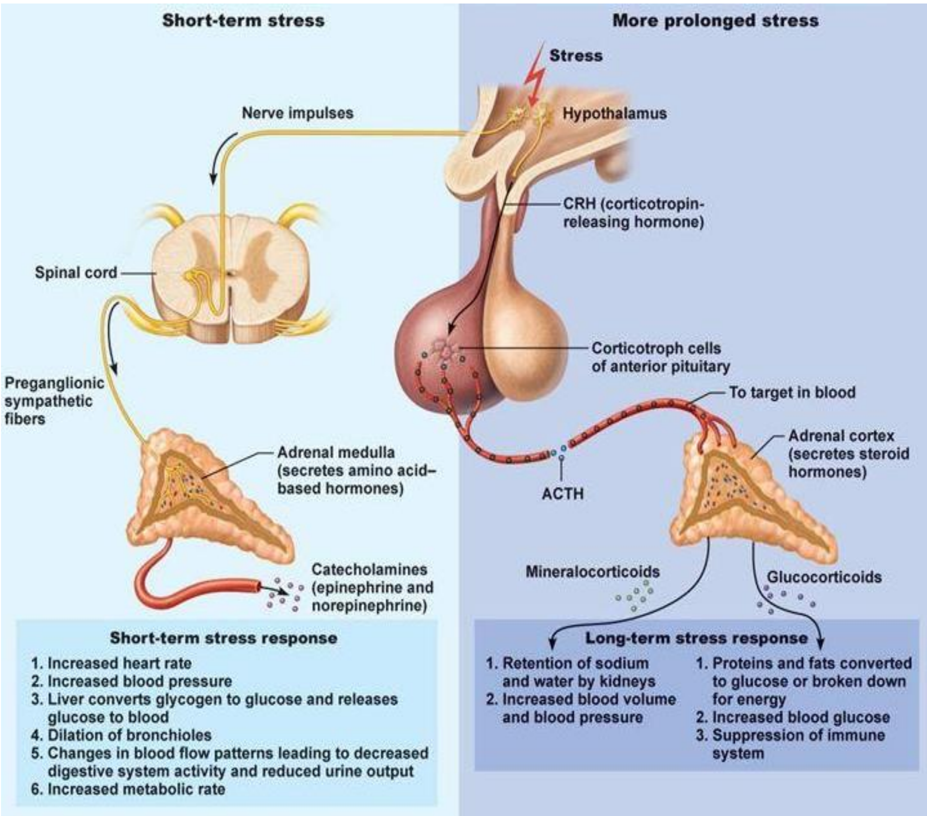
It is a male sex hormone. It is an anabolic steroid by nature which helps in building body muscles. In males, it plays an important role in the development of male reproductive tissues, testes and prostate. It also promotes secondary sexual characteristics like increasing the mass of muscles and bones, growth of body hair etc. If testosterone is secreted insufficient in men, then it may lead to abnormalities including bone loss.

Serotonin

It is a mood-boosting effect hormone or also known as nature's feel-good chemical. It is associated with learning and memory, regulating sleep, digestion, regulates mood, some muscular functions etc. Due to the imbalance of serotonin in the body, brain does not produce enough of the hormone to regulate mood or stress level. Low level of serotonin causes depression, migraine, weight gain, insomnia, craving of carbohydrate etc. Excess level of serotonin in the body causes agitation, stage of confusion, sedation etc.

Cortisol

This hormone is produced by the adrenal gland. It helps you stay healthy and energetic. Its main role is to control physical and psychological stress



Role of cortisol in stress

In dangerous conditions, it increases heart rate, blood pressure, respiration etc. At stressful times body secretes cortisol to cope up with the situation. High level of cortisol consistently causes ulcer, high blood pressure, anxiety, high levels of cholesterol etc. Similarly, a low level of cortisol in the body causes alcoholism, a condition responsible for chronic fatigue syndrome etc.

Adrenaline

Adrenaline hormone is secreted in the medulla in the adrenal gland as well as some of the central nervous system's neurons. It is also known as an emergency hormone because it initiates the quick reaction which makes the individual to think and respond quickly to the stress. It increases the metabolic rate, dilation of blood vessels going to the heart and the brain. During a stressful situation, adrenaline quickly releases into the blood, send impulses to the organs to create a specific response.

Adrenocorticotropic Hormone

The **adrenocorticotropic hormone (ACTH)**, also called corticotropin, stimulates the adrenal cortex (the more superficial "bark" of the adrenal glands) to secrete corticosteroid hormones such as cortisol.

The release of ACTH is regulated by the corticotropin-releasing hormone (CRH) from the hypothalamus in response to normal physiologic rhythms.

Follicle-Stimulating Hormone and Luteinizing Hormone

The endocrine glands secrete a variety of hormones that control the development and regulation of the reproductive system (these glands include the anterior pituitary, the adrenal cortex, and the gonads—the testes in males and the ovaries in females). Much of the development of the reproductive system occurs during puberty and is marked by the development of sex-specific characteristics in both male and female adolescents. Puberty is initiated by gonadotropin-releasing hormone (GnRH), a hormone produced and secreted by the hypothalamus. GnRH stimulates the anterior pituitary to secrete **gonadotropins**—hormones that regulate the function of the gonads. The levels of GnRH are regulated through a negative feedback loop; high levels of reproductive hormones inhibit the release of GnRH. Throughout life, gonadotropins regulate reproductive function and, in the case of women, the onset and cessation of reproductive capacity.

The gonadotropins include two glycoprotein hormones: **follicle-stimulating hormone (FSH)** stimulates the production and maturation of sex cells, or gametes, including ova in women and sperm in men. FSH also promotes follicular growth; these follicles then release estrogens in the female ovaries. **Luteinizing hormone (LH)** triggers ovulation in women, as well as the production of estrogens and progesterone by the ovaries. LH stimulates production of testosterone by the male testes.

PROLACTIN This hormone is released by the pituitary gland after childbirth for lactation, which enables female to breastfeed. Levels of prolactin hormone rise during pregnancy i.e., it also plays an important role in fertility by inhibiting follicle-stimulating hormone (FSH) and gonadotropin-releasing hormone (GnRH).

As its name implies, prolactin (PRL) promotes lactation (milk production) in women. During pregnancy, it contributes to development of the mammary glands, and after birth, it stimulates the mammary glands to produce breast milk. However, the effects of prolactin depend heavily upon the permissive effects of estrogens, progesterone, and other hormones. And as noted earlier, the let-down of milk occurs in response to stimulation from oxytocin.

In a non-pregnant woman, prolactin secretion is inhibited by prolactin-inhibiting hormone (PIH), which is the neurotransmitter dopamine, and is released from neurons in the hypothalamus. Only during pregnancy do prolactin levels rise in response to prolactin-releasing hormone (PRH) from the hypothalamus.

Intermediate Pituitary: Melanocyte-Stimulating Hormone

The cells in the zone between the pituitary lobes secrete a hormone known as melanocyte-stimulating hormone (MSH. Local production of MSH in the skin is responsible for melanin production in response to UV light exposure. The role of MSH made by the pituitary is more complicated. For instance, people with lighter skin generally have the same amount of MSH as people with darker skin. Nevertheless, this hormone is capable of darkening of the skin by inducing melanin production in the skin’s melanocytes. Women also show increased MSH production during pregnancy; in combination with estrogens, it can lead to darker skin pigmentation, especially the skin of the areolas and labia minora.

SECTION THREE

IMMUNITY AND INFECTION PREVENTION

3.1 MICROBIOLOGY

3.1 MICROBIOLOGY

The term microbiology is derived from three Greek words, “micro” meaning small; “bios” meaning living; “ology” meaning study.

Microbiology is the study of microscopic organisms, such as bacteria, viruses, archaea, fungi and protozoa. This discipline includes fundamental research on the biochemistry, physiology, cell biology, ecology, evolution and clinical aspects of microorganisms, including the host response to these agents.

This is about the living organisms which are so small that they cannot be seen with the naked eye and are only visible with microscopes. Some are so minute that they cannot be seen with an ordinary microscope but require much powerful electronic optical instrument called electron microscope. These organisms are called microbes or micro-organisms. These have been known to exist for almost two centuries prior to the recognition of their importance in disease, since then it has become even more apparent that the invisible microbial world is huge and affects our lives enormously.

Importance of microbiology:

1) The science of microbiology is essential to Family Welfare Worker because it provides answers to the “why” for a large segment of their practice. For example:
2) Knowledge of means of transfer of micro-organisms will ensure correct procedures in handling babies, in assisting in the operating room, in changing surgical dressings and in caring for patients with transmissible diseases.
3) Knowledge because foods are stored in a refrigerator.
4) Knowledge of immunity to infection by micro-organisms will provide information helpful in teaching patients and families about prevention of disease.
5) Knowledge of why ‘penicillin’ and the ‘sulfas’ are effective in treating certain diseases but ineffective in others.

Association between human beings and micro-organisms:

Throughout life the human body meets micro-organisms. They are in the air man breathes, in the food he eats, on things he touches. Some of them find conditions suitable for their growth on the body surfaces such as the skin and mucous membranes lining the nose and throat and the alimentary tract. These micro- organisms grow and multiply; they become a normal part of these regions of the body. Under ordinary conditions they do not penetrate below the surface or if they do, they are quickly destroyed. They are saprophytes i.e. they live on the dead cells on the skin’s surface or the secretions of the host’s body or the digestive tract and on the food it contains.

SYMBIOSIS:

It is the term used to describe close association between two kinds of organisms. There are three types of symbiosis:

Mutualism:

In this both parties are benefited by the relationship. The bacteria in the human intestine are benefited by getting food, water, darkness and a constant warm temperature which is helpful to their growth. The host also derives something useful from his guests because some of these bacteria produce vitamins which can be absorbed and used by the human body, like vitamin K and folic acid.

Commensal association:

In this one type of organism (bacterium) gets its food from the other (man), who is neither helped nor harmed by the relationship.

Parasitism: -

In this kind of symbiosis or association, one type of organism is benefited, while other is harmed. The parasite either lives in the tissues of the host or outside the host e.g., a larger parasite such as a blood-sucking insect attaches itself only to take host's blood for food.

Pathogenesis or disease production:

Pathogenicity means the ability of micro-organisms to cause disease by overcoming the defense system of the body of host. Whenever our defenses are weakened the opportunist micro-organisms cause the disease which otherwise are not harmful.

Virulence:

It is the power or ability of germs to cause disease. It either depends on the number of organisms or the ability of organism to counter the barriers offered by immune system of the host. The seriousness of an infectious disease depends largely on the toxins produced by the micro-organism and on the kind of host tissue injured by the infection. For example, it is possible to destroy considerable amounts of skin, muscle or bone without causing death, while a relatively small injury to certain areas of the brain or heart might prove fatal.

Properties of micro-organisms:

All micro-organisms are not harmful there are many instances where they prove to be useful. People are inclined to think that all micro-organisms are evil and enemies of human life but only a few kinds cause disease. Micro-organisms may be divided into two great groups according to their activities: the harmful and the useful.

Pathogenic:

These micro-organisms can thrive only in the body and find the outside world cold, dry and unfriendly. They die soon if they are thrown into it.

Saprophytic or autotrophic:

These micro-organisms are adapted only to life in the outside world. They find conditions in the human body unsuitable to their growth and they cannot multiply there. These are sometimes pathogenic for plants and animals. It is necessary to know the activities of useful micro-organisms and their place and importance in the world.

Micro-organisms as Benefactors:

Many micro-organisms are useful especially yeasts, molds and bacteria. They are of great value in the industries and are used to manufacture alcohol, lactic acid, butter, cheese, solvents for paints and oils, antibiotics such as penicillin, and other products, and to increase soil fertility.

Decay, Putrefaction and Fermentation:

These are processes which transform organic refuse into useful plant foods. When tissues of dead animals or plants are buried in the ground, micro- organisms from the soil and those already in the animal's intestine enter the tissues and cause these to disintegrate. The gases and water which are formed pass off into the earth or air and in this way the dead matter disappears.

Purification of sewage and water:

Species of micro-organisms also purify sewage. A sewage disposal plant is merely a man-made device to control and exploit the decomposing activities of certain groups of saprophytic micro-organisms. The solid waste material is slowly decomposed through the hydrolytic action of microbial enzymes. It eventually forms a sort of mud or sludge, rich in plant food, which is pumped out, dried and frequently used as garden fertilizer.

Micro-organisms in the air:

The number of micro-organisms in the air usually depends on the amount of dust since these are riding around on dust particles. They come from the soil, are harmless and soon die in the dry air and sunlight. However, the air of unclean, badly ventilated, and dark rooms may contain many pathogenic bacteria, especially when occupied by persons who harbour such organisms in their nose and mouth.

Micro-organisms in food:

Many saprophytic microorganisms, and some dangerous pathogenic bacteria, grow well in foods that are moist, at warm room temperature and not too acidic. Such foods include milk, cooked cereals, macaroni dishes, custards, soups, potatoes, gelatin and so on. The bacteria come from dust, dishes and hands, ingredients in the foods, water and utensils. We eat large numbers of saprophytic micro-organisms in foods every day with no adverse results.

The growth of certain micro-organisms in some kinds of food is advantageous. The good flavours of butter and cheese are produced by the action of certain harmless streptococci purposefully added to them. Varieties of cheese are largely determined by the kinds of micro-organisms (bacteria and molds) present in them.

Excessive growth of saprophytic microorganisms in food, results in spoilage. The anaerobic digestion and decomposition of protein (meat, egg white, fish and similar foods) by micro-organisms is called putrefaction. It is usually accompanied by very bad odours due to the formation of ammonia, hydrogen sulfide and other volatile, odoriferous substances.

The spoiling or decay of foods is caused by the growth of various saprophytic micro-organisms in them. Tainted meat, rancid butter, rotten eggs and decaying fruit and vegetables are all the result of the growth of micro-organisms.

Infection of Foods:

Sometimes pathogenic bacteria get into various foods such as milk, meat, sandwich fillings, salads and puddings. The bacteria come from the hands and respiratory droplets and secretions of cooks, or from flies, cockroaches, rats or mice which come to extract their food from and to pollute the kitchen. These pathogenic bacteria may multiply in the food and cause disease in the people who eat it.

Micro-organisms in industry:

Industrial fermentations are carried on in great vats or tanks holding thousands of gallons. Here the skills and knowledge of microbiologist, engineer and chemist are pooled for the common goal. The fermentative, putrefactive, synthetic and other enzymic powers of micro-organisms are also utilized in the manufacture of rubber, coffee, cocoa, tobacco, linen, spices, leather, stock feed, pickles, drugs and other products.

Micro-organisms, nitrogen and life:

All life depends on certain lowly and obscure micro- organisms of the soil, which include the nitrogen-fixing bacteria. Nitrogen is one of the elements that are essential to the formation of all protoplasm.

Nitrogen Fixation:

Although we are surrounded by an atmosphere of which 80 percent is nitrogen, man has always been totally unable to utilize atmospheric nitrogen (until relatively recent advances were made in chemical engineering). We have been wholly dependent on “lower” forms of life to prepare it for us by combining it with other elements, mainly oxygen, hydrogen and carbon. The process of combining nitrogen of the atmosphere with other elements is called nitrogen fixation.

Some common causes of disease in humans			
Viruses	DNA viruses	Adenoviruses	Human adenoviruses (e.g., types 3, 4, and 7)
		Herpesviruses	Herpes simplex, varicella zoster, Epstein–Barr virus, cytomegalovirus, Kaposi's sarcoma
		Poxviruses	Vaccinia virus
		Parvoviruses	Human parvovirus
		Papovaviruses	Papilloma virus
		Hepadnaviruses	Hepatitis B virus
	RNA viruses	Orthomyxoviruses	Influenza virus
		Paramyxoviruses	Mumps, measles, respiratory syncytial virus
		Coronaviruses	Common cold viruses
		Picornaviruses	Polio, coxsackie, hepatitis A, rhinovirus
		Reoviruses	Rotavirus, reovirus
		Togaviruses	Rubella, arthropod-borne encephalitis
		Flaviviruses	Arthropod-borne viruses, (yellow fever, dengue fever)
		Arenaviruses	Lymphocytic choriomeningitis, Lassa fever
		Rhabdoviruses	Rabies
		Retroviruses	Human T-cell leukemia virus, HIV
Bacteria	Gram +ve cocci	Staphylococci	*Staphylococcus aureus*
		Streptococci	*Streptococcus pneumoniae, S. pyogenes*
	Gram –ve cocci	Neisseriae	*Neisseria gonorrhoeae, N. meningitidis*
	Gram +ve bacilli		*Corynebacteria, Bacillus anthracis, Listeria monocytogenes*
	Gram –ve bacilli		*Salmonella, Shigella, Campylobacter, Vibrio, Yersinia, Pasteurella, Pseudomonas, Brucella, Haemophilus, Legionella, Bordetella*
	Anaerobic bacteria	Clostridia	*Clostridium tetani, C. botulinum, C. perfringens*
	Spirochetes		*Treponema pallidum, Borrelia burgdorferi, Leptospira interrogans*
	Mycobacteria		*Mycobacterium tuberculosis, M. leprae, M. avium*
	Rickettsias		*Rickettsia prowazeki*
	Chlamydias		*Chlamydia trachomatis*
	Mycoplasmas		*Mycoplasma pneumoniae*
Fungi			*Candida albicans, Cryptococcus neoformans, Aspergillus, Histoplasma capsulatum, Coccidioides immitis, Pneumocystis carinii*
Protozoa			*Entamoeba histolytica, Giardia, Leishmania, Plasmodium, Trypanosoma, Toxoplasma gondii, Cryptosporidium*
Worms	Intestinal		*Trichuris trichura, Trichinella spiralis, Enterobius vermicularis, Ascaris lumbricoides, Ancylostoma, Strongyloides*
	Tissues		*Filaria, Onchocerca volvulus, Loa loa, Dracuncula medinensis*
	Blood, liver		*Schistosoma, Clonorchis sinensis*

3.2 CLASSIFICATION OF MICRO-ORGANISMS

3.2 CLASSIFICATION OF MICRO-ORGANISMS:

Micro-organisms may be found in seven large groups of living forms. Some clearly belong to the animal kingdom, others to the plant kingdom but some are not clearly in one kingdom or another. These form a link between the two and are sometimes referred to as Protista.

The seven principal groups consisting of micro-organisms are as follows:

- **Algae** (green plants) –various seaweeds, many microscopic species
- **Fungi** (yeasts and molds) – baker's yeast
- **Protozoa** (microscopic organisms) –amoebae, malarial parasites
- **Bacteria** (microscopic organisms) –cause of tuberculosis, typhoid fever and boils
- **Rickettsia** (probably vegetable kingdom) –cause of Rocky Mountain spotted fever
- **Viruses** (unclassified) –cause of poliomyelitis, influenza and measles
- **Pleuropneumonia**-like organisms (PPLO) –mostly bacterial derivatives

Algae:

Algae are green plants and require sunlight for growth. None is pathogenic for man. Instead, some species are useful such as Chlorella which are cultivated on the surface of sewage effluents in large artificial lagoons. They help to decompose the organic material in the sewage. They grow so luxuriantly that when harvested they produce large amounts of food for livestock and in some places for man.

Algae will play an important role in the nuclear and space age, since if cultivated under artificial sunlight (ultraviolet light) in submarines and spaceships, they will not only produce life-giving oxygen like other green plants but take up poisonous carbon dioxide from the atmosphere, help purify human wastes and provide at least some food

Fungi (Yeasts and Molds):

Fungi vary in size and complexity from microscopic, one-celled yeasts to large mushrooms. Fungi (yeasts, unicellular and molds, multicellular) are classed as plants and are grouped with the algae and bacteria as the simplest form of plant life. Molds grow as filamentous, branching strands of connected cells known as Hyphae

Fungi and most bacteria are unique among plants, since they lack chlorophyll, the green pigment responsible for photosynthesis. Hence, the fungi and most bacteria must obtain some of the organic portions of their food from other plants and animals. Fungi resemble other plants in having definite cell walls and demonstrable nuclei and most are non-motile. Spore formation as a reproductive method is the best indication of close relationship fungi have to other plants, which also reproduce by spores or seeds. Many activities of fungi are beneficial to man. Probably the most important is the decomposition of organic wastes.

Protozoa:

These are micro- organisms belonging to the animal kingdom. The protozoan cell is the most complex in structure and activities of all micro-organisms. They are single celled, microscopic organisms that can perform all necessary functions of metabolism and reproduction. Many of these micro- organisms grasp and take solid food particles into their single-celled bodies, swim or creep and sometimes form quite complex communities.

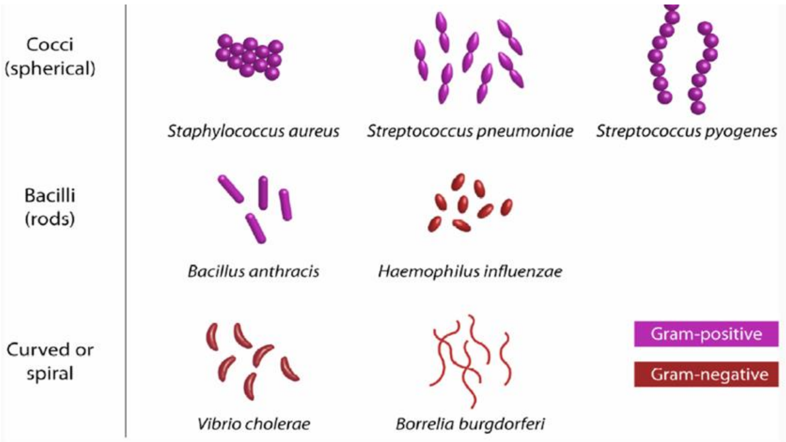
Most species of protozoa are harmless creatures living on dead organic matter or on bacteria (which are much smaller). They are found in the sea, lakes, rivers, sewage and damp soil. A few protozoa are found only in animals and plants where they cause disease i.e., malaria and amoebic dysentery.

Bacteria:

Bacteria are microscopic fungi and like all other fungi have no green coloring matter, or chlorophyll, they can thus grow well in the dark.

There are four types of bacteria:

- Cocci: Spherical types of bacteria (singular - coccus; from a Greek word meaning berry)
- Bacilli: Elongated, cylindrical forms (singular - bacillus; from a Greek word meaning rod)
- Vibrios: Comma shaped (e.g., vibrio cholerae
- Spirilla: Curved or wavy, like a coiled wire spring. Spirochetes: Some of the spirally coiled bacteria which are capable of flexing and twisting movements.



Types of cocci: The cells of many species of cocci, after fission, remain together in pairs they are called diplococci, other species of cocci cling together in long chains as they continue to divide, and this is called streptococci (strepto - chain). Still other cocci form neither regular pairs nor chains, but irregular groups and masses like clusters of grapes and these are called staphylococci (staphylo - cluster).

Spores:

Only two groups of bacteria have the power to change into spores, such forms are capable of surviving under unfavourable conditions and when the environment becomes congenial again, they return to the vegetative form of the germs. Spores are thus formed under unfriendly circumstances and are small, round, or oval granules, glistening and apparently hard and thick-walled within the cells.

Spores are of great importance in disinfection and surgery because they are very resistant to chemical disinfectants and boiling etc. The health care provider should, therefore, definitely know which organisms produce spores and how to kill these spores for making equipment and instruments / linen sterile.

A spore may leave a bacillus, which after the formation and departure of the spore is nothing more than an empty shell often called a sporangium. The spore may be blown about with the dust. Dust contains the spores of many organisms and is always a potential source of contamination. When conditions are favourable for the active, vegetative and reproductive life of the micro-organism, as in a surgical wound or injured tissue or in non-refrigerated food (moisture, nutrient and warmth are necessary), the spore sprouts or germinates i.e., changes back to the ordinary vegetative form of the organism and goes on growing. Only few species of bacteria form spores but the diseases they cause are often fatal. Among them are anthrax, tetanus (lockjaw), gas gangrene and botulism (food poisoning).

Rickettsia:

The rickettsia are much like bacteria, but are even smaller, and are segregated into a special group. Several species of rickettsia cause serious diseases in man e.g., Typhus fever, Rocky Mountain spotted fever and others.

Viruses:

Viruses are much smaller units, but they are not cells and are incapable of independent life or reproduction and are obligate intracellular organisms. The complete infectious virus is called the Virion. The Virion consists of specific nucleic acid (DNA or RNA) surrounded by a protein coat called the Capsid They have at least two distinctive properties.

- They are like the rickettsia in that they cannot be cultivated outside the living cells.
- They are so small that they can only be seen with special electronic instruments of very high magnification and are able to pass through fine clay or porcelain filters that hold back yeasts, molds, bacteria, most rickettsia and all larger living organisms.

Since cellular injury, ranging from necrosis to abnormal cellular proliferation occurs because of viral multiplication, we know viruses mainly by the diseases they cause. Common examples of viral diseases are poliomyelitis, influenza, measles, mumps, warts, chickenpox, common cold, HIV/AIDS and Hepatitis A, B, C, D & E viruses. More than 200 viruses are known at present and new ones are constantly being discovered. They do not form a homogenous group. The study of viruses is called virology.

Pleuropneumonia Like Organisms (PPLO):

The first of these curious organisms was isolated from the pleural fluids (fluids collecting around the lungs) of cattle with the infectious disease called bovine pleuropneumonia and are called pleuropneumonia organisms. These are minute, non-motile organisms that lack rigid cell wall. Their shape and size are extremely variable.

3.3 USEFUL MICRO-ORGANISMS

3.3 USEFUL MICRO-ORGANISMS

The environment is incomplete without microorganisms. With every breath we take, there are millions of microscopic organisms that we breathe in. Apart from that, the human body hosts a plethora of microbes both inside and outside. Besides this, they are a crucial part of the ecosystem and take part in activities like production of minerals like nitrogen, gases like oxygen, carbon dioxide, taking care of dead and decaying materials

Uses of Microorganisms

Microorganisms are beneficial for humans in various ways. They play an important role in human welfare and for the environment. These include processing and preservation of food, production of biomolecules, manufacture of pharmaceutical products, cosmetics industries, recycling the nutrients in the soil and so on.

The microorganisms that help in the production of several food items, medicines, manufacturing, and research. There are a few useful bacteria present in our body that aid in the digestion process. Bacteria are used in brewing and baking and other fermentation processes. They play a key role in nitrogen fixation. Bacteria are also used as pesticides and in composting processes in agriculture.

Following are a few useful microorganisms:

- Bacteria
- Fungi
- Protozoa

Listed below are some of the applications of microorganisms in human welfare.

Food Industry and Beverages

The role of microorganisms in food preparation and beverage manufacturing is known for ages. They are used in the manufacture of bread, curd, wine, and alcohol etc. *Lactobacillus* bacteria are responsible for the curd formation. They multiply and convert milk into curd. Another example is Yeast, which is used in baking industries for the preparations of bread and cakes.

Micro-flora

Bacteria are not only present outside the human body, but they also live inside the body too. This aggregate collection of microorganisms that is present in the human body is termed as Microflora.

Bacteria are also present in the gut, and they aid the process of digestion by releasing certain enzymes. They live in a symbiotic relationship with a human. Other roles of microflora are vitamin K production, which is crucial in enabling blood clotting. They also prevent the invasion of the foreign bodies, by acting against other fatal microbes.

Pharmaceutical Industry

Antibiotics go hand in hand with microbes in the medical field. Typically, antibiotics are obtained from a weakened form of an otherwise **harmful microorganism**. This is then injected into the body and the body learns to fight off the diseases caused by these organisms. Examples of this include mumps and the measles.

Environment

In the environment, microorganisms have two vital roles- one is an enhancement of soil fertility another is cleaning. Azotobacter, Rhizobium, Clostridium are few examples of Nitrogen-fixing bacteria which play a primary role in transforming atmospheric nitrogen into inorganic compounds which are then used by the plants. Without this process, most of the nitrogen present in the atmosphere becomes unusable.

Microorganisms also act as cleaners. Plants and animals eventually die and their bodies are turned into nutrients which the environment can use.

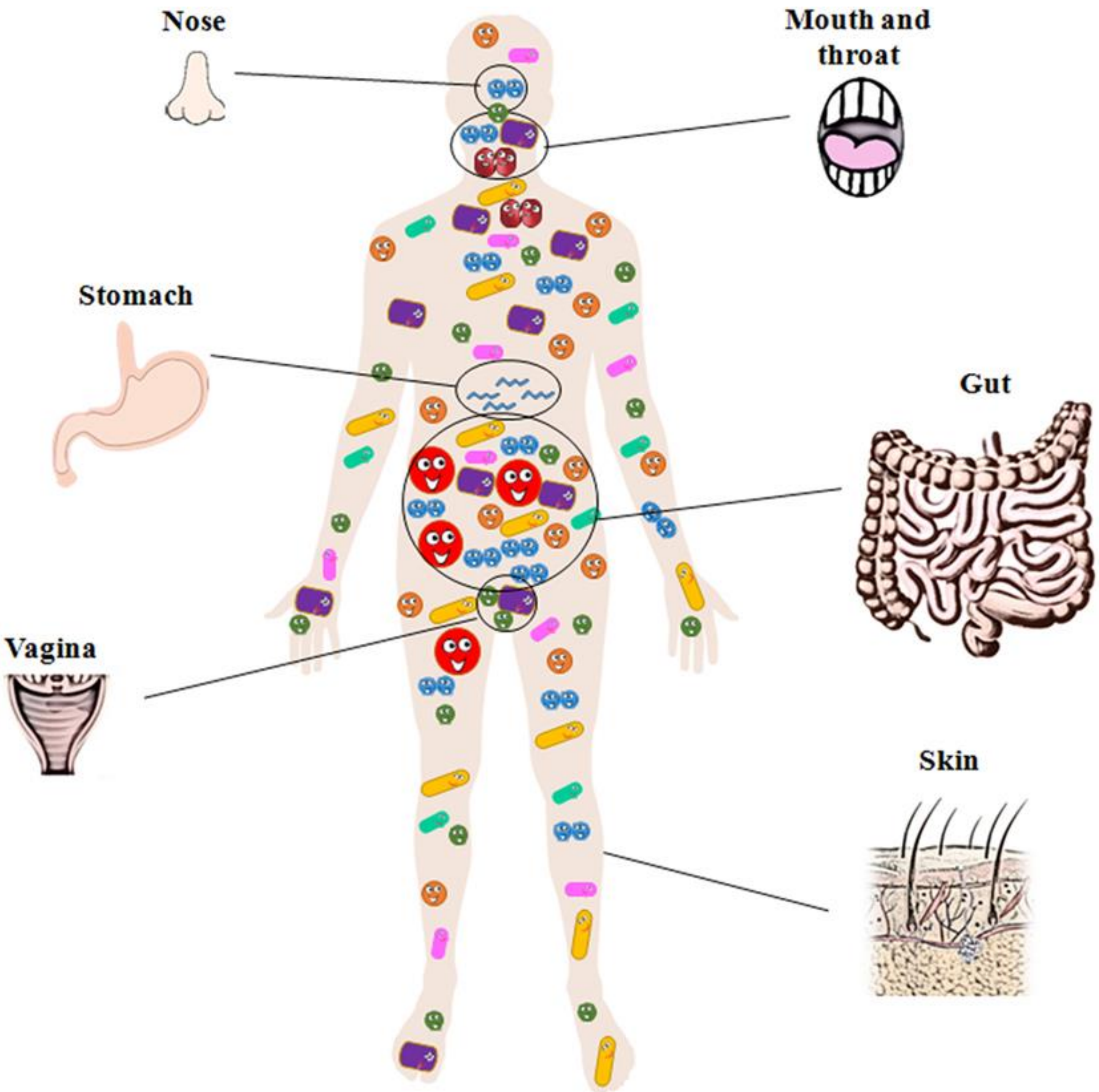
Human Microbiota

The human body is inhabited by millions of tiny living organisms, which, all together, are called the human microbiota. Bacteria are microbes found on the skin, in the nose, mouth, and especially in the gut. We acquire these bacteria during birth and the first years of life, and they live with us throughout our lives. The human microbiota is involved in healthy growth, in protecting the body from invaders, in helping digestion, and in regulating moods.

Some changes in the microbiota may occur during our growth, depending on the foods we eat, the environment in which we live, the people and animals that interact with us, or medicines that we take, such as antibiotics. The human microbiota helps us to keep us healthy, but sometimes these bacteria can also be harmful. We need to take good care of our microbiota to avoid the development of some diseases, such as obesity and asthma. We should eat healthy foods that contribute to the development of a healthy microbiota.

What are bacteria?

Bacteria are tiny living microorganisms that are too small to be seen by the naked eye. They are 1,000 times smaller than a pencil tip. We must use an instrument called a microscope, which makes the image of the bacteria big enough to be seen. There are many kinds of bacteria with diverse shapes and sizes. Some look like a baseball bat, others are round like a basketball (but millions of times smaller)



The human body is the home of millions of bacteria. Several body sites are full of bacteria and they are especially concentrated in the gut, in the throat and mouth, and on the skin.

Where are bacteria in the human body?

Bacteria live on the skin, inside the nose, in the throat, in the mouth, in the vagina, and in the gut. Most of the bacteria found in the body live in the human gut. There are billions of bacteria living there. We call the group of all the microbes found in the body the human microbiota These microorganisms colonize the body, which means that they usually do not cause any harm. When a microorganism causes sickness, that is called an infection.

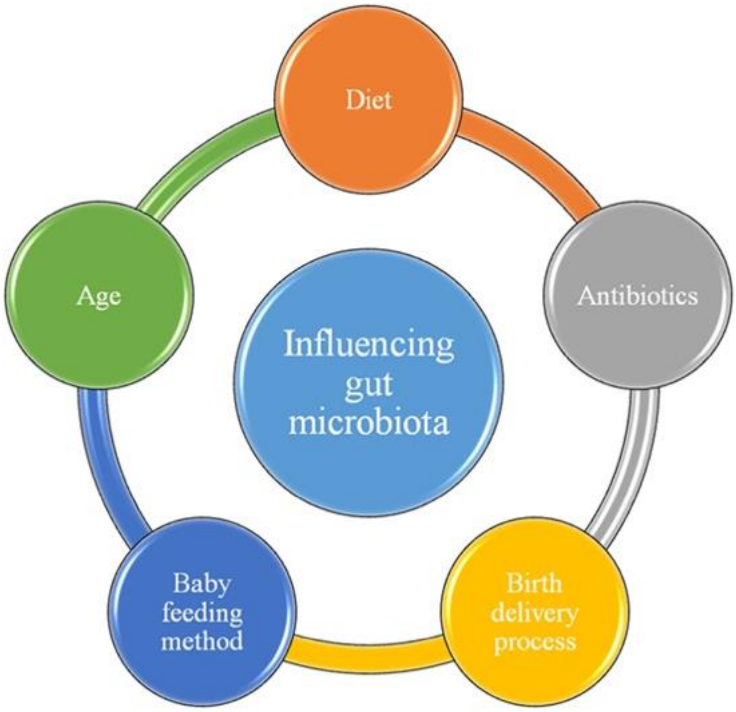
Where do the bacteria that live in the human body come from?

We begin to be colonized by bacteria during birth. During the birth process and immediately after birth, we get our first microorganisms. Babies get microorganisms from their moms during delivery, when they pass through the vagina, or from contact with the mom's skin, if the delivery is by caesarean section. Lactobacilli, a type of bacteria considered to be one of the "good guys," live in the mother's vagina and they colonize the baby's intestines to help in the **digestion** of milk, which contains a sugar called lactose.

If the baby is delivered by caesarean section, Lactobacilli will not immediately become part of the baby's microbiota, which will be made up mostly by bacteria from the mom's skin and the baby's environment. These differences in a baby's microbiota, resulting from the type of birth that baby experienced, will remain until the baby is 12–24 months of age. All babies also acquire bacteria from the skin of the nurses and medical doctors and the environment they live in.

After babies begin to eat, they get microbes from their diet. In the first days of life, the type of the microorganisms that colonize their intestines will be different, depending on whether the baby is breast feeding or drinking formula. Breast feeding is healthy for the baby, because it helps the baby to acquire bacteria from the mother's skin that will then colonize the baby's intestines, and there are also other components of the mother's milk that protect the baby from disease. As babies grow, they get microorganisms from the solid food they eat, from crawling on the floor, from putting their hands in their mouths, from licking toys, and from many other sources!

The microbes that live in the human body change during our growth, until we are 3 years old. At that point, the microbiota becomes stable until adult life. Everyone has his or her own microbiota, which depends in part, but not only, on the types of food eaten, the environment where the person lives, and the other people and animals that the person interacts with



Factors that influence our microbiota are showed in the small circles around the middle circle.

During birth, the first microorganisms that we get depend on the *birth delivery process* (natural or c-section). The *baby feeding method* (mom's milk or drinking formula) will influence the microbiota in our first years of life. *Diet* will influence the composition of microbiota in all stages of our life. As we get older (*age*), microbiota alterations depend on our diet, environment where we live, and lifestyle. *Antibiotics* will also alter the composition of our gut microbiota

Antibiotics

Antibiotics are medicines we take to treat infections caused by bacteria. Antibiotics are not active against infections by fungi or viruses. So, do antibiotics kill our good bacteria friends too? Yes, they do. However, if we have a bacterial infection, we must treat it, so in many cases we must take antibiotics. Be sure to only take antibiotics when your doctor says you really need to and take them during the time he advises. You do not need an antibiotic to treat a cold or the flu, because these diseases are caused by viruses.

People who take a lot of antibiotics may get sick because the antibiotics destroy lots of the bacteria in their bodies, including the good ones. When lots of the bacteria in the gut are killed, the gut then has more free space and available food for the bad bacteria, which can then multiply. When these bad bacteria reach higher numbers, they can sometimes cause disease. Therefore, individuals taking antibiotics frequently get diarrhea or more complicated intestinal diseases. When you take antibiotics without needing to do so, you might contribute to the emergence of “superbugs,” which are bacteria that are not killed by most of the antibiotics available today. These superbugs can survive in the presence of the antibiotic (which is called resistance to the antibiotic), so the infection continues even when the antibiotics are being used.

Glossary

Microbes/Microorganisms: Mostly one-celled organisms that include bacteria, some fungi (such as yeast), and microalgae.

Bacteria: Tiny living microorganisms that can be beneficial or dangerous for people.

Human Microbiota: The group of microbes that live in the human body and do not cause disease.

Colonization: Living in the body without causing any harm.

Digestion: To break down food into small pieces to be used by the human body.

Bacterial Infection: A disease caused by pathogenic bacteria.

Antibiotics: Special medicines used to fight against bacteria.

Pathogen: Microorganism that causes disease (sometimes also called a germ).

Prebiotics: Compounds that help the growth of the good microbes in the gut.

Probiotics: Live microorganisms are good for our health, especially the digestive system

3.4 IMMUNITY

3.4 IMMUNITY

The word 'immunity' derives from the Latin *immunitas*, the legal status of Roman city-states granted immunity from paying tributes to Rome or to individuals freed from municipal duties; the root *munis* referring to change and (ex)changeable goods

Immunity is defined as the specific resistance to infections i.e., resistance to individual species of micro- organisms. Immunity is of two kinds i.e., inherited and acquired. Immunity to a disease is achieved through the presence of antibodies to that disease in a person's system. Antibodies are proteins produced by the body to neutralize or destroy toxins or disease-carrying organisms. Antibodies are disease specific. For example, measles antibody will protect a person who is exposed to measles disease but will have no effect if he or she is exposed to mumps.

INHERITED IMMUNITY

It depends on inherited or genetic characteristics where immunity may occur as a natural phenomenon, existing even though there has been no previous contact between the host and the infectious agent. It is of three types.

Species Immunity:

The human host has a natural resistance to many micro-organisms that cause disease in other species. There are, for example, almost no infectious diseases of plants to which man is susceptible and vice versa.

Racial Immunity:

Certain races and families are more resistant to some infectious diseases than others. For example, the incidence and severity of some infectious diseases like polio and tuberculosis have varied markedly among peoples of the world.

Individual Immunity:

Populations highly susceptible to a particular micro-organism may contain individuals who are strongly resistant to it, even though no previous contact with the organisms can be demonstrated.

Acquired Immunity

The immunity that results from the production and activity of antibodies in the host defending itself specifically against intruding foreign substances is referred to as acquired. This type of immunity is produced by the reaction of the body to certain kinds of foreign chemical substances not naturally present in it and called antigens.

Antigens:

An antigen is a substance, usually foreign to the host and protein in nature that upon introduction into tissues of an animal host stimulates production of antibodies by that host.

Antibodies:

The definition of an antibody, like its name, is the converse of that given for an antigen. It is a specialized protein substance produced by an animal host in response to a foreign antigen in its tissues and it is capable of reacting specifically with that antigen.

Micro-organisms are no more antigenic than any other source of foreign material, but they act as antigens more frequently, because they get into the tissues more often. Food proteins, for example, would be antigenic if injected, but they normally pass through the alimentary tract where they are digested and enter the body proper, not as proteins, but as amino acids, which are not foreign at all. Virulent micro-organism, on the other hand, enters the tissues with their proteins and polysaccharides intact.

ACQUIRED IMMUNITY IS OF TWO TYPES:

1) Natural Acquired Immunity:
2) Artificial Acquired Immunity:

1) NATURAL ACQUIRED IMMUNITY:

This immunity which is observed in persons who have recovered from an infection seems to be due to two factors: a continued, low-level production of antibodies and a state of sensitivity to the particular antigen, so that when the same antigen enters the body again there is a rapid production of antibodies.

The natural immunity may be acquired by having either a clinical or a subclinical attack of the disease. The duration of such immunity varies with the organism and with the individual host. In some bacterial and viral infections, an apparently lifelong immunity to a particular strain of micro-organism is produced, while in other cases it is of much shorter duration. In tuberculosis, syphilis and some diseases caused by animal parasites, there may be a relative insusceptibility to a second or “super” infection while the organisms are still present in the body, but no effective, lasting immunity comparable to that in many viral, rickettsia and bacterial infections.

2) ARTIFICIAL ACQUIRED IMMUNITY:

It requires the introduction of the organism (in some form in which it will not cause clinical infection) or some fraction or product of the organism, which contains the antigens necessary for effective immunization.

The materials commonly used are listed below.

Exotoxins are separated from the bacteria by filtering a liquid culture and its toxicity destroyed by treatment with heat or formalin; such a product is called a toxoid. Diphtheria and tetanus toxoids are examples of this type of immunizing material.

Micro-organisms killed by heat or chemical disinfectants such as formalin, phenol or ultraviolet irradiation. The organisms are grown in pure culture, separated from the culture medium, suspended in saline and killed. These preparations are commonly called vaccine. Typhoid vaccine, whooping cough vaccine and the Salk poliomyelitis vaccine are example of this type of preparation.

Living micro-organisms with their virulence attenuated (i.e., reduced). It is sometimes possible to treat an organism so that it loses the ability to cause disease but remains alive and capable of immunizing against virulent organisms.

It is also well known that several infectious diseases can be prevented by the administration of vaccines. A vaccine is a preparation that contains the infectious agent of a particular disease, or some product of that agent (such as a toxin) responsible for the damage to tissues, treated in some way so that it can be administered safely. Given orally or injected into the tissue it will not produce disease, but the antigen or antigens it contains will induce the body to form antibodies. The vaccinated individual will then have immunity to the micro-organism in future.

Artificial Acquired Immunity is again of two kinds:

1) Active immunity
2) Passive Immunity

1) Active acquired Immunity:

Active immunity results when exposure to a disease organism triggers the immune system to produce antibodies to that disease. The disease was caused by a micro-organism that damaged his tissues through some pathogenic property, as we know. Being a foreign substance, the micro-organism acted also as an antigen stimulating the body to produce antibodies. Exposure to the disease organism can occur through infection with the actual disease (resulting in natural immunity), or introduction of a killed or weakened form of the disease organism through vaccination (vaccine-induced immunity). Either way, if an immune person comes in contact with that disease in the future, their immune system will recognize it and immediately produce the antibodies needed to fight it.

Active immunity is long-lasting, and sometimes life-long.

The term active acquired immunity implies that the host has produced his own antibodies in response to the presence of an antigen in his body.

2) Passive Acquired Immunity:

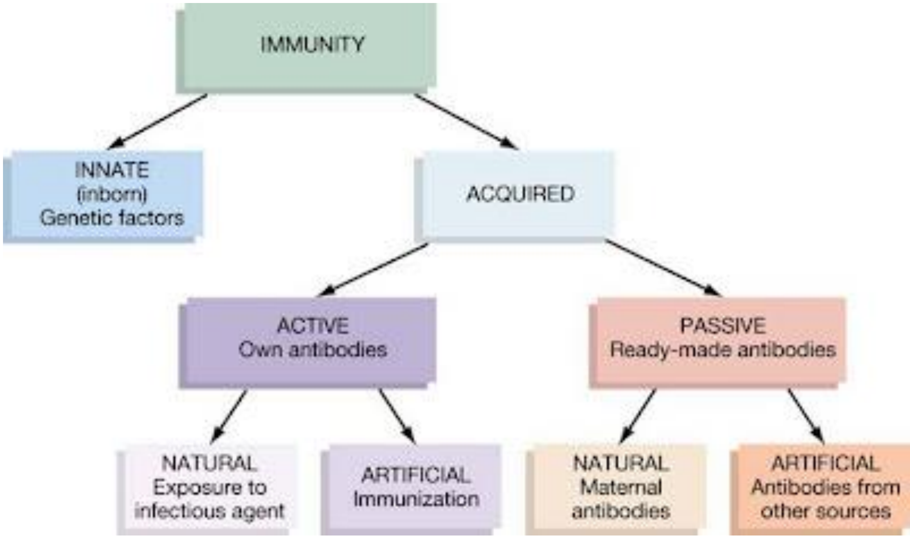
Passive immunity is provided when a person is *given* antibodies to a disease rather than producing them through his or her own immune system. Passive immunity may again be acquired by a natural or artificial process

Passive acquired immunity means protection of the host by antibodies he did not produce himself but acquired from another host, either naturally (as by placental transfer from mother to child) or artificially by injection. Passive immunity may again be acquired by a natural or artificial process.

Natural or Congenital Passive Immunity:

Antibodies in the blood of a pregnant female pass through the placenta from maternal to fetal blood, and infants are commonly born with antibodies for infections to which their mothers are immune. These are, however, only temporary. They are gradually metabolized and excreted, and when they are gone the child is susceptible to the disease. (Antibodies may also be transferred though the mother's milk, especially the early secretion i.e., the colostrum).

A newborn baby acquires passive immunity from its mother through the placenta. A person can also get passive immunity through antibody-containing blood products such as immune globulin, which may be given when immediate protection from a specific disease is needed. This is the major advantage to passive immunity; protection is immediate, whereas active immunity takes time (usually several weeks) to develop.However, passive immunity lasts only for a few weeks or months. Only active immunity is long-lasting.



`

3.5 HYPERSENSITIVITY / HYPER IMMUNE REACTIONS

3.5 HYPERSENSITIVITY / HYPER IMMUNE REACTIONS

Hypersensitivity reactions occur when the normally protective immune system responds abnormally, potentially harming the body. Various autoimmune disorders as well as allergies fall under the umbrella of hypersensitivity reactions. The difference being that allergies are immune reactions to exogenous substances (antigens or allergens), whereas autoimmune diseases arise from an abnormal immune response to endogenous substances (autoantigens). A symptomatic reaction only occurs in sensitized individuals, i.e., they must have had at least one prior asymptomatic contact with the offending antigen

Allergy:

An abnormal immunological response to an otherwise harmless environmental stimulus (e.g., food, pollen, animal dander) or exogenous antigens and allergens

Autoimmune disease:

An abnormal immunological response directed against an antigen that is part of the body itself

Stages

Sensitization: initial asymptomatic contact with an antigen

Effect: harmful immune response following sensitization and subsequent antigen contact.

Hypersensitivity reactions are classified into four types.

- **Type I:** Immediate **Hypersensitivity** (Anaphylactic Reaction)
- **Type II:** Cytotoxic Reaction (Antibody-dependent)
- **Type III:** Immune Complex Reaction.
- **Type IV:** Cell-Mediated (Delayed **Hypersensitivity**

The hypersensitivity reactions can be memorized with the mnemonic ACID: A – Allergic/Anaphylactic/Atopic (Type I); C – Cytotoxic (Type II); I – Immune complex deposition (Type III); D – Delayed (Type IV)

Type 1 Hypersensitivity reactions

Are immediate allergic reactions (e.g., food and pollen allergies, asthma, anaphylaxis

Type I is first and fast.

Immediate reactions appear within a few seconds or minutes of the eliciting dose of antigen. Clinical symptoms may be localized or systemic. Immediate local tissue reactivity is seen in a variety of allergic responses. The well-known problems of asthma, hay fever, hives and other skin rashes exemplify this type of limited hypersensitivity. The nature and degree of injury vary under different circumstances but in general the following physiologic changes are involved:

Release of histamine from certain cells of connective tissue, leads to;

1) Contraction of smooth-muscle cells and constricting muscle spasm particularly in the bronchioles of the lungs and the small arteries.
2) Blood vessel walls become more permeable, and plasma and cells accumulate in the surrounding tissues producing oedema.
3) Damage to the blood vessels causing lowering of blood pressure which results in severe shock.
4) Release of heparin reduces the coagulability of the blood.

Cross-reactivity

Individuals with allergies may also react to substances that contain particles that are similar to the main antigen.

Examples (primary allergen – cross-reactant allergen)

Pollen – various foods (e.g., apple, hazelnut, carrot, kiwi, apricots, peaches)

Type II hypersensitivity reaction

- Type II hypersensitivity reactions are referred to as cytotoxic and play a role in several autoimmune diseases.
- Clinical features, diagnostics, and treatment depend on the underlying etiology (see also overview of hypersensitivity reactions above).

Distribution of disease: often limited to a particular tissue type Diagnosis may involve autoantibody testing (see antibody diagnosis of autoimmune diseases) and the Coombs test.

Type II hypersensitivity reactions are referred to as cytotoxic, as they involve antibodies that are specific to particular tissues within the body and cause destruction of cells in these tissues (e.g., autoimmune hemolytic anemia, Goodpasture syndrome).

Type III hypersensitivity reaction

Type III hypersensitivity reactions are referred to as immune complex reactions and include many glomerulo-nephritis and vasculitis. Clinical features, diagnostics, and treatment depend on the underlying etiology (see also the overview of hypersensitivity reactions above) Distribution of disease is systemic

Serum sickness

Reaction appearing as a complication of antitoxin or antivenom administration .Serum sickness-like reaction is much more common than Type III hypersensitivity reactions are immune complex-mediated, with tissue damage caused by antigen-antibody complex deposition (e.g., many vasculitis and glomerulo-nephritis). This is a systemic type of hypersensitivity that can sometimes be induced by an initial dose of sensitizing antigen.

The type of antigen most frequently involved is animal serum given prophylactically to provide immediate passive immunity. Horse serum is commonly implicated because many anti-sera can be obtained in large quantities by artificially immunizing horses. Tetanus antitoxin, for example is prepared in this way. It is used to treat patients who have sustained accidents in which tetanus infection and intoxication are threatened. The symptoms of serum sickness are similar in many ways to those of anaphylaxis, but less severe. They include sudden fever, hives, oedema of the face, hands and feet, lymphoid reactions with swelling of many nodes and often an intense reaction at the site of serum injection. Oedema of the laryngeal and other upper respiratory tissues can be a severe threat to normal respiration. The illness continues until all the antigen has been inactivated or eliminated.

Type IV hypersensitivity reactions

Type IV hypersensitivity reactions (e.g., TB skin tests, contact dermatitis) are delayed and cell-mediated and are the only hypersensitivity reaction that involves sensitized T lymphocytes rather than antibodies. Unlike true hypersensitivity reactions, which occur after sensitization, nonallergic hypersensitivity reactions (e.g., pseudo allergies) cause mast cell activation and histamine release after initial exposure to a trigger substance (e.g., radiocontrast media).

4 Ts associated with the **type IV** hypersensitivity: **T** cells, **T**ransplant

rejection, **T**B skin tests, **T**ouching (contact dermatitis)

Anaphylaxis:

The extreme reaction that can be produced by hypersensitive immune mechanisms is anaphylactic shock. It is an allergic response of a severe nature in which the individual becomes overly reactive to the antigen i.e., stimulation and his response described as being hypersensitive. He is also said to display an altered reactivity or allergy which occurs in allergic reactions at the site of antibody activity. The antigens that induce hypersensitivity are called allergens. The development and extent of allergic reactions differ widely among individuals. In any one person, they depend primarily on his genetic faculty for sensitization by antibody and then on the nature and frequency of his contacts with allergens.

Nonallergic Hypersensitivity

Pseudo allergy

Definition: an IgE-independent reaction that is clinically indistinguishable from type I hypersensitivity

Etiology: radiocontrast media, narcotics, vancomycin, NSAIDs

Substances cause direct (or complement-mediated in case of anaphylactoid reaction) mast cell activation and subsequent release of histamine not mediated by immunoglobulin. In contrast to true anaphylactic reactions, no sensitization to allergens is required → First contact can already lead to anaphylactic shock.

Symptoms

Include urticaria, pruritis, oedema, hypotension or even symptoms of anaphylactic shock in rare cases

Treatment

Avoid offending drug

Give antihistamines for pruritus or urticaria.

For pseudo allergy with anaphylactic characteristics, see anaphylaxis

Infection-induced urticaria

Viral (e.g., rotavirus and rhinovirus) or bacterial infections (esp. Mycoplasma pneumoniae and group A streptococcal pharyngitis).

Parasitic infections (e.g., Anisakis simplex infection from eating raw fish and Plasmodium falciparum)

There is mast cell activation and subsequent release of histamine, most likely IgE-independent Usually self-limited; antihistamines may be given for pruritus

Skin Test in Hypersensitivity:

The intra-cutaneous injection of a small dose of an antigen often serves to reveal a hypersensitive state and to identify if it is immediate or delayed in type.

Skin testing is also commonly used to detect allergies to foods, pollens and other inhalants, or other sensitizing agents. An antigenic extract of the material in question can be applied to the skin either in a small scratch made with a dull instrument or by intra-dermal injection. Some materials may produce an immediate wheal and flare; others may give a delayed positive result; therefore, negative test sites should be read daily for two or three days. When the cause of a food, inhalant, or contact allergy can be identified in this way, the patient can sometimes be offered relief of symptoms by avoidance of the allergen, if this is possible or by desensitizing techniques

3.6 INFECTION

3.6 INFECTION

It is the response of the body to micro-organisms which enter the body, multiply and damage tissues, disturbs its functions, and produce the signs and symptoms of the disease. The signs and symptoms are common like fever, chills, nausea and headache. Some infections are so mild that they hardly cause any discomfort while others are fatal. A pimple, for example, is a trivial reaction to an infection of the skin whereas the typhoid fever is a serious one and without antibiotic treatment it is often a fatal infection of the blood, intestine and other organs.

Types of Infections

- **Communicable Infections** are caused by specific organisms of high virulence: Since the invasiveness of these organisms is high, they will cause disease in normal healthy hosts. If they are transferred to new hosts, they will also be able to invade and cause disease; so, the infection may be communicable. Because the organism invades and grows in a particular way, the changes in the host are often highly characteristic; one species of organism gives rise to a specific set of signs and symptoms, and the disease is said to be a specific one. The infection is exogenous, that is, it comes from outside the body. Such diseases are given specific names as diphtheria, typhoid fever, poliomyelitis, and mumps.
- **Non-Communicable** Infections are caused by organisms of low virulence: Either because they are present in very large numbers or because the resistance of the host is low. Since this type of infection depends on special conditions in the host, the small number of organisms ordinarily transferred to a new host will not cause infection in a normal individual; so, such diseases are usually non communicable.

Commonly Used Terms

Infectious disease: It occurs in human due to the presence of an infectious agent on or in the body i.e., micro-organisms like virus, bacteria, protozoa and rickettsia or even fungus and helminths.

Contagious disease: It is a state of disorder in human that results from direct contact with an infectious agent.

Communicable disease: A disease capable of being directly (through contact with bodily secretions) or indirectly (through contact with inanimate objects) transmitted from person to person.

Immune: A person who possesses power to resist infections.

Epidemic: (Epi-upon; demos-people) When a disease affects a large number of persons within a short space of time. If a disease not previously presenting an area occurs for the first time, it is also considered as an epidemic.

Sporadic: When the number of immune persons is greater than the susceptible, the disease is said to be sporadic (a case here and a case there).

Endemic: When the number of susceptible and immune persons is almost equal, the disease continues to smolder in a community and is always present in the community, it is said to prevail in an endemic form.

Pandemic: When the susceptibility of the whole country or the world is increased for a particular organism, the disease is said to occur in a pandemic.

Exotic: When a disease is not usually present in a locality but is introduced from abroad, it is called exotic.

Incubation Period: Incubation period is a period from the entry of the micro-organisms in the human body till the appearance of the disease.

Infective Period: It is the time interval during which an infectious agent can be transferred from a reservoir (patient) to the susceptible host.

Fomites: The inanimate objects which have been soiled with infective material such as bedding, pillows, linen, towels, handkerchiefs, books, spoon, fork and knives etc. Fomites if freshly soiled are likely to spread the agents of infection.

Vector: It is capable of transmitting the disease under natural conditions e.g., Anopheles mosquito is a vector for malaria.

Carrier: A carrier is a person or animal who harbours and discharges living pathogenic organisms although he is free from any effect of the infection.

Cross Infection: When patients suffering from a particular disease are admitted in a hospital, they may acquire fresh infection from their neighbours in the ward, who may be suffering from another disease. This is called cross infection.

Clinical Stages Of Infectious Disease

Clinical infections are often described as being either acute or chronic, depending on the rise and fall of symptoms displayed by the host. In either case, infection proceeds in a series of stage reflected by host responses.

What is the clinical iceberg?

The symptom **iceberg** describes the phenomenon that most symptoms are

managed in the community without people seeking professional health care.

The size of the **iceberg** for many symptoms is unknown, as is their association with personal characteristics, including history of a chronic disease

Who is at risk of infection?

Everyone is at the risk of developing infections but there a few groups of people who are at higher risk of getting infection.

The clients:

Clients for various services are at risk of post procedure infections when:

- Service providers do not wash their hands before and after providing care to each client and before and after every procedure.
- Service providers do not adequately prepare clients before clinical procedures.
- Service providers do not correctly process instruments and other items used in clinical procedures.

The service providers and support staff:

Service providers and support staff are at significant risk of infections because they are exposed to potentially infectious blood and other body fluids daily.

- Service providers are at risk during clinical procedures and when handling sharp instruments.
- Cleaning and housekeeping staff who process instruments and other items, do clean-up after procedures, clean the procedure rooms and dispose the waste, are particularly at risk because of lack of education and understanding of their own risk of infections.
- Most of health care providers are at higher risk of Hepatitis B & C infections because of poor infection prevention practices.

The Community:

Members of the community are also at risk of infections, particularly from inappropriate disposal of medical waste, such as contaminated sharps.

Improper disposal of medical waste including contaminated dressings, tissue, used needles, syringes and surgical blades can be found by children or others scavenging in open dumps or can scatter on the ground where adults and children travel, putting community members at risk of infections and injury.

Acute infectious Disease:

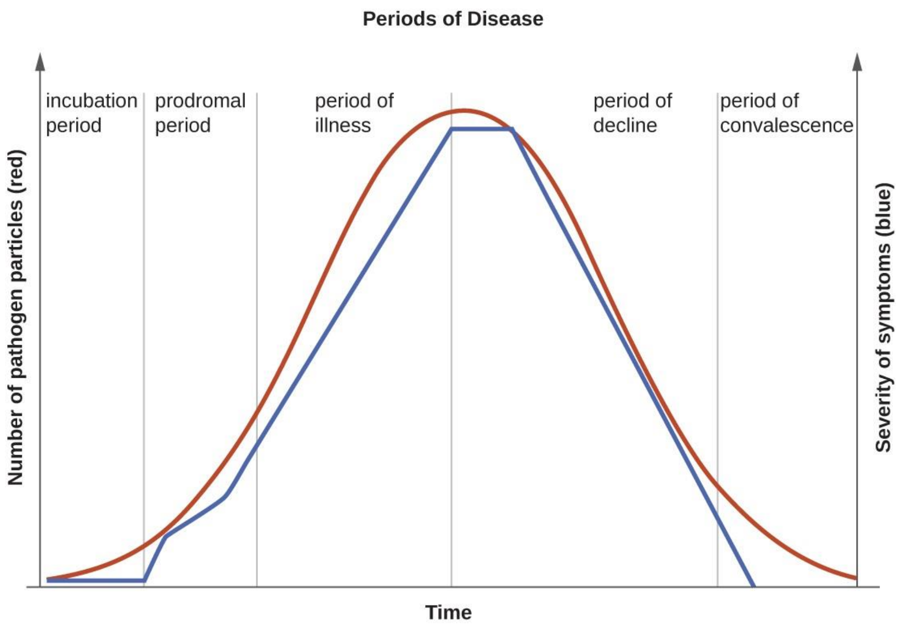
Acute infections are characterized by a rising pitch of symptoms that continue for as long as the micro-organisms or its products are actively capable of inflicting damage, then subside and disappear as host defenses become effective.

Human responses to acute infection fall into four periods with respect to the activities of the infectious agent and the symptoms produced thereby. These are the incubation period, the prodromal period, the acute stage of active disease, and the convalescent stage of recovery.

Stages of Infectious Disease.

1) incubation period. silence stage time between infection and the appearance of signs and symptoms of the disease.

2) prodromal phase. pathogens begin to invade tissues.
3) invasive phase. ...
4) Acute infection
5) Convalescence phase



Stages of infectious disease

Incubation Period:

- Incubation period is a period from the entry of the micro-organisms in the human body till the appearance of the disease. There are no outward signs of infection during this period when the "incubating" parasite is attempting to establish itself. If the organism survives and multiplies, the symptomless incubation period comes to an end when the parasite's activities begin to embarrass host cells. The length of this period varies. It may be very short (two or three days) for some virulent bacteria or quite long for a virulent viruses and fungi (weeks or months) but the average incubation time for most agents of acute infections lies in the range of 10 to 21 days.

Prodromal Period:

In Greek the word prodromal means "running before". It refers to a brief period, usually one or two days, in which the earliest symptoms of trouble appear preceding the development of acute illness. The patient feels mildly uneasy or indisposed and may have a "scratchy" sore throat, headache or gastrointestinal discomfort, but often is unable to point out the source of this malaise.

Acute Period:

This is the period when host parasite interactions reach full intensity, producing symptoms of illness corresponding to the degree and site of injury. The inflammatory response of the host is in full swing and immune mechanisms come into play.

Fever is the most characteristic and least variable symptom of infection.

Febrile reactions are also influenced by the age and general condition of the patient. Children develop sudden high fevers for reasons that may be quite insignificant or extremely serious. Very old people may also display this kind of unstable temperature control. Patients in shock may have no fever or even a depressed body temperature. Fever is accompanied by a rise in pulse and respiration rates, as well as general metabolic activity. It often induces restlessness, irritability, loss of appetite, headache or diffuse pains.

Rash is another frequent characteristic of the acute phase of infectious disease. In some infections, the appearance of a rash and its distribution on the body may be highly typical and diagnostic, as in scarlet fever, measles or chickenpox.

Localized Symptoms:

The symptoms of many acute infections are related to the original or extending sites of localization of the infectious agent. Nausea, vomiting and diarrhea are frequent hallmarks of gastrointestinal infection, together with the pain in intestinal spasm.

Abscess formation and other manifestations of the inflammatory process, wherever they occur, produce symptoms referable to the local tissue injury. Inflammatory infections of the brain or other central nervous system tissue may be associated with such symptoms as drowsiness, mental confusion and stiffness of the neck, a spastic or flaccid paralysis of involved muscle groups or other neurologic signs of motor nerve damage.

Convalescent Period:

The patient’s survival and recovery from the acute phase of disease depend on the extent and nature of the damage done, on the strength of his own resistance mechanisms and on the adequacy of medical support.

The convalescent phase begins with the decline of fever, often accompanied by a feeling of weakness but definite improvement. The speed and completeness of recovery in any case are determined by the nature of any injury induced, its extent and permanence or reversibility.

Chronic Disease:

Chronic situations arise when a pathogenic organism is able to survive the host’s defenses and to maintain some level of damaging activity over a longer period of time. A persistent, chronic relationship between a host and a given parasite may remain unnoticeable if the latter exerts no pressures the host cannot readily encompass. More usually, chronicity of infection is characterized by a rise and fall of symptoms referable to the activities of the parasite or its products, and host’s responses to them. These responses often involve the reactions of hypersensitivity.

The symptoms may be similar and acute each time the parasite enters an ascendant phase; they may be of diminished character (sub-acute) if the host’s defenses are more effective or increase in intensity if new tissues become involved. Syphilis affords an excellent example of the latter situation.

Sources Of Infection

Most pathogenic organisms grow in the bodies of their hosts and the source of infection is therefore the person or animal which is discharging the specific pathogen. The organisms may leave the person or animal in the ordinary body excretions such as the faeces urine or saliva. They may also be discharged in abnormal excretions such as sputum or pus discharged from suppurating lesions. Some leave the body only when blood is withdrawn by biting or sucking insects or for transfusion. Each species of pathogen has its characteristic means of leaving the body. Intestinal pathogens leave in the faeces and the vomitus, the organisms of pulmonary disease leave in the sputum, the parasites of malaria and certain other diseases are removed from the body only by specific insects.

Carrier:

A carrier is a person or animal who harbours and discharges living pathogenic organisms although he is free from any effect of the infection. He seems to be at least partially immune to the organism, although it continues to grow in some part of his body. Carriers are frequently not detected until they have passed the disease on to others. The different types of carriers are:

Chronic carriers are those in whom the carrier state persists for long periods. Persons recovering from typhoid fever have been known to discharge Salmonella typhi for as long as 30 years.

Convalescent carriers are temporary carriers who discharge organisms after their apparent recovery from an attack of disease. Convalescent carriers are common in diphtheria and in scarlet fever.

Contact carriers are individuals who acquire and harbour some pathogen for a while as the result of close contact with a case of communicable disease. They are often persons who are immune to the disease in question as a result of artificial immunization or from having had the disease. A person caring for a case of diphtheria, who has himself been immunized to the disease, may pick up the organisms and become a temporary carrier of this type.

Subclinical cases are usually individuals who have not had the disease, or been immunized otherwise, but who on contact with the organism, develop so slight an infection that they do not appear ill. Not all subclinical cases are dangerous, because in many instances they do not discharge a sufficient number of organisms to cause disease in others but in some cases, they apparently do serve as sources of infection.

Animals as sources of Infection:

A considerable number of infectious diseases of lower animals also attack man and so infected animals may be sources of infection for human cases. These diseases are seldom communicable from man to man. The animals that are hosts to these infections are usually mammals the warm-blooded, hairy animals that suckle their young. Cattle pass on tuberculosis to human beings; dogs give us rabies; and rodents are sources of at least half a dozen important human diseases. Diseases that may be acquired from animals other than mammals include two respiratory infections from birds and broad tapeworm infestation from fresh-water fish. The population of infected animals from which man may acquire infection is called the animal “reservoir” of the disease. The insects are not considered sources of infection since their role is to carry infection from one animal or person to another, they are considered as modes of infection.

Other Sources of Infection:

Plants may also be the source of infection. In pathogenic fungi the organism enters through contact between a break in the skin and a plant or even dead plant tissue such as wood, which contains the fungus. Occasionally a pathogenic organism is capable of living for months or years in the environment, so that this may be thought of as the source of infection. One pathogenic fungus lives for long periods in dust and is inhaled by man from this source, rather than from other human cases.

Transmission of Infection

The six components of the Infection Transmission Cycle are:

1) Infectious Agent:

It is the micro-organism that can cause infection or disease. The infectious agent can include bacteria, viruses, fungi and parasites. These are found everywhere in nature i.e., in air, dust, dirt, water, spoiled food, skin and intestinal tracts of animals, plants or any favorable medium as food and water etc.

2) Reservoir:

These are people, place, things and environment where the agent survives, grows and multiplies. People, animals, plants, items of daily use, soil, air, water and other solutions, instruments and items used in clinical procedures can serve as reservoirs for potentially infectious micro-organisms.

3) Portal of Exit:

The infectious micro-organisms must be able to leave the infected person through either of the following routes:

- Skin: Pus from boils or impetigo is filled with millions of bacteria. Bandages that have been used to cover burns or wounds also are heavily infected.
- Blood: Malaria spreads from the blood of one person to the blood of another by means of mosquito bites. Other diseases, which spread through blood, include HIV / AIDS and Hepatitis B and C.
- Nose, throat and mouth: These are among the most common and important portals of exit. Mucous from the nose and sputum from the mouth are sources of tuberculosis, sore throat, diphtheria, and many other serious diseases. For example, when people with tuberculosis spit, the germs (bacteria) become available to other people and so may infect them. Other illnesses such as colds, measles and many other viral diseases are transmitted in tiny droplets from the nose and throat. Droplets

are particularly evident when a person sneezes, but just ordinary breath will transmit the droplets very effectively also.

- Faeces: Faecal material is loaded with bacteria many of which are harmful to man. Some bacteria are beneficial as those present in the intestinal tract. It is of utmost importance for people to defecate in a privy or away from the supply of drinking water. Even more important, one should wash his/her hands carefully with soap and water after defecation to make sure none of the stool remains on the hands.
- Genito-urinary tract: Urine is normally sterile, but bacterial growth occurs in stagnant urine. It is important for men and women to urinate away from the drinking water source to prevent the bacteria from entering it. Venereal diseases, such as gonorrhoea and syphilis are carried in the vagina and on the penis. Most discharges from the genital organs of the male and female contain bacteria, yeasts or protozoa. It is readily apparent that if sputum, faeces, pus and other discharges are properly disposed of, the micro-organism cannot spread. This is the basis of hygiene.

Mode of Transmission:

An infectious agent may be transmitted from its natural reservoir to a susceptible host in different ways. The micro-organisms must be carried alive to another person.

There are different classifications for modes of transmission. Here is one classification:

Direct

1) Direct contact
2) Droplet spread

Indirect

1) Airborne
2) Vehicle borne
3) Vector borne (mechanical or biologic)

In direct transmission, an infectious agent is transferred from a reservoir to a susceptible host by direct contact or droplet spread.

Direct contact

Occurs through skin-to-skin contact, kissing, and sexual intercourse. Direct contact also refers to contact with soil or vegetation harboring infectious organisms. Thus, infectious mononucleosis (“kissing disease”) and gonorrhea are spread from person to person by direct contact. Hookworm is spread by direct contact with contaminated soil.

Droplet spread

Refers to spray with relatively large, short-range aerosols produced by sneezing, coughing, or even talking. Droplet spread is classified as direct because transmission is by direct spray over a few feet before the droplets fall to the ground. Pertussis and meningococcal infection are examples of diseases transmitted from an infectious patient to a susceptible host by droplet spread. direct human to human transmission Pathogens are sneezed or breathed or coughed out of the respiratory system of the one person to the other

Examples include,

Most airborne-droplet diseases including

- Tuberculosis
- Measles,
- Whooping cough

Most other respiratory diseases including those caused by,

- Common Flu/cold virus
- Step Pneumoniae
- Pandemic Flu
- Meningococcal meningitis)

Indirect Transmission

Refers to the transfer of an infectious agent from a reservoir to a host by suspended air particles, inanimate objects (vehicles), or animate intermediaries (vectors).

Airborne transmission

Occurs when infectious agents are carried by dust or droplet nuclei suspended in air. Airborne dust includes material that has settled on surfaces and become resuspended by air currents as well as infectious particles blown from the soil by the wind. Droplet nuclei are dried residue of less than 5 microns in size. In contrast to droplets that fall to the ground within a few feet, droplet nuclei may remain suspended in the air for long periods of time and may be blown over great distances. Measles, for example, has occurred in children who came into a physician’s office after a child with measles had left, because the measles virus remained suspended in the air. COVID19 is the recent example

Vehicle borne transmission

Can occur by indirectly transmit an infectious agent include food, water, biologic products (blood), and fomites (inanimate objects such as handkerchiefs, bedding, or surgical scalpels). A vehicle may passively carry a pathogen — as food or water may carry hepatitis A virus. Alternatively, the vehicle may provide an environment in which the agent grows, multiplies, or produces toxin — as improperly canned foods provide an environment that supports production of botulinum toxin by *Clostridium botulinum*.

Vector borne transmission

Diseases are also spread by insects, chiefly the fly, when the insect transfers the harmful micro-organism from one place to another by simply coming in direct contact with contaminated object, for example faecal matter and then coming in contact with food and water. Vectors such as mosquitoes, fleas, and ticks may carry an infectious agent through purely mechanical means or may support growth or changes in the agent. Examples of mechanical transmission are flies carrying *Shigella* on their appendages and fleas carrying *Yersinia pestis*, the causative agent of plague, in their gut. In contrast, in biologic transmission, the causative agent of malaria or guinea worm disease undergoes maturation in an intermediate host before it can be transmitted to humans

Portal of entry

The portal of entry refers to the manner in which a pathogen enters a susceptible host. The portal of entry must provide access to tissues in which the pathogen can multiply, or a toxin can act. Often, infectious agents use the same portal to enter a new host that they used to exit the source host. For example, influenza virus exits the respiratory tract of the source host and enters the respiratory tract of the new host. In contrast, many pathogens that cause gastroenteritis follow a so-called “fecal-oral” route because they exit the source host in feces, are carried on inadequately washed hands to a vehicle such as food, water, or utensil, and enter a new host through the mouth. The micro-organisms must enter the new host so that it can find a place where it can multiply.

Nose and throat:

Most respiratory infections enter the new host by the respiratory tract (airborne).

Organisms pass through the nose and mouth to reach the lungs and may cause disease as pneumonia, sore throat, tuberculosis, colds, diphtheria and measles.

Mouth:

Intestinal infections usually enter by this route. Germs on dirty hands which touch food, dirty utensils or eating raw vegetables, salads and contaminated water are examples by which micro-organism may enter into the body. Cholera, dysentery, food poisoning and most worm infestations are examples of infections transmitted this way.

Skin:

Infections enter the skin when it is damaged e.g. burns, cuts, abrasions, wounds.

Genitals:

Venereal diseases are transmitted by direct contact at the time of intercourse. Vaginal infections can result from faeces entering the vagina in the absence of good personal hygiene. Other common sources of infection are the objects introduced in vagina to cause an abortion.

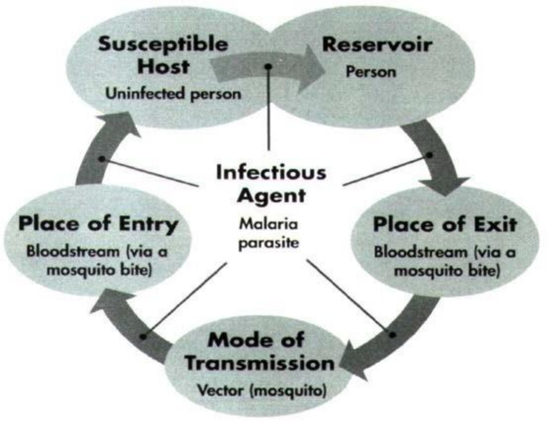
Susceptible host:

The final link in the chain of infection is a susceptible host. It is a person who can become infected by the infectious agent. The susceptible hosts include clients, service providers, support staff and members of the community. These people can pass germs to other people during the incubation period because the germs are excreted through one or more portals (routes of exit).

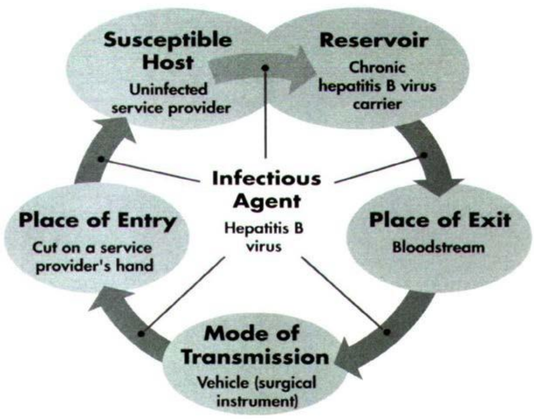
Susceptibility of a host depends on genetic or constitutional factors, specific immunity, and nonspecific factors that affect an individual's ability to resist infection or to limit pathogenicity. An individual's genetic makeup may either increase or decrease susceptibility. For example, persons with sickle cell trait seem to be at least partially protected from a particular type of malaria

The Infectious agent survives, grows and/or multiplies in a reservoir and then leaves the reservoir through a place of exit by a mode of transmission. The infectious agent then enters the susceptible host through a place of entry.

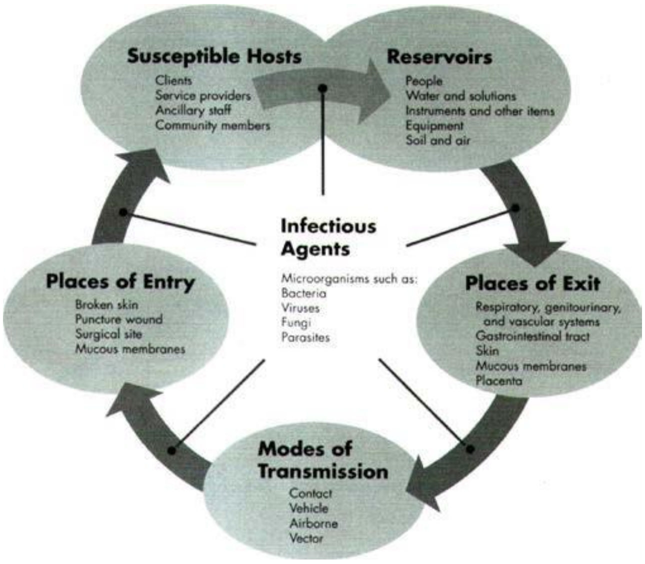
Examples illustrate how specific infections may be transmitted via the disease transmission cycle.



Infection Transmission Cycle



An example of spread of malaria



An example of how Hepatitis B may be transmitted in the health care setting

Spread Of Infection

Most harmful organisms can live only inside people, so they have to go from one person to another. They have to leave an infected person, move across and go into a healthy person. When organisms go from person to person they spread or are transmitted in a community.

Organisms have found many paths for leaving an infected person, moving across and going into a healthy person, each organism has its own special path. If this path is cut or blocked the spread of infectious diseases can be prevented. The organisms can be stopped from leaving people moving across to other persons and entering them.

Pathways For Infection Transmission

Faeces-to-mouth infections (Path A):

Many harmful organisms live in the gut and leave the body in the faeces. Faeces may contain the ova of worms, the bacteria or viruses causing diarrhoea or the viruses which cause hepatitis or polio; so, faeces are very dangerous. Organisms which come out of the body in faeces usually go into another person through his/her mouth by means of drinking water, food or flies. Common examples are:

1) Diarrheal diseases including,
2) Cholera. Shigella, Salmonellas, E Coli
3) Rota virus
4) Amebiasis
5) Giardiasis
6) Typhoid
7) Most intestinal worms
8) Hepatitis A

9) Hepatitis A

10) Polio

Faeces-to-skin infections (Path B):

Some worms leave the body in faeces and enter through the skin. Hookworm ova, for example, are passed in the faeces. They hatch into larvae on the ground. If a person walks bar feet or sits on these larvae, they bite their way through the skin. Fresh faeces on the skin are not dangerous. Faeces is dangerous only after ova have had time to hatch and become larvae. This takes some days. If people use latrines and wear shoes, they can prevent this kind of infections.

Examples include **faeces to skin** (hookworm), mucous membranes (syphilis), and blood (hepatitis B, human immunodeficiency

Droplet infections (Path C):

When a person with a respiratory infection coughs or sneezes, droplets containing millions of bacteria and viruses are thrown into the air. If a healthy child inhales them, he may become infected. Children get T.B, measles, pneumonia, whooping cough and upper respiratory infections through this path. Droplet infections are difficult to prevent. The best way to prevent T.B is to treat all infectious adults. T.B patients are advised to swallow their sputum and not spit it onto the floor.

Contact Infections (Path D):

Contact means touching. Organisms on the skin can spread if an infected person touches a healthy person. Scabies, skin sepsis and ring worm spread like this. The pus from a person with a septic skin lesion contains millions of bacteria. These bacteria easily spread to another person who touches him. Colds too can spread by contact. If a person touches his nose, he contaminates his hands with viruses. If another person touches the infected person’s hands and then his own nose, he gets the cold.

Organisms from an infected person can contaminate towels, thermometers and forceps and these can infect the next person who uses them. Organisms can spread through tables, chairs and health workers hands.

Infections carried by Vectors (Insects) (Path E):

In Malaria, a mosquito bites an infected person and sucks his blood containing malarial parasites. These parasites live and grow in the mosquito. If this infected mosquito bites a healthy person, it transmits the disease.

Infections carried by syringes and needles (Path F):

Pathogens are directly transmitted from the infected person’s blood to another person. If needles and syringes are not sterilized, they carry organisms from one to another. This is a common way of spreading infections by health workers. HIV/AIDS, Hepatitis B and C can spread in this way.

Mother to child transmission:

Pathogens are transmitted by the mother to the newborn baby HIV, Hepatitis B and Syphilis

Unclean Wound

Pathogens exist in nature and enter the body through a wound

3.7 COMMONLY USED TERMS IN INFECTION PREVENTION

3.7 COMMONLY USED TERMS IN INFECTION PREVENTION

Infectious disease: It occurs in human due to the presence of an infectious agent on or in the body i.e., micro-organisms like virus, bacteria, protozoa and rickettsia or even fungus and helminths.

Contagious disease: It is a state of disorder in human that results from direct contact with an infectious agent.

Communicable disease: A disease capable of being directly (through contact with bodily secretions) or indirectly (through contact with inanimate objects) transmitted from person to person.

Immune: A person who possesses power to resist infections.

Epidemic: (Epi-upon; demos-people) When a disease affects a large number of persons within a short space of time. If a disease not previously presenting an area occurs for the first time, it is also considered as an epidemic.

Sporadic: When the number of immune persons is greater than the susceptible, the disease is said to be sporadic (a case here and a case there).

Endemic: When the number of susceptible and immune persons is almost equal, the disease continues to smolder in a community and is always present in the community, it is said to prevail in an endemic form.

Pandemic: When the susceptibility of the whole country or the world is increased for a particular organism, the disease is said to occur in a pandemic.

Exotic: When a disease is not usually present in a locality but is introduced from abroad, it is called exotic.

Incubation Period: Incubation period is a period from the entry of the micro-organisms in the human body till the appearance of the disease.

Infective Period: It is the time interval during which an infectious agent can be transferred from a reservoir (patient) to the susceptible host.

DISEASES	INCUBATION PERIOD	INFECTIVE PERIOD
Chickenpox	13-17 days	2-3 weeks
Measles	10-14 days	10 days (5 days before & 5 days after rash)
Whooping cough	7-21 days	1-6 weeks
Diphtheria	2-5 days	2-4 weeks
Pulmonary TB	6 weeks	As long as bacilli are discharged
Influenza	1-3 days	10 days
Mumps	12-16 days	3 weeks
Poliomyelitis	7-21 days	3 weeks
Cholera	1-5 days	1-3 weeks
Typhoid fever	10-17 days	6 weeks
Rabies	10-60 days	During illness
Plague	2-6 days	10 days

Fomites: The inanimate objects which have been soiled with infective material such as bedding, pillows, linen, towels, handkerchiefs, books, spoon, fork and knives etc. Fomites if freshly soiled are likely to spread the agents of infection.

Vector: It is capable of transmitting the disease under natural conditions e.g. Anopheles mosquito is a vector for malaria.

Carrier: A carrier is a person or animal who harbours and discharges living pathogenic organisms although he is free from any effect of the infection.

Cross Infection: When patients suffering from a particular disease are admitted in a hospital, they may acquire fresh infection from their neighbours in the ward, who may be suffering from another disease. This is called cross infection.

Terms Used In Infection Prevention

Before specific antimicrobial methods are studied, you must clearly understand the meaning of certain terms. While the misuse of these terms may not be important under some conditions, but it is very dangerous in hospital and public health practice. The division of these terms into three groups is helpful.

- Terms which refer to **complete destruction** of all micro-organisms present
- Terms which refer to the **destruction of some** particular group or species of undesirable organism
- Terms which indicate **suppression of growth** of microorganisms but not necessarily their death.

Terms indicating complete microbial destruction

- **Sterilization:** It is the process that eliminates all micro-organisms (bacteria, viruses, fungi and parasites) including bacterial endospores from inanimate objects.
- **Sterile:** An object completely free from any living micro-organisms is said to be sterile. Such words as sterilize, sterilization, sterility, sterilizer should be clear.
- **Asepsis or Aseptic technique:** These are general terms used in health care settings to describe the combination of efforts made to prevent entry of microorganisms into any area of the body where they are likely to cause infection. The goal of asepsis is to reduce or eliminate the number of micro-organisms on both animate (living) surfaces (skin and tissue) and inanimate objects (surgical instruments) to a safe level.
- **Aseptic:** It means without infection. The noun asepsis is also used. These terms are used chiefly when referring to the absence of pathogenic organisms.
- **Surgical Asepsis:** It is the use of sterile materials and of techniques which exclude any contaminating micro-organisms, as practiced in surgical procedures.
- **Surgically Clean:** It is the term used to refer to sterility in all surgical materials and techniques. It has no advantage over the term sterile, and the latter is preferable.

Under no conditions should the word clean be used as a synonym.

- **Cleaning:** It is the process that physically removes all visible blood, body fluids or any other foreign material such as dust or soil from skin or inanimate objects.

Terms referring to destruction of specific undesirable organism

Disinfection is the process that eliminates most but not all disease causing (pathogenic) micro- organisms from inanimate objects.

- High-level disinfection (HLD) is through boiling, or the use of chemicals eliminates all micro-organisms except some bacterial endospores.
- Disinfectant, it is the agent used for destruction of pathogenic organisms.
- Medical Asepsis is the technique of handling and disinfecting all discharges and materials coming from patients with communicable disease, with the object of preventing the survival of the causative organisms.
- Bacterial Technique is the technique of killing bacteria.
- Bactericide is an agent that kills bacteria. Germicidal is also used but is not correct, since the true biologic meaning of germ is reproductive cell, not micro-organisms.
- Note that sterilization does not distinguish between pathogenic and non-pathogenic organisms. There are no degrees of sterility; if one organism is present, the object is not sterile.

Note that disinfection, unlike sterilization, does not imply that all microorganisms are killed. Furthermore, disinfectant may be effective against some kinds of pathogens but not others. The common pathogenic bacteria, for example, are not spore-formers, and an agent which kills vegetative forms, but not spores, may be satisfactory in some instances. If the pathogens to be destroyed are spore-forming bacteria, or viruses, or fungi, or amoebic cysts, it is not safe to assume that a disinfectant will destroy all these. The terms sporicidal, fungicidal, virucidal, etc. are used to denote these properties. On the other hand, agents which are sporicidal or virucidal usually also kill vegetative forms of bacteria. There is a tendency to use the word disinfectant for substances used primarily on inanimate objects.

Decontamination is the process that makes inanimate (non-living) objects safer to be handled by staff before cleaning. Such objects include large objects (e.g., examination tables) and surgical instruments and gloves contaminated with body fluids during or following procedures.

Terms indicating Control of Growth of Micro-organisms

- Antisepsis is the prevention of infection by killing or inhibiting the growth of micro-organisms on skin and other body tissues using chemical agents (Antiseptic).
- Antiseptic literally means “against putrefaction,” it is a substance used to prevent putrefaction or decay. To achieve this, it is necessary only to inhibit the growth of micro- organisms.
- Bacteriostasis is a condition in which bacteria are prevented from growing and spreading. The adjective is bacteriostatic. Bacteriostatic is the agent used for

bacteriostasis.

- Antibacterial means against bacteria and antimicrobial means against microbes. These terms are coming into more common use. They are generally used with reference to inhibition of growth.
- Sanitation refers to the treatment of inanimate objects and implies a cleaning as well as disinfecting action. On the other hand, it does not suggest sterilization or even complete disinfection, but rather some degree of bactericidal action, so that the number of organisms is kept low. Sanitizer is the agent used for sanitation.

Similar terms are used in describing control of micro-organisms other than bacteria. Note that the prefix anti- always means against; the prefix a - always means without; the suffix - cide means killing; and the suffix - static means stopping. The meanings of such terms as fungistatic, viricidal and antimycotic should be clear.

Factors Important In Control Of Micro-Organisms

Bactericidal techniques:

Concentration of the chemical or intensity of the physical agent used: Directions for methods of sterilization and disinfection must always include the concentration of the chemical to be used or the degree of heat to be maintained. If a weaker concentration of the chemical is used, or a lower temperature, some of the organisms may survive.

Time allowed:

No chemical or physical agent of disinfection acts instantaneously. It always takes time to kill micro-organisms. All satisfactory directions for sterilization and disinfection state the exact time needed. The time for chemical disinfection begins when the material is completely immersed in the chemical and completely saturated with it. The time for any method using heat begins when the temperature has reached the desired level.

Nature of the material to be treated:

If the material is of solid or semisolid consistency and micro-organisms are not limited to the surface, a chemical disinfectant that has penetrating power must be employed. Unless the material to be disinfected is of negligible value, a method is chosen which injures it as little as possible. No chemical which coagulates protein can be used when the material to be treated contains this type of substance. Mucus, blood, pus and other body materials protect micro-organisms and make them more difficult to kill. Fatty material is resistant to penetration by most substances in water solution.

Type of Organism to be destroyed:

Some non-sporing bacteria may be killed in 10 minutes at 70ºC, but spore formers will require at least 15 minutes at 15-pound pressure (121.5ºC) in the autoclave. Chemical disinfectants vary in their ability to kill different types of micro-organisms. For example, carbolic acid kills vegetative bacteria readily but is much less effective against viruses.

Bacteriostatic techniques:

Since methods of bacteriostasis must be continuous, the time element is not a factor. A food is not preserved by drying for 10 minutes or 1 hour. It is dried and kept dry until it is used. On the other hand, the concentration of a chemical bacteriostatic agent is important and so is the intensity of a physical agent. The housewife's jam will spoil if the sugar content is much less than 50 percent. Foods in the refrigerator are preserved poorly unless the temperature maintained is below 45ºF. As has been already noted, any satisfactory agent for control of microbial growth must not be injurious in the situation where it is used.

3.8 INFECTION PREVENTION

3.8 INFECTION PREVENTION

Understanding the basic principles of preventing infection and disease transmission in a clinical setting is vital for the service provider and program managers. It may not always be possible to know in advance, whether a client is infected. Instruments, needles, syringes, linen and other items from every client must be handled as if infected.

With the increasing realization of the serious consequences of acquiring the infections like hepatitis B, C and HIV, their spread in family planning and health care facilities can only be prevented by taking strict aseptic precautions. The FWW should realize that negligence on their part could lead to transmission of infectious disease which, of course, can be prevented by adoption of simple procedures of infection prevention.

A simple procedure such as an IUCD or Implant insertion may result in the transfer of vaginal infection (e.g., trichomoniasis) from one client to another if the instruments used are not decontaminated and disinfected or sterilized. In addition, all types of hepatitis viruses may be transmitted from an infected individual if sterilized syringes are not used.

Serious infections may occur in clients undergoing surgical contraceptive procedures if sterilization techniques are poor or inadequate. The Acquired Immuno-Deficiency Syndrome (AIDS) is presenting a very serious problem to clients and health personnel, especially the operation theatre staff all over the world. Stringent aseptic measures need to be always practiced in order to maintain asepsis.

Expensive sophisticated equipment is not essential to prevent infection. A simple procedure such as handwashing or using protective gloves before handling contaminated instruments or soiled linen is effective in preventing or reducing the risk of the spread of infection. Likewise, inexpensive equipment and facilities can provide a safe environment for performing family planning procedures including surgery. An example is the drastic reduction in the risk of all types of hepatitis viruses and HIV transmission by decontamination of table surfaces, gowns, gloves and instruments with the use of chlorine solution, commonly used as household bleaching agent. High Level Disinfection (HLD) preceded by decontamination and proper cleaning is only acceptable where autoclaving is not possible.

In order to prevent the spread of infections, the infection transmission cycle needs to be broken at some point. The easiest point at which to break the cycle is the mode of transmission.

People At Risk Of Infection

For preventing infection, it is also important to know the categories of people who are at risk of getting infection.

The clients:

Clients are at risk of post procedure infections when:

- Service providers do not wash their hands before and after providing care to each client and before and after every procedure.

- Service providers do not adequately prepare clients before clinical procedures. Service providers do not correctly process instruments and other items used in clinical procedures.

The service providers and support staff:

Service providers and support staff are at significant risk of infections because they are exposed to potentially infectious blood and other body fluids on a daily basis

Service providers are at risk during clinical procedures and when handling sharp instruments.

Cleaning and housekeeping staff who process instruments and other items, do clean-up after procedures, clean the procedure rooms and dispose the waste, are particularly at risk because of lack of education and understanding of their own risk of infections.

Most of health care providers are at higher risk of Hepatitis B & C infections because of the service-delivery conditions and poor infection prevention practices.

The community:

Members of the community are also at risk of infections, particularly from inappropriate disposal of medical waste, such as contaminated sharps. Improper disposal of medical waste including contaminated dressings, tissue, used needles and syringes and surgical blades can be found by children or others scavenging in open dumps or can scatter on the ground where adults and children travel, putting community members at risk of infections and injury.

Principles Of Infection Control In Community

Infection can have a detrimental and potentially life-threatening impact on the health and wellbeing of patients. Infection control and prevention is as important in the community as it is in an acute hospital.

The principals of control are discussed below:

Early Diagnosis:

The first step in the control of a communicable disease is its rapid identification The physician who takes care of the patient makes a tentative diagnosis and advises isolation measures.

Notification:

It is the immediate intimation of the occurrence of every case of infectious disease to the health officer. It enables the health authorities to take immediate measures for preventing the further spread of the disease. Once an infectious disease has been detected (or even suspected), it should be notified to the local health authority whose responsibility is to put into operation control measures, including the provision of medical care to patients, perhaps in a hospital. Certain diseases are statutorily notifiable The diseases to be notified vary from country to country: and even within the same country. Usually, diseases which are considered 'to be serious menaces to public health are included in the list of notifiable diseases

Isolation:

Isolation is the oldest communicable disease control measure. It is defined as ;separation, for the period of communicability, of infected persons or animals from others in such places and under such conditions, as to prevent or limit the direct or indirect transmission of the infectious agent from those infected to those who are susceptible, or who may spread the agent to others

It is the separation to prevent the transmission from the sick to the healthy. The techniques used in the isolation of any specific diseases depend on the ways in which the disease is spread. The person with chickenpox or measles is rigidly isolated, since this disease can spread by material from the skin lesions as well as by respiratory discharges.

Isolation has a distinctive value in the control of some infectious diseases, e. g., diphtheria, cholera, streptococcal respiratory disease, pneumonic plague, etc. In some diseases where there is a large component of subclinical infection and carrier state (polio, hepatitis A, and typhoid fever), even the most rigid isolation will not prevent the spread of the disease. It is also futile to impose isolation if the disease is highly infectious before it is diagnosed as in the case of mumps

All the isolation needed in malaria is screening to keep away the mosquitoes that are the sole means by which the disease can reach another person. Animals as well as persons may be isolated because of infection.

Quarantine

Refers to the limitation of freedom of movement of such well persons or domestic animals exposed to communicable disease for a period of time not longer than the longest usual incubation period of the disease, in such manner as to prevent effective contact with those not so exposed “

Persons who have been exposed to infection may be quarantined. Quarantine may be complete or modified. Persons entering the country from areas where hepatitis or cholera is epidemic are rigidly quarantined. Modified quarantine is more common. The person who has been exposed to scarlet fever may not be allowed to handle food; children exposed to measles are excluded from school. In contrast to isolation, quarantine applies to restrictions on the healthy contacts of an infectious disease. COVID 19 has brought quarantine back as a crucial step in infection control.

Surviellance

Frequently contacts are kept under surveillance. i.e., they are examined at intervals to detect the earliest possible signs of infection. Unfortunately, there is no really effective way of detecting carriers. Once carrier has been identified, the public health authorities have the power to restrict his/her activities so that he/she does not infect others.

3.9 INFECTION PREVENTION PRACTICES

3.9 INFECTION PREVENTION PRACTICES

Microorganisms that cause infections live everywhere in the environment, in human beings, animals, plants, soil, air and water. Human beings normally carry them on their skin and in the throat, intestines and genital tract. All microorganisms become dangerous when favorable environment is present. Microorganisms include bacteria, virus, fungi and parasites. Infections can be spread in health facilities from client to client, client to provider or provider to client due to lack of infection prevention practices and/or through contaminated equipment and instruments. For IP purposes, bacteria can be further divided into three categories: vegetative (staphylococcus), mycobacteria (tuberculosis), and endospores (tetanus), which are the most difficult to kill.

The terms "**asepsis, antisepsis, decontamination, cleaning, disinfection**, and **sterilization**'' often are confusing. For the purpose of this manual, the following definitions will be used:

Asepsis and antisepsis:

Are general terms used to describe the combination of efforts made to prevent entry of microorganisms into any area of the body where they are likely to cause infection. The goal of asepsis is to reduce to a safe level, or eliminate, the number of microorganisms on both animate (living) surfaces (skin and tissue) and inanimate objects (surgical instruments and other items).

Antisepsis:

Is the prevention of infection by killing or inhibiting the growth of microorganisms on skin and other body tissues using a chemical agent (an antiseptic)

Decontamination:

Is the process that makes objects safer to be handled by staff before cleaning (i.e., reduces, but does not eliminate, the number of microorganisms on instruments and other items). Objects to be decontaminated include large surfaces (e.g., pelvic examination or operating tables) and surgical instruments, gloves, and other items contaminated with blood or body fluids.

Cleaning:

Is the process that physically removes all visible blood, body fluids, or any other foreign material such as dust or dirt from skin or inanimate objects.

Disinfection:

Is the process that eliminates most, but not all, disease-causing microorganisms from inanimate objects.

High-level disinfection (HLD):

HD by boiling, steaming, or the use of chemicals eliminates **all** microorganisms except some bacterial endospores from inanimate objects.

Sterilization:

Is the process that eliminates all microorganisms (bacteria, viruses, fungi, and parasites) **including** bacterial endospores from inanimate objects.

Standard precautions:

Are guidelines designed to create barriers between microorganisms and an individual to prevent the spread of infection (i.e., the barrier serves to break the disease transmission cycle). They apply to all clients, patients, and staff at health facilities.

Protective barriers:

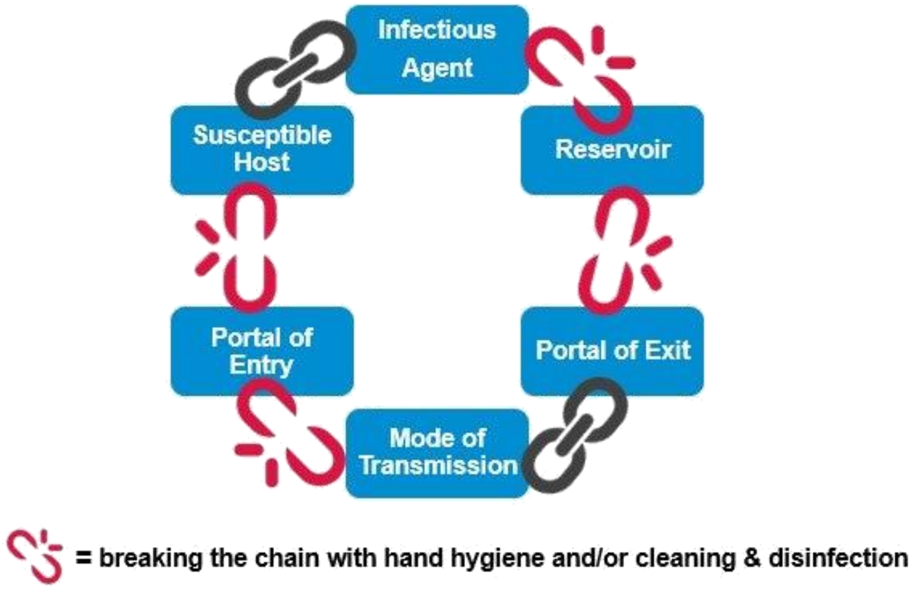
Infection prevention is achieved by placing a barrier between the human beings and microorganisms. These barriers are called protective barriers that prevent transmission of infection from client to client, client to provider or provider to client. The protective barriers are physical (wearing gloves), mechanical (hand washing), and chemical (antiseptics and disinfectants).

The protective barriers include:

1) Hand washing
2) Wearing gloves, masks, caps, gowns
3) Using antiseptic solutions
4) Processing of equipment and other items
5) Managing clinical waste

What is infection prevention?

Infection prevention is the interruption (breaking) of the disease transmission cycle from the infected person to another person. The primary objectives of infection prevention (IP) in family planning facilities are to prevent infections and to minimize the risk of transmitting blood-borne viral infections (including HBV and HIV) to clients, service providers, and other staff, including cleaning and housekeeping personnel



Chain of Infection

Standard Precautions are guidelines designed to create barriers between microorganisms and an individual to prevent the spread of infection (i.e., the barrier serves to break the disease transmission cycle).

They apply to all clients, patients, and staff at health facilities. Standard Infection Control Precautions are always intended for use by all healthcare staff in all healthcare settings whether infection is known to be present or not to ensure the safety of patients, staff and visitors to the healthcare environment.

Infection Prevention

BASIC RULES FOR INFECTION CONTROL
1) Wash hands (hand washing may be the single most important infection-prevention procedure).
2) Wash hands before and after contact with each client.
3) Use soap and clean running water from a tap or bucket for washing.
4) Wash hands before putting on gloves and whenever they get dirty.
5) Be sure to clean between the fingers and under fingernails.
6) Wash hands after handling soiled instruments and other items or touching mucous membranes, blood, or other body fluids.
7) Wash hands before putting on gloves, after taking off gloves, and whenever hands get dirty. Wash hands when you arrive at work, before and after you use the toilet and when you leave work.
8) Dry hands with a paper towel or a clean, dry cloth towel that no one else uses, or air dry

1) If clean water and soap are not available, a hand sanitizer containing at least 60% alcohol can reduce the number of germs on the hands. 2) Sanitizers do not eliminate all types of germs and might not remove harmful chemicals. 1.5 DEMOGRAPHY
1) Wear gloves. 2) Wear gloves when there is a chance of contact with blood or other body fluids. 3) Before any procedure with each client, put on a new pair of single-use gloves,if possible. 4) Use sterilized gloves for any surgical procedure.
1) Perform vaginal examinations only when needed or requested (vaginal exams generally are not needed for most contraceptive methods—except for female sterilization, diaphragm, and IUCDs). 2) For vaginal exams, wear either a new pair of single-use gloves or reusable, highly disinfected, or sterile gloves. 3) Perform vaginal exams only when needed—such as for VIA (Visual inspection with acetic acid) and Pap smear or upon suspicion of disease when the exam could help with diagnosis or treatment.
1) Clean the client's skin (Preferable to ask the woman to wash the area with soap and empty the bladder if relevant) 2) Appropriately clean the client's skin before an injection or insertion of implants. 3) Use a locally available antiseptic on dirty skin, or have the patient wash the skin with clean water and soap. 4) Antiseptics have minimal effects when used on clean skin.
1) Clean the cervix with antiseptic as part of the "No touch" technique for IUCD insertion.
1) Use a new, single-use needle and syringe. 2) For each injection, use a new, single-use needle
1) After use with each client, reusable instruments, equipment, and supplies should be decontaminated (soaked in 0.5% chlorine solution [bleach] or another disinfectant) for 10 minutes. Cleaned with soap and water, and disinfected (by boiling or steaming) or sterilized (by steam or dry heat). 2) Vaginal specula, uterine sounds, gloves for pelvic exams, and other equipment and instruments that touch mucous membranes should be decontaminated, cleaned, and then either high-level disinfected or sterilized, as appropriate. 3) Scalpel holders and other equipment and instruments that touch human tissue beneath the skin should be decontaminated, cleaned, and then sterilized.

4) Disinfected or sterilized objects should not be touched with bare hands.
5) Gloves should be worn when cleaning instruments and equipment.
6) Linens should be washed in warm, soapy water using utility gloves and line-dried.
7) After each client, examination tables, bench tops, and other surfaces that will come in contact with unbroken skin should be washed with 0.5% chlorine solution.

1) Decontamination of surfaces in the screening clinic. Procedure tables, trolleys, equipment (lamp, etc.) in the screening clinic may be contaminated with body fluids such as vaginal secretions, purulent discharge, blood, etc.
2) While the surface of the procedure table should be decontaminated after each patient procedure, the other surfaces should be decontaminated on a daily basis by wiping with 0.5% chlorine solution, 60-90% ethyl or isopropyl alcohol or other chemical disinfectants such as Iodophors.
3) The clinic floors should also be decontaminated on a daily basis.

Standard precautions in health care

Standard precautions are meant to reduce the risk of transmission of blood borne and other pathogens from both recognized and unrecognized sources. They are the basic level of infection control precautions which are to be used, as a minimum, in the care of all patients.

Hand hygiene is a major component of standard precautions and one of the most effective methods to prevent transmission of pathogens associated with health care. In addition to hand hygiene, the use of personal protective equipment should be guided by risk assessment and the extent of contact anticipated with blood and body fluids, or pathogens.

In addition to practices carried out by health workers when providing care, all individuals (including patients and visitors) should comply with infection control practices in health-care settings. The control of spread of pathogens from the source is key to avoid transmission. Among source control measures, respiratory hygiene/cough etiquette, developed during the severe acute respiratory syndrome (SARS) outbreak, is now considered as part of standard precautions.

Worldwide escalation of the use of standard precautions would reduce unnecessary risks associated with health care. Promotion of an institutional safety climate helps to improve conformity with recommended measures and thus subsequent risk reduction. Provision of adequate staff and supplies, together with leadership and education of health workers, patients, and visitors, is critical for an enhanced safety climate in health-care settings.

Important Advice:

1) Promotion of a safety climate is a cornerstone of prevention of transmission of pathogens in health care.
2) Standard precautions should be the minimum level of precautions used when providing care for all patients.

3) Risk assessment is critical. Assess all health-care activities to determine the personal protection that is indicated.
4) Implement source control measures for all persons with respiratory symptoms through promotion of respiratory hygiene and cough etiquette.
5) Reduce the risk of the transmission of microorganisms from both known and unknown sources of infection when caring for patients or clients in any healthcare setting, as well as at home.

Standard precautions, therefore, apply to all blood and body secretions, excretions, non-intact skin, and mucous membranes for every person. Placing a physical, mechanical, or chemical barrier between you and microorganisms can prevent the acquisition of disease.

Standard universal precautions of infection prevention include:

1) Hand washing or hand hygiene
2) Ensuring self-protection by wearing gloves and employing other physical barriers Use of personal protective equipment (e.g., gloves, gowns, masks).
3) Safe injection practices and needle stick and sharps injury prevention adopting safe work practices (to prevent injuries from sharps instruments).
4) Maintaining proper methods of environmental cleanliness, cleaning and disinfection.
5) Safe handling of potentially contaminated equipment or surfaces in the patient environment and ensuring the proper processing of instruments and other items.
6) Following proper waste-disposal practices and handling, transporting, and processing used and/or soiled linens in the recommended and prescribed manner.
7) Respiratory hygiene/cough etiquette.
8) Staff health & safety.

Hand Washing

Thorough hand washing and use of protective gloves are key components in minimizing the spread of disease and maintaining an infection-free environment.

When to wash hands?

Hand Washing is indicated before:

1) Examining (direct contact with) a client.
2) Putting on sterile gloves.

3) Wash hands when you arrive at work.
4) Routine hand washing should be done before wearing gloves.
5) Before and after each patient contact.

Hand Washing is indicated after:

Any situation in which hands may be contaminated, such as:

1) Handling soiled instruments and other items.
2) After each contact with a potentially contaminated item, even when wearing gloves.
3) After accidently touching mucous membranes, blood, or other body fluids (secretions or excretions).
4) Removing gloves.
5) When you leave work.
6) After you use the toilet
7) Dry hands with a paper towel or a clean, dry cloth towel that no one else uses, or air-dry.
8) Dry hands with a clean, dry towel or air dry; shared towels quickly become contaminated.

Routine Hand Washing

Plain or antiseptic soap should be used for routine hand washing. Hands should be rinsed in a stream of running water and dried with a clean personal towel or air-dried. Towels should not be shared. Practices such as using a common basin where several people or even one-person washes or dips his/her hand(s) repeatedly is dangerous and must be abandoned.

The vigorous rubbing together of all surfaces of lathered hands mechanically removes and inactivates most organisms. One of the pre-requisites for ensuring the practice of hand washing is the continuous provision of soap and a continual supply of clean water, either from a tap or bucket, and single use towels. Do not use shared towels to dry hands. When no visible blood or mucus is on the hands, an alcoholic hand rub may be used and is as effective as hand washing

Types of hand washing

1) Simple hand wash (40-60 seconds) (before and after examining patients, giving injections, pelvic examination and insertion and removal of IUCDs)
2) Surgical hand wash (3-5 minutes) (for surgical procedures)

How to do simple hand washing

1) Simple hand washing is done by scrubbing the hand vigorously with plain soap about 25-30 seconds.
2) Air dry by shaking off excess water. If a clean towel is available, use the clean towel

3) Collect the used water in a container and discard it.

4) It is advisable to avoid using standing water in basins and other containers as microorganisms grow and multiply in moisture.

5) Make sure is adequate drainage of water where the soap is kept there.

6) Use running water from a tap. If no tap available, use a bucket with a tap or a bucket with a mug, so that the water is not contaminated.

Hand Washing: steps

- Step 1- Rub Palm together.
- Step 2- Rub the back of both hands.
- Step 3- Interface fingers and rub the hands together.
- Step 4- Interlock fingers and rub the back of fingers of both hands.
- Step 5- Rub thumb in a rotating manner followed by the area between index finger and thumb.
- Step 6- Rub fingertips on palm for both hands.
- Step 7- Rub both wrists in a rotating manner rinse and dry thoroughly.

Microorganisms grow and multiply in moisture and in standing water.

1) If bar soap is used, provide small bars and soap racks that drain.
2) Avoid dipping hands repeatedly into basins containing standing water. Even with the addition of antiseptic agents such as Dettol® or Savlon®, microorganisms can survive and multiply in these solutions.
3) Choose from several options when running water is not available.
4) Use a bucket with a tap that can be turned off to lather hands and turned on again for rinsing, or a bucket and pitcher.
5) Use an alcoholic hand rub that does not require water.

Locally made hand scrub:

Add 5cc Glycerin into 100cc Rubbing alcohol, this works as quick and easy hand scrub.

Surgical Scrub:

The surgeon and his/her assistant must scrub both their hands and forearms up to the elbows thoroughly with soap and water or antiseptic agents. The entire procedure should be repeated several times so that the scrub lasts for 3 to 5 minutes. The hands and forearms should be dried with a sterile towel only. A small stick or brush should be used for cleaning fingernails.

Ideally, the surgeon and the assistant should scrub thoroughly between each procedure. In high caseload settings, in order to prevent re-colonization of the skin by micro-organisms, the surgical staff should do a three-minute surgical scrub every hour or after every five cases (whichever is earliest), or if the surgeon (and/or the surgical stuff) goes out of the OT, or touches any infected item, or if the glove is torn. An alcohol scrub should be done after every procedure.

When to Wear Gloves

1) Gloves should be worn by all staff prior to contact with blood and body fluids from any client.
2) A separate pair of gloves must be used for each client to avoid cross-contamination.
3) All health workers should wear gloves prior to contact with blood and body fluids, both while providing services to a client (example: during pelvic examination and insertion / removal of IUCD), while handling infected equipment and materials).
4) Wear gloves for any procedure that risks touching blood, other body fluids, mucous membranes, broken skin, soiled items, dirty surfaces, or waste.
5) Wear surgical gloves for surgical procedures such as insertion of implants, IUCDs and mini laparotomy.
6) Wear single-use examination gloves for procedures that touch intact mucous membranes or generally to avoid exposure to body fluids.
7) Change gloves between procedures on the same client and between clients.
8) Do not touch clean equipment or surfaces with dirty gloves or bare hands.

9) Wash hands before putting on gloves. Gloves are not a substitute for hand washing.

10) Wear clean utility gloves when cleaning soiled instruments and equipment, handling waste, and cleaning blood or body fluid spills.

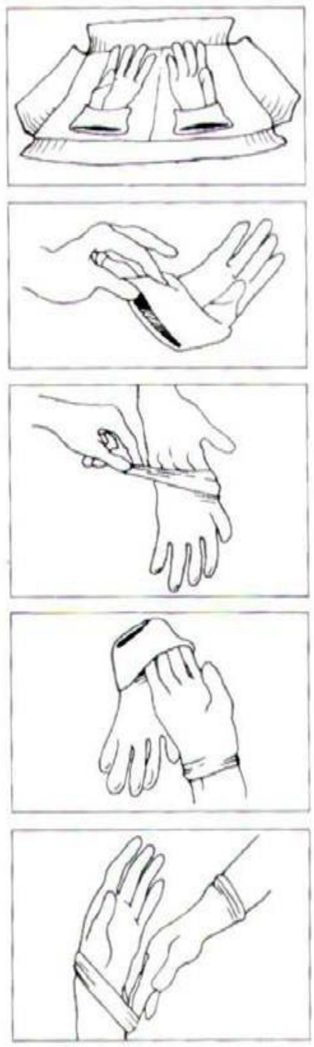
11) The type of gloves used while providing FP services include:

12) Single use/ re-usable gloves (high-level disinfected or sterile) for surgical procedures, insertion/removal of IUCD and pelvic examination.

13) Utility gloves (household gloves) for handling used instruments, cleaning blood and body fluids and handling wastes.

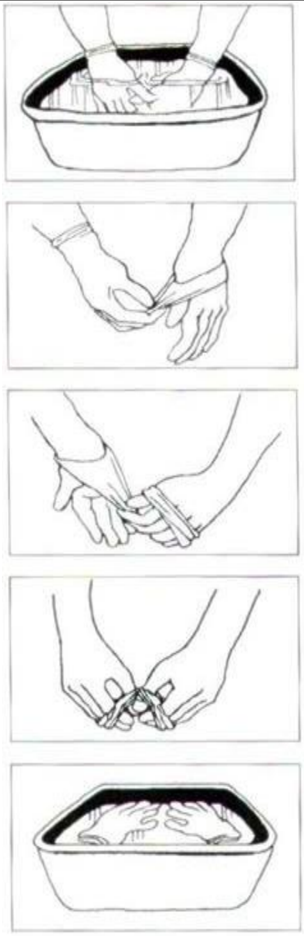
How To Put On Surgical Gloves

- Prepare a large, clean, dry area for opening the package of gloves.
- Open the inner glove wrapper, exposing the cuffed gloves with the palms up.
- Pick up the first glove by the cuff, touching only the inside or exposed portion of the cuff (the side that will be touching your skin when the glove is on).
- While holding the cuff, slip your other hand into the glove. (Pointing the fingers of the glove toward the floor will keep the fingers open). Be careful not to touch anything and hold the gloves above waist level. (Note: if the first glove is not fitted correctly, wait to make any adjustment until the second glove is on. Then use the sterile or high-level disinfected fingers of one glove to adjust the sterile or high-level disinfected portion of the other glove).
- Pick up the second glove by sliding the fingers of the gloved hand under the cuff (unexposed side) of the second glove. Be careful not to contaminate the gloved hand with the ungloved hand as the second glove is being put on.
- Put the second glove on the ungloved hand by maintaining a steady pull through the cuff.
- Adjust the position of the glove fingers until the gloves fit comfortably.



How To Remove Surgical Gloves

1) Rinse gloved hands in a basin of decontamination solution to remove blood or other body fluids.
2) Grasp one of the gloves near the cuff and pull it part of the way off. The glove will turn in inside out. It is important to keep the first glove partially on your hand before removing the second glove to protect you from touching the outside surface of either glove with your bare hands.
3) Leaving the first glove over your fingers, grasp the second glove near the cuff and pull it part of the way off. The glove will turn inside out. It is important to keep the second glove partially on your hand to protect you from touching the outside surface of the first glove with your bare hand.
4) Pull off the two gloves at the same time, being careful to touch only the inside surface of the gloves with your bare hands.
5) If the gloves are disposable or are not intact, dispose off these properly. If they are to be processed for reuse, place them in a container of decontamination solution. Wash your hands immediately after the gloves are removed, since the gloves may contain invisible holes or tears, leaving you at risk of exposure to contaminated blood and other body fluids.



Personal Protective Barriers

Wearing gloves and protective attire:

It is important to understand when sterile or high-level disinfected surgical gloves are required and, equally important, when they are not, can reduce costs while maintaining safety for both clients and staff.

Self-protection of Health Care Providers

1) All doctors, nurses, and other health providers must wear proper gloves during all procedures involving contact with any patients and biological fluids.
2) Cleaners and other staff working in sluice rooms and laundries should wear protective heavy-duty gloves and gumboots while cleaning and handling other soiled materials and linen.
3) The staff should wear utility gloves when handling and transporting waste and should wash the gloves as well as their hands when finished.
4) For female sterilizations, all medical personnel working in the OT must change their shoes, wear theatre gowns/short-sleeved shirts, pajamas, caps, masks, and surgical

gloves.

5) For vasectomy procedures that are not done in the OT, all medical personnel must at least wear caps, masks, and surgical gloves.
6) Operating surgeons should have short and clean fingernails and should remove all jewelry. The surgical mask should always cover the bridge of the nose.
7) Do not use torn or cracked gloves.

Using personal protective barriers:

The appropriate use of barriers helps reduce the risk of post procedure infections in both clients and service providers by decreasing the likelihood that clients or service providers will be exposed to potentially infectious microorganisms.

These barriers include gloves, masks, eye-covers, gowns or waterproof aprons, caps and footwear.

Gloves:

Gloves prevent micro-organisms on the provider’s hands from entering the client and protect the provider’s hands from contact with blood, other fluids or tissues.

Masks:

Masks prevent micro-organisms expelled during talking, coughing, or breathing from entering the client and protect the provider’s mouth from splashes of blood or other fluids.

Eye-Covers:

Eye-covers and face shields protect the provider’s eyes, nose and mouth from splashes of blood and other fluids.

Gowns or waterproof aprons:

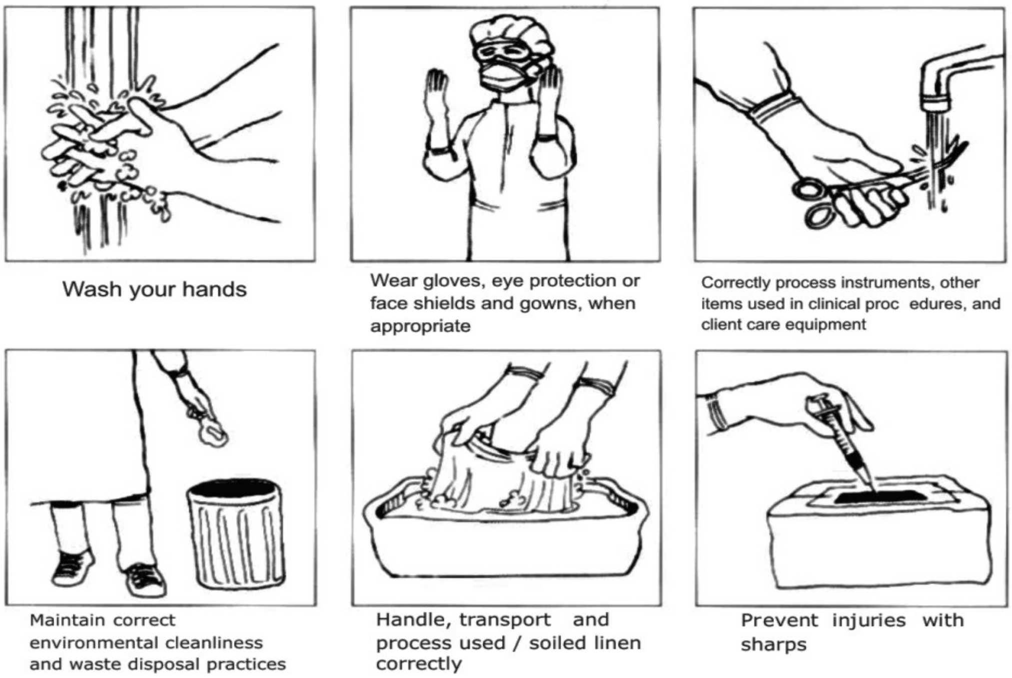
Gowns or waterproof aprons prevent micro-organisms from the providers’ arms, torso and clothing from entering the client and protect the provider’s skin and clothes from splashes of blood and other fluids.

Caps:

Caps prevent micro-organisms from air and skin on the provider’s head from entering the client.

Footwear:

Footwear that is clean and sturdy (closed rubber or leather boots or shoes) helps minimize the number of micro-organisms brought into the surgical/procedure area and protects the service provider's feet from injury or splashes of blood and other fluids.



Safe Handling of Hypodermic Needles and Syringes:

Needle pricks, scalpels and suture needles are the leading source of penetrating injuries. Hypodermic (hollow-bore) needles cause the most injuries to health care providers at all levels.

1) Surgeons and assistants are most often stuck by hypodermic needles during procedures.
2) Cleaning staff are most often stuck by needles when washing soiled instruments. Housekeeping staff are most often stuck by needles when disposing of infectious waste material.

Safe work practices:

1) Safe handling of sharp instruments during the operation requires using the 'no touch technique' by placing them on a small kidney tray.
2) Accidental needle-stick injuries occur mostly during the removal of the needle from the syringe or during cap replacement. Therefore, used needles should not be bent, broken, recapped, or removed from the syringe before disposal. Instead, the assembled needle and syringe should be discarded in a puncture-resistant container. If recapping is necessary, the cap should be held with a clamp while lacing it back over the needle or a one-handed technique should be used (while holding the syringe in one hand, scoop the cap off the flat surface with the needle, and then secure the cap on the needle with the other hand).

3) Immediately after use, sharp objects (such as needles, scalpel blades, suture needles, glass ampoules, etc.) should be disposed of in a puncture-resistant container with a lid made of either metal or heavy rigid plastic or cardboard. The container should be sealed and disposed of once three-fourths is filled, either by burying or incinerating.

Safety Tips for Using Hypodermic Needles and Syringes

1) Use needle and syringe only once.
2) Do not disassemble the needle and syringe after use.
3) Do not recap, bend, or break needles prior to disposal.
4) Decontaminate the needle and syringe prior to disposal.
5) Dispose of the needle and syringe in a puncture-resistant container.

If the needle has to be recapped, use the one-handed recap method:

Sharps Containers:

Using sharps disposal containers helps prevent injuries from sharps. Sharps containers should be fitted with a cover, and should be puncture-proof, leak- proof, and tamper-proof (difficult to open or break). If plastic or metal containers are unavailable, use containers made of dense cardboard (card board safety boxes) that meet WHO specifications. If cardboard safety boxes are unavailable, easily available objects can substitute as sharps containers:

1) Tin with a lid.
2) Thick plastic bottle.
3) Heavy plastic box.
4) Heavy cardboard box.

Recommendations for Safe Use of Sharps Containers:

1) All sharps' containers should be clearly marked "SHARPS" and have pictorial instructions for their use and disposal.
2) Place sharps containers away from high-traffic areas and as close as possible to where the sharps will be used.
3) Do not place containers near electric switches, overhead fans, or thermostat controls

where people might accidentally put one of their hands into them.

4) Attach containers to walls or other surfaces if possible. Position the containers at a convenient height so staff can use and replace them easily.
5) Never reuse or recycle sharps containers.
6) Mark the containers clearly so that people will not unknowingly use them as garbage receptacles.
7) Do not fill the safety box beyond three-quarters of its capacity.
8) Avoid shaking a container to settle its contents to make room for more sharps.
9) Appropriate waste disposal management.

Sharps Containers: Dos and Don'ts

Sharps containers are a key component in minimizing injuries from disposable sharps—such as hypodermic needles, scalpels and suture. When using sharps containers, either commercial or locally produced, here are some DOs and DON'Ts to consider:

DOs

DO put sharps containers as close to the point of use as possible and practical, ideally within arm's reach. Also, they should be easy to see, recognize and use.

DO attach containers to walls or other surfaces if possible.

DO mark them clearly so that people will not unknowingly use them as a garbage container or for discarding cigarettes.

DO place them at a convenient height so staff can use and replace them easily.

DO mark the fill line at the three quarters full level.

DON'Ts

DON'T shake a container to settle its contents and make room for more sharps.

DON'T place containers in high traffic areas (corridors outside patient rooms or procedure rooms) where people could bump into them or be stuck by someone carrying sharps to be disposed of.

DON'T place containers on the floor or anywhere they could be knocked over or easily reached by a child.

DON'T place containers near light switches, overhead fans or thermostat controls where people might accidentally put their hand into them.

Needle-Stick Injuries:

Health care providers could be exposed to HIV through needle sticks or through contact with mucous membranes or broken skin.

1) The risk of infection is low (the average risk of HIV infection after a needle-stick exposure to HIV-positive blood is only three infections per 1,000 needle sticks).
2) Needle sticks or cuts cause most infections in health care settings. The average risk of HIV infection after a needle-stick exposure to HIV-infected blood is 3 infections per 1,000 needle sticks.
3) The risk after exposure of the eye, nose, or mouth to HIV-infected blood is estimated to be about 1 infection per 1,000 exposures. Following universal precautions is the best way that providers can avoid workplace exposure to HIV and other fluid-borne infections. Post-exposure prophylaxis (PEP) with antiretroviral medicines will help to prevent HIV infection if a needle stick might have exposed a provider to HIV.

Individuals who are most likely to get needle-stick injuries are the following:

- Surgeons, who are most often stuck by needles in theatre by accidentally sticking themselves during suturing.
- Nurses, who are most often stuck by needles in hospitals, either by accidentally sticking themselves while handling hypodermic needles and syringes or being accidentally stuck by surgeons.
- Cleaning and housekeeping staff, when processing soiled instruments or disposing of waste material such as used needles.
- In the event of a needle-stick injury, PEP should be initiated as soon as possible as prescribed in the National guidelines for Post- Exposure Prophylaxis, and preferably within 26-36 hours after injury.
- Make infection prevention a habit, and always follow universal precautions to avoid workplace exposure to HIV and other fluid- borne infections:

Cleaning up infectious spills:

- Clean spills immediately.
- Always wear gloves.
- Small spills:clean with cloth soaked in chlorine solution.
- Large spills:cover spill with 0.5% chlorine, mop up, and clean again with disinfectant.

If exposed:

1) If exposure caused a bleeding wound, allow to bleed briefly.
2) Immediately flush area with clean water.
3) Wash wound and skin thoroughly, flush mucous membranes.
4) Determine exposure risk.

5) Give post-exposure prophylaxis, when available.

6) Consult an infectious-disease specialist.

Infection Prevention Practices for giving Injection

To reduce the risk of transmitting infections among clients:

- Always use a new disposable needle and syringe every time an injection is given.
- Reusing the same syringe to give injections to multiple clients, even if the needle is changed, is not a safe practice.

Before giving an injection:

If there is visible dirt, wash the injection site with soap and water.

Wipe the client's skin at the injection site with an antiseptic solution to minimize the number of micro-organisms and reduce the risk of infections. (Do not use spirit in case of administrating live vaccine wash with soup and water only if needed)

Using a fresh swab, wipe in a circular motion from the center outward.

If spirit is used, allow it to dry to provide maximum effectiveness in reducing micro-organisms.

Always warn clients before giving an injection as unexpected client movements at the time of injection can lead to accidents.

After giving an injection:

- Avoid needle stick accidents by following steps of recapping syringes as given below.
- Dispose these properly as described.

Tips to remember

Do not store instruments or other items, such as scalpel blades and suture needles in solutions. Always store them dry because micro-organisms can live and multiply in both antiseptic and disinfectant solutions, which can contaminate instruments and other items leading to infections. In addition, antiseptic solutions are made for killing micro-organisms on the skin and mucous membranes and some of the objects as thermometers.

Management of injuries from needles and other sharps: Clinic staff at risk of exposure to blood or other body fluids should be vaccinated against hepatitis B.

If accidental exposure to blood or other body fluids occurs:

- Wash needle sticks and cuts with soap and water
- Flush splashes to the nose, mouth or skin with water
- Irrigate splashes to the eyes with water or saline
- Immediately contact a doctor for further management

There is no scientific evidence that cleaning the wound with an antiseptic or squeezing the wound decreases the risk of transmitting blood borne pathogens. Do not use caustic agents such as bleach on sharp object injuries.

Post Exposure Prophylaxis:

Post exposure prophylaxis with drugs or other therapy can reduce the risk of transmission of some blood borne pathogens. Whether post exposure prophylaxis is indicated following exposure to blood or other body fluids depends on a number of factors, including.

- The infection status of the source client (the client whose blood or other body fluids are involved)
- The type of exposure (e.g. a splash to the skin versus a deep punctured wound with a very bloody hypodermic needle)
- Whether or not the exposed person has been vaccinated against hepatitis B
- How much time has passed since the exposure and the availability of needed drugs or other therapy.

To minimize the client's risk of post-insertion/removal infection, clinic staff should strive to maintain an infection-free environment.

IP for IUCD insertion

Before IUCD Insertion:

- Exclude clients who are by history and physical examination at risk for sexually transmitted genital tract infections.
- Wash hands thoroughly with soap and water before and after each insertion/removal.
- When possible, have the client wash her genital area before doing the pelvic examination.
- Use clean, high-level disinfected (or sterilized) instruments and gloves (both hands). Alternatively, disposable (single-use) examination gloves can be used. After inserting the speculum and while looking at the cervix, thoroughly apply antiseptic solution two or more times to the cervix and vagina before beginning the procedure.
- Use a "no touch" insertion technique to reduce contamination of the uterine cavity (i.e., do not pass the uterine sound or loaded IUCD through the cervical Os more than once.)
- Properly dispose off waste material (gauze, cotton, and disposable gloves) after inserting/removing the IUCD.
- Decontaminate instruments and reusable items immediately after using them. use appropriate technique of decontamination.
- Maintain the environment safe
- Limit movements while doing the procedure.

These rules apply the universal precautions for infection prevention to the family planning clinic.

Wash hands	1) Hand washing may be the single most important infection-prevention procedure. 2) Wash hands before and after examining or treating each client. (Hand washing is not necessary if clients do not require an examination or treatment). 3) Use clean water and plain soap and rub hands for at least 10 to 15 seconds. 4) Be sure to clean between the fingers and under fingernails. 5) Wash hands after handling soiled instruments and other items or touching mucous membranes, blood, or other body fluids. 6) Wash hands before putting on gloves, after taking off gloves, and whenever hands get dirty. Wash hands when you arrive at work, after you use the toilet and when you leave work. 7) Dry hands with a paper towel or a clean, dry cloth towel that no one else uses, or air-dry. 8) If clean water and soap are not available, a hand sanitizer containing at least 60% alcohol can reduce the number of germs on the hands. 9) Sanitizers do not eliminate all types of germs and might not remove harmful chemicals.
Process instruments that will be reused	1) High-level disinfect or sterilize instruments that touch intact mucous membranes or broken skin. 2) Sterilize instruments that touch tissue beneath the skin.
Wear gloves	1) Wear gloves for any procedure that risks touching blood, other body fluids, mucous membranes, broken skin, soiled items, dirty surfaces, or waste. Wear surgical gloves for surgical procedures such as insertion of implants. 2) Wear single-use examination gloves for procedures that touch intact mucous membranes or generally to avoid exposure to body fluids. Gloves are not necessary for giving injections. 3) Change gloves between procedures on the same client and

	between clients. 4) Do not touch clean equipment or surfaces with dirty gloves or bare hands. 5) Wash hands before putting on gloves. Do not wash gloved hands instead of changing gloves. 6) Gloves are not a substitute for hand washing. 7) Wear clean utility gloves when cleaning soiled instruments and equipment, handling waste, and cleaning blood or body fluid spills.
Do pelvic examinations only when needed	1) Pelvic examinations are not needed for most family planning methods—only for female sterilization, the IUCD, diaphragm, and cervical cap. 2) Pelvic examinations should be done only when there is a reason—such as suspicion of sexually transmitted infections, when the examination could help with diagnosis or treatment.
For injections, use new auto-disable syringes and needles	1) Auto-disable syringes and needles are safer and more reliable than standard single-use disposable syringes and needles. 2) Any disposable syringes and needles are safer than sterilizing reusable syringes and needles. 3) Cleaning the client's skin before the injection is not needed unless the skin is dirty. If it is, wash with soap and water and dry with a clean towel. 4) Wiping with an antiseptic has no added benefit.
Wipe surfaces with chlorine solution	1) Wipe examination tables, bench tops, and other surfaces that come in contact with unbroken skin with 0.5% chlorine solution after each client.
Dispose of single-use equipment and supplies properly and safely	1) Use personal protective equipment—goggles, mask, apron, and closed protective shoes, when handling wastes. 2) Needles and syringes meant for single use must not be reused. 3) Do not take apart the needle and syringe. 4) Used needles should not be broken, bent, or recapped. Put used needles and syringes immediately into a puncture-proof container for disposal. 5) The puncture-proof sharps container should be sealed and either burned, incinerated, or deeply buried when three-fourths full. 6) Dressings and other soiled solid waste should be collected in plastic bags and within 2 days, burned and buried in a deep pit.

	7) Liquid wastes should be poured down a utility sink drain or a flushable toilet, or poured into a deep pit and buried. 8) Clean waste containers with detergent and rinse with water. 9) Remove utility gloves and clean them whenever they are dirty and at least once every day. 10) Wash hands before and after disposing of soiled equipment and waste.
Wash linens	1) Wash linens (for example, bedding, caps, gowns, and surgical drapes) by hand or machine and line-dry or machine-dry. 2) When handling soiled linens, wear utility gloves, hold linens away from your body, and do not shake them.

3.10 INFECTION PREVENTION PRACTICES FOR INSTRUMENT PROCESSING

3.10 INFECTION PREVENTION PRACTICE FOR INSTRUMENT PROCESSING

Proper processing of instruments is critical to reduce the transmission of infections during clinical procedures. It is equally important to keep in mind that staff involved in processing instruments and other items are themselves at high risk of infections and need to take appropriate steps to reduce this risk. When processing instruments and other items, staff is at risk of exposure to blood or other body fluids through:

- Open cuts on the hands or forearms, chapped or cracked hands.
- Injuries due to needle sticks or other sharp instruments (such as scalpel blades).
- Splashing of blood or other body fluids contained on the instruments or other items onto mucous membranes (such as the eyes).

The four steps in processing are:

- Decontamination.
- Cleaning.
- High-Level disinfection or sterilization.
- Storage.

The 4 Steps of Processing Instruments
Decontaminate: To kill infectious organisms such as HIV and hepatitis B and to make instruments, gloves, and other objects are safer for people who clean them. Soak in 0.5% chlorine solution for 10 minutes. Rinse with clean cool water or clean immediately.
Clean: To remove body fluids, tissue, and dirt, wash or scrub with a brush with liquid soap or detergent and water. Avoid bar soap or powdered soap, which can stay on the equipment. Rinse and dry. While cleaning, wear utility gloves and personal protective equipment, goggles, mask, apron, and enclosed shoes.
High-level disinfect or sterilize: High-level disinfect to kill all infectious organisms except some bacterial endospores (a dormant, resistant form of bacteria) by boiling, by steaming, or with chemicals. High-level disinfect instruments or supplies that touch intact mucous membranes or broken skin, such as vaginal specula, uterine sounds, and gloves for pelvic examinations.
Sterilize: To kill all infectious organisms, including bacterial endospores, with a high-pressure steam autoclave, a dry-heat oven, chemicals, or radiation. Sterilize instruments such as scalpels and needles that touch tissue beneath the skin. If sterilization is not possible or practical (for example, for laparoscopes), instruments must be high-level disinfected
Store Instruments and supplies to protect them from contamination. They should be stored in a

high-level disinfected or sterilized container in a clean area away from clinic traffic. The equipment used to sterilize and high-level disinfect instruments and supplies also must be guarded against contamination.

A 0.5% dilution of chlorine is the standard disinfectant for materials and surfaces contaminated by blood or body fluids as recommended by the World Health Organization.

IP Principles:

1) All equipment should be cleaned regularly.
2) Equipment that will contact only intact skin requires cleaning and low-level disinfection.
3) Equipment having contact with mucous membranes requires cleaning and high-level disinfection.
4) Instruments that penetrate skin or mucosal membranes must be cleaned and then sterilized.

1) DECONTAMINATION

This is the first step in treating instruments and objects that have come in contact with blood and body fluids to make them safer for handling by personnel before cleaning them. Proper decontamination inactivates the HIV and hepatitis viruses.

Immediately after use, place instruments and other items, such as gloves, in a clean large plastic bucket containing 0.5% chlorine solution for 10 minutes, this effectively decontaminates them. This kills many microorganisms making instruments and other items safer to handle by staff who clean them.

Let them soak for 10 minutes. A container for this solution should be kept beside every procedure table and procedure room so that used items can be placed directly into the bucket. Service providers should put instruments and other items in 0.5% chlorine solution as soon as they are finished using each instrument or item.

After 10 minutes, remove the items from the chlorine solution and either rinse with water or clean immediately. Do not leave items in the solution for more than 10 minutes since excessive soaking in the solution can damage instruments and other items. Always wear utility gloves when removing instruments and other items from chlorine solution.

Prepare a new chlorine solution at the beginning of each day or when the solution looks as though it needs to be changed, such as when it becomes contaminated with blood or other body fluids or becomes cloudy. It may be useful to set up a bucket of tap water next

1) Chlorine is the cheapest, most universally available disinfectant.
2) Prepare solution in a plastic bucket with lid.
3) Place all used instruments and reusable gloves in it.
4) Soak for 10 minutes and rinse immediately.
5) Wipe surfaces (exam tables) with chlorine solution.

6) The prepared solution can last for 24 hours but will need to be changed earlier if becomes hazy.

Preparation of Chlorine Solution:

The 0.5% chlorine solution can be prepared by adding one part of concentrated household bleach (sodium hypochlorite solution, 5% available chlorine) to nine parts of water.

The general formulas for making a dilute solution from a commercial preparation of any given concentration is as follows:

FORMULA 1:

Concentration of bleach times 2 -1 =Parts of water required

EXAMPLE: Concentration of available Chlorine solution is 5%

5 times 2-1 = 9

FORMULA 2:

% concentration /% dilution needed -1 = Total parts of water

EXAMPLE: to make a 0.5% dilute solution of chlorine from 5% concentrated liquid household bleach = [5.0%/0.5%] -1 = 10-1 = 9 parts of water; hence add one part of concentrated bleach to nine parts of water.

For chlorine powder:

If one is using commercially available dry powder chlorine, use the following formula to calculate the amount (in grams) of dry powder required to make 0.5% chlorine solution:

[% dilution needed /% concentrate] x 1000 = Grams of Chlorine powder per litre of water

For example, to make a 0.5% dilute chlorine solution from a dry powder of 35% calcium hypochlorite = [0.5%/35%] x 1000 = 14.2 g.Hence add 14.2 grams of dry powder to 1 litre of water or 142 grams to 10 litres of water.

Precautions:

1) Turn off the fan.
2) Wear gloves, cap, mask, and eyeglasses to avoid splashing in eyes and preventing irritating effects.
3) Always use plastic containers and spoons.
4) Make fresh solution, every day; discard the solution if it becomes cloudy.
5) Do not expose the solution to direct sunlight.
6) The instruments should not be left in dilute bleach for more than 10 minutes and should be cleaned in boiled water immediately after decontamination to prevent

discoloration and corrosion of metal.

Steps of Preparation:

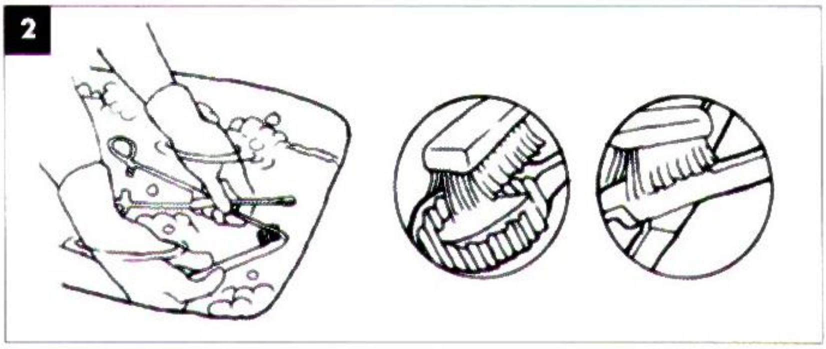
1) Calculate the amount of water and bleach. Put the calculated parts of clean tap water in a plastic container.
2) Add calculated parts of liquid bleach/powder (when preparing with powder, add small amount of water to make the paste and then add the rest of the water).
3) Stir well

2) Cleaning

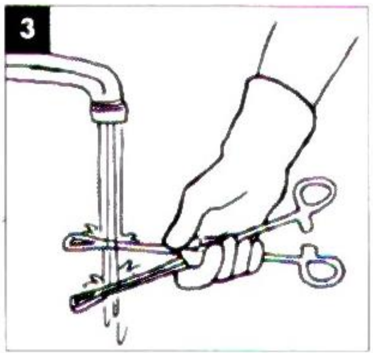
Cleaning is a crucial step that helps reduce the number of organisms and endospores (such as tetanus) on the instruments and other objects. Cleaning is a crucial step in providing safe, infection-free instruments. Vigorous manual cleaning with running water and liquid soap or detergent removes biological material such as blood, body fluids and tissue remnants. Instruments should be cleaned as soon as possible after use. If biological material is left behind, it can act as a sanctuary for residual microorganisms, protecting them from the effects of disinfection and sterilization. A thorough cleaning using a soft brush and detergent followed by rinsing helps to physically remove tissues and blood. Organic matter such as blood and tissues trap microorganisms that make it difficult to kill them during high- level disinfection or sterilization. They also inactivate some of the disinfectants making them less effective. detergent (not soap) should be used in lukewarm water. Do not use powder or cakes that are used for scrubbing

Steps of Cleaning

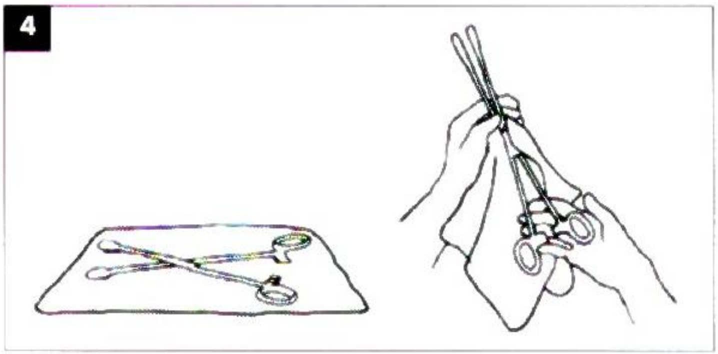
1 Wear utility gloves, goggles, a mask, and protective eyewear when cleaning instruments and other items.



Using a soft brush or old toothbrush, detergent, and water, scrub instruments and other items vigorously to completely remove all blood, other body fluids, tissue, and other foreign matter. Hold instruments and other items under the surface of the water while scrubbing and cleaning to avoid splashing. Disassemble instruments and other items with multiple parts, and be sure to brush in the grooves, teeth, and joints of instruments and other items, where organic material can collect and stick.



Rinse instruments and other items thoroughly with clean water to remove all detergent.



Allow instruments and other items to air-dry, or dry with a clean towel. (Instruments and other items should be dry before chemical high-level disinfection to avoid diluting the chemicals, which may decrease their effectiveness.) *Note:* Instruments and other items to be high-level disinfected by boiling or steaming do *not* need to be dried first.

Method of cleaning:

Thorough manual cleaning of instruments with water and detergent to remove all organic material, after decontamination in 0.5% chlorine solution for 10 minutes, is of the utmost importance before to sterilization or HLD. A brush should be used to scrub the instruments free of biological matter. Instruments should be cleaned as soon as possible after use, so that no organic material will dry and stick to the instruments, providing a sanctuary for microbes. The person cleaning should use utility gloves while washing instruments.

Protective glasses or goggles should be worn by the cleaners to protect their eyes from contaminated water. Special attention should be given to instruments with teeth (e.g., biopsy punches), joints and screws (e.g., vaginal specula), to which biological material can become stuck. After cleaning, rinse the instruments thoroughly with boiled water to remove detergent residue.

Use of Detergent in Cleaning

Detergent is important for effective cleaning, since water alone cannot remove protein, oils or grease:

- When detergent is dissolved in water, it breaks up and dissolves or suspends grease, oil and other foreign matter, making them easy to remove by cleaning.
- Do not use hand soap for cleaning instruments and other items because the fatty acid contained in the soap will react with the minerals of hard water, leaving a residue or scum that is difficult to remove.
- Avoid using steel wool or abrasive cleaners such as Vim. These products can scratch or pit metal or stainless steel resulting in grooves that can become a nesting place for micro- organisms. This also increases the potential for corrosion of the instruments and other items.

Special Considerations for Cleaning:

The following items require special attention. To clean them, follow the procedures outlined below:

- ***Gloves***: To avoid tearing gloves, handle with care, do not scrub with a brush and always wash separately from instruments and other items.
- Wash with detergent and warm water. Rinse in clean water until all detergent is gone. Check for holes by inflating the gloves with air and holding them underwater; air bubbles will appear if there are holes in the gloves. Alternatively, fill the glove with water and see if any water leaks out. Towel-dry inside and out or air-dry by hanging gloves in an area of low activity.
- ***Linen*** (caps, gowns, masks and surgical drapes): Handle soiled linen as little as possible. Utility gloves should be worn when handling or washing soiled linen.
- Wash with detergent and hot water and rinse with clean water. Air or machine dry. To reduce the risk of exposure to infectious material, machine washing is recommended, where possible. When machine washing is not possible, staff that washes linen by hand should wear protective gear, such as gloves, waterproof aprons and goggles/masks or face shields to reduce the likelihood of exposure to blood and other body fluids.
- ***Physical Surfaces***: Examination couches, tabletops, operating tables, walls and other surfaces that may have been contaminated by blood or other body fluids should be cleaned after attending each client. Wipe these surfaces with a cloth damped with a disinfectant cleaning solution.

3) A High Level Disinfection

1) High-level disinfection is effective in destroying microorganisms (including the HIV and hepatitis viruses). The process does not kill endospores. This is the only acceptable alternative when sterilization is not possible.

2) High-level disinfection is appropriate for items that do not come in touch with blood stream or tissues under the skin (such as instruments and gloves used for pelvic

examination, IUCD insertion).

3) The pre-requisite for high-level disinfection is that all instruments and objects that have to be high-level disinfected must be first decontaminated with chlorine solution, cleaned and air-dried.

Types of high-level disinfection:

1) Boiling
2) Chemicals
   - Chlorine Solution
   - Glutaraldehyde

Hld By Boiling

Boiling plain tap water in a clean vessel offers a cheap and readily accessible form of HLD. The contact time for instruments should be at least 20 minutes after boiling has started. Water in the boiler or the pot should be changed daily. The vessel should be washed and kept dry every day.

1) Decontaminate all instruments for HLD
2) The water must touch all surfaces for HLD to be achieved, completely submerge all instruments and other items in the water in the pot or boiler. Open all hinged instruments and other items and disassemble those with sliding or multiple parts. Place any bowls and containers upright, not upside down and fill with water.
3) Cover the pot or close the lid on the boiler and bring the water to a gentle, rolling boil.
4) When the water comes to a rolling boil, start timing for 20 minutes.
5) Use a timer or make sure to record the time that boiling begins.
6) From this point on, do not add or remove any additional water, instruments or other items.
7) Lower the heat to keep the water at a gentle, rolling boil; too vigorous boiling will cause the water to evaporate and may damage the instruments and other items if they bounce around the container and hit the sidewalls and other instruments or items. The lower heat also saves fuel / electricity.
8) After 20 minutes, remove the instruments and other items using dry, high level disinfected pickups (lifters, cheatle forceps).
9) Place the instruments and other items on a high-level disinfected container, away from insects and dust and in a low traffic area.
10) Allow to air dry before use or storage.
11) Never leave boiled instruments and other items in water that has stopped boiling; they can become contaminated as the water cools down.
12) Storage: Use instruments and other items immediately or keep in a covered, dry,

high level disinfected container and use within one week.

13) Air dry before use or storage.

Hld By Chemicals

Chemical disinfection:

Chemical agents such as 2% glutaraldehyde (Cidex), 0.1% chlorine, and formaldehyde, provide high-level disinfection. The most commonly recommended is 2% glutaraldehyde as it is less toxic and irritating and does not corrode metal. Chemical disinfection is not recommended for needles and syringes, as it is difficult to rinse them effectively. Change chlorine solution daily.

HLD by Chlorine:

0.1% Chlorine solution is used. If boiled water is used to make the solution, 0.1% chlorine may be used for HLD. If not, one should use 0.5% solution. The contact time required is 20 minutes. The solution is very corrosive to stainless steel. After disinfection, instruments should be thoroughly rinsed with boiled water and then air-dried or dried with a sterile cloth before use**.**

Chlorine solution:

1) If boiled water is used to make the solution, 0.1% chlorine may be used for HLD.
2) If not, one should use 0.5% solution.
3) The contact time required is 20 minutes.
4) After disinfection, instruments should be thoroughly rinsed with boiled water and then air-dried or dried with a sterile cloth before use.
5) Rinse with boiled and cooled water.
6) Air dry before use or storage.

High-Level Disinfection with Chemical 2 % Glutaraldehyde (Cidex):

Activated 2% solution in a covered container has a shelf life of two weeks. The contact time is 20 minutes. As glutaraldehyde forms a residue on instruments, which is toxic to tissues, the instruments must be rinsed thoroughly with sterile water and dried with a sterile cloth before use.

1) It must be prepared according to the manufacturer’s instructions.
2) The activated 2% solution in a covered container has a shelf life of two weeks
3) The contact time is 20 minutes.
4) As glutaraldehyde forms a residue on instruments, which is toxic to tissues, the instruments must be rinsed thoroughly with sterile water and dried with a sterile cloth before use.
5) To protect yourself from exposure to glutaraldehyde use local exhaust ventilation and use a fume hood where possible.

6) Avoid contact with the skin by using nitrile or rubber gloves (latex does not provide adequate protection).
7) Always wear appropriate Personal Protective Equipment (PPE) when handling any High-Level Disinfectant.
8) Wear goggles and face shields when handling.

3 B Sterilisation

Sterilization is defined as the process of destroying all microorganisms including endospores on an instrument by exposure to physical or chemical agents. This process kills all forms of microbial life including bacterial spores. In practice, sterility is achieved if the probability of a surviving microorganism is less than one in a million. The sterilization process is fundamental for the safe reuse of instruments in clinical care. It is appropriate for all objects entering the blood vessel. The pre-requisite for sterilization is that all instruments and objects that must be sterilized must be first decontaminated with chlorine solution, cleaned and air-dried.

Types of sterilization:

Steam Sterilization (Autoclave):

1) Clean instruments are opened (forceps and scissors) and double wrapped before autoclave
2) Wrapped items are labelled with processing date, initials of team member, content or wrap and date of sterile expiration
3) 1210C(2500F) -1330C; 106 kPa (26 lbs./in2) pressure: 20 minutes for unwrapped items, 30 minutes for wrapped items
4) Items are removed using sterile pickups and placed on a sterile surface to cool
5) Allow all items to dry before removing

Dry heat (oven):

1) 1700C (3400F) for 1 hour, or 1600C (3200F) for 2 hours

Chemical sterilization:

1) Soak items in glutaraldehyde for 10 hours.
2) Rinse with normal saline or boiled and cooled water.

4) STORAGE OF INSTRUMENTS

Proper storage is as critical as sterilizing or high-level disinfection:

1) Sterile items should be stored in closed containers, properly labelled, away from contaminated areas.
2) The sterile items should be handled properly so that they do not get contaminated.

3) Sterile containers should not be left on the floor and should be stored in enclosed cabinets to protect from dust and other contaminants.

1) Stored in a sterile container for a maximum of seven days.
2) Once opened, content must be used within 24 hours or re-processed.
3) Stored packs are kept in dry and closed place.
4) Packs are clearly labelled with the date of processing.

Instruments/Object	Decontaminate	Clean	Sterilize or high- level disinfection
Metal instruments for IUCD insertion/ removal and pelvic examination	Soak in 0.5% chlorine for 10 minutes before cleaning	Wear gloves and clean with soap and water until clean. Rinse and air-dry	Sterilize (preferred, not mandatory) Boil for at least 20 minutes or soak for 20 to 30 minutes in 2% glutaraldehyde, then rinse with boiled water
Metal containers for storing instruments and Cheatle forceps	Soak in 0.5% chlorine for 10 minutes before cleaning	Wear gloves and clean with soap and water until clean. Rinse.	Boil for 20 minutes once a week Autoclave or soak interior surface for 20-30 minutes in any disinfectant and rinse
Pelvic examination table top	Wearing gloves, wipe the top with 0.5% chlorine solution	NA	NA

House Keeping:

Housekeeping staff are at a high risk of exposure to blood, used sharps and other contaminated objects.

1) Everything in the clinic should be clean and dry.
2) Use 0.5% chlorine solution or soapy water for cleaning.
3) Clean ceiling first, floor last.
4) A damp mop works better than dry dusting.
5) Use detergents and disinfectants.
6) Clean tables between uses.
7) Clean floors and equipment when visibly contaminated and at end of day.

Infection Prevention in the Clinic:

Infection-prevention procedures are simple, effective, and inexpensive. Germs (infectious organisms) of concern in the clinic include bacteria (such as staphylococcus), viruses (particularly HIV and hepatitis B), fungi, and parasites. In the clinic, infectious organisms can be found in blood, body fluids with visible blood, and tissue. (Feces, nasal secretions, saliva, sputum, sweat, tears, urine, and vomit are not considered potentially infectious unless they contain blood.) The organisms can be passed through mucous membranes or broken skin, such as cuts and scratches, and by needle sticks with used needles and other puncture wounds. Infectious organisms can pass from clinics to communities when waste disposal is not proper, or staff members do not wash their hands properly before leaving the clinic.

Risk of HIV Infection in the Clinic
Health care providers may be exposed to HIV through needle sticks, mucous membranes, or broken skin, but the risk of infection is low.
Needle sticks or cuts cause most infections in health care settings. The average risk of HIV infection after a needle-stick exposure to HIV-infected blood is 3 infections per 1,000 needle sticks.
The risk after exposure of the eye, nose, or mouth to HIV-infected blood is estimated to be about 1 infection per 1,000 exposures.
Following universal precautions is the best way that providers can avoid workplace exposure to HIV and other fluid-borne infections. Post-exposure prophylaxis (PEP) with antiretroviral medicines will help to prevent HIV infection if a needle stick might have exposed a provider to HIV.

3.11 MEDICAL WASTE MANAGEMENT

3.11 Medical Waste Management

Appropriate disposal of medical waste is an important issue, so it is useful to develop a medical-waste management plan and to designate an individual to coordinate medical-waste management. The management plan should include training of all the staff who handle medical waste as well as orienting the entire staff to the plan.

The purpose of waste management is to:

1) Protect people who handle waste items from accidental injury.
2) Prevent the spread of infection to health care providers who handle the waste.
3) Prevent the spread of infection to the local community.

There are four aspects of medical waste management.

1) Sorting:

Only a small percentage of the waste generated by a health care facility is medical waste that must be specially handled to reduce the risk of infections or injury. Therefore, sorting the waste at the point at which it is generated can greatly reduce the amount that needs special handling. Poor separation of waste at the point at which it is generated leads to large amounts of waste having to be handled specially which can overwhelm the disposal system, lead to improper disposal off medical waste and put everyone at risk.

1) Separate container should be used for disposing of general and medical waste.
2) Waste should be put in the appropriate containers by the person who generates it.
3) Use colored plastic containers/bags, painted drums or easily readable labels on containers to help distinguish between general and medical waste containers. For example, paint the containers used for medical waste red or use red plastic bags, if possible.
4) Sharps to be collected in puncture-proof containers.
5) Burnable contaminated and non-contaminated wastes should be collected in covered buckets.
6) Human tissues and fluids collected in leak-proof containers.
7) Glass should be collected in separate container.
8) Place containers at convenient places so that the wastes need not be carried from one place to the other, which increases the risk of infection.

2) Handling:

Handle medical waste as little as possible before disposal. Waste containers in operating theaters, procedure rooms, toilets and sluice rooms should be emptied when they become three-quarters full. Do not collect medical waste from client-care areas by emptying it into open carts or wheelbarrows, this may lead to contamination of the surroundings and scavenging of waste as well as increase the risk of injury to staff, clients and visitors. Always wear heavy utility gloves and shoes when handling medical waste. Always wash hands after handling waste and removing gloves.

3) Interim Storage:

If it is necessary to store medical waste on-site before disposal:

1) Place waste in an area that is minimally accessible to staff, clients and visitors.
2) Make sure all containers have lids, cover the containers so that insects, rodents and other animals cannot get into them.
3) Plan for short-term storage only (usually for several hours but no more than one or two days).

4) Transportation of waste:

1) Persons handling waste should wear heavy-duty gloves to avoid injuries by accidental pricking.
2) The waste containers should be emptied when three quarters full or at least once daily.
3) Transport in closed, leak proof containers to the disposal site.

Disposal:

1) Contaminated waste should be incinerated (most preferred method), burned or buried
2) Wash all the waste containers especially the ones with contaminated waste with 0.5% chlorine and rinse with water.

Waste Disposal

Three types of waste is found in health care facilities i.e., General, Medical and Hazardous Chemical Waste.

General waste:

Non-hazardous waste that poses no risk of injury or infections. This is similar in nature to household trash. Examples include uncontaminated paper, boxes, packaging materials, bottles, plastic containers and food-related trash.

Medical waste:

Material generated in the diagnosis, treatment and/or immunization of people, including:

1) Blood, blood products and other body fluids as well as materials containing fresh or dried blood or body fluids such as bandages and surgical sponges
2) Organic waste such as human tissue, body parts, placentas and products of conception
3) Sharps (used or unused) including hypodermic and suture needles, scalpel blades, blood tubes, pipettes and other glass items that have been in contact with potentially

infectious materials (such as glass slides and cover slips).

Chemical Waste:

Hazardous substances are used in a workplace. Appropriate disposal of medical and hazardous chemical waste is a problem because: The staff that collect and dispose of waste at health care facilities are often unaware of the risks that medical and hazardous chemical waste pose to themselves, other facility staff, clients, visitors, the community and the environment.

Many health care facility staff do not know how waste is handled or where it goes, and they generally assume that waste is disposed off in an appropriate manner. In addition, those who decide on the facility’s budget (such as government officials) or those who handle or dispose off trash once it leaves the facility (such as trash haulers or dump operators) and often do not understand the risks to the facility’s staff, clients, visitors, the community and the environment.

Health care facilities are often designed with little consideration given to waste disposal.

Waste disposal often requires compromises because practical disposal may not be optimal as far as health, safety or the environment is concerned.

In some settings, there may be a widespread feeling that fancy, expensive waste-disposal technology is necessary. If this technology is not available or unaffordable, many people believe that there is little they can do to address the problem of inadequate waste disposal.

Proper handling and disposal of medical and hazardous chemical waste

1) Minimizes the spread of infections and reduces the risk of accidental injury to staff, clients, visitors and the local community
2) Helps to provide an aesthetically pleasing atmosphere
3) Reduces odours
4) Reduces the number of insects and animals
5) Reduces the likelihood of contaminating the soil or ground water with chemicals or micro-organisms

Housekeeping and other staff have a responsibility to dispose of all medical and hazardous chemical waste in a manner that poses the least hazard to themselves, clients, visitors, other health care workers and the community. Proper waste disposal is a preventive and protective practice. The way in which waste is handled depends on the type and size of the facility (e.g., a hospital versus a health post), the amount of waste generated and the location of the facility (urban or rural).

People at risk of Medical and Hazardous Chemical Waste

1) Anyone who handles medical or hazardous chemical waste- from time it is thrown out by a service provider until it reaches the site of disposal - is at risk of infections or injury.

2) Improperly disposed off sharps pose the greatest risk to staff who handle and dispose off waste and can cause injury and transmission of serious infections including HIV and hepatitis B.

3) A large percentage of staff collects and removes waste both inside and outside the health care facilities, reports having experienced work-related injuries. Those reporting high rates of medical waste-related injuries include nurses, midwives, nursing aides and cleaning and maintenance staff. If at all possible, these staff should be vaccinated against hepatitis B.

One of the greatest risks that members of the community face in regard to the health care facility is exposure to potentially infectious medical waste. When contaminated dressings, sharps and other waste products are not disposed of properly, it can be found by children who are playing and cause injury and infection. Lack of proper waste- disposal practices also put the local community at risk of infections when waste such as syringes and needles, is scavenged. In many low-resource settings, scavenging of medical waste is a significant problem. The World Health Organization has reported numerous cases around the world of the transmission of hepatitis B to people who have scavenged medical waste.

Types of Wastes:

1) Domestic
   - Wrappers
   - Newspapers
   - Papers etc.
2) Clinical
   - Sharps
   - Chemicals
   - Solid waste

Waste from hospitals and health care facilities may be contaminated (potentially infectious) or non-contaminated. Contaminated wastes include blood, pus, urine, stool, and other body fluids, as well as items that come in contact with them, such as used dressings. Wastes from operating rooms (human tissue, blood or blood-soaked sponges, gauze, or cotton) and laboratories (blood, feces, sputum, urine specimens, and microbiological cultures) should be considered contaminated. Soiled medical devices or items that can inflict injury (e.g., used needles and scalpel blades) are capable of spreading blood-borne diseases such as hepatitis B, hepatitis C, and AIDS and are also considered contaminated waste.

Open piles of waste should be avoided because they:

1) Are risks to those who scavenge and unknowingly reuse contaminated items.
2) Allow persons to accidentally step on sharp items and injure themselves.
3) Produce foul odours.
4) Attract insects and animals.

Handling of Contaminated Waste:

1) Proper handling of contaminated waste minimizes the spread of infection to health care personnel and to the local community.
2) Whenever possible, contaminated waste should be collected and transported to disposal sites in leak- proof, covered waste containers.
3) Use plastic or galvanized metal containers with tight-fitting covers for contaminated wastes.
4) Many facilities now use color-coded plastic bags to alert handlers to the contents and to keep the general (non-contaminated) waste separate from contaminated waste. Use puncture-resistant sharps containers for all disposable sharps (sharps that will not be reused).
5) Place waste containers close to where the waste is generated and where convenient for users (carrying waste from place to place increases the risk of infection for handlers). This is especially important for sharps, which carry the highest risk of injury for health care providers.
6) Equipment that is used to hold and transport wastes must not be used for any other purpose in the clinic or hospital. (Contaminated waste containers should be marked.)
7) Wash all waste containers with a disinfectant cleaning solution (0.5 percent chlorine solution plus soap) and rinse with water regularly. When possible, use separate containers for combustible and non-combustible wastes prior to disposal. This step prevents workers from having to handle and separate wastes by hand later.
8) Use PPE when handling wastes (e.g., heavy-duty utility gloves and closed protective shoes). Wash hands or use a waterless, alcohol-based antiseptic hand rub after removing gloves when handling wastes.

Disposal of Sharps:

sharps disposal box

Disposal of sharp items (hypodermic needles, suture needles, razors, and scalpel blades) require special handling because they are the items most likely to injure health care providers who handle them as well as people in the community if these items go to the municipal landfill.

Encapsulation:

Encapsulation is recommended as the easiest way to safely dispose of sharps. Sharps are collected in puncture-resistant and leak-proof containers. When the container is three-quarters full, a material such as cement (mortar), plastic foam, or clay is poured into the container until it is completely filled. After the material has hardened, the container is sealed and may be land-filled, stored, or buried. It is also possible to encapsulate chemical or pharmaceutical waste together with sharps.

Steps for the Disposal of Sharps	
Step 1	Do not recap needle or disassemble needle and syringe
Step2	After use, hold the needle tip under the surface of a 0.5 percent chlorine solution, fill the syringe with solution, and push out (flush) three times.
Step 3	Place assembled needles and syringes to be disposed of in a puncture-resistant sharps container such as a heavy cardboard box, plastic bottle, or tin can with lid. The opening in the lid should be large enough so that items can be easily dropped through it, but small enough that nothing can be removed from inside. (Old intravenous fluid bottles may also be used, but they can break.)
Step 4	When the container is three-quarters full, it should be removed from the procedure area for disposal.

Disposing of the Sharps Container	
Step 1	Wear heavy-duty utility gloves.
Step 2	When the sharps container is three-quarters full it should be capped, plugged, or taped tightly closed. Be sure that no sharp items are sticking out of the container.
Step 3	Dispose of the sharps container by burning, encapsulating, or burying.
Step 4	Remove utility gloves (wash daily or when visibly soiled, and dry).
Step 5	Wash hands and dry them with a clean cloth or towel or air dry. (Alternatively, if hands are not visibly soiled, apply 5 ml, about 1 teaspoonful of an antiseptic hand rub and rub the solution vigorously onto hands until dry.)
How to Dispose of Solid Contaminated Waste	
Step 1	Wear heavy-duty or utility gloves when handling and transporting solid wastes.

Step 2	Dispose of solid wastes by placing them in a plastic or galvanized metal container with a tight-fitting cover.
Step 3	Collect the waste containers on a regular basis and transport the burnable ones to the incinerator or another area for burning.
Step 4	Remove utility gloves (wash daily or when visibly soiled and dry)
Step 5	Wash and dry hands or use an antiseptic hand rub as described above.

Burning:

It is preferable to burn medical waste since the high temperature destroys micro-organisms and reduces the amount of waste. Burning in an incinerator or oil drum is recommended.

Open burning is not recommended because it causes scattering of waste, is dangerous and is unattractive. However, if open burning must be done, carry the waste to the site just before burning and burn it in a small-designated area. Remain with the fire until it is extinguished: If medical waste cannot be burned, on-site burial is the next best option. However, burial is feasible only when there is sufficient space to dig a pit according

Incineration:

Incineration is a high-temperature process that reduces the volume and weight of waste. This process is usually selected to treat waste that cannot be recycled, reused, or disposed of in a sanitary landfill or dumpsite. Incinerators can range from extremely sophisticated, high-temperature ones to very basic units that operate at much lower temperatures. All types of incinerators, if operated properly, eliminate micro-organisms from waste and reduce it to ashes.

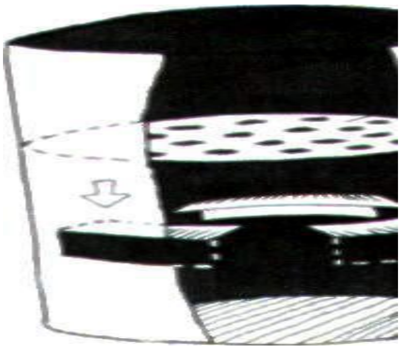
Four basic types of incinerators are used for treating waste:

1) Double-chamber, high-temperature incinerators are designed to burn infectious waste.
2) Single-chamber, high-temperature incinerators are less expensive and are used when double-chamber incinerators are not affordable.
3) Rotary kilns operate at high temperatures and are used for destroying cytotoxic substances and heat-resistant chemicals.
4) Drum or brick (clay) incinerators operate at lower temperatures and are less effective but can be made locally using readily available materials. Open burning is not recommended because it is dangerous, unsightly, and the wind will scatter the waste. For health care facilities with limited resources and where high-temperature incinerators are not affordable, waste may be incinerated in a drum incinerator. A drum incinerator is the simplest form of single-chamber incinerator. It can be made inexpensively and is better than open burning.

Drum Incinerator:

Small facilities with low-volume medical waste can use a drum incinerator to burn medical waste. When using a drum incinerator:

- Choose a place that is downwind from the clinic, so that smoke and odours do not blow.
- Use an oil drum. Make sure the incinerator has sufficient air inlets on the side of the drum for efficient burning.
- Place the incinerator on hard earth or a concrete base to prevent grass from catching fire during the burning process.
- Burn only that medical waste to reduce the amount of waste that requires to be burnt.
- In many cases, medical waste does not burn easily, especially if it is wet. Add kerosene oil to make the fire hot enough to burn all the waste. Be sure to add the kerosene before burning the fire, since adding it afterwards might cause the fire to explode.
- Put up a fence or wall around the incinerator and never leave a fire unattended to ensure the safety of clients, visitors and community members while burning waste.
- Treat the ash from the incinerated material as general waste: bury or dispose it off in a designated area.

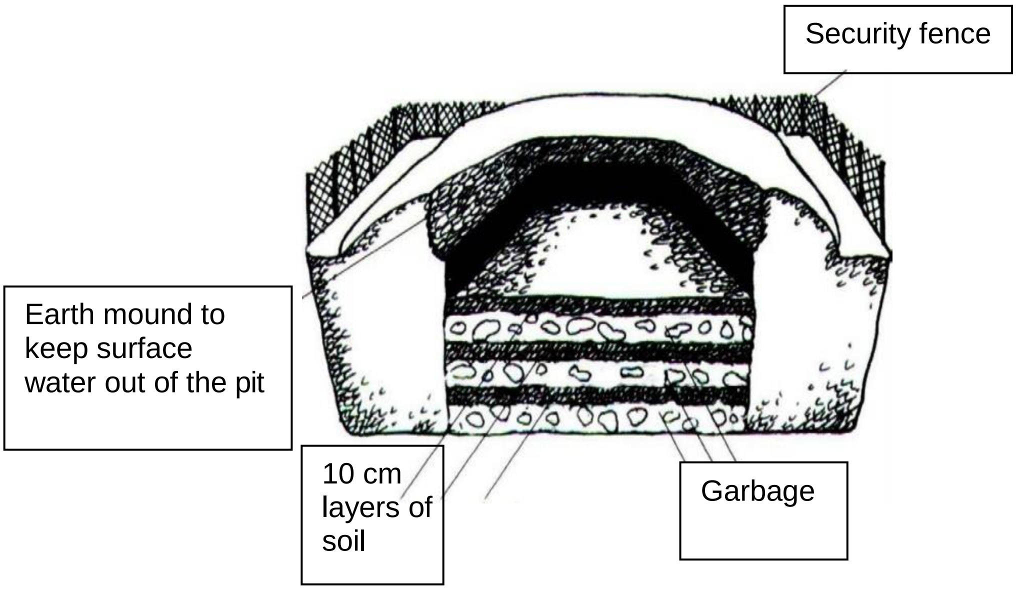


Perforated fire bed made from the drum top (holes act as air inlets)

How to Build and Use a Simple Drum Incinerator for Waste Disposal

Step 1	**Where possible, select a site downwind from the clinic.**
Step 2	Build a simple incinerator using local materials (mud or stone) or a used oil drum (e.g., a 55-gallon drum). The size depends on the amount of daily waste collected.
Step 3	Make sure the incinerator has: Sufficient air inlets underneath for good combustion. Loosely placed fire bars to allow for expansion. An adequate opening for adding fresh refuse and removing ashes. A long enough chimney to allow for a good draught and evacuation of smoke.
Step 4	Place the drum on hardened earth or a concrete base.
Step 5	Burn all combustible waste, such as paper and cardboard, as well as used dressings and other contaminated wastes. If the waste or refuse is wet, add kerosene so that a hot fire burns all of the waste. Ash from incinerated material can be treated as non-contaminated waste

How to Make and Use a Small Burial Site for Waste Disposal



Step 1	Find an appropriate location. Choose a site that is at least 50 metres away from any water source to avoid contaminating the water source. The site should be in an area that is located downhill from any wells, is free of standing water, will not flood and has proper drainage. The site should not be located on land that will be used for agriculture or development.
Step 2	Dig a pit 1-meter (3 feet) square and 2 meters (6 feet) deep. The bottom of the pit should be 2 meters (6 feet) above the water table. (Consult local water engineer / water authority for information about the location of the water table).
Step 3	Dispose of the contaminated waste in the pit and cover the waste with 10–15 cm (4–6 inches) of dirt each day. The final layer of dirt should be 50–60 cm (20–24 inches) and compacted to prevent odors and attraction of insects, and to keep animals from digging up the buried waste. Depending on the volume of waste, the capacity of the pit should last for 30–60 days.
Step 4	Put up a fence or wall around the site or opening to keep animals and children out. Cover the pit with a 10 to 30cm layer of soil every time waste is added. When the level of waste reaches to within 30-50 cm of the ground surface, fill the pit with dirt, seal it with concrete and dig another pit

Different types of disposal for different types of wastes

TYPES OF WASTE	DISPOSAL
Paper towels, used	Paper basket, municipal waste
Small quantities of pharmaceutical waste (drugs or medicine)	Leak proof container/medical waste; incineration, encapsulation, or safe burial. This waste may also be discharged into the sewer (except cytotoxic and antibiotics) but should not be put into natural rivers, lakes, etc.
Surgical gloves	Drop the gloves after rubbing both hands together and taking them off inside out in the bucket with 0.5% chlorine solution and leak proof container/medical waste, incineration, burial, encapsulation.
Mercury from broken thermometer or sphygmomanometer	Put examination gloves on both hands, collect mercury drops with a spoon, place in a small container for re-use or disposal (send back to suppliers, encapsulation).
Thermometer, broken	If no mercury is present, sharp containers
Gauze with blood	Leak proof container/medical waste; incineration, safe burial

Glutaraldehyde (after 14 days of use)	Dilute with water and pour down a drain/utility sink or toilet, flushing with water if it goes to the sewer. Do not put down open drains.
Depo-Provera containers / vials, empty	Sharps container/medical waste. Incineration, safe burial, or encapsulation
Sharps container (¾ full but open)	Close and transport to the proper area for incineration, safe burial, or encapsulation.
Chlorine, 0.5% solution used for decontamination	Pour into a utility toilet, sink, or drain. Flush with water. If powder bleach was used to make the solution, flush with large amounts of water to prevent calcium precipitate from clogging drains.
Bleach bottle, empty	If plastic container: rinse three times with water and dispose of by burning, encapsulating, or burying. Can be reused as a sharp's container.
Bucket with plastic bag, ¾ full of medical waste	Close the container and transport it to the proper place for incineration, safe burial, or encapsulation.

3.12 HEALTH-CARE FACILITY RECOMMENDATIONS FOR STANDARD PRECAUTIONS BY WHO

3.12 Health-Care Facility Recommendations For Standard Precautions By Who

1) Hand hygiene

Technique:

- Hand washing (40–60 sec): wet hands and apply soap; rub all surfaces; rinse hands and dry thoroughly with a single use towel; use towel to turn off faucet.
- Hand rubbing (20–30 sec): apply enough product to cover all areas of the hands; rub hands until dry.
- **Indications:**
- Before and after any direct patient contact and between patients, whether or not gloves are worn.
- Immediately after gloves are removed.
- Before handling an invasive device.
- After touching blood, body fluids, secretions, excretions, non-intact skin, and contaminated items, even if gloves are worn.
- During patient care, when moving from a contaminated to a clean body site of the patient.
- After contact with inanimate objects in the immediate vicinity of the patient.

2) Gloves

- Wear when touching blood, body fluids, secretions, excretions, mucous membranes, non-intact skin.
- Change between tasks and procedures on the same patient after contact with potentially infectious material.
- Remove after use, before touching non-contaminated items and surfaces, and before going to another patient.
- Perform hand hygiene immediately after removal.

3) Facial protection (eyes, nose, and mouth)

- Wear (1) a surgical or procedure mask and eye protection (eye visor, goggles) or (2) a face shield to protect mucous membranes of the eyes, nose, and mouth during activities that are likely to generate splashes or sprays of blood, body fluids, secretions, and excretions

4) Gown

- Wear to protect skin and prevent soiling of clothing during activities that are likely to generate splashes or sprays of blood, body fluids, secretions, or excretions.

- Remove soiled gown as soon as possible, and per- form hand hygiene.

5) Prevention of needle stick and injuries from other sharp instruments

Use care when:

- Handling needles, scalpels, and other sharp instruments or devices.
- Cleaning used instruments.
- Disposing of used needles and other sharp instruments.

6) Respiratory hygiene and cough etiquette

Persons with respiratory symptoms should apply source control measures:

- Cover their nose and mouth when coughing/sneezing with tissue or mask, dispose of used tissues and masks, and perform hand hygiene after contact with respiratory secretions.
- Health-care facilities should:
- Place acute febrile respiratory symptomatic patients at least 1 metre (3 feet) away from others in common waiting areas, if possible.
- Post visual alerts at the entrance to health-care facilities instructing persons with respiratory symptoms to practise respiratory hygiene/cough etiquette.
- Consider making hand hygiene resources, tissues and masks available in common areas and areas used for the evaluation of patients with respiratory illnesses.

7) Environmental cleaning

- Use adequate procedures for the routine cleaning and disinfection of environmental and other frequently touched surfaces.

8) Linens

Handle, transport, and process used linen in a manner which:

- Prevents skin and mucous membrane exposures and contamination of clothing.
- Avoids transfer of pathogens to other patients and or the environment.

9) Waste disposal

- Ensure safe waste management.
- Treat waste contaminated with blood, body fluids, secretions and excretions as clinical waste, in accordance with local regulations.
- Human tissues and laboratory waste that is directly associated with specimen processing should also be treated as clinical waste.
- Discard single use items properly.

10) Patient care equipment

- Handle equipment soiled with blood, body fluids, secretions, and excretions in a manner that prevents skin and mucous membrane exposures, contamination of clothing, and transfer of pathogens to other patients or the environment.
- Clean, disinfect, and reprocess reusable equipment appropriately before use with another patient.

3.13 THE CONCEPT OF DISEASE

3.13 The Concept Of Disease

A **disease** is any condition in which the normal structure or functions of the body are damaged or impaired. Physical injuries or disabilities are not classified as disease, but there can be several causes for disease, including infection by a pathogen, genetics (as in many cancers or deficiencies), noninfectious environmental causes, or inappropriate immune responses. Our focus in this chapter will be on infectious diseases, although when diagnosing infectious diseases, it is always important to consider possible noninfectious causes.

Signs and Symptoms of Disease

An **infection** is the successful colonization of a host by a microorganism. Infections can lead to disease, which causes signs and symptoms resulting in a deviation from the normal structure or functioning of the host. Microorganisms that can cause disease are known as pathogens.

The **signs** of disease are objective and measurable and can be directly observed by a clinician. Vital signs, which are used to measure the body's basic functions, include body temperature (normally 37 °C [98.6 °F]), heart rate (normally 60–100 beats per minute), breathing rate (normally 12–18 breaths per minute), and blood pressure (normally between 90/60- and 120/80-mm Hg). Changes in any of the body's vital signs may be indicative of disease. For example, having a fever (a body temperature significantly higher than 37 °C or 98.6 °F) is a sign of disease because it can be measured.

In addition to changes in vital signs, other observable conditions may be considered signs of disease. For example, the presence of antibodies in a patient's serum (the liquid portion of blood that lacks clotting factors) can be observed and measured through blood tests and, therefore, can be considered a sign. However, it is important to note that the presence of antibodies is not always a sign of an active disease. Antibodies can remain in the body long after an infection has resolved; also, they may develop in response to a pathogen that is in the body but not currently causing disease.

Unlike signs, **symptoms** of disease are subjective. Symptoms are felt or experienced by the patient, but they cannot be clinically confirmed or objectively measured. Examples of symptoms include nausea, loss of appetite, and pain. Such symptoms are important to consider when diagnosing disease, but they are subject to memory bias and are difficult to measure precisely. Some clinicians attempt to quantify symptoms by asking patients to assign a numerical value to their symptoms. For example, the Wong-Baker Faces pain-rating scale asks patients to rate their pain on a scale of 0–10. An alternative method of quantifying pain is measuring skin conductance fluctuations. These fluctuations reflect sweating due to skin sympathetic nerve activity resulting from the stressor of pain.[1]

A specific group of signs and symptoms characteristic of a particular disease is called a **syndrome**. Many syndromes are named using a nomenclature based on signs and symptoms or the location of the disease. The table below lists some of the prefixes and suffixes commonly used in naming syndromes.

Nomenclature of Symptoms		
Affix	Meaning	Example
cyto-	cell	cytopenia: reduction in the number of blood cells
hepat-	of the liver	hepatitis: inflammation of the liver
-pathy	disease	neuropathy: a disease affecting nerves
-emia	of the blood	bacteremia: presence of bacteria in blood
-itis	inflammation	colitis: inflammation of the colon
-lysis	destruction	hemolysis: destruction of red blood cells
-oma	tumor	lymphoma: cancer of the lymphatic system
-osis	diseased or abnormal condition	leukocytosis: abnormally high number of white blood cells
-derma	of the skin	keratoderma: a thickening of the skin

Clinicians must rely on signs and on asking questions about symptoms, medical history, and the patient's recent activities to identify a particular disease and the potential causative agent. Diagnosis is complicated by the fact that different microorganisms can cause similar signs and symptoms in a patient.

For example, an individual presenting with symptoms of diarrhea may have been infected by one of a wide variety of pathogenic microorganisms. Bacterial pathogens associated with diarrheal disease include *Vibrio cholerae*, *Listeria monocytogenes*, *Campylobacter jejuni*, and enteropathogenic *Escherichia coli* (EPEC). Viral pathogens associated with diarrheal disease include norovirus and rotavirus. Parasitic pathogens associated with diarrhea include *Giardia lamblia*. Likewise, fever is indicative of many types of infection, from the common cold to the deadly Ebola haemorrhagic fever.

Asymptomatic or Subclinical,

Finally, some diseases may be meaning they do not present any noticeable signs or symptoms. For example, most individual infected with herpes simplex virus remain asymptomatic and are unaware that they have been infected.

Classifications Of Disease

The World Health Organization's (WHO) International Classification of Diseases (ICD) is used in clinical fields to classify diseases and monitor morbidity (the number of cases of a disease) and mortality (the number of deaths due to a disease). In this section, we will introduce terminology used by the ICD (and in health-care professions in general) to describe and categorize various types of disease.

1) Infectious Diseases

A disease caused by the direct effect of a pathogen. A pathogen may be cellular (bacteria, parasites, and fungi) or acellular (viruses, viroids, and prions).

Some infectious diseases are also **communicable**, meaning they are capable of being spread from person to person through either direct or indirect mechanisms.

Some infectious communicable diseases are also considered **contagious** diseases, meaning they are easily spread from person to person. Not all contagious diseases are equally so; the degree to which a disease is contagious usually depends on how the pathogen is transmitted.

For example, measles is a highly contagious viral disease that can be transmitted when an infected person coughs or sneezes and an uninfected person breathes in droplets containing the virus. Gonorrhea is not as contagious as measles because transmission of the pathogen (*Neisseria gonorrhoeae*) requires close intimate contact (usually sexual) between an infected person and an uninfected person.

2) Iatrogenic diseases.

Diseases that are contracted as the result of a medical procedure are known as Iatrogenic diseases can occur after procedures involving wound treatments, catheterization, or surgery if the wound or surgical site becomes contaminated.

For example, an individual treated for a skin wound might acquire necrotizing fasciitis (an aggressive, “flesh-eating” disease) if bandages or other dressings became contaminated by *Clostridium perfringens* or one of several other bacteria that can cause this condition.

3) Nosocomial Diseases

Diseases acquired in hospital settings are known as Nosocomial diseases.

Several factors contribute to the prevalence and severity of nosocomial diseases. First, sick patients bring numerous pathogens into hospitals, and some of these pathogens can be transmitted easily via improperly sterilized medical equipment, bed sheets, call buttons, door handles, or by clinicians, nurses, or therapists who do not wash their hands before touching a patient.

Second, many hospital patients have weakened immune systems, making them more susceptible to infections. Compounding this, the prevalence of antibiotics in hospital settings can select for drug-resistant bacteria that can cause very serious infections that are difficult to treat.

4) Zoonotic Disease (Or Zoonosis)

Certain infectious diseases are not transmitted between humans directly but can be transmitted from animals to humans. Such a disease is called zoonotic disease According to WHO, a zoonosis is a disease that occurs when a pathogen is transferred from a vertebrate animal to a human; however, sometimes the term is defined more broadly to include diseases transmitted by all animals (including invertebrates). For example, rabies is a viral zoonotic disease spread from animals to humans through bites and contact with infected saliva. Many other zoonotic diseases rely on insects or other arthropods for transmission. Examples include yellow fever (transmitted through the bite of mosquitoes infected with yellow fever virus) and Rocky Mountain spotted fever (transmitted through the bite of ticks infected with *Rickettsia rickettsii*).

5) Noncommunicable Diseases

In contrast to communicable infectious diseases, a infectious disease is not spread from one person to another. One example is tetanus, caused by *Clostridium tetani*, a bacterium that produces endospores that can survive in the soil for many years. This disease is typically only transmitted through contact with a skin wound; it cannot be passed from an infected person to another person. Similarly, Legionnaires disease is caused by *Legionella pneumophila*, a bacterium that lives within amoebae in moist locations like water-cooling towers. An individual may contract Legionnaires disease via contact with the contaminated water, but once infected, the individual cannot pass the pathogen to other individuals.

6) Noninfectious Diseases

In addition to the wide variety of noncommunicable infectious diseases, (those not caused by pathogens) are an important cause of morbidity and mortality worldwide. Noninfectious diseases can be caused by a wide variety factor, including genetics, the environment, or immune system dysfunction, to name a few. For example, sickle cell anaemia is an inherited disease caused by a genetic mutation that can be passed from parent to offspring. Other types of noninfectious diseases are listed in table below.

Table
TYPES OF NONINFECTIOUS DISEASES

Type	Definition	Example
Inherited	A genetic disease	Sickle cell anaemia
Congenital	Disease that is present at or before birth	Down syndrome
Degenerative	Progressive, irreversible loss of function	Parkinson disease (affecting central nervous system)
Nutritional deficiency	Impaired body function due to lack of nutrients	Scurvy (vitamin C deficiency)
Endocrine	Disease involving malfunction of glands that release hormones to regulate body functions	Hypothyroidism – thyroid does not produce enough thyroid hormone, which is important for metabolism
Neoplastic	Abnormal growth (benign or malignant)	Some forms of cancer
Idiopathic	Disease for which the cause is unknown	Idiopathic juxta foveal retinal telangiectasia hh(dilated, twisted blood vessels in the retina of the eye)

The five periods of disease (sometimes referred to as stages or phases) include the incubation, prodromal, illness, decline, and convalescence periods

7) Acute and Chronic Diseases

The duration of the period of illness can vary greatly, depending on the pathogen, effectiveness of the immune response in the host, and any medical treatment received. For an **acute disease**, pathologic changes occur over a relatively short time (e.g., hours, days, or a few weeks) and involve a rapid onset of disease conditions. Forexample, influenza (caused by Influenzavirus) is considered an acute disease because the incubation period is approximately 1–2 days. Infected individuals can spread influenza to others for approximately 5 days after becoming ill. After approximately 1 week, individuals enter the period of decline.

For a **chronic disease**, pathologic changes can occur over longer time spans (e.g., months, years, or a lifetime). For example, chronic gastritis (inflammation of the lining of the stomach) is caused by the gram-negative bacterium *Helicobacter pylori*. *H. pylori* is able to colonize the stomach and persist in its highly acidic environment by producing the enzyme urease, which modifies the local acidity, allowing the bacteria to survive indefinitely.[2] Consequently, *H. pylori* infections can recur indefinitely unless the infection is cleared using antibiotics. Hepatitis B virus can cause a chronic infection in some patients who do not eliminate the virus after the acute illness. A chronic infection with hepatitis B virus is characterized by the continued production of infectious virus for 6 months or longer after the acute infection, as measured by the presence of viral antigen in blood samples.

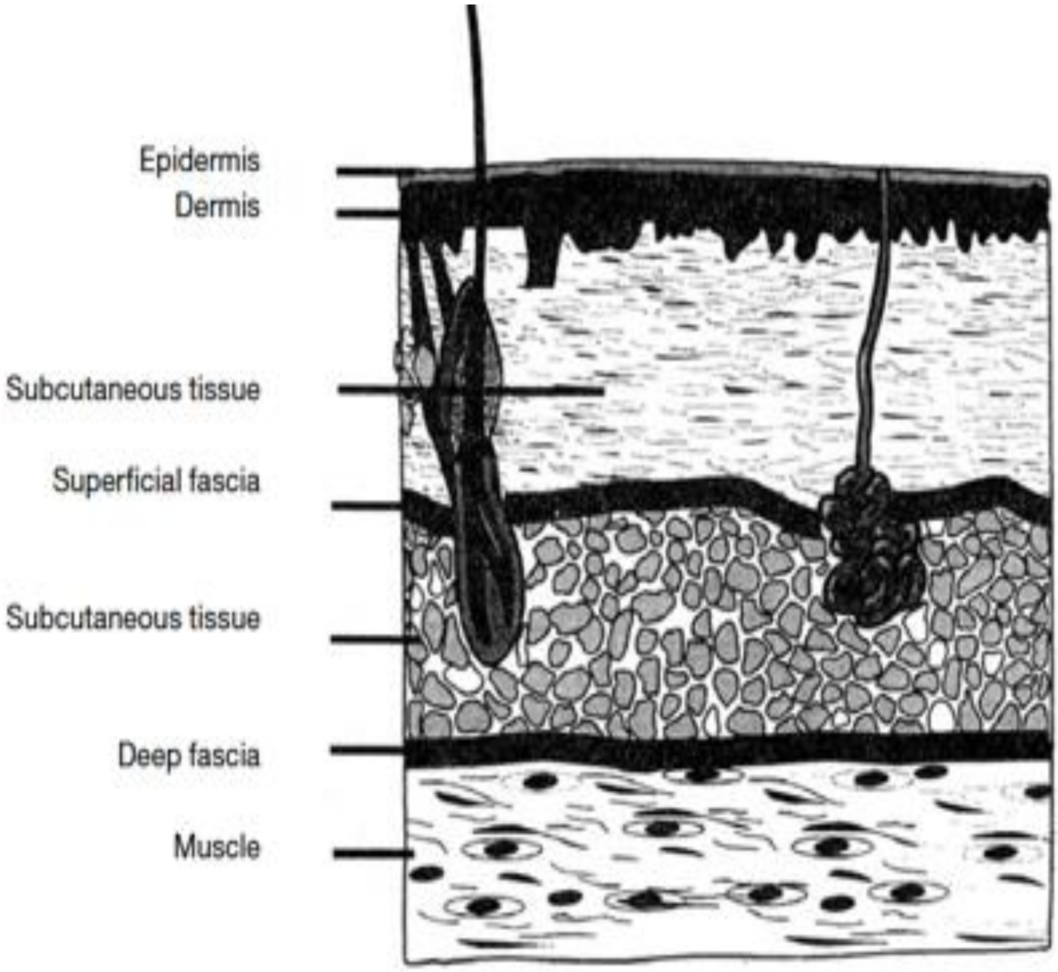
In **latent diseases**, as opposed to chronic infections, the causal pathogen goes dormant for extended periods of time with no active replication. Examples of diseases that go into a latent state after the acute infection include herpes (herpes simplex viruses [HSV-1 and HSV-2]) and chickenpox (varicella-zoster virus [VZV]).HSV-1, HSV-2, and VZV evade the host immune system by residing in a latent form within cells of the nervous system for long periods of time, but they can reactivate to become active infections during times of stress and immunosuppression. For example, an initial infection by VZV may result in a case of childhood chickenpox, followed by a long period of latency. The virus may reactivate decades later, causing episodes of shingles in adulthood.

3.14 HAND WASHING

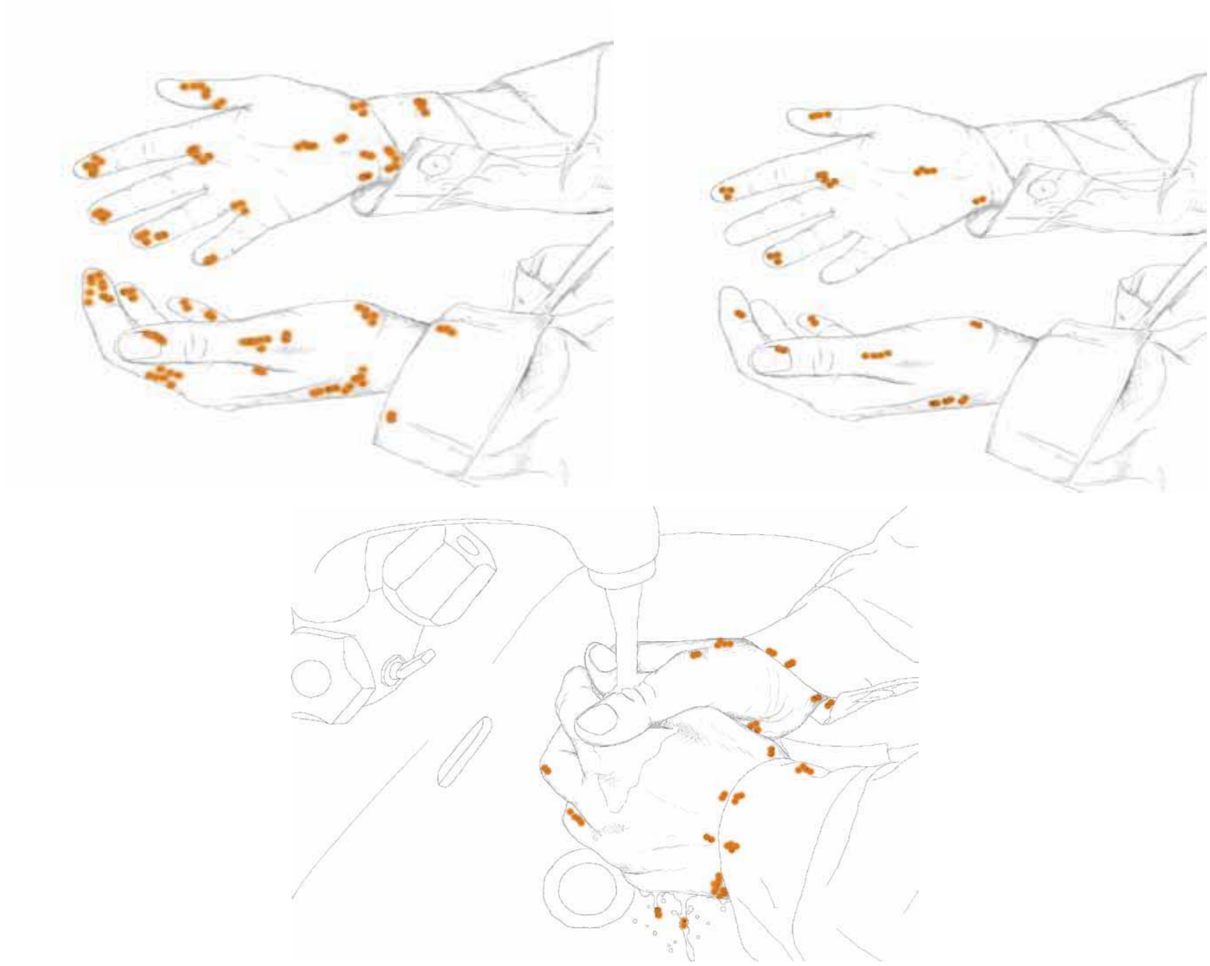
3.14 HAND WASHING

The World Health Organization defines critical moments for health-care worker hand hygiene, using the 'My 5 moments for hand hygiene approach'.

- Before touching a patient,
- Before aseptic procedures,
- After body fluid exposure/risk,
- After touching a patient, and
- After touching patient surroundings



Anatomical layers of the cutaneous tissue



Microorganisms (in this case Gram-positive cocci) survive on hands.

INCORRECT CLEANSING

Inappropriate handwashing can result in hands remaining contaminated, in this case, with Gram-positive cocci.

The figure intentionally shows that long-sleeved white coats may become contaminated by microorganisms during patient care.

WATER

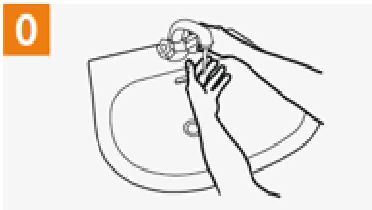
The purpose of routine handwashing in patient care is to remove dirt and organic material as well as microbial contamination acquired by contact with patients or the environment. While water is often called a “universal solvent”, it cannot directly remove hydrophobic substances such as fats and oils often present on soiled hands. Proper handwashing therefore requires the use of soaps or detergents to dissolve fatty materials and facilitate their subsequent flushing with water. To ensure proper hand hygiene, soap or detergent must be rubbed on all surfaces of both hands followed by thorough rinsing and drying. Thus, water alone is not suitable for cleaning soiled hands; soap or detergent must be applied as well as water.

HOW TO HANDRUB?

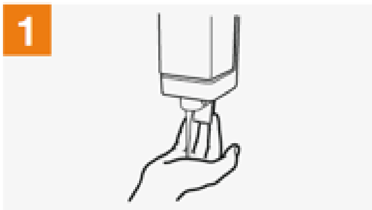
Hand hygiene technique with alcohol-based preparations

HOW TO HANDWASH?

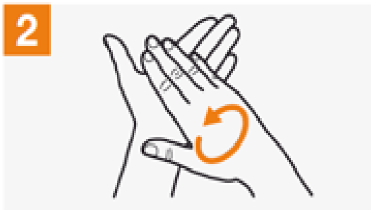
Duration of the entire procedure: 40-60 seconds



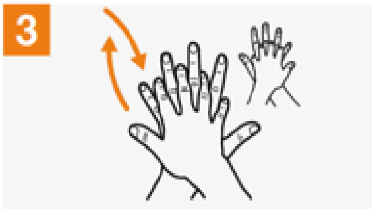
Wet hands with water;



Apply enough soap to cover all hand surfaces;



Rub hands palm to palm;

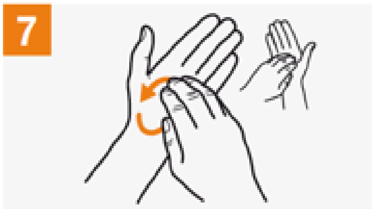


Right palm over left dorsum with interlaced fingers and vice versa;

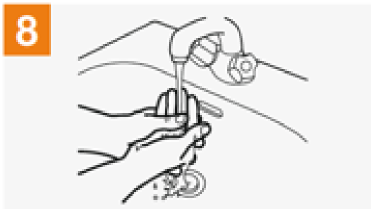
Palm to palm with fingers interlaced;

Backs of fingers to opposing palms with fingers interlocked;

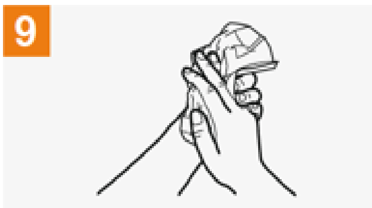
Rotational rubbing of left thumb clasped in right palm and vice versa;



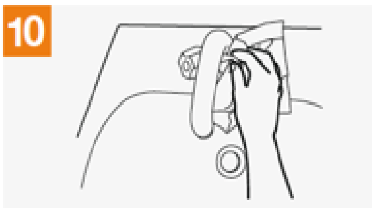
Rotational rubbing, backwards and forwards with clasped fingers of right hand in left palm and vice versa;



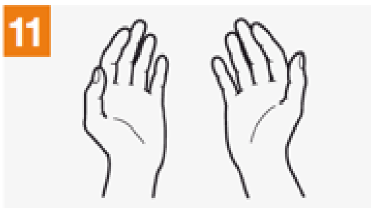
Rinse hands with water;



Dry hands thoroughly with a single use towel;



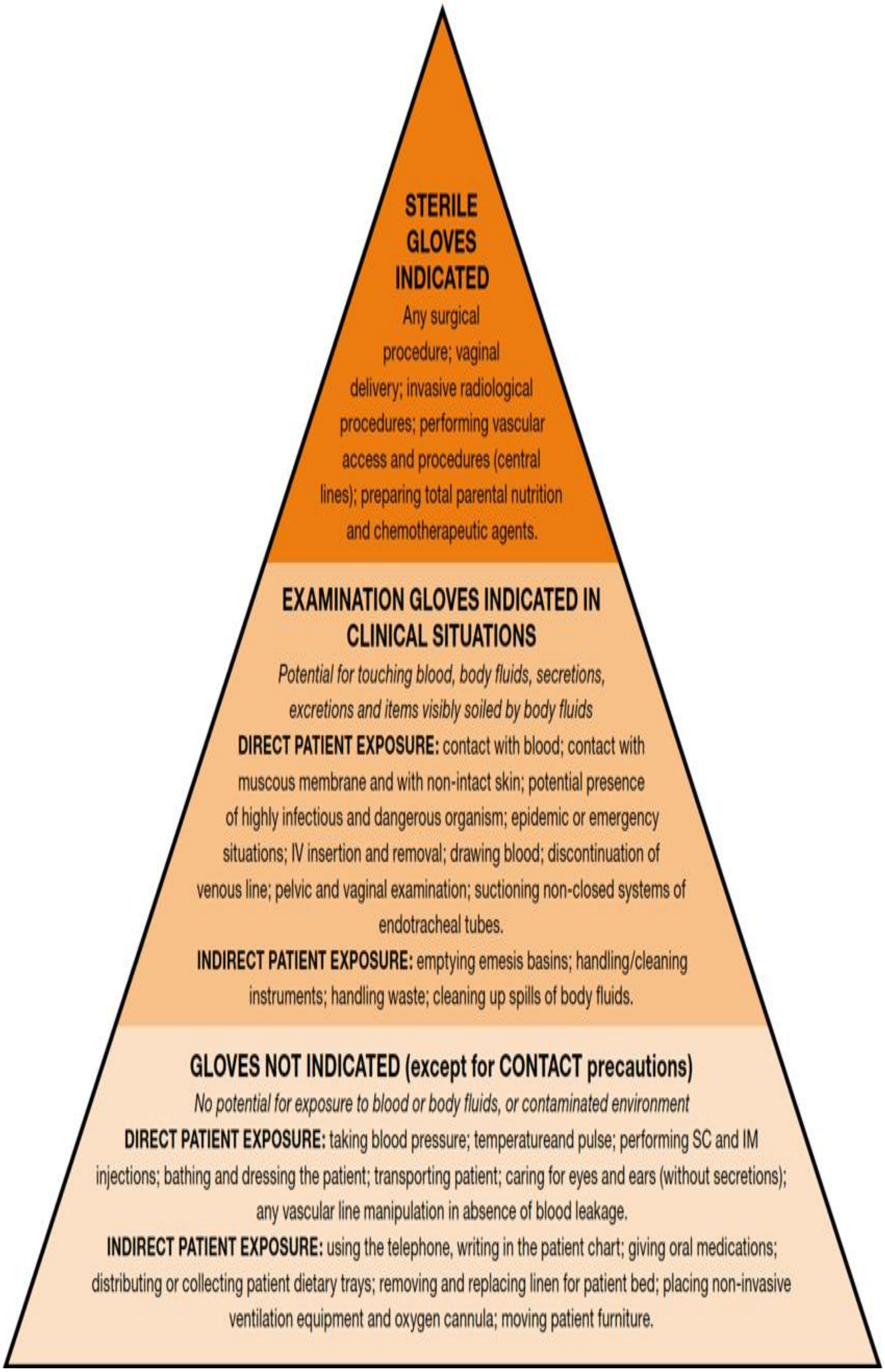
Use towel to turn off faucet;



Your hands are now safe.

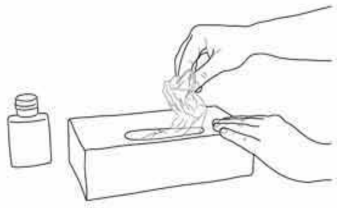
hand hygiene technique with soap and water

Situations requiring and not requiring glove use



When the hand hygiene indication occurs before a contact requiring glove use, perform hand hygiene by rubbing with an alcohol-based handrub or by washing with soap and water.

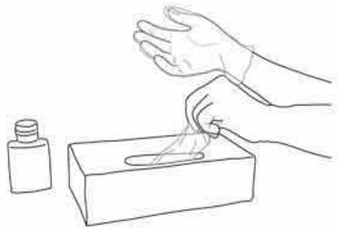
I. HOW TO DON GLOVES:



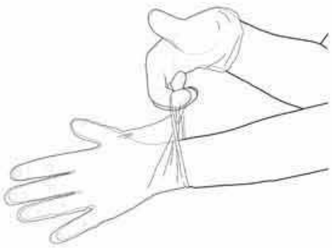
1. Take out a glove from its original box

2. Touch only a restricted surface of the glove corresponding to the wrist (at the top edge of the cuff)

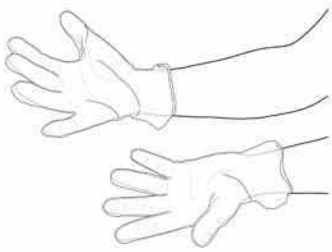
3. Don the first glove



4. Take the second glove with the bare hand and touch only a restricted surface of glove corresponding to the wrist

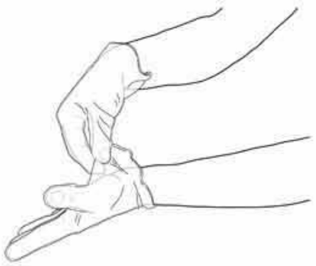


5. To avoid touching the skin of the forearm with the gloved hand, turn the external surface of the glove to be donned on the folded fingers of the gloved hand, thus permitting to glove the second hand

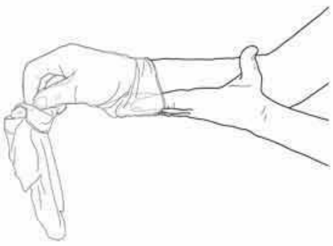


6. Once gloved, hands should not touch anything else that is not defined by indications and conditions for glove use

II. HOW TO REMOVE GLOVES:



1. Pinch one glove at the wrist level to remove it, without touching the skin of the forearm, and peel away from the hand, thus allowing the glove to turn inside out



2. Hold the removed glove in the gloved hand and slide the fingers of the unglo-ved hand inside between the glove and the wrist. Remove the second glove by rolling it down the hand and fold into the first glove

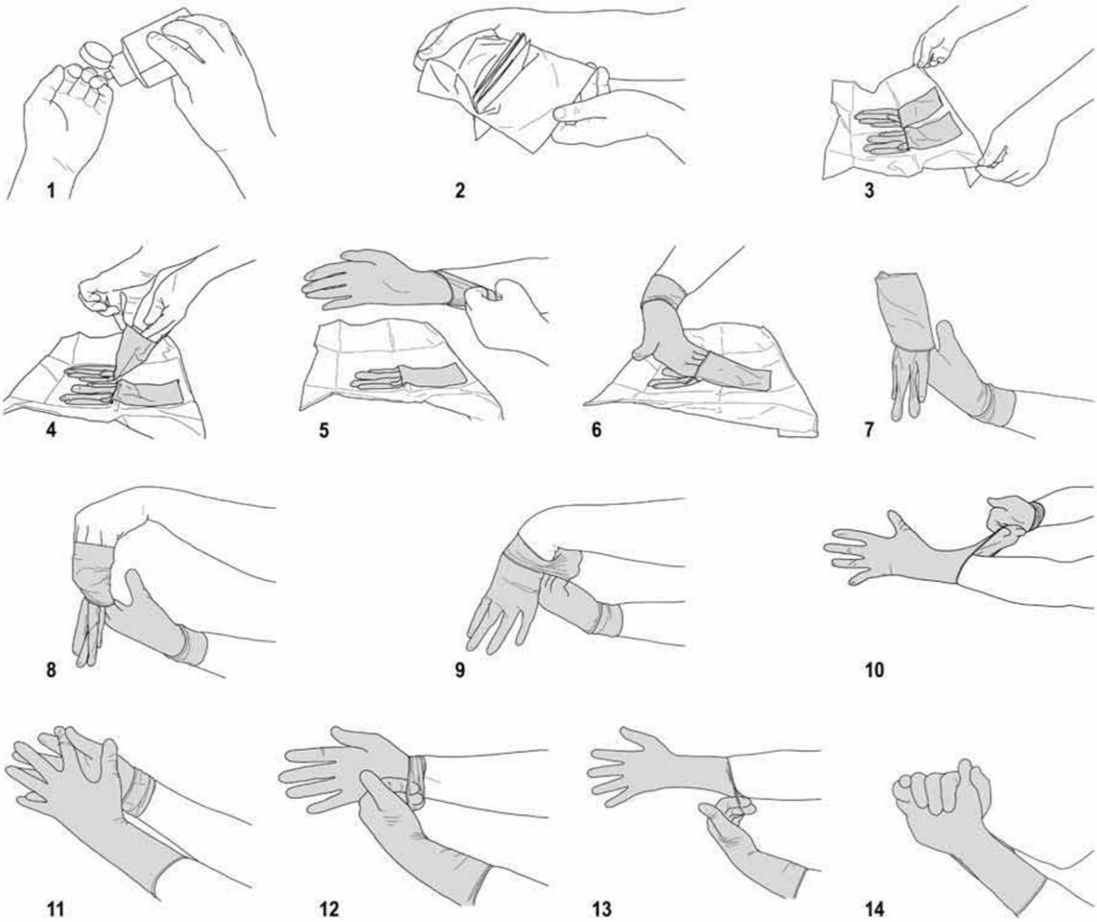
3. Discard the removed gloves

4. Then, perform hand hygiene by rubbing with an alcohol-based handrub or by washing with soap and water

How to don and remove sterile gloves

The purpose of this technique is to ensure maximum asepsis for the patient and to protect the health-care worker from the patient's body fluid(s). To achieve this goal, the skin of the health-care worker remains exclusively in contact with the inner surface of the glove and has no contact with the outer surface. Any error in the performance of this technique leads to a lack of asepsis requiring a change of gloves.

I. HOW TO DON STERILE GLOVES



1. Perform hand hygiene before an "aseptic procedure" by handrubbing or hand washing.
2. Check the package for integrity. Open the first non-sterile packaging by peeling it completely off the heat seal to expose the second sterile wrapper, but without touching it.
3. Place the second sterile package on a clean, dry surface without touching the surface. Open the package and fold it towards the bottom so as to unfold the paper and keep it open.
4. Using the thumb and index finger of one hand, carefully grasp the folded cuff edge of the glove.
5. Slip the other hand into the glove in a single movement, keeping the folded cuff at the wrist level.

6-7. Pick up the second glove by sliding the fingers of the gloved hand underneath the cuff of the glove.

8-10. In a single movement, slip the second glove on to the ungloved hand while avoiding any contact/resting of the gloved hand on surfaces other than the glove to be donned (contact/resting constitutes a lack of asepsis and requires a change of glove).

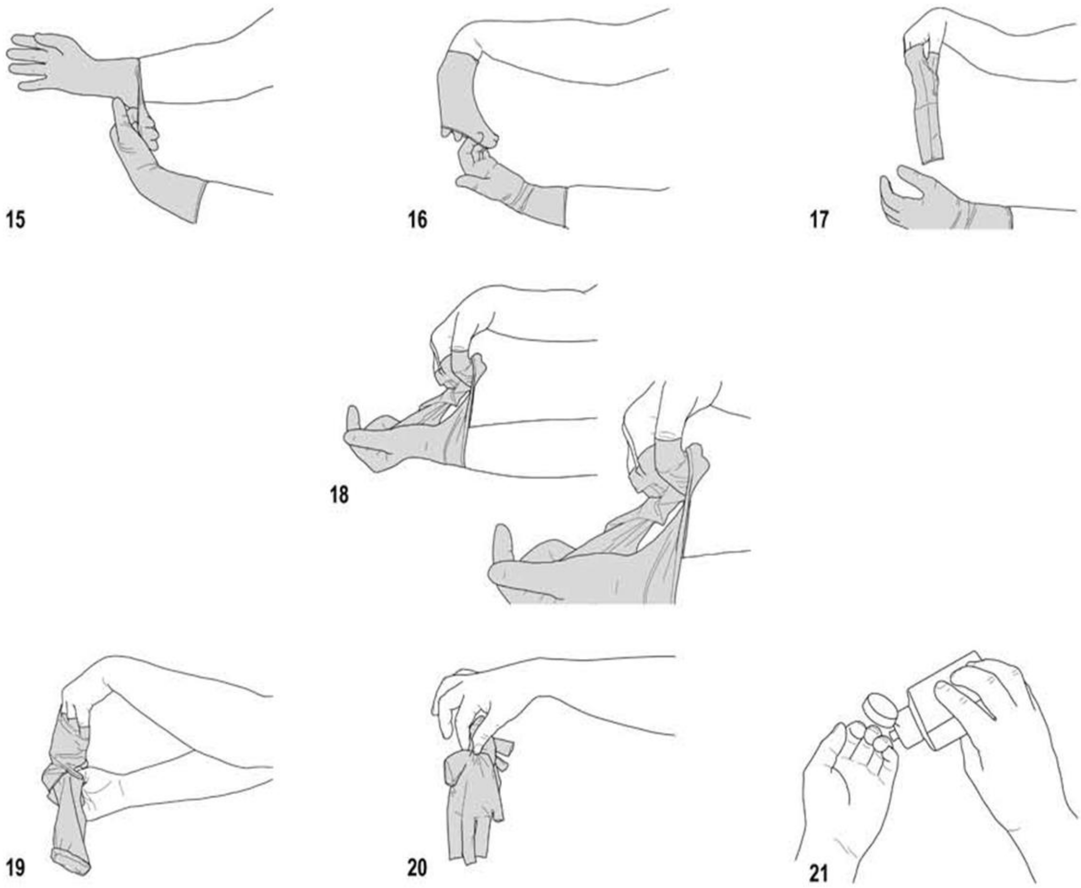
11. If necessary, after donning both gloves, adjust the fingers and interdigital spaces until the gloves fit comfortably.

12-13. Unfold the cuff of the first gloved hand by gently slipping the fingers of the other hand inside the fold, making sure to avoid any contact with a surface other than the outer surface of the glove (lack of asepsis requiring a change of gloves).

14. The hands are gloved and must touch exclusively sterile devices or the previously-disinfected patient's body area.

How to don and remove sterile gloves (Cont.)

II. HOW TO REMOVE STERILE GLOVES



15-17. Remove the first glove by peeling it back with the fingers of the opposite hand. Remove the glove by rolling it inside out to the second finger joints (do not remove completely).

18. Remove the other glove by turning its outer edge on the fingers of the partially ungloved hand.

19. Remove the glove by turning it inside out entirely to ensure that the skin of the health-care worker is always and exclusively in contact with the inner surface of the glove.

20. Discard gloves.

21. Perform hand hygiene after glove removal according to the recommended indication.

NB: Donning surgical sterile gloves at the time of a surgical intervention follows the same sequences except that:

- it is preceeded by a surgical hand preparation;
- donning gloves is performed after putting on the sterile surgical gown;
- the opening of the first packaging (non-sterile) is done by an assistant;
- the second packaging (sterile) is placed on a sterile surface other than that used for the intervention;
- gloves should cover the wrists of the sterile gown.

Crucial steps for hand hygiene action.

The handrubbing technique for surgical hand preparation must be performed on perfectly clean, dry hands.
On arrival in the operating theatre and after having donned theatre clothing (cap/hat/bonnet and mask), hands must be washed with soap and water.
After the operation when removing gloves, hands must be rubbed with an alcohol-based formulation or washed with soap and water if any residual talc or biological fluids are present (e.g. the glove is punctured).

Surgical procedures may be carried out one after the other without the need for handwashing, provided that the handrubbing technique for surgical hand preparation is followed (Images 1 to 17).

1

Put approximately 5ml (3 doses) of alcohol-based handrub in the palm of your left hand, using the elbow of your other arm to operate the dispenser

2

Dip the fingertips of your right hand in the handrub to decontaminate under the nails (5 seconds)

3

Images 3–7: Smear the handrub on the right forearm up to the elbow. Ensure that the whole skin area is covered by using circular movements around the forearm until the handrub has fully evaporated (10-15 seconds)

4

See legend for Image 3

5

See legend for Image 3

6

See legend for Image 3

7

See legend for Image 3

8

Put approximately 5ml (3 doses) of alcohol-based handrub in the palm of your right hand, using the elbow of your other arm to operate the dispenser

9

Dip the fingertips of your left hand in the handrub to decontaminate under the nails (5 seconds)

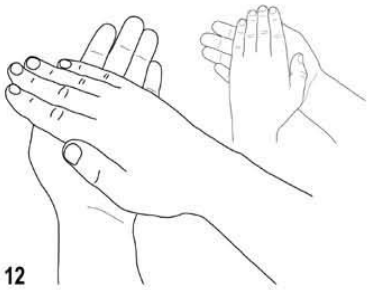
Surgical hand preparation technique with an alcohol-based handrub formulation

10

Smear the handrub on the left forearm up to the elbow. Ensure that the whole skin area is covered by using circular movements around the forearm until the handrub has fully evaporated (10-15 seconds)

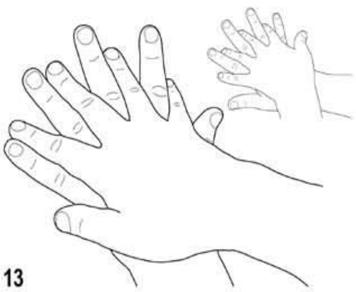
11

Put approximately 5ml (3 doses) of alcohol-based handrub in the palm of your left hand, using the elbow of your other arm to operate the distributor. Rub both hands at the same time up to the wrists, and ensure that all the steps represented in Images 12-17 are followed (20-30 seconds)



12

Cover the whole surface of the hands up to the wrist with alcohol-based handrub, rubbing palm against palm with a rotating movement



13

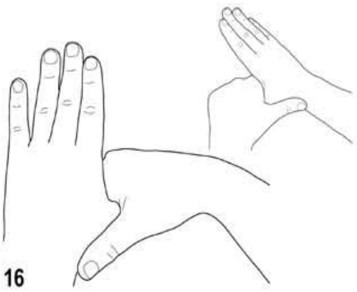
Rub the back of the left hand, including the wrist, moving the right palm back and forth, and vice-versa

14

Rub palm against palm back and forth with fingers interlinked

15

Rub the back of the fingers by holding them in the palm of the other hand with a sideways back and forth movement



16

Rub the thumb of the left hand by rotating it in the clasped palm of the right hand and vice versa

17

When the hands are dry, sterile surgical clothing and gloves can be donned

Repeat the above-illustrated sequence (average duration, 60 sec) according to the number of times corresponding to the total duration recommended by the manufacturer for surgical hand preparation with an alcohol-based handrub.

SECTION FOUR

NUTRITION

4.1 NUTRITION AND NUTRIENTS

4.1 NUTRITION AND NUTRIENTS

Nutrition is defined as the processes by which an animal or plant takes in and utilizes food substances. Essential nutrients include protein, carbohydrate, fat, vitamins, minerals and electrolytes. Normally, 85% of daily energy use is from fat and carbohydrates and 15% from protein. In humans, nutrition is mainly achieved through the process of putting foods into our mouths, chewing and swallowing it. The required amounts of the essential nutrients differ by age and the state of the body

Why is nutrition important?

Nutrition is essential for growth and development, health and wellbeing. Eating a healthy diet contributes to preventing future illness and improving quality and length of life. The nutritional status is the state of our health as determined by what we eat. There are several ways of assessing nutritional status, including anthropometric (i.e., physical body measurement), food intake and biochemical measurement.

The body mass index (BMI) is a good indicator of our nutritional status. It takes into account weight and height, and correlates well with total body fat expressed as a percentage of body weight. The correlation depends on age, with the highest correlation seen in ages 26–55 years and the lowest in the young and the elderly. Weight in kilograms divided by height in meters squared, gives the BMI.

Essential nutrient requirements

Nutrients can be described as the chemical components of food and can be classified into six broad groups: carbohydrates, proteins, fats, vitamins, minerals and water. Water is not technically a nutrient, but it is essential for the utilization of nutrients. Nutrients perform various functions in our bodies, including energy provision and maintaining vital processes such as digestion, breathing, growth and development.

The foods we eat contain nutrients. Those nutrients that contain carbon are called organic while those that do not contain carbon are called inorganic. Nutrients are substances required by the body to perform its basic functions. Since the human body does not synthesize nutrients, they must be obtained from the diet, making them essential. Eating inadequate amounts can cause poor health.

Nutrients are used to produce energy, detect and respond to environmental surroundings, move, excrete wastes, respire (breathe), grow, and reproduce. There are six classes of nutrients required for the body to function and maintain overall health. These are carbohydrates, lipids, proteins, water, vitamins, and minerals

MACRONUTRIENTS

Nutrients that are needed in large amounts (grams) are called macronutrients. There are three classes of macronutrients: carbohydrates, lipids, and proteins. These can be metabolically processed into cellular energy. The energy from macronutrients comes from their chemical bonds. This chemical energy is converted into cellular energy that is then utilized to perform work, allowing our bodies to conduct their basic functions. A unit of measurement of food energy is the calorie.

Carbohydrates

Carbohydrates can be classified as monosaccharide (e.g. glucose, fructose, galactose), disaccharide (e.g. sucrose, lactose, maltose) and polysaccharide (e.g. starch, fibre). Carbohydrates must be reduced to the simplest form of glucose (through digestion) before your body can make use of them. Carbohydrates should make up at least 55% of your total energy intake. The brain is a special part of the body that depends primarily on glucose for its energy and requires about 100 g/day of glucose for fuel. In some situations, the body can compensate for decreased levels of carbohydrates by using alternative energy pathways such as burning fatty acids.

Grains

Is the first group from which one has to eat a relatively large amount. Grains are foods that contain mainly starch (carbohydrates) and a certain amount of proteins. For example: bread, noodles, potatoes, oats, corn, wheat, rice, morning cereals. Most of the foods in this group also contain fibers (especially when they are eaten as whole grain), vitamins and minerals.

Vegetables and fruits

Vegetables and fruits contain carbohydrates (sugars), water, fiber, vitamins and minerals. For example, vegetables and fruits rich in vitamin C: cabbage, tomato, pepper, lettuce, citrus fruits, kiwi, melon, strawberry. It is advisable to eat unpeeled vegetables and fruits as much as possible. It is recommended to include vegetables and fruits of different colors in every meal. Vegetables contain less sugar and calories compared with fruits; therefore, It is recommended to maintain a ratio of 2/3 vegetables and 1/3 fruits.

Protein

Protein is important for the production, maintenance, and repair of tissues in the body. When energy intake is insufficient, protein intake must be raised. This is because ingested proteins are preferentially directed towards glucose (sugar) synthesis and oxidation. The tissues and organs in the body, enzymes, antibodies and hormones are made of protiens.The building blocks of protein are called amino acids. The body can make all of the 20 amino acids except eight, which are termed essential amino acids.

For adults, the recommended dietary allowance of protein is about 0.75 g/kg body weight per day. Animal products tend to have the highest amount of proteins, followed by legumes (beans), cereals (rice, wheat, corn) and roots. Animal protein (from meat, eggs, fish, milk) contains all the essential amino acids and is normally referred to as ‘complete’ or ‘high biological value’ protein.

Protein derived from plants lack one or two essential amino acids. However, a good combination of plant-based protein can be of equal value to animal protein. For example, legumes lack methionine but have adequate amounts of lysine. Cereals, on the other hand, lack lysine but have a lot of methionine. Therefore, a mixture of rice and beans will supply all the essential amino acids. Excess protein cannot be stored in the body, so we need to consume protein daily.

Protein rich foods

This group contains meat products (source of iron), milk products (source of calcium), eggs and legumes (source of iron and calcium). The group provides other components: zinc, vitamin B12– in animal products, fiber – in legumes, Omega 3 – in fish. It is recommended to diversify and eat animal products (meat, chicken, fish, milk, eggs) and plant products (legumes like lentils, beans, humus). It is recommended to consume low fat foods: cheese up to 5%, milk and yogurt 1-3%, lean, skinless meat products.

Fats and oils

Most of the fats we consume occur in foods as triglycerides. A triglyceride is comprised of three fatty acid molecules attached to a glycerol molecule. Monounsaturated fats are found mainly in nuts, avocados, olive oil, canola oil, grapeseed oil, peanut oil, flaxseed oil, sesame oil, corn oil, safflower oil, sunflower oil, etc.

Fats are a concentrated and rich source of energy. It is recommended that the total fat intake is no more than 30% of one's energy (calorie/kilojoule) intake. Polyunsaturated fat should be less than 10% of energy, and saturated fat and trans-fat together should be less than 10%. The rest of the fat intake should consist of monounsaturated fat.

Oil rich foods

This food group contains foods like oil, avocado, mayonnaise, nuts, almonds, olives, margarine, butter. These foods are important to one's health, but the body needs them in moderation. From this group it is recommended to use the foods rich in various types of unsaturated fats, like vegetable oils, instead of foods rich in saturated fat of animal sources (e.g., butter), or in plants (such as hard margarine). Cholesterol (of animal source) and trans-fat (from processed foods) are not recommended.

Sweets, snacks and sweet beverages

This group contains foods rich in fat and sugar and oftentimes also salt. These foods are not essential to the physical and nutritional health but are associated with eating and cultural habits. It is recommended to eat these foods sparingly.

VITAMINS

These constitute a group of nutrients that are needed in small quantities. Like amino and fatty acids, most vitamins cannot be made in the body and must be obtained from dietary sources. Only vitamin D can be manufactured by the body. Essential vitamins are grouped into two families: water soluble and fat soluble.

Water soluble vitamins can dissolve in water (thiamine, riboflavin, niacin, vitamin C, folic acid). These cannot be stored by the body and need to be consumed every day.

Fat soluble vitamins can dissolve in a fat medium (vitamins A, D, E, K). These are taken into our bodies when we consume fat-containing foods. Vitamins are needed for various reasons, including the formation of hormones and blood cells. They generally act as coenzymes. An inadequate supply of vitamins in our diet leads to the development of diseases.

Vitamin A:

Derived from carotene, vitamin A affects vision, reproduction, and the formation and maintenance of skin, mucous membranes, bones and teeth. Deficiency results in night blindness (difficulty in adapting to darkness). The body obtains vitamin A from either carotene (vitamin A precursor) or by absorbing ready-made vitamin A from plant-eating organisms. Carotene is found in dark green leafy vegetables and yellow-orange fruit/vegetables. Preformed vitamin A is found in milk, butter, cheese, egg yolk, liver, and fish-liver oil.

Vitamin B complex:

The vitamin B complex is a mixture of eight essential vitamins necessary to enhance immune and nervous system function, and promote cell growth and division. Pregnant or lactating women, alcoholics and the elderly are more likely to suffer from vitamin B deficiency.

Vitamin B1 (thiamine):

Thiamine, or vitamin B1, acts as a catalyst in carbohydrate metabolism. Thiamine deficiency causes beriberi, a vitamin deficiency disorder characterized by muscular weakness, swelling of the heart and leg cramps. In severe cases, beriberi may lead to heart failure and death. The richest dietary sources of thiamine are organ meats (liver, heart, and kidney), brewer’s yeast, lean meats, eggs, leafy green vegetables, whole or enriched cereals, wheat germ, berries, nuts, and legumes.

Vitamin B2 (riboflavin):

Riboflavin, or vitamin B2, acts as a coenzyme in the metabolism of carbohydrates, fats, and respiratory proteins. The best sources of riboflavin are liver, milk, meat, dark green vegetables, whole grain and enriched cereals, pasta, bread and mushrooms.

Vitamin B6 (pyroxidine):

Pyridoxine, or vitamin B6, is necessary for the absorption and metabolism of amino acids. It also plays a role in the body’s use of fats and in the formation of red blood cells. The best sources of pyridoxine are whole grains, cereals, bread, liver, avocados, spinach, green beans and bananas.

Folic acid (vitamin B9 or folacin):

Folic acid is a coenzyme needed for forming body protein and haemoglobin. Folic acid deficiency is associated with neural tube defects. Dietary sources are organ meats, leafy green vegetables, legumes, nuts, whole grains and brewer’s yeast. Folic acid is lost in foods stored at room temperature and during cooking.

MINERALS

Minerals are essential, acting as cofactors of enzymes (i.e. enzymes would not exist or function without minerals). Some of the minerals necessary for health are:

Calcium:

Calcium is a very important mineral in the diet, especially for women at menopause. The major function of calcium is to build and help maintain strong bones. It can stop the onset of osteoporosis and reduce bone loss and fragility. It is involved in blood clotting. Calcium deficiency can develop when there is a lack of vitamin D.

Iron:

Iron in food exists as haem and non-haem iron. Haem iron, found in red meat, is relatively well (20–30%) absorbed. Non-haem iron, found mostly in cereals, pulses, certain vegetables (e.g., spinach) and eggs, is generally less well absorbed. Non-haem iron absorption depends on other factors in the diet. For example, vitamin C and animal protein enhance non-haem iron absorption, while tea, coffee and phytates inhibit it.

Zinc:

Zinc represents only 0.003% of the human body, but is essential for synthesizing protein, DNA and RNA. It is required for growth in all stages of life. Sources include meats, oysters and other seafood, milk, and egg yolk.

4.2 ENERGY CONTENT OF NUTRIENTS

4.2 ENERGY CONTENT OF NUTRIENTS

The energy requirement depends on your age, size and activity level. If your energy intake equals the amount of energy you expend, then you are in energy balance. If your intake exceeds your expenditure, the excess energy is converted to body fat and you gain weight. On the other hand, if your intake is less than your expenditure, your body uses up fat stores, and you lose weight. Therefore, for weight to remain stable, the total amount of calories that are consumed must not exceed the total that is used up through metabolic processes (e.g., exercising, sweating, breathing). Energy intake must match energy output. The average energy intake is about 2800 kcal/day for men and 1800 kcal/day for women, although this varies with body size and activity level.

CALORIE:

The qualitative food requirements are estimated in term of energy is calories. Physiologic calorie is the unit of energy, which is the amount of heat necessary to raise the temperature of one gram of water by 1ºC, from 14.5ºC to 15.5ºC. often used to measure the energy value of foods.

A kilocalorie is the amount of heat taken to raise the temperature of 1000 g (1 Liter) of water by $1^{O}C$.

As calorie is such a tiny measure of heat, food energy is more often expressed in terms of a kilocalorie, which is equal to 1000 calories.

	1gm protein provides	4 calories
	1 gm carbohydrate provides	4 calories
	1 gm fats provide	9 calories
And	1 kilocalorie =	42 kilojoules

On nutrition food labels the amount given for “calories” is actually equivalent to each calorie multiplied by one thousand. A kilocalorie (one thousand calories, denoted with a small “c”) is synonymous with the “Calorie” (with a capital “C”) on nutrition food labels.

Water is also a macronutrient in the sense that you require a large amount of it, but unlike the other macronutrients it does not yield calories.

Energy Content of Nutrients

Nutrients provide the energy necessary to perform body functions by utilizing carbohydrates, fats and proteins. Foods generally contain more than one form of these energy sources. The energy in food is often measured in terms of calories.

BASIC FOOD GROUPS

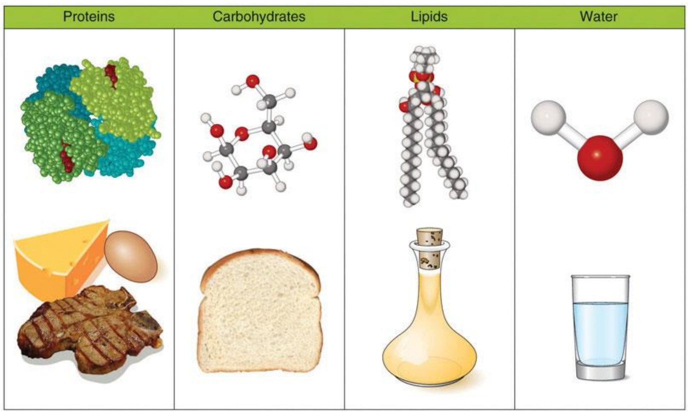
To enjoy full health, the body foods must contain all the essential food nutrients. According to the nature of the work they perform, these nutrients are divided in three groups.

- Growth Foods for growth, repair and maintenance
- Energy Foods for energy and maintenance of body temperature
- Protective Foods for health and protection against disease

Carbohydrates

Carbohydrates are molecules composed of carbon, hydrogen, and oxygen. The major food sources of carbohydrates are grains, milk, fruits, and vegetables, including starchy vegetables like potatoes. Nonstarchy vegetables also contain carbohydrates but in lesser quantities. Carbohydrates are broadly classified into two forms based on their chemical structure: fast-releasing carbohydrates often called simple sugars, and complex or slow-releasing carbohydrates also called polysaccharides.

Fast-releasing carbohydrates consist of one or two basic units. Examples of simple sugars include sucrose, the type of sugar you would have in a bowl on the breakfast table, and glucose, the type of sugar that circulates in your blood.



The Macronutrients: Carbohydrates, Lipids, Protein, and Water

Slow-releasing or complex carbohydrates are long chains of simple sugars that can be branched or unbranched. Starch is an example of a slow-releasing carbohydrate. During digestion, the small intestine breaks down all slow-releasing carbohydrates to simple sugars, mostly glucose. Glucose is then absorbed and transported to all our cells where it is stored in the form of glycogen, used to make energy, or used to build macromolecules. Fiber is also a slow-releasing carbohydrate, but it cannot be broken down in the human body and passes through the digestive tract undigested unless the bacteria that inhabit the gut break it down.

One gram of carbohydrates yields four calories of energy for the cells in the body to perform work. In addition to providing energy and serving as building blocks for bigger macromolecules, carbohydrates are essential for proper functioning of the nervous system, heart, and kidneys. As mentioned, glucose can be stored in the body for future use. In humans, the storage molecule of carbohydrates is called glycogen and in plants, it is known as starches. Glycogen and starches are slow-releasing carbohydrates.

Lipids

Lipids are also a family of molecules composed of carbon, hydrogen, and oxygen, but unlike carbohydrates, they are insoluble in water. This class of molecules may be visible (for example vegetable oil) or invisible (for example, cream) in the food you eat. Lipids are found predominately in butter, oils, meats, dairy products, nuts, and seeds, and in many processed foods. The three main types of lipids are triglycerides (also called triacylglycerols), phospholipids, and sterols. The main job of lipids is to store energy. Lipids provide more energy per gram than carbohydrates (nine calories per gram of lipids versus four kilocalories per gram of carbohydrates). In addition to energy storage, lipids serve as cell membranes, surround and protect organs, aid in temperature regulation, and regulate many other functions in the body. The main job of lipids is to store energy

Proteins

Proteins are macromolecules composed of chains of subunits called amino acids which are called the building blocks of protein. Amino acids are simple subunits composed of carbon, oxygen, hydrogen, and nitrogen. The food sources of protein come from animals such as meats, dairy products, seafood, and a variety of different plant-based foods, for example, soy, beans, and nuts.

The word protein comes from a Greek word meaning “of primary importance,” which is an apt description of these macronutrients; they are also known colloquially as the “workhorses” of life. Proteins provide four kilocalories of energy per gram; however, providing energy is not protein’s most important function. Proteins provide structure to bones, muscles, and skin, and play a role in conducting most of the chemical reactions that take place in the body. Scientists estimate that greater than one-hundred thousand different proteins exist within the human body.

Water

There is one other nutrient that we must have in large quantities: water. Water does not contain carbon but is composed of two hydrogens and one oxygen per molecule of water. More than 60 percent of our total body weight is water. Without it, nothing could be transported in or out of the body, chemical reactions would not occur (acts as a solvent), organs would not be cushioned, joints would not be lubricated, and body temperature would fluctuate widely.

On average, an adult consumes just over two liters of water per day from food and drink. According to the “rule of threes,” a generalization supported by survival experts, a person can survive three minutes without oxygen, three days without water, and three weeks without food.

MICRONUTRIENTS

Micronutrients are nutrients required by the body in lesser amounts but are still essential for carrying out bodily functions. Micronutrients include all the essential minerals and vitamins. There are thirteen vitamins and sixteen essential minerals

In contrast to carbohydrates, lipids, and proteins, micronutrients are not directly used for making energy, but they assist in the process as being part of enzymes (i.e., coenzymes). Enzymes are proteins that catalyze chemical reactions in the body and are involved in all aspects of body functions from producing energy to digesting nutrients to building macromolecules. Micronutrients play many roles in the body.

Vitamins

The thirteen vitamins are organic compounds (carbon-based) categorized as either water soluble or fat-soluble. The water-soluble vitamins are vitamin C and all the B vitamins, which include thiamine, riboflavin, niacin, pantothenic acid, pyridoxine, biotin, folate, and cobalamin. The fat-soluble vitamins are A, D, E, and K. Vitamins are required to perform many functions in the body (regulatory and metabolic capacity) such as making red blood cells, synthesizing bone tissue, and playing a role in normal vision, nervous system function, and immune system function. Some function in chemical reactions involved in the release of energy from carbohydrates, fat, protein, and alcohol. Vitamins do not supply energy directly and are not structural; they enable chemical reactions to occur.

Many vitamins are needed to prevent certain disorders and diseases such as scurvy (vitamin C), night blindness (vitamin A), and rickets (vitamin D).

Minerals

Minerals are solid inorganic substances that form crystals and are classified depending on how much of them we need. Trace minerals, such as molybdenum, selenium, zinc, iron, and iodine, are only required in a few milligrams or less or others like calcium, magnesium, potassium, sodium, and phosphorus, are required in hundreds of milligrams. Minerals function in structural, regulatory, and metabolic capacities. Building bone and teeth are an example of a structural function; while maintaining fluid balance, building bone tissue, synthesizing hormones, transmitting nerve impulses, contracting and relaxing muscles, and protecting against harmful free radicals are examples of regulatory and metabolic processes. Minerals do not supply energy directly.

Food Energy and Food Quality

In everyday life, you have probably heard people talk about how many Calories they burned on the treadmill or how many Calories are listed on a bag of chips. Calories are a measure of energy. It takes quite a lot of Calories (energy) to keep us alive. Even if a person is in a coma, they still burn approximately 1000 Calories of energy in order for their heart to beat, their blood to circulate, their lungs to breathe, etc... We burn even more calories when we exercise. The carbohydrates, fats, and proteins we eat and drink provide calories for us (and alcohol as well if we choose to consume it). Sometimes people refer to these nutrients as "energy yielding". As you read above, carbohydrates provide 4 Calories for every gram we consume; proteins provide 4 Calories for every gram we consume; fats provide 9 Calories for every gram we consume, and alcohol provides 7 Calories of energy for every gram we consume. Vitamins, minerals, and water do not provide any calories, even though they are still essential nutrients.

4.3 BASAL METABOLISM

4.3 BASAL METABOLISM

Definition of BMR

BMR is defined as the energy expenditure of a subject at complete physical and mental rest, awake (and not during sleep) having normal body temperature and in the post absorption state (12 hours after the last meal) and 8–12 hours after any significant physical activity.

Basal metabolism (Basal Metabolic Rate BMR) is the energy expenditure necessary to maintain basic physiologic conditions such as:

1) The activity of the heart
2) Respiration
3) Conduction of nerve impulses
4) Ion transport across membranes
5) Reabsorption in the kidney, and
6) Metabolic activity such as synthesis of macromolecules under standard conditions.

About 60% or more of the energy the average person spends goes to support the ongoing metabolic work of the body's cells, the basic metabolism. This is the work that goes on all the time, without conscious awareness, e.g., beating of the heart, inhaling and exhaling of air, maintenance of the body temperature and sending nerve and hormonal messages to direct these activities are the basal procedures that maintain life.

Basal metabolism refers to the minimum energy requirement of an individual to maintain vital processes at complete rest, in a comfortable and relaxed position both physically and mentally. It depends on such factors as age, sex, and race, state of nutrition, surface area, external temperature and pathological conditions. These factors have to be considered in deciding whether the basal metabolic rate (BMR) of an individual is within the normal range of (+ or –)10%. If above 10%; BMR is higher and if below 10%; BMR is lower than normal. Basal Metabolic Rate (BMR) is the amount of heat given out per square metre of body surface per hour. It has been estimated that the BMR of an adult male is 40 calories per square metre of the body surface per hour. It is 37 for women, 44 for boys above 15 years, 50 for boys between 12 and 13 years.

The calorie requirement of an adult male of surface area 1.75 square metres in 24 hours will be: $40 \times 1.75 \times 24 = 1680$ or 1700 calories.

Basal metabolic needs are surprisingly large. A person whose total energy expenditure amounts to 2000 calories per day spends as much as 1200–1400 calories to support usual metabolism. The basal metabolic rate accounts for about 60 to 75% of the calories you burn every day.

Factors influencing total energy requirements

Muscular activity:

Physical activity requires largest number of calories. Sedentary work like bookkeeping, typing and teaching do not require more energy than nursing, working at home or gardening.

Temperament:

People with nervous temperament burn more calories.

Effect of food:

If high protein foods are eaten the metabolic rate is increased by 30%.

Maintenance of body temperature:

When body is subjected to extreme cold, shivering sets in, this results in an increase of the metabolic rate. For every rise of body temperature by 1^{O}F, BMR is raised by 7% (14% for each Celsius degree).

Growth:

The calorie requirements are highest of an infant i.e.,120 calories/kg body weight/hour. It declines gradually throughout childhood and accelerates slightly in adolescence and decreases still further to 1 or 0.9 calories/kg body weight for an adult.

FACTORS AFFECTING BMR

BMR differs among different individuals and depends on:

a) Variable factors
b) Invariable factors

Variable factors affecting BMR

- Nutritional state: BMR is low in starvation and undernourishment as compared to well fed state. Starvation leads to an adaptive decrease in BMR, which results from a decrease in lean body mass.
- Body size or surface area: The BMR is directly proportional to the surface area of the subject. Larger the surface area, greater will be the heat loss and equally higher will be the heat production and BMR.
- Body composition: The BMR is proportionate to lean body mass (LBM). LBM is the body weight minus non-essential (storage triacyl glycerol) weight. Adipose tissue is not as metabolically active as lean body mass. BMR is often expressed as per kilogram of lean body mass or fat free mass. Therefore, higher the percentage of adipose tissue in the body lower the BMR/ kg body weight.
- Endocrinal or hormonal state: In hyperthyroidism, the BMR is increased and in hypothyroidism it may be decreased by up to 40%, leading to weight loss.

- Environmental temperature or climate: In colder climate the BMR is higher and in tropical climate the BMR is proportionately low. Stress, anxiety and disease states, especially infections, fever, burns and cancer also increases the BMR.
- Drugs: Smoking (nicotine), coffee (coffine) and tea (theophylline) increase the BMR whereas β-blockers tend to decrease energy expenditure

Invariable factors affecting BMR

a) Gender or sex:

The BMR of males is slightly higher than that of females particularly due to:

- Womens lower percentage of muscle mass (lean body mass) and higher percentage of adipose tissue (that has lower rate of metabolism) when compared to men of the same body weight, and.
- The difference in sex hormone profile of the two genders.

b) Age:

Decrease in BMR with increasing age is probably related to loss of muscle mass (lean body mass) and replacement of muscle with adipose tissue that has lower rate of metabolism.

Normal Value of BMR • BMR values are expressed as K cal or KJ per square meter of body surface per hour. In adults BMR for:- Healthy males is 40 K cal (168 KJ) per hour and healthy females is 37 K cal (155 KJ) per hour. This means that the total caloric expenditure in 24 hours to complete basal state is 1800 K cal (7500 Kj) for adult males and1400 K cal (5859 KJ) for females assuming that the total body surface across are 1.8 sqm and 1.6 sqm respectively.

CLINICAL APPLICATIONS OF BMR

BMR estimation is used to diagnose thyroid disorders and in calculating food and drug requirements.

Physical activity

Physical activity is the largest variable affecting energy expenditure and represents 20–40% of the energy expenditure.

The reference man is in the age group of 20- 39 years. With a weight of 55 Kgs without any disease and with a capacity to perform 8 hours of moderate activity.

When not engaged in work, a reference man spends 8 hours in bed and 4 to 6 hours in moving around or in a sitting position and 2 hours either walking or doing household activities.

In the case of a reference woman, the difference is only in her body weight (45 Kg). Instead of the physical activity of the occupation, the woman does household duties. Other conditions are the same in case of a reference man. The energy expenditure for men and woman is calculated considering their internal and external activities.

CLASSIFICATION OF ACTIVITIES BASED ON OCCUPATION

Sedantary

- Male: Teacher, tailor, priest, executive, shoemaker, retired personnel, landlords peon.
- Female: Teacher, nurse, housewife, executive.

Moderate

- Male: Fisherman, weaver driver, porter, fitter, turner, carpenter, agricultural labourer.
- Female: Servant maid, basket maker, beedi maker.

Heavy

- Male: Stone cutter, blacksmith, mineworker, wood cutter.
- Female: Stone cutter etc.

The activities which demand maximum energy are in the following order.

Walking very fast, severe exercise, running, swimming, labourer's work, carpentry, metal and industrial work, walking slowly, laundry work and ironing.

BMR in Pregnancy

Additional energy is needed for the growth of the foetus, placenta and tissues during pregnancy. The BMR is also increased due to increased internal activities.

- Daily 150 K cals during the first semester and 300 K cal during the rest of the pregnancy is recommended. The energy cost during the term of pregnancy is 62,500 K cals.
- Additional energy requirements during lactation is for the secretion of milk. For a normal output of 850 ml per day, during the first six months, 550 K cal per day is recommended.

Energy intake and expenditure

Thermogenic effect of food

Thermic Effect of Food (TEF) is the energy used to digest food and absorb and further process the nutrients recently consumed. It is called diet induced thermogenesis. It is energy spend for digestion, absorption and storage of food. It is about 5-10% of total energy expenditure.

4.4 ROLE OF NUTRITION IN HEALTH MAINTENANCE

4.4 ROLE OF NUTRITION IN HEALTH MAINTENANCE

Following are a few definitions related to food and nutrition to help you understand this topic better

Nutrition: Nutrition is defined as the science of food, the nutrients, and substances therein, their action, interaction and balance in relation to health and disease, and the process by which the person/organism ingests, digests, absorbs, transports, utilizes and excretes food substances

Dietic: It is the practical application of the principles of nutrition which includes planning of meals for the healthy as well as the sick, e..g: "eat less meat, do not eat this or that vegetable"

Food is what we eat and is the source of nutrients for the body. Food when eaten not only satisfies our hunger but also serves a specific purpose. Food provides both energy and the materials needed to build and maintain all body cells.

Diet: refers to whatever people eat, drink each day. It includes the normal diet people consume and the diet people consume in groups but will also be modified for the sick as part of their therapy t is according to the need of the body i.e: considering its health conditions

The science of nutrition is the study of what happens to the various foods eaten and how they are absorbed in blood and carried to the trillions of cells in the body, where they are used for building and repair of tissues and also to produce heat and energy. Adequate nutrition is essential to health. Nutrition depends on the provision of the correct amount of nutrients. It is an important factor in preserving life, promoting growth, maintaining health and resisting disease.

Nutrients are the nourishing substances in food that are essential for growth of the infant, development from childhood to adulthood, and the maintenance of body functions throughout the life. Nutrients are found in different foods in variable quantities to prevent dietary deficiencies and other disorders thus protecting the humans from diseases.

NUTRITION AND HEALTH

Nutrition plays a very important role in our bodies.

1) Nutrition helps growth and development
2) Prevents malnutrition
3) Resists infection and
4) Prevents diseases (decrease morbidity and mortality)

Nutrition helps growth and development

According to Mental Health Organization in UK: Nearly two thirds of those who do not report daily mental health problems eat fresh fruit or fruit juice every day. This pattern is similar for fresh vegetables and salad. Those who report some level of mental health problem also eat fewer healthy foods (fresh fruit and vegetables, organic foods and meals made from scratch) and more unhealthy foods (chips and crisps, chocolate, ready meals and takeaways).

A balanced mood and feelings of wellbeing can be protected by ensuring that our diet provides adequate amounts of complex carbohydrates, essential fats, amino acids, vitamins and minerals and water.

Nutrition is a critical part of health and development. Better nutrition is related to improved infant, child and maternal health, stronger immune systems, safer pregnancy and childbirth, lower risk of non-communicable diseases (such as diabetes and cardiovascular disease), and longevity. Healthy children learn better. People with adequate nutrition are more productive and can create opportunities to gradually break the cycles of poverty and hunger.

Nutritional needs at different stages of the lifecycle. The nutrient requirements during the four main stages of the human lifecycle vary considerably. What infants and children require is different from what adults and the elderly need. In addition, there might be specific nutrients which a pregnant women and lactating mothers need in higher amounts than adult men

There are seven major classes of nutrients:

- Carbohydrates.
- Fats.
- Dietary Fiber.
- Minerals.
- Proteins.
- Vitamins.
- Water.

VWHO states the following key facts:

- A healthy diet helps to protect against malnutrition in all its forms, as well as noncommunicable diseases (NCDs), including such as diabetes, heart disease, stroke and cancer.
- Unhealthy diet and lack of physical activity are leading global risks to health.
- Healthy dietary practices start early in life – breastfeeding fosters healthy growth and improves cognitive development and may have longer term health benefits such as reducing the risk of becoming overweight or obese and developing NCDs later in life.
- Energy intake (calories) should be in balance with energy expenditure. To avoid unhealthy weight gain, total fat should not exceed 30% of total energy intake. Intake of saturated fats should be less than 10% of total energy intake, and intake of trans-fats less than 1% of total energy intake, with a shift in fat consumption away from saturated fats and trans-fats to unsaturated fats, and towards the goal of eliminating industrially-produced trans-fats .
- Limiting intake of free sugars to less than 10% of total energy intake (2, 7) is part of a healthy diet. A further reduction to less than 5% of total energy intake is suggested for additional health benefits.

- Keeping salt intake to less than 5 g per day (equivalent to sodium intake of less than 2 g per day) helps to prevent hypertension, and reduces the risk of heart disease and stroke in the adult population

Consuming a healthy diet throughout the life-course helps to prevent malnutrition in all its forms as well as a range of noncommunicable diseases (NCDs) and conditions. However, increased production of processed foods, rapid urbanization and changing lifestyles have led to a shift in dietary patterns. People are now consuming more foods high in energy, fats, free sugars and salt/sodium, and many people do not eat enough fruit, vegetables and other dietary fibre such as whole grains.

The exact make-up of a diversified, balanced and healthy diet will vary depending on individual characteristics (e.g. age, gender, lifestyle and degree of physical activity), cultural context, locally available foods and dietary customs. However, the basic principles of what constitutes a healthy diet remain the same.

LEVELS OF NUTRITIONAL STATUS

Individual nutritional status will vary depending on a person's living situation, available food supply and health.

Ideal Nutrition:

Evidence of sound positive nutrition includes a well-developed body, ideal weight for body composition (ratio of muscle mass to fat) and height, good muscle development and tone. The skin is smooth and clear, the hair glossy, the eyes clear and bright. Posture is good; facial expression is alert. Appetite, digestion and elimination are normal.

Well-nourished persons are much more likely to be alert, both mentally and physically. They are meeting not only their day-to-day needs but also maintaining essential nutrient reserves for resisting infectious diseases and generally extending their years of normal functioning.

Borderline Nutrition:

Persons with only a borderline nutritional status may manage to meet their minimum day-to-day nutritional needs. However, they lack nutritional reserves to meet any added physiologic or metabolic demand resulting from injury or illness, sustain foetal development during pregnancy or attain proper growth in childhood. A state of borderline nutrition may exist in persons with poor eating habits or those who are living in stressed environments on low incomes.

On the average, however, persons who do not get enough of these nutrients have greater risk of physical illness than persons who are well nourished. The human body has great capacity to adapt to lowered nutritional states, but it can only sustain a given amount of physiologic stress before signs of malnutrition appear.

Malnutrition:

Signs of malnutrition appear when nutritional reserves are depleted, and nutrient and energy intake is insufficient to meet day-to-day needs or added metabolic stress. Many malnourished people live in high-risk conditions of poverty. These conditions influence the health of all persons involved, but especially the lives of the most vulnerable ones e.g., infants, children, pregnant women and elderly people.

Over Nutrition:

Some persons may be in a state of over nutrition that gradually results in degrees of overweight and obesity from excess energy intake over time. In a sense, over nutrition can be viewed as another form of malnutrition, especially when excess caloric intake produces gross harmful body weight i.e., morbid obesity.

Obesity:

It is a major nutritional problem in communities with over-eating habits. The main features of obesity are over-weight and fatness. The health hazards of obesity are diabetes mellitus, hypertension, atheroma, cerebrovascular diseases and diseases of gall bladder. Childhood and adolescent obesity may set the state for continuing adult obesity, increasing the risk for chronic disease. Obesity is preventable by careful diet management and exercise

CLINICAL SIGNS OF NUTRITIONAL STATUS

Features	Good	Poor
General appearance	Alert, responsive	Listless, apathetic, cachexic
Hair	Shiny, lustrous with healthy scalp	Stringy, dull, brittle, dry, depigmented
Neck glands	No enlargement	Thyroid enlarged
Skin: face, neck	Smooth, slightly moist, good color, reddish pink mucous membranes	Greasy, discolored, scaly
Skin: general	Smooth, slightly moist, good color	Rough, dry, scaly, pale, pigmented, irritated; petechiae, bruises
Eyes	Bright, clear, no fatigue circles	Dryness, signs of infection, increased vascularity, thickened conjunctivae
Lips	Good color, moist	Dry, scaly, swollen, angular lesions (stomatitis)
Tongue	Good pink color, surface papillae present, no lesions	Papillary atrophy, smooth appearance, swollen, red, beefy (glossitis).
Gums	Good pink color, no swelling or bleeding, firm	Marginal redness or swelling, receding, spongy

Teeth	Straight, no crowding, well-shaped jaw, clean, no discoloration	Unfilled cavities, absent teeth, worn surfaces, mottled, mis positioned
Abdomen	Flat	Swollen
Legs & Feet	No tenderness, weakness or swelling, good color	Oedema, tender calf, tingling, weakness
Skeleton	No malformations	Bowlegs, knock-knees, chest deformity at diaphragm, beaded ribs, prominent scapula
Weight	Normal for height, age, body build	Overweight or underweight
Posture	Erect, arms and legs straight, abdomen in, chest out	Sagging shoulders, sunken chest, humped back
Muscles	Well-developed, firm	Flaccid, poor tone, undeveloped, tender
Nervous control	Good attention span for age, does not cry easily, not irritable or restless	Inattentive, irritable
Gastrointestinal function	Good appetite and digestion, normal, regular defecation	Anorexia, indigestion, constipation or diarrhea
General vitality	Endurance, energetic, sleeps well at night, vigorous	Easily fatigued, no energy, falls asleep in school, looks tired, apathetic

4.5 NUTRITIONAL REQUIREMENTS THROUGHOUT THE LIFE CYCLE

4.5 NUTRITIONAL REQUIREMENTS THROUGHOUT THE LIFE CYCLE

We need essential amino acids, carbohydrates, essential fatty acids, and an array of vitamins and minerals to sustain life and health. However, nutritional needs vary from one life stage to another. During intrauterine development, infancy, and childhood, recommended intakes of macronutrients and most micronutrients are higher relative to body size, compared with those during adulthood. In elderly persons, some nutrient needs (e.g., vitamin D) increase, while others (e.g., energy and iron) are reduced.

It should be noted, however, that the DRIs apply to healthy people and are not designed for individuals who are either chronically ill or who are at high risk for illness due to age, genetics, or lifestyle factors (e.g., smoking, alcohol intake, strenuous exercise). Clinicians must make their own judgments regarding nutrient requirements in such cases based on available information

First, the predominant nutritional problem in developing countries like Pakistan was traditionally under-nutrition. Now with urbanization and the fast-food industries, many people suffer from bad choices of food and overnutrition, at least regarding energy and macronutrients. Excessive intake has led to unprecedented epidemics of obesity and chronic diseases. We as health care providers can assist patients in making the dietary shifts necessary to prevent overnutrition and its sequelae.

We need a renewed emphasis on vegetables, fruits, whole grains, and legumes to help to prevent weight problems and chronic illnesses, including cardiovascular disease, diabetes, and cancer, among others. Plant-based diets meet or exceed recommended intakes of most nutrients and have the advantage of being lower in total fat, saturated fat, and cholesterol than typical Western diets, with measurable health benefits. Well-planned plant-based diets are appropriate across the lifespan may help to prevent or treat some chronic diseases.

Excess Calorie Intakes: A Risk Factor Common to All Age Groups in cities

The major nutritional problems encountered in developed countries are excess macronutrient intake (especially saturated fat, protein, and sugar) and insufficient intake of the fiber and micronutrients provided by vegetables, fruits, whole grains, and legumes.

Overnutrition begins early. While an expectant mother must provide nutrition for both herself and her developing baby, the increased energy requirements of pregnancy are modest. Typically, pregnant women’s estimated energy requirements are like those of nonpregnant women in the first trimester and increase by 340 calories per day in the second trimester and 452 calories per day in the third trimester. Recommended weight gain during pregnancy varies by pre-pregnancy BMI, with overweight and obese women recommended to gain less weight than underweight or normal weight women. Excess energy intake may result in overly rapid weight gain, conferring a greater risk for labor induction, caesarean section, higher birth weight, and other complications of pregnancy and delivery.

Overfed infants and children may develop dietary habits and perhaps even metabolic characteristics that have lifelong consequences. Infants should be exclusively breastfed for the first 6 months of life if possible. Breastfed infants are less likely to be overweight or obese in childhood and adolescence.

At 6 months of age, in addition to breastfeeding, complementary foods should be introduced; parents should avoid both underfeeding and overfeeding. The heavier ("obese") infants and infants with rapid weight gain were more likely to be obese in childhood, adolescence, and early adulthood Therefore, caretakers should select foods conducive to healthy body weights and restrain their desire to promote child growth through overfeeding.

Adolescents face a similar problem. Many teens consume higher-than-recommended amounts of fat, saturated fat, sodium, and sugars, thereby increasing the risk for adolescent and adult obesity, among other health problems. The increased prevalence of excess body weight in adolescents is correlated with escalating risk for type 2 diabetes. This does not mean that adolescents are well nourished, however. Despite their higher energy intake, adolescents frequently fail to achieve required intakes of essential micronutrients (e.g., vitamins A and C), and under consume fiber. This problem is compounded by the fact that roughly 60% of female and more than 25% of male adolescents are dieting to lose weight at any given time, and between 1% and 9% report using maladaptive habits, such as purging, to do so.

Fertility

The role of nutrition in fertility has been the subject of a limited body of research focusing particularly on the role of antioxidants, other micronutrients, and alcohol. However, while nutritional and lifestyle factors may affect fertility directly, they also influence risk for several diseases that impair fertility, including polycystic ovarian syndrome, endometriosis, and uterine fibroids (See relevant chapters).

In females, some studies suggest a potential role for high-dose (750 mg/d) vitamin C and combinations of antioxidants, iron, and arginine supplements in achieving pregnancy

Obesity is also associated with decreased fertility in women, although being underweight is also problematic: Time to conception doubles with BMI > 35 and quadruples with BMI < 19. Women who may become pregnant should also supplement with 400 mcg/d of folic acid to reduce the risk of neural tube defects, and also ensure adequate vitamin B12 status.

In males, infertility may occur by disruption of the normal equilibrium between the production of reactive oxygen species by semen and oxygen-radical scavengers. This may occur through smoking, infection of the reproductive tract, varicocele, and perhaps through poor diet as well. The result is oxidative damage to sperm. Controlled studies of high dose of combinations of supplementary antioxidants (vitamin C,>200 mg/d; vitamin E, 200 to 600 IU/d; selenium, 100 to 200 μg/d) found improved sperm motility and morphology and increased pregnancy rates, particularly in former smokers. Adequate serum levels of vitamin D are also positively correlated with fertility and sperm motility

Carnitine is concentrated within the epididymis and contributes directly to the energy supply required by sperm for maturation and motility Treatments with carnitine or acetylcarnitine (1.0-2.0 g/d) increases the number and motility of sperm and the number of spontaneous pregnancies.

Smoking and alcohol consumption is associated with decreased fertility in both women and men. In males, alcohol consumption contributes to impotence and to a reduction of blood testosterone concentrations and impairment of Sertoli cell function and sperm maturation

Pregnancy and Lactation

Pregnant and lactating women have increased requirements for both macronutrients and micronutrients. The failure to achieve required intakes may increase risk for certain chronic diseases in their children, sometimes manifesting many years later. Undernutrition during mid- to late pregnancy increased the risk for glucose intolerance and resulted in greater progression of age-related hypertension. Malnutrition of women during early pregnancy correlated with higher body weights of their offspring as adults, along with increased risk for coronary heart disease and certain central nervous system anomalies.

Protein requirements in pregnancy rise to 1.1 g/kg/d to allow for fetal growth and milk production. The source of protein may be as important as the quantity, however. Some evidence suggests that protein requirements can be more safely met by vegetable than by animal protein. Meat is a major source of saturated fat and cholesterol; it is also a common source of ingestible pathogens and a rich source of arachidonic acid, a precursor of the immunosuppressive eicosanoid PGE2.

Vegetable protein sources, aside from meeting protein needs, can help to meet the increased needs for folate, potassium, and magnesium and provide fiber, which can help to reduce the constipation that is a common complaint during pregnancy.

Pregnant and/or lactating women also require increased amounts of vitamins A, C, E, and certain B vitamins (thiamine, riboflavin, niacin, pyridoxine, choline, cobalamin, and folate). Folate intake is especially important in early pregnancy for the prevention of neural tube defects and should be consumed in adequate amounts prior to conception; evidence shows that average intakes are only~60% of current recommendations.

Regardless of folate consumed from food sources, women capable of becoming pregnant are recommended to take 400 mcg/d of folic acid to reduce the risk of neural tube defects. The available Folic Acid preparation in Pakistan has 5 mg of folate

Pregnant women also require increased amounts of calcium, phosphorus, magnesium, iron, zinc, potassium, selenium, copper, chromium, manganese, and molybdenum. Prenatal vitamin-mineral formulas are suggested to increase the likelihood that these nutrient needs will be met.

Infancy and Early Childhood

Requirements for macronutrients and micronutrients are higher on a per-kilogram basis during infancy and childhood than at any other developmental stage. These needs are influenced by the rapid cell division occurring during growth, which requires protein, energy, and nutrients involved in DNA synthesis and metabolism of protein, carbohydrates, and fat. Increased needs for these nutrients are reflected in DRIs for these age groups, some of which are briefly discussed below.

Energy.

While most adults require 25 to 30 calories per kg, a 4-kg infant requires more than 100 cals/kg (430 calories/day). Infants 4 to 6 months who weigh 6 kg require roughly 82 cals/kg (490 calories/day). Energy needs remain high through the early years. Children 1 to 3 years of age require approximately 83 cals/kg (990 cals/d). Energy requirements decline thereafter and are based on weight, height, and physical activity.

As an energy source, breast milk offers significant advantages over manufactured formula. Breastfeeding is associated with reduced risk for obesity, allergies, hypertension, and type 1 diabetes; improved cognitive development; and decreased incidence and severity of infections. It is also less costly than formula feeding.

WHO recommends exclusive breastfeeding for the first 6 months of life, followed by continued breastfeeding as complementary foods are introduced. Breastfeeding may continue for 2 years. Parents should be encouraged to delay introduction of solid foods until 6 months of age to all for optimal infant nutrition, growth and development.

Protein.

Older infants, aged 7-12 months, have a Recommended Daily Allowance (RDA) for protein of 1.2 g/kg/d, or 11 g/d of protein. Children aged 1–3 years have an RDA of 1.05 g/kg/d or 13 g/d of protein and children aged 4–8 years have an RDA of 0.95 g/kg/d or 19 g/d of protein.

Water.

Total water requirements (from beverages and foods) are also higher in infants and children than for adults. Children have larger body surface area per unit of body weight and a reduced capacity for sweating when compared with adults, and therefore are at greater risk of morbidity and mortality from dehydration. Parents may underestimate these fluid needs, especially if infants and children are experiencing fever, diarrhea, or exposure to extreme temperatures (e.g., in vehicles during summer).

Essential fatty acids.

Requirements for fatty acids on a per-kilogram basis are higher in infants than adults Through desaturation and elongation, linolenic and alpha-linolenic acids are converted to long-chain fatty acids that play key roles in the central nervous system.

Adolescence and Adulthood

higher intakes of protein and energy in the adolescent population for growth. For most micronutrients, recommendations are the same as for adults. Exceptions are made for certain minerals needed for bone growth (e.g., calcium and phosphorus).

Males require more vitamin C, K, B1, B2, and B3; choline; magnesium; zinc; chromium; and manganese. Menstruating females require more iron, compared with males of similar age, This is very important for us as most of our girls are anaemic and it is important to get their Hb at a normal level

Later Years

Some elderly persons have difficulty getting adequate nutrition because of age- or disease-related impairments in chewing, swallowing, digesting, and absorbing nutrients

Nutrient status may also be affected by decreased production of digestive enzymes, senescent changes in the cells of the bowel surface, and drug-nutrient interactions Approximately 10-30% of older adults are commonly affected by atrophic gastritis, which can interfere with absorption of vitamin B12.So Vitamin B should be given to the elderly.

Due to reductions in lean body mass, metabolic rate, and physical activity, elderly persons require less energy than younger individuals need. For example, in order to reduce the risk for age-related bone loss and fracture, the DRI for vitamin D is increased from 600 IU/d in individuals 19-70 years of age to 800 IU/d for those > 70 years of age

Suggested iron intakes drop from 18 mg per day in women ages 19-50 to 8 mg/d after age 50, due to iron conservation and decreased losses in postmenopausal women, compared with younger women.

Although diets that are modest in protein have been associated with health benefits, including reductions in diabetes and cancer incidence and overall mortality for people aged 65 and under, for those over aged 65, it remains important to ensure adequate protein intake for older people. Plant sources of protein are preferable. It goes without saying that recommendations regarding nutritional interventions in elderly patients should take patients' wishes into account, particularly when a limited lifespan reduces the expected benefit of an *intervention*

Pregnancy*	**Increased requirements**: energy, protein, essential fatty acids, vitamin A, vitamin C, B-vitamins (B1, B2, B3, B5, B6, B12, folate, choline) & calcium, phosphorus,** magnesium, potassium, iron, zinc, copper, chromium, selenium, iodine, manganese, molybdenum
Lactation*	**Increased requirements**: vitamins A, C, E, all B-vitamins, sodium, magnesium** **Decreased requirements**: iron
Infancy, childhood*	**Increased requirements**: energy, protein, essential fatty acids
Adolescence*	**Increased requirements**: energy, protein, calcium, phosphorus, magnesium, zinc (females only)
Early adulthood (ages 19-50)	**Increased requirements for males, compared with females**: vitamins C, K; B1, B2, B3, and choline; magnesium, zinc, chromium, manganese **Increased requirements for females, compared with males**: iron
Middle age (ages 51-70)*	**Increased requirements:** vitamin B_6, vitamin D

Elderly (age 70+)*	**Increased requirements:** vitamin D **Decreased requirements:** energy; iron (females only) **Changing Nutrient Needs Through the Life Cycle**

4.6 ACCESSORY ORGANS FOR DIGESTION

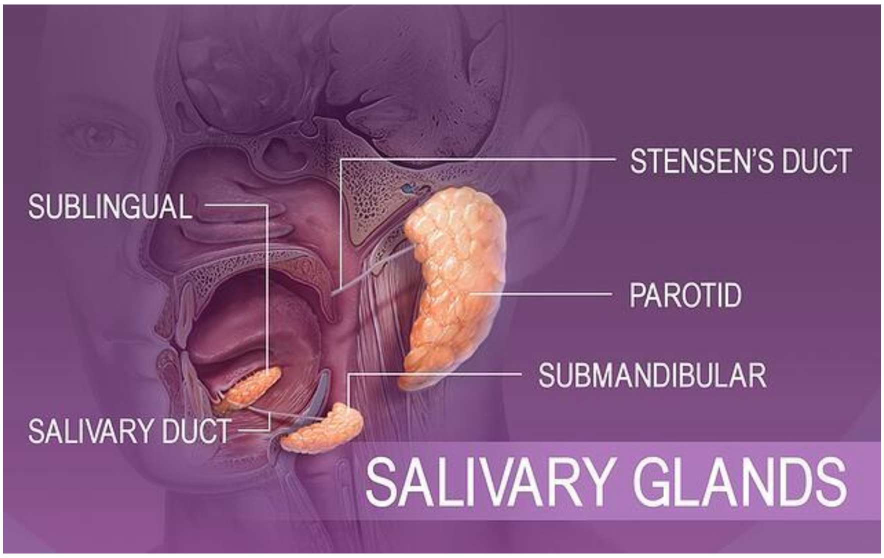
4.6 ACCESSORY ORGANS FOR DIGESTION:

Food that is chewed in the oral cavity then swallowed ends up in the stomach where it is further digested so its nutrients can be absorbed in the small intestine. The salivary glands, liver, gallbladder, and pancreas are not part of the digestive tract, but they have a role in digestive activities and are considered accessory organs.

1) SALIVARY GLANDS

Three pairs of major salivary glands

Parotid, submandibular, and sublingual glands) and numerous smaller ones secrete saliva into the oral cavity, where it is mixed with food during mastication. Saliva contains water, mucus, and enzyme amylase.



Functions of saliva include the following:

- It has a cleansing action on the teeth.
- It moistens and lubricates food during mastication and swallowing.
- It dissolves certain molecules so that food can be tasted.
- It begins the chemical digestion of starches through the action of amylase, which breaks down polysaccharides into disaccharides.

The six salivary glands, located around the oral cavity, secrete saliva. This substance moves out of the glands into the oral cavity through ducts. Saliva is 99% water, but also contains enzymes and proteins that lubricate the oral cavity and begin chemical digestion of food. There are three pairs of salivary glands (parotid, submandibular, and sublingual glands) and two ducts (Stensen's and salivary ducts) on either side of the oral cavity.

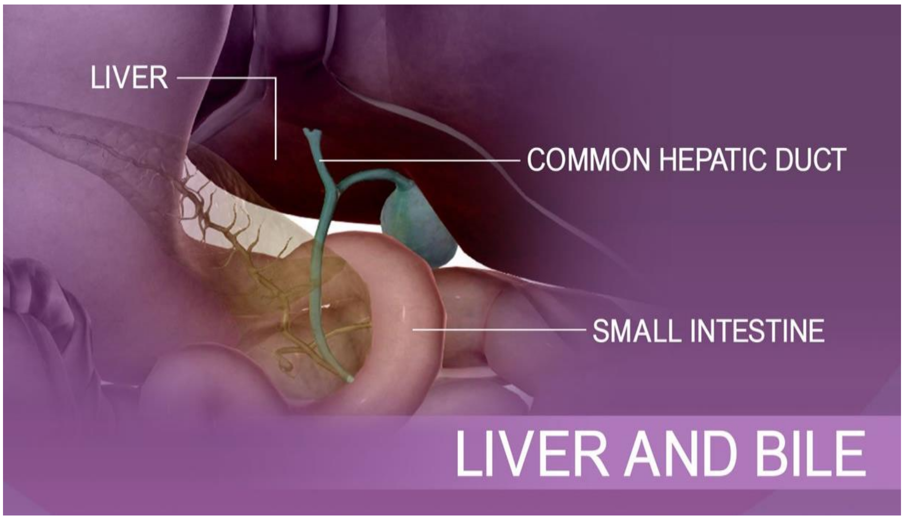
2) The Liver Secretes Bile to Emulsify Fats in the Small Intestine

The liver is located primarily in the right hypochondriac and epigastric regions of the abdomen, just beneath the diaphragm. It is the largest gland in the body. On the surface, the liver is divided into two major lobes and two smaller lobes. The functional units of the liver are lobules with sinusoids that carry blood from the periphery to the central vein of the lobule.

The liver receives blood from two sources. Freshly oxygenated blood is brought to the liver by the common hepatic artery, a branch of the celiac trunk from the abdominal aorta. Blood that is rich in nutrients from the digestive tract is carried to the liver by the vein. The liver has a wide variety of functions and many of these are vital to life. Hepatocytes perform most of the functions attributed to the liver, but the phagocytic Kupffer cells that line the sinusoids are responsible for cleansing the blood.

Liver functions include the following:

- secretion
- synthesis of bile salts
- synthesis of plasma protein
- storage
- detoxification
- excretion
- carbohydrate metabolism
- lipid metabolism
- protein metabolism
- filtering

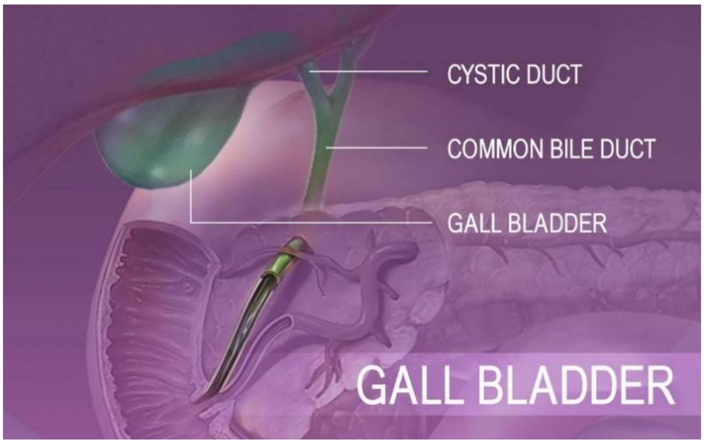


The liver is one of the largest organs in the body and it is continuously producing bile. This yellowish-brown fluid aids chemical digestion by emulsifying fats in the duodenum. Bile flows out of the liver into the right and left hepatic ducts, into the common hepatic ducts, and toward the small intestine to help with digestion and the absorption of fats.

3) The Gall Bladder Stores Bile

The gallbladder is a pear-shaped sac that is attached to the visceral surface of the liver by the cystic duct. The principal function of the gallbladder is to serve as a storage reservoir for bile. Bile is a yellowish-green fluid produced by liver cells. The main components of bile are water, bile salts, bile pigments, and cholesterol.

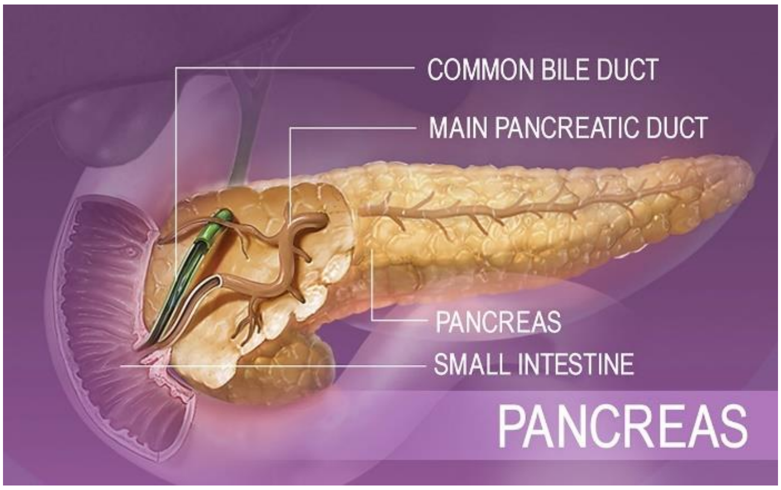
Bile salts act as emulsifying agents in the digestion and absorption of fats. Cholesterol and bile pigments from the breakdown of haemoglobin are excreted from the body in the bile.



If bile is not immediately needed for digestion, it flows up the cystic duct to the gall bladder. The gall bladder is a green, pear-shaped sac about 10 cm or 4 in. long that stores and concentrates excess bile secreted by the liver. Bile is released by the gall bladder as needed into the small intestine.

4) Pancreatic Juice Breaks Down Protein, Fats, and Carbohydrates

The pancreas has both endocrine and exocrine functions. The endocrine portion consists of the scattered islets of Langerhans, which secrete the hormones insulin and glucagon into the blood. The exocrine portion is the major part of the gland. It consists of pancreatic acinar cells that secrete digestive enzymes into tiny ducts interwoven between the cells. Pancreatic



enzymes include amylase, trypsin, peptidase, and lipase. Pancreatic secretions are controlled by the hormones secretin and cholecystokinin

The pancreas secretes pancreatic juice, a mix of digestive enzymes, water, buffers (bicarbonates), and electrolytes produced by acinar and epithelial cells. Pancreatic juice drains through the main pancreatic duct (duct of Wirsung) into the common bile duct and then into the small intestine. There it buffers stomach acids and breaks down protein, fats, and carbohydrates.

4.7 BASIC FOOD GROUPS

4.7 BASIC FOOD GROUPS

Essential nutrients

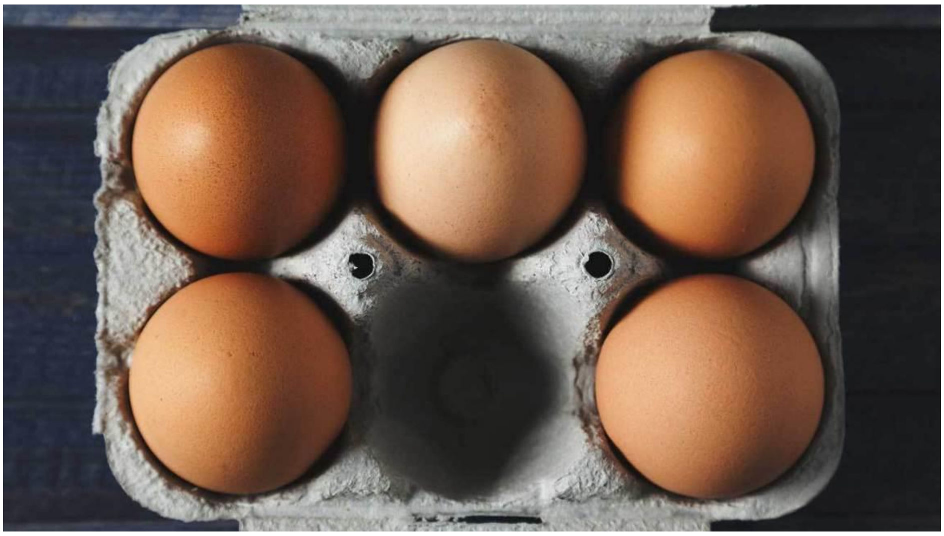
Essential nutrients are compounds that the body can't make or can't make in sufficient quantity. According to the World Health Organization Trusted Source, these nutrients must come from food, and they're vital for disease prevention, growth, and good health. While there are many essential nutrients, they can be broken into two categories: macronutrients and micronutrients.

Macronutrients are eaten in large amounts and include the primary building blocks of your diet — protein, carbohydrates, and fat — which provide your body with energy. Vitamins and minerals are micronutrients, and small doses go a long way. There are six main groups of essential micronutrients and macronutrients. to function properly.

GROWTH FOODS:

1-Proteins are important in all processes of life. Protein should form about 15- 25% of the total caloric intake i.e., about 25-40 gm/day. Excess protein that is not utilized as body building material is used for energy, after removing the nitrogen as a waste product. They are primarily responsible for the following:

1) Normal physical and mental growth of children.
2) Repair and maintenance of tissues undergoing wear and tear from birth to death.
3) Form an integral part of hormones and enzymes that control the biological function.
4) Essential for the formation of haemoglobin (Haem - iron and globulin - protein) and the antibodies of the blood.



Protein is essential for good health. Protein provides the building blocks of the body, and not just for muscle. Every cell, from bone to skin to hair, contains protein. A startling 16 percent of the average person's body weight is from protein. Protein is used primarily for growth, health, and body maintenance.

All of our hormones, antibodies, and other important substances are composed of protein. Protein is not used to fuel the body unless necessary. Proteins are made of up different amino acids. While the body can create some amino acids on its own, there are many essential amino acids that can only come from food. You need a variety of amino acids for your body

Amino Acids are the smallest digested absorbable form of proteins. The human body can synthesize certain amino acids if it has an adequate source of proteins but cannot produce other amino acids to meet the body needs. Such amino acids, which cannot be synthesized and must be provided through diet are termed as “Essential Amino Acids”. The proteins that contain all these essential amino acids are said to be “Complete” proteins’, also known as first-class proteins.

Proteins are obtained from two sources:

1) Animal Source
2) Vegetable Source

Animal Sources:

Milk and its products, meat, fish, poultry etc. (First class proteins).

Vegetable Sources:

Peanuts, beans, peas, lentils, pulses etc. (Second class proteins).

Proteins of animal origin are complete and are of a high biologic value. They contain enough essential amino acids and are responsible for the normal and healthy growth in children. If these foods are not consumed in adequate quantities, the child becomes weak and his mental and physical development is hampered.

The vegetable proteins are incomplete as one or more of the essential amino acids are lacking. To make the vegetable proteins complete, the amino acid that is lacking can be complemented from another source. Having a mixed diet of roti and dal, or rice and dal, as in “Khitchri” are typical examples where proteins are complemented through individual incomplete sources of vegetable origin (legumes + cereals).

Healthy sources

While meat, fish, and eggs are good sources of essential amino acids, you can also get protein from plant sources like beans, soy, nuts, and some grains. Exactly how much protein you need daily depends on a variety of factors including how active you are, and your age.

Carbohydrates

Carbohydrates are necessary for a healthy body. Carbs fuel our body, especially our central nervous system and brain, and protect against disease Carbohydrates should make up 45 to 65 percent of your total daily calories,

Healthy sources

Before we reach for the white bread or pasta, keep in mind that the type of carb you eat matters. Some carbs are healthier than others. Opt for whole grains, beans, and fiber-rich vegetables and fruits instead of refined grains and products with added sugar.

ENERGY FOODS: CARBOHYDRATES AND FATS

Carbohydrates:

They are the main sources of energy. They are also essential for the oxidation of fats and for synthesis of certain non-essential amino acids. The optimum requirement of carbohydrate in a balanced diet is 50-70% of total energy intake. Most Pakistani diets contain excessive amount of carbohydrate providing as much as 90% of total energy intake. The carbohydrate reserve of an adult is 500 grams. When a person is fasting, this reserve is rapidly exhausted. There are three main sources of carbohydrates i.e., starches, sugar and cellulose. All sugars and starches are converted to glucose by the digestive enzymes before they are absorbed. Excess of glucose is converted to glycogen and is stored in the liver and muscles.

Cellulose is the fibrous substance lining fruits, vegetables and cereals. During the recent past there has been a good deal of interest on the possible role of dietary fibre. A wide range of diseases are related to fibre deficiency in the diet. Some of them are constipation, colonic cancer, atherosclerosis, coronary disease of the heart, appendicitis and gallstones.

Fats:

Fats include such substances as fat, oil and related compounds that are greasy to touch and insoluble in water. Desirable amount of daily intake of fat is 25-30% of total caloric intake or about 40-60 gm/day. Fats are taken as ghee, butter, cream, cheese, fish oil, vegetable oils, sunflower oil, corn oil and animal fat. Highly refined fats like vegetable ghee and fish oil contain appreciable amount of the fat-soluble vitamins A, D, E & K.

Other food forms of fat are more hidden: egg yolk, internal tissue fat of meats, olives, nuts and seeds. During oxidation, fats give off more heat than either carbohydrates or proteins. One gram of fat burnt in the body gives nine calories as compared with four calories for a gram of protein or carbohydrate. Because of the high caloric value, it is most important to reduce the fat content of the diet in treating obesity. Absence of fats in diet causes malnutrition and predisposes to tuberculosis. If glucose is not available for energy, fats burn to give energy and we thus lose weight. Smallest digested form of fats is “fatty acid”, which is absorbed from the gut.

Fats also serve as protection against (mechanical) injury, as padding and support for organs and as insulation against rapid body temperature change. It is now recognized that there is an association between high blood cholesterol values, coronary artery disease and atherosclerosis. High total blood cholesterol can be reduced by eating food which is low in total cholesterol and using fats which contain large amount of poly-unsaturated fatty acids such as fish oil, corn oil or sunflower oil. Fats which become liquid at body temperature like oils, ghee and butter are digested and absorbed more readily.

The good fats support many of our body's functions such as vitamin and mineral absorption, blood clotting, building cells, and muscle movement. Yes, fat is high in calories, but those calories are an important energy. WHO suggests keeping it under 30 percent of our calories.

Including healthy fats in diet can help to balance your blood sugar, decrease the risk of heart disease and type 2 diabetes, and improve brain function. They're also powerful anti-inflammatories, and they may lower the risk of arthritis, cancer, and Alzheimer's disease.

Healthy sources

The most famous unsaturated fats are omega-3 and omega-6 fatty acids. Unsaturated fats are important for the body as they provide essential fatty acids our body can't make. We can find these healthy fats in nuts, seeds, fish, and vegetable oils (like olive, avocado, and flaxseed). Coconut oil provides plant-based fats in the form of medium-chain triglycerides which impart health benefits like faster utilization by organs as fuel and appetite control. Avoid trans fats and limit the intake of saturated animal-based fats like butter, cheese, red meat, and ice cream.

Vitamins

Vitamins are vital for warding off disease and staying healthy. The body needs these micronutrients to support its functions. There are 13 essential vitamins that the body needs to function properly, including vitamins A, C, B_6, and D.

Each vitamin plays an important role in the body, and not getting enough of them can cause health problems and disease. Many families in Pakistan do not get enough of many essential vitamins. Vitamins are essential for healthy vision, skin, and bones. Vitamins may lower the risk of lung and prostate cancer, and they're powerful antioxidants. Vitamins like vitamin C boost the immune system and help the body heal.

Minerals

Much like vitamins, minerals help support the body. They're essential for many body functions, including building strong bones and teeth, regulating our metabolism, and staying properly hydrated. Some of the most common minerals are calcium, iron, and zinc.

In addition to strengthening bones, calcium helps with nerve signal transmission, maintaining healthy blood pressure, and muscle contraction and relaxation. Iron supports red blood cells and hormone creation, while zinc boosts the immune system and wound healing.

Water

We can go for weeks without food but can't last more than a few days without water. Water is crucial for every system in our body. It's also the main thing we are made of. About 62 percent of our body weight is water. Water improves our brain function and mood. It acts a shock absorber and a lubricant in the body. It also helps flush out toxins, carry nutrients to cells, hydrate the body, and prevent constipation. Even mild dehydration can make us feel tired and impair concentration

FWWs advice to families should include:

1) Eating a varied diet full of fruits, vegetables, healthy proteins and fats
2) Whole grains are the best way to get enough of these six essential nutrients plus the important category of phytonutrients — the beneficial chemicals in colorful plants that prevent disease.
3) These micronutrients and macronutrients are vital for your body to function normally and stay healthy

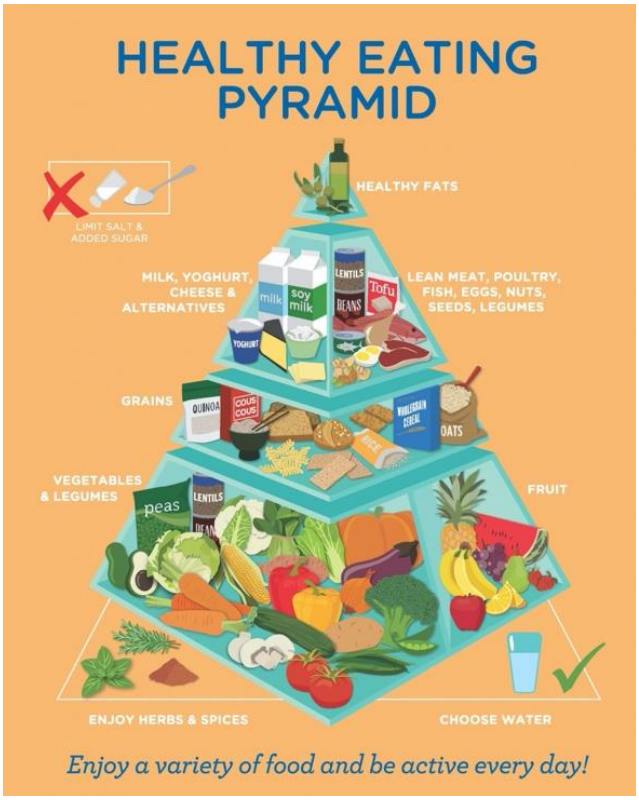
4.8 BALANCED DIET

4.8 BALANCED DIET

Water

For adults, 1–1.5 mL water per kcal of energy expenditure is usually sufficient to allow for normal changes in physical activity, sweating, and dietary solute load. Water losses consist of 50–100 mL/day through faeces (stools), 500–1000 mL/day by evaporation, and approximately 1000 mL/day through urine. If external losses increase, we must increase the amount of water we ingest. In special circumstances such as diarrhoea and vomiting, water requirements further increase.

Healthy eating pyramid



It Is a simple but valuable tool, which gives us the list of components of as well as visual proportion of a balanced diet

A healthy diet consists mainly of plant foods (e.g. fruits and vegetables, potatoes, cereals, etc.) and moderate amounts of animal products (e.g. milk, fish, lean red meat and poultry). Fats and oils should normally provide less than 30% of our energy, and less than 10% of this should be saturated fat. Lean red meat, poultry and fish, eggs and dairy foods are rich sources of animal protein. Dairy foods, apart from supplying quality protein, are good sources of calcium. Good vegetable sources of protein include legumes (e.g. peanuts, lentils, kidney beans), soya products (e.g. tofu), grains, nuts and seeds.

A balanced diet contains all the essential nutrients for functioning of the body, in an appropriate / optimal proportion. The balanced diet is composed of all food nutrients which are essential for growth, development, maintenance, repair and smooth functioning of the internal activities. The essential nutrients are grouped in three basic food groups.

Food Requirement for a Balanced Diet:

Growth Foods

- Milk At least 2 glasses for children daily At least 1 glass for adults
- Meat 2 or more servings of 2 oz meat or ½ cup cooked
- Dal, beans, peas

Energy Foods

- Rice 4 or more servings of rice (1 serving rice = ½ cup cooked rice)
- Wheat flour 4 or more servings of wheat

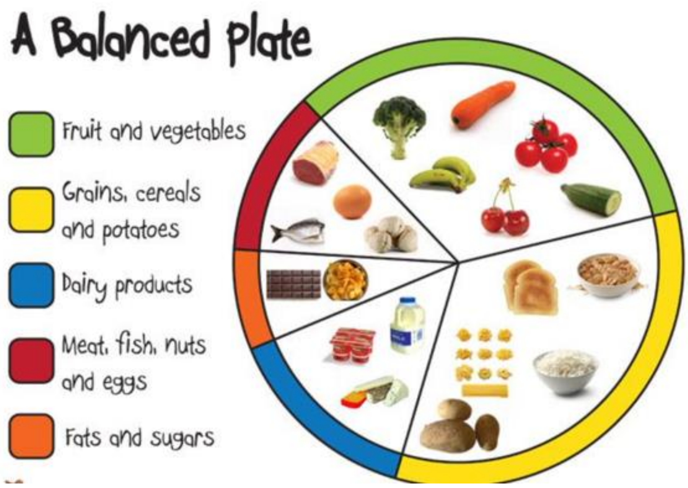
Protective Foods

- Vegetables ½ - 2 cups or more servings of cooked vegetables Dark green or yellow vegetables at least on alternate days
- Fruits 1 raw Vit. C rich fruit daily

Additional Foods:

Fats, sweets and beverages should be taken within the limits of the individual calorie requirements. All these three groups should be consumed in such quantities that proteins should contribute 10-15% of the total calories, carbohydrates should provide 60- 65% and fats 20-25%. If 2400 calories are required by a person/day, then 60 gm of proteins, 360 gm of carbohydrates and 65 gm of fats must be present in the day's meals.

PLANNING A BALANCED DIET:



The basic function of food is to supply the body with the necessary energy to maintain body temperature and to work. Carbohydrates, fats and proteins are the chief sources of energy. The food burns as fuel in our body releasing heat and energy. The nutrients are present in the food we eat and are selected and absorbed in the digestive system and utilized in the human body for various purposes.

The objective of planning a balanced meal is to serve well prepared, palatable, and satisfying meal, at a reasonable cost. The basic factors in successful meal planning include consideration of the nutritional requirements of the family as determined by age, sex, and activity, numbers to be fed, food habits, availability and season-availability of foods, storage and food budget. Meals of a mixed family of adults and children should be simple without strong flavours and spices

The meal should be balanced in respect to all the food nutrients and considered adequate if a child is gaining weight and an adult of reasonable weight is not losing weight and, when signs of deficiency do not appear. All the meals of the day are to be considered as a dietary unit i.e., it is not necessary that all the meals should represent the basic groups but must be there during any one of the meals but once in 24 hours of the day.

WHO RECOMMENDED BALANCE DIETS:

FOR ADULTS

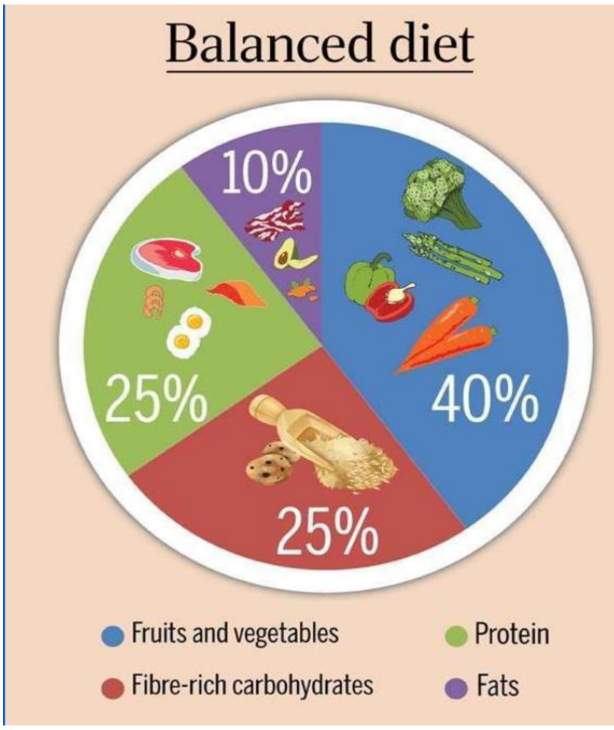
1) Fruit, vegetables, legumes (e.g., lentils and beans), nuts and whole grains (e.g., unprocessed maize, millet, oats, wheat, and brown rice)
2) At least 400 g (i.e., five portions) of fruit and vegetables per day, excluding potatoes, sweet potatoes, and other starchy roots.
3) Less than 10% of total energy intake from free sugars which is equivalent to 50 g (or about 12 level teaspoons) for a person of healthy body weight consuming about 2000 calories per day, but ideally is less than 5% of total energy intake for additional health benefits. Free sugars are all sugars added to foods or drinks by the manufacturer, cook or consumer, as well as sugars naturally present in honey, syrups, fruit juices and fruit juice concentrates.
4) Less than 30% of total energy intake from fats. Unsaturated fats (found in fish, avocado and nuts, and in sunflower, soybean, canola and olive oils) are preferable to saturated fats (found in fatty meat, butter, palm and coconut oil, cream, cheese and ghee) and trans-fats of all kinds, including both industrially-produced trans-fats (found in baked and fried foods, and pre-packaged snacks and foods, such as frozen pizza, cookies, biscuits, wafers, and cooking oils and spreads) and ruminant trans-fats (found in meat and dairy foods from ruminant animals, such as cows, sheep, goats and camels). It is suggested that the intake of saturated fats be reduced to less than 10% of total energy intake and trans-fats to less than 1% of total energy intake. In particular, industrially produced trans-fats are not part of a healthy diet and should be avoided.
5) Less than 5 g of salt (equivalent to about one teaspoon) per day. Salt should be iodized.

For infants and young children

In the first 2 years of a child’s life, optimal nutrition fosters healthy growth and improves cognitive development. It also reduces the risk of becoming overweight or obese and developing NCDs later in life.

Advice on a healthy diet for infants and children is like that for adults, but the following elements are also important:

- Infants should be breastfed exclusively during the first 6 months of life.
- Infants should be breastfed continuously until 2 years of age and beyond.
- From 6 months of age, breast milk should be complemented with a variety of adequate, safe and nutrient-dense foods. Salt and sugars should not be added to complementary foods



GLYCAEMIC INDEX AND GLYCAEMIC LOAD

Carbohydrates should make up at least 55% of our total daily energy intake. The quality and quantity of these carbohydrates are important in blood sugar and appetite control. After we consume carbohydrate-containing foods,the pancreas secretes insulin to break the carbohydrates down into their building blocks. Insulin acts to lower blood glucose levels.

When the blood glucose levels decrease to a particular level, the brain is sent a signal and we become hungry again.Even though different foods may contain the same amounts of carbohydrate, their effects on blood glucose control may be very different. This has lead to the development of measures such as the glycaemic index (GI) and glycaemic load (GL) of a food product.

The concept of GI was formulated by Jenkins and colleagues in 1984. They found that blood glucose response to carbohydrate foods is independent of the amount of carbohydrates they contain. The limitation of the GI lies in the difficulty of translating the concept into practice, since the glycaemic effect of foods is not constant and can vary depending on the way the food is cooked.

Low GI and GL foods have been shown to be associated with health advantages such as decreased blood sugar levels. Foods with a low GI (less than 55) cause a slower and lower rise in blood glucose levels. These include breads such as mixed-grain and oat breads, barley, pasta, noodles, beans, sweet potatoes, green peas and milk. Foods with a high GI (greater than 70) cause a faster and higher rise in blood glucose levels. High GI foods include white bread, steamed white rice and chips.

By incorporating low GI foods into your diet, you will bring down the average GI of your meal, have a lower, slower blood sugar response to the meal and feel 'full' for longer. By consuming low GI foods, you are more likely to be satisfied and feel full for longer periods of time. This helps you to maintain a healthy weight and avoid diseases such as heart disease, diabetes and some cancers

PRACTICAL ADVICE ON MAINTAINING A HEALTHY DIET

Fruit and vegetables

Eating at least 400 g, or five portions, of fruit and vegetables per day reduces the risk of Non-Communicable Diseases (NCDs) and helps to ensure an adequate daily intake of dietary fibre.

Fruit and vegetable intake can be improved by:

- always including vegetables in meals;
- eating fresh fruit and raw vegetables as snacks;
- eating fresh fruit and vegetables that are in season; and
- eating a variety of fruit and vegetables.

Fats

Reducing the amount of total fat intake to less than 30% of total energy intake helps to prevent unhealthy weight gain in the adult population. Also, the risk of developing Non communicable diseases (NCDs) is lowered by:

- reducing saturated fats to less than 10% of total energy intake;
- reducing trans-fats to less than 1% of total energy intake; and
- replacing both saturated fats and trans-fats with unsaturated fats – in particular, with polyunsaturated fats.
- Fat intake, especially saturated fat and industrially produced trans-fat intake, can be reduced by:
- steaming or boiling instead of frying when cooking;
- replacing butter and ghee with oils rich in polyunsaturated fats, such as soybean, canola (rapeseed), corn, safflower and sunflower oils;
- eating reduced-fat dairy foods and lean meats, or trimming visible fat from meat; and

- limiting the consumption of baked and fried foods, and pre-packaged snacks and foods (e.g., doughnuts, cakes, cookies, biscuits and wafers) that contain industrially produced trans-fats.

Salt, sodium and potassium

Most people consume too much sodium through salt (corresponding to consuming an average of 9–12 g of salt per day) and not enough potassium (less than 3.5 g). High sodium intake and insufficient potassium intake contribute to high blood pressure, which in turn increases the risk of heart disease and stroke.

Reducing salt intake to the recommended level of less than 5 g per day could prevent 1.7 million deaths across the globe each year. People are often unaware of the amount of salt they consume. Many processed foods have a large amount of salt.

Salt intake can be reduced by:

- limiting the amount of salt and high-sodium condiments when cooking and preparing foods;
- not having salt or high-sodium sauces on the table;
- limiting the consumption of salty snacks; and
- choosing products with lower sodium content.

Potassium can mitigate the negative effects of elevated sodium consumption on blood pressure. Intake of potassium can be increased by consuming fresh fruit and vegetables.

Sugars

In both adults and children, the intake of free sugars should be reduced to less than 10% of total energy intake. A reduction to less than 5% of total energy intake would provide additional health benefits.

Consuming free sugars increases the risk of dental caries (tooth decay). Excess calories from foods and drinks high in free sugars also contribute to unhealthy weight gain, which can lead to overweight and obesity.

Sugars intake can be reduced by:

limiting the consumption of foods and drinks containing high amounts of sugars, such as sugary snacks, candies and sugar-sweetened beverages (i.e., all types of beverages containing free sugars – these include carbonated or non-carbonated soft drinks, fruit or vegetable juices and drinks, liquid and powder concentrates, flavoured water, energy and sports drinks, ready-to-drink tea, ready-to-drink coffee and flavoured milk drinks); and eating fresh fruit and raw vegetables as snacks instead of sugary snacks.

4.9 NEED FOR A BALANCED DIET

4.9 NEED FOR A BALANCED DIET

The quantities of the various nutrients that people consume vary widely, and the nutrient amounts present in different foods also vary a great deal. The total daily intake of protein, fat, and carbohydrate amounts to about 500 gm. In contrast, the typical daily mineral intake totals about 20 gm and the daily vitamin intake less than 300 mg. The daily requirement is nearly a gram of some minerals, such as calcium and phosphorous and a few milligrams or less of other minerals. For example, we need about 15 mg of zinc per day, which is just a few specks of the mineral.

The optimum requirements of various nutrients for an adult per day have been obtained from the, if the family members are eating enough calories and the right types of food. This table does not include infants under one year of age. A balanced diet is divided into four types/groups of food:

1) the staple,
2) vitamin and mineral rich,
3) protein rich and
4) energy rich foods.

All four groups are important each day. Within the group many different foods can be eaten. If the amount required to eat is different, substitutions or equivalents are on the chart and are given subsequently. For example, some people eat rice or corn instead of chapatti. For the two or three serving of fruit, one small piece of fruit or ½ cup of juice are equal. The recommended serving for vegetables is cooked, if uncooked vegetables are eaten then 2 times the amount should be eaten. In the protein group, legumes, meat and milk products should be eaten in the amounts specified each day. However, an egg can substitute for meat. If neither egg nor meat is eaten that day then additional legumes (dal) should be consumed.

Oil or fat should be added to the food during cooking. It is an important source of calories for family members. A specific amount of sugar is not recommended. While sugar can be an important source of energy, it contains no vitamins and minerals and can cause tooth decay. Sweet beverages and snacks are often expensive. Sugar and sweets should be used in moderation.

Food Type	Woman	Pregnant Woman	Lactating Woman	Man	Female 10-19	Male 10-19	Child 7-9	Child 4-6	Child 1-3
Staple: Rice or Chappati	5 Roti	6 Roti	7 Roti	8 Roti	5 Roti	7 Roti	6 Roti	5 Roti	2 Roti
Vitamin & Mineral Rich: Fruit	3	3	3	2	3	3	2	2	2
Vegetables	½ cup	1 cup	1 cup	1 cup	½ cup	1 cup	½ cup	½ cup	½ Cup
Protein Rich: Legumes	½ cup	½ cup	1 cup	1½ cup	1 cup	1 cup	1 cup	1 cup	¼ Cup
Meat or 1 Egg	¼ cup	¼ cup	¼ cup	¼ cup	¼ cup	¼ cup	¼ cup	¼ cup	¼ Cup
Milk or Yogurt	2 cups	3 cups	4 cups	2 cups	3 cups	3 cups	2 cups	2 cups	3 cups
Breast Milk									on demand until 2 years
Energy rich: Oils or Fat	8 teasp.	8 teasp.	8 teasp.	8 teasp.	6 teasp.	6 teasp.	4 teasp.	4 teasp.	2 teasp.
Total Calories	2113	2606	3050	2956	2342	2917	2201	1898	1328

Staples

1) cup of atta = 2 chappaties
2) chappaties = 1½ cups cooked rice

Protein Rich Foods

33 gms. of meat = 1/4 teacup or 4 small pieces

½ cup cooked dal = 1/4 cup meat = 1 egg

Vitamin and Mineral Rich

2 cups cooked = 1 cup raw vegetables

Equivalents:

1 roti = ¾ cup cooked rice

1 small fruit = ½ cup juice

½ cup cooked vegetables = 1 cup raw vegetables

½ cup cooked dal = ¼ teacup of meat = 1 egg.

THE FOOD GUIDE PYRAMID

The number of servings to consume from each food group in the current Food Guide Pyramid as shown above depends on a person's age and energy needs. Serving size is also adjusted downward for young children.

The plan for an adult over age 24 years essentially consists of the following:

- 2 servings from the milk, yogurt and cheese group
- 2 to 3 servings from the meat, poultry, fish, dry beans, eggs and nuts group (5 to 7 ounces total)
- to 5 servings from the vegetable group
- 2 to 4 servings from the fruit group
- to 11 servings from the bread, cereals, rice and pasta group

For some population groups-children, teenagers, adults under age 25 and pregnant or lactating women; 3 servings of the milk, yogurt and cheese group are recommended. Foods from the final category, which includes fats, oils and sweets that could be eaten to help meet individual energy needs but should not replace foods from other groups.

The Guide to Daily Pakistani Food, A Summary.

Food group	**Servings**	**Major contributions**	**Foods and serving sizes**
Bread, cereals, rice, pasta	6-11	Starch Thiamine Riboflavin Iron Niacin Folate Magnesium Fibre Zinc	1 slice of bread 1 oz. ready to eat cereal ½-¾ cup cooked cereal, rice, pasta

Vegetables	3-5	Vitamin A and C Folate Magnesium Fibre	½ cup raw or cooked vegetables 1 cup raw leafy vegetables
Fruits	2-4	Vitamin C Fibre	¼ cup dried fruit ½ cup cooked fruit ¾ cup juice 1 whole piece of fruit 1 melon wedge
Milk, yogurt, cheese	(adults) (children, teens, young adults, pregnant or lactating women)	Calcium Riboflavin Protein Potassium Zinc	cup milk 1½ oz. cheese oz. processed cheese 2 cups cottage cheese 1 cup yogurt 1 cup custard/pudding 1½ cups ice cream
Meat, poultry, fish, dry beans, eggs, nuts	2-3	Protein Niacin Iron Zinc Thiamine Vitamin B 6 Vitamin B 12	2-3 oz. cooked meat, poultry, fish 1-1½ cups cooked dry beans 4 tbsp peanut butter 2 eggs ½ -1 cup nuts
Fats, oils, sweets	Foods from this group should not replace any from the other groups. Amounts consumed should be determined by individual energy needs.		

HOW CAN YOU AS A FWW PROMOTE HEALTHY DIET?

A healthy diet trend evolves over time, being influenced by many social and economic factors that interact in a complex manner to shape individual dietary patterns. These factors include income, food prices (which will affect the availability and affordability of healthy foods), individual preferences and beliefs, cultural traditions, and geographical and environmental aspects (including climate change). Therefore, promoting a healthy food environment – including food systems that promote a diversified, balanced, and healthy diet – requires the involvement of multiple sectors and stakeholders, including government, and the public and private sectors.

Your role as FWW is of crucial importance, as the women and families look up to you for advice. You can help in the change for healthy eating by doing the following:

1) promoting awareness of a healthy diet
2) developing school policies and programs that encourage children to adopt and maintain a healthy diet
3) educating children, adolescents and adults about nutrition and healthy dietary practices

4) discuss balanced diet in women's groups
5) highlighting the needs of pregnant and lactating women
6) encouraging culinary skills, including in children through schools
7) providing nutrition and dietary counselling at primary health-care facilities.

4.10 MALNUTRITION

4.10 MALNUTRITION

Malnutrition is a condition that results from nutrient deficiency or overconsumption.

Types of malnutrition include

- **Undernutrition:** This type of malnutrition results from not getting enough protein, calories or micronutrients. It leads to low weight-for-height (wasting), height-for-age (stunting) and weight-for-age (underweight).
- **micronutrient-related malnutrition**, which includes micronutrient deficiencies (a lack of important vitamins and minerals) or micronutrient excess; and
- **Overnutrition:** Overconsumption of certain nutrients, such as protein, calories or fat, can also lead to malnutrition. This usually results in overweight or obesity.

Various forms of malnutrition

Undernutrition

There are 4 broad sub-forms of undernutrition: wasting, stunting, underweight, and deficiencies in vitamins and minerals. Undernutrition makes children much more vulnerable to disease and death.

Low weight-for-height is known as wasting. It usually indicates recent and severe weight loss because a person has not had enough food to eat and/or they have had an infectious disease, such as diarrhoea, which has caused them to lose weight. A young child who is moderately or severely wasted has an increased risk of death, but treatment is possible.

Low height-for-age is known as stunting. It is the result of chronic or recurrent undernutrition, usually associated with poor socioeconomic conditions, poor maternal health and nutrition, frequent illness, and/or inappropriate infant and young child feeding and care in early life. Stunting holds children back from reaching their physical and cognitive potential.

Children with low weight-for-age are known as underweight. A child who is underweight may be stunted, wasted, or both.

Micronutrient-related malnutrition

Inadequacies in intake of vitamins and minerals often referred to as micronutrients, can also be grouped together. Micronutrients enable the body to produce enzymes, hormones, and other substances that are essential for proper growth and development.

Iodine, vitamin A, and iron are the most important in global public health terms; their deficiency represents a major threat to the health and development of populations worldwide, particularly children and pregnant women in low-income countries.

Overweight and obesity

Overweight and obesity is when a person is too heavy for his or her height. Abnormal or excessive fat accumulation can impair health.

Body mass index (BMI) is an index of weight-for-height commonly used to classify overweight and obesity. It is defined as a person's weight in kilograms divided by the square of his/her height in meters (kg/m^2). In adults, overweight is defined as a BMI of 25 or more, whereas obesity is a BMI of 30 or more.

Overweight and obesity result from an imbalance between energy consumed (too much) and energy expended (too little). Globally, people are consuming foods and drinks that are more energy-dense (high in sugars and fats) and engaging in less physical activity.

Diet-related non communicable diseases

Diet-related noncommunicable diseases (NCDs) include cardiovascular diseases (such as heart attacks and stroke, and often linked with high blood pressure), certain cancers, and diabetes. Unhealthy diets and poor nutrition are among the top risk factors for these diseases globally.

A child who does not get adequate amount of food is graded as mal-nourished. Malnutrition literally means bad nutrition but practically it means under nutrition i.e., the child is getting too little of food and so he does not gain weight properly Many families cannot afford or access enough nutritious foods like fresh fruit and vegetables, legumes, meat, and milk, while foods and drinks high in fat, sugar, and salt are cheaper and more readily available, leading to a rapid rise in the number of children and adults who are overweight and obese, in poor as well as rich countries. It is quite common to find undernutrition and overweight within the same community, household or even individual – it is possible to be both overweight and micronutrient deficient

PREVENTIVE ASPECTS OF MALNUTRITION

Majority of the women attending the FW Centers come from low-income groups with their income around the subsistence level. Since the Centers are the main institutions where mothers and children come for getting health and medical care, this gathering could be utilized for educating and counselling mothers to attain a balanced diet and thus prevent malnutrition.

Who is at risk?

Every country in the world is affected by one or more forms of malnutrition. Combating malnutrition in all its forms is one of the greatest global health challenges. Women, infants, children, and adolescents are at particular risk of malnutrition. Optimizing nutrition early in life—including the 1000 days from conception to a child's second birthday—ensures the best possible start in life, with long-term benefits.

Poverty amplifies the risk of, and risks from, malnutrition. People who are poor are more likely to be affected by different forms of malnutrition. Also, malnutrition increases health care costs, reduces productivity, and slows economic growth, which can perpetuate a cycle of poverty and ill-health

In our society mostly the mothers will bring their children with the complaint of:

- He is very weak
- He is always sick

- He has diarrhea or coughs and colds
- He is miserable and cries a lot

All these complaints have a hidden factor of malnutrition which is never complained about

Effects OF MALNUTRITION

Malnutrition is directly responsible for

1) Certain specific nutritional deficiency diseases like kwashiorkor, marasmus, vitamin A deficiency, anaemia, goiter etc.
2) Resistance to Infection
3) Malnutrition predisposes the body to infections like tuberculosis
4) Infections in turn aggregate malnutrition and metabolism.
5) Mortality and Morbidity
6) Thus, food plays a prominent role in providing physical, mental and social wellbeing which is the WHO definition of health.
7) Thus, food reduces incidences of disease therefore it reduces morbidity/mortality rate (death rate).

Factors influencing food habits:

There are a multitude of factors, which play an important role in ensuring intake of a balanced diet and hence adequate nutrition. They include:

1) Superstitions
2) Social and cultural factors
3) Religions factors
4) Income
5) Geography/availability
6) Advertising and media

1) Superstitions and Cultural Factors

Food habits are handed over from generation to generation. Though these factors have very little or no scientific basis, people rigidly adhere to them. e.g: In many parts of Pakistan, pregnant women are not allowed to take dates or bitter gourd as they are thought to cause abortion. Some others believe drinking milk will result in a baby with a very fair complexion

2) Child Rearing Practices

In some families, late introduction of weaning foods, prolonged breastfeeding and the adoption of commercially produced baby foods Baby at 4 months is fed soft food, fruit or vegetables,

3) Income

Financial resources determine the type of food we consume. Depending on the availability one selects the food. People of higher income groups can choose food from all groups irrespective of season.

Common signs of malnutrition include:

- unintentional weight loss – losing 5% to 10% or more of weight over 3 to 6 months is one of the main signs of malnutrition
- a low body weight – people with a body mass index (BMI) under 18.5 are at risk of being malnourished (use the BMI calculator to work out your BMI)
- a lack of interest in eating and drinking
- feeling tired all the time
- feeling weak
- getting ill often and taking a long time to recover
- in children, not growing or not putting on weight at the expected rate

Symptoms of malnutrition in a child can include:

- not growing or putting on weight at the expected rate (faltering growth)
- changes in behaviour, such as being unusually irritable, slow or anxious
- low energy levels and tiring more easily than other children

Malnutrition is a group of conditions in children and adults generally related to poor quality or insufficient quantity of nutrient intake, absorption, or utilization.

There are two major types of malnutrition:

- Protein-energy malnutrition - resulting from deficiencies in any or all nutrients
- Micronutrient deficiency diseases - resulting from a deficiency of specific micronutrients

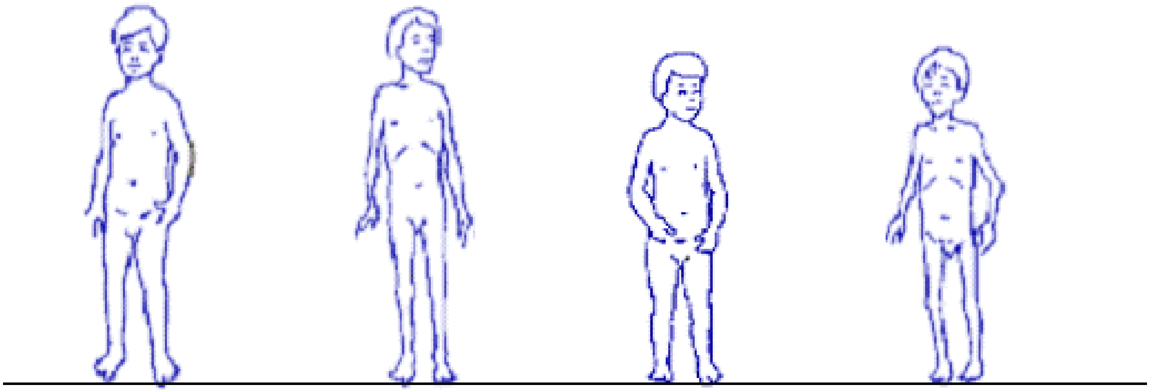
Protein-energy malnutrition

There are three types of protein-energy malnutrition in children:

Type	Appearance	Cause
Acute malnutrition	Wasting or thinness	Acute inadequate nutrition leading to rapid weight loss or failure to gain weight normally
Chronic malnutrition	Stunting or shortness	Inadequate nutrition over long period of time leading to failure of linear growth

Acute and chronic malnutrition	Underweight	A combination measure, therefore, it could occur as a result of wasting, stunting, or both

These forms of protein-energy malnutrition in children can be pictured like this:



Normal
Normal weight and height

Wasted
Thinner than normal

Stunted
Shorter than normal

Wasted and stunted
Thinner and shorter than normal

Wasting and stunting are very different forms of malnutrition. Stunting is chronic and its causative factors are poorly understood. Stunting usually does not pose an immediate threat to life and is relatively common in many populations in less-developed countries. This is not to say that it is unimportant, just less important than wasting in humanitarian emergencies. Wasting results from an acute shortage of food, is reversible with refeeding, and has a relatively high mortality rate. For these reasons, wasting is the highest priority form of malnutrition in humanitarian emergencies

The common factors in Malnutrition:

It is caused by a number of complex and closely related factors which relate to the social and economic condition of the family.

- No breast feeding or breast-feeding failure
- Use of too small amount of over diluted milk
- Too late introduction of inadequate and improperly prepared solid food (inadequate weaning/ complementary feeding)
- Poverty
- Ignorance about good feeding practices
- Superstitions

- Lack of food
- Inadequate Hygiene (lack of cleanliness)
- Infectious diseases occurrence in the area where the family lives

Importance of detecting Malnutrition Early:

It is important to identify children with malnutrition at the earliest possible stage to manage them more effectively.

Methods for detecting Malnutrition

Malnutrition is a chronic condition. When a child has been malnourished for a long time the growth failure can be seen in several ways. He is not only underweight being thinner (wasted), but also shorter (stunted) than a normal child of the same age. Malnutrition can be detected by:

Weighing the babies: (weight for age). The simplest way for detecting mal nutrition is to weigh the babies regularly and to compare their weight with the normal growth guide on the Road to Health Chart. If a child is not gaining weight adequately at a certain age, as compared to normal standards, he may be called as suffering from “Malnutrition”.

Measuring height of the babies: The babies who are malnourished do not grow in height as compared to the well-nourished babies and are short statured.

CHARACTERISTICS OF UNDERWEIGHT CHILD

Protein-energy malnutrition occurs when there is not enough protein and energy (two important nutrients) in the diet. Energy deficiency is probably more common and important than protein deficiency. Usually if a diet is adequate in energy, it will contain enough protein. Protein- energy malnutrition is a very common condition among children under 5 years of age in poor communities. Protein-energy malnutrition and infectious diseases often occur together.

Clinical Forms of Malnutrition:

We can grade malnutrition according to the Grade-I, Grade-II and Grade-III; (after Gomes),

If the Harvard Standard (50th Centile) is taken as 100%. Those children below 80% are Grade I, below 70% are Grade II and below 60% weight for age are grade III.

Grade-III protein-energy mal-nutrition is usually obvious and there are two severe types of protein-energy malnutrition i.e., Marasmus & Kwashiorkor.

DEFICIENCY OF ENERGY (FATS AND CARBOHYDRATES):

Marasmus:

It usually occurs below 2 years of age.

Functions of Energy foods:

- The body uses energy during the various activities of its systems
- Energy helps to keep these functions going.

Signs/Symptoms of Marasmus:

- Extreme growth failure
- The child becomes thin
- The child's weight is 60% lower than standard norms
- Marked muscle wasting and loss of subcutaneous fat
- Apparently large head, disappearance of fat pads of cheeks
- The eyes look big and bright, the old wise man look (monkey face)
- The skin becomes dry and wrinkled
- The abdomen is protruded due to muscle weakness
- The child is usually very hungry
- The child is disinterested in his surroundings
- The child becomes irritable but alert
- The child may suffer from diarrhea or constipation.

Treatment and Prevention:

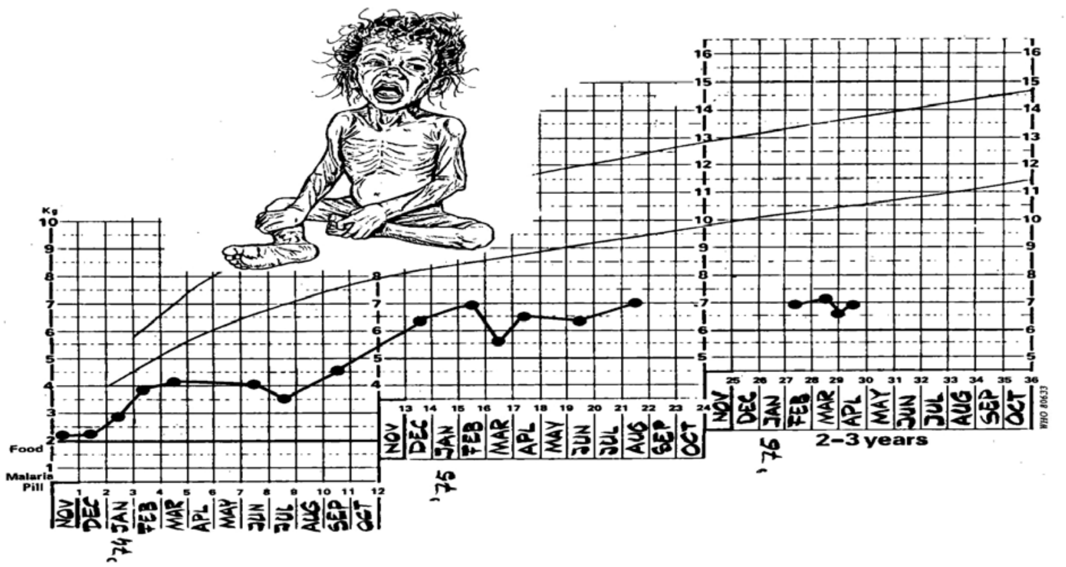
- The child should be exclusively breast fed for 4 to 6 months of age. After six months breast milk alone is not enough.
- Supplementary foods should be introduced along with breast feeding when the child is 6 months of age.
- Foods like sugar, sugarcane, potatoes, sweet potatoes, wheat, maize, bajra, ghee, oil should be given to the child.
- The child should be fed frequently about six to seven times in a day i.e., small meals at small intervals.
- The child should be taken to the health outlet to be weighed every month and the weight is plotted in the growth chart to measure and assess the degree of marasmus.

If the child has any signs and symptoms of infectious disease, he should be treated under the guidance of a doctor, other children, for reasons not entirely understood, develop thinness without oedema. This condition is called marasmus. Some children have signs of both kwashiorkor and marasmus. They have marasmic-kwashiorkor. Both kwashiorkor and marasmus are life-threatening medical emergencies which need to be treated by sophisticated feeding programs. Such programs must be run by medical professionals with experience in refeeding children with severe protein-energy malnutrition.

Children with marasmus are very thin and wasted and are mostly between the ages of 6 and 24 months and have been called "skin and bone children". Their food is deficient in calories. The fat under the skin has been used and eaten up to provide calories and there are loose folds of skin over the arms, legs, and buttocks. The muscles are wasted and as a result the arms and legs are thin, and all the bones stand out. The abdomen is distended, partly because the abdominal muscles are weak. The face is also wrinkled, and the bones stand out. The eyes are prominent, and the child looks like a "worried old man"' or a "wise old man". The hair is usually normal in colour but may be rather sparse (not thick). Marasmic children are usually hungry.

Children fed on bottle milk from the early months of life often develop marasmus. This is usually because the milk is diluted too much. Diluted milk does not have enough energy in it. Furthermore, the milk is fed through dirty bottles and as a result the children often suffer from diarrhea. This leads to nutritional marasmus, and the children weigh about half the weight of healthy children of their age.

GROWTH CHART OF A CHILD WITH MARASMUS



Kwashiorkor

Deficiency of Protein:

It usually occurs between 1-5 years of age.

Functions of proteins:

- They ensure the growth and development of the body
- They repair tissues and replenish the loss of energy.
- Signs/Symptoms of Kwashiorkor:
  - The disease is characterized by oedema, initially on the extremities i.e., of hands and legs which spreads to the face (moon face) and gradually on whole of the body
  - Growth retardation, wasting of muscles but retention of some subcutaneous fat
  - The color of the hair changes from black to brown and they become brittle
  - The child becomes irritable, disinterested, and lethargic
  - The skin becomes red, small patches can be observed
  - The child loses appetite, and cries constantly
  - The weight of the child is normal
  - Diarrhea, anaemia, enlargement of liver are common features.

Treatment and Prevention:

- The intake of protein, like milk and milk products, groundnuts, grams, peas and fish etc. should be increased, since the child is mainly fed on carbohydrates and his diet lacks proteins.
- Mother is advised to start weaning at 6 months.
- Infection, if present, should be treated.
- If symptoms persist, child is referred to hospital.
- If growth is not normal, refer to hospital.

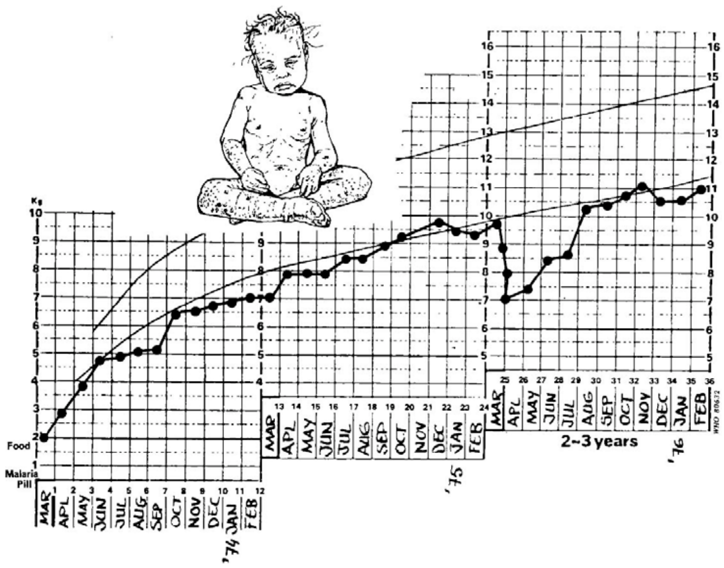
Some children with acute protein-energy malnutrition develop oedema. Oedema is an accumulation of fluid in the tissue, especially the feet and legs. Such children may not lose weight when developing acute protein-energy malnutrition because the weight of this excess oedema fluid counterbalances the weight of lost fat and muscle tissue. These children may look fat or swollen. Such children have kwashiorkor.

Kwashiorkor is very important to distinguish because the risk of death for children with kwashiorkor is higher than it is in children with just wasting or thinness.

Kwashiorkor may occur at a later age than marasmus, often in children between 18 and 48 months old. This is the more serious form of protein-energy malnutrition. It is due to eating less protein in diet. The most evident sign of this condition is body swelling (called oedema), especially swelling of the forearms, hands, legs and feet. The face, abdomen, and genitals may also be swollen. It is possible to make mistake and think that these children are fat. Test the swelling over the front of the lower leg bone. Press with your thumb for half a minute. There will be a hollow depression when you remove your thumb. This does not happen with a child who is just fat.

Children with kwashiorkor are always unhappy and often irritable. Many of them cry for long periods. They sit still and take no interest in anything, not even in food. Many of them have no appetite. Some children with kwashiorkor have abnormal skin and hair. Their hair has lost the colour (de-pigmentation). The skin is often paler than normal, and over the legs there may be lines and cracks. Sometimes their skin peels off in small pieces like old paint. Some children have sores from which a fluid flows. The hair of some children with kwashiorkor is pale, brownish, orange or blonde, sparse, and the hair are thin and break easily (brittle).

Growth chart of a child with kwashiorkor



Comparison between Marasmus & Kwashiorkor

Marasmus	Kwashiorkor
	
It is due to diet deficient in proteins and calories (carbohydrates + fats)	It is due to diet deficient in Proteins with excess of carbohydrates
It occurs between age of 6-24 months	Develops later (after 18 months) common in 2-5 years
Child looks like skin & bones *(Sookhas)*	Child looks like skin, bones & water (swollen)
Child is under weight	Child is normal in weight (oedema compensates) or there is loss of weight
Subcutaneous fat is dissolved (to provide calories) therefore:	Muscle wasting is present (Muscles eaten up to provide proteins)
Skin is wrinkled	Skin is not wrinkled
Eyes are prominent, observes & takes interest in surroundings (old wise man's face)	Apathetic, irritable, unhappy & miserable (often crying)

Skin & hair are normal in color	Skin and hair lose color (de-pigmentation) Skin is pale Hair is pale, brownish, orange & blonde Hair is sparse & brittle
Always hungry	Less appetite or loss of appetite

Other forms of Malnutrition:

There are many other forms of malnutrition in children, important amongst these are the following three:

- Vitamin “A” deficiency causes night blindness. Give your children lots of green or colored vegetables besides butter. Vitamin “A” drops are being provided these days by the mobile immunization teams for prevention of this deficiency disease.
- Vitamin “D” deficiency causes rickets. Let them be exposed to sunshine and drink a lot of milk. They will not get rickets. (Details of deficiency diseases is given in chapter on Nutrition)
- Iron deficiency causes anaemia. Give small supplements of iron starting from 4—6 months.

Prevention of Malnutrition:

- Breast feed all babies
- Do not dilute the liquid milk (in bottle fed babies) because nourishment is reduced, and the babies will not grow well.
- Start soft solid foods from age of 4-6 months. (Proper weaning at proper time)
- Weigh the babies every month and make sure their weight is going up. If not, find out what is the reason. Babies should generally double their birth weight at 5 months and triple it at 12 months age.
- Protect the babies from infectious diseases through immunization.
- Observe personal hygiene and proper sanitation.

ANAEMIA

Anaemia is a condition in which the number of red blood cells or the haemoglobin concentration within them is lower than normal. Haemoglobin is needed to carry oxygen and if you have too few or abnormal red blood cells, or not enough haemoglobin, there will be a decreased capacity of the blood to carry oxygen to the body’s tissues.

This results in symptoms such as fatigue, weakness, dizziness and shortness of breath, among others. The optimal haemoglobin concentration needed to meet physiologic needs varies by age, sex, elevation of residence, smoking habits and pregnancy status. The most common causes of anaemia include nutritional deficiencies, particularly iron deficiency, though deficiencies in folate, vitamins B12 are also important causes; haemoglobinopathies;

and infectious diseases, such as malaria, tuberculosis, HIV and parasitic infections also cause anaemia

Anaemia is a serious global public health problem that particularly affects young children and pregnant women. WHO estimates that 42% of children less than 5 years of age and 40% of pregnant women worldwide are anaemic.

IRON DEFICIENCY (ANAEMIA):

The most widespread nutritional deficiency worldwide is iron deficiency. Iron deficiency can lead to anaemia. This is a blood disorder that causes fatigue, weakness, and a variety of other symptoms.

Iron is found in foods such as dark leafy greens, red meat, and egg yolks. It helps your body make red blood cells.In iron-deficient state, the body produces fewer red blood cells. The red blood cells it produces are smaller and paler than healthy blood cells. They're also less efficient at delivering oxygen to your tissues and organs.

According to the WHO, over 30 percent of the world's population is anaemic. Many of these people are anaemic due to iron deficiency. In fact, it's the only nutritional deficiency that's prevalent in both developing and industrialized countries. Iron deficiency anaemia affects so many people that it's now widely recognized as a public health epidemic. It is a common nutritional problem in pregnancy and childhood especially in countries or regions with high incidence of hook worm infestation.

Functions of Iron:

It forms the haem part of haemoglobin present in red blood cells to transfer oxygen in the body.

Signs/symptoms of Anaemia:

- Weakness, lethargy
- Breathlessness on little exertion
- Palpitations
- Night cramps
- Pallor of tongue and loss of papillae
- Pallor of inner sides of lips and lower eyelids
- Nails and palms are light pink/white in colour
- Spoon shaped nails (koilonychia)
- Swelling of feet
- Low haemoglobin level in blood
- Ova of intestinal worms in stools (especially in children).

Treatment and Prevention:

- Diet rich in iron - meat, egg, pulses, liver, apple, green leafy vegetables etc.
- Well-balanced diet.
- Observe personal and food hygiene.
- Iron supplements e.g., tab. Ferrous sulphate 200 mg TDS (it turns the color of stools black).
- Hook worm infestation to be treated if present.
- In case of severe anaemia, refer to doctor.

MINERAL DEFICIENCY DISEASES

IODINE DEFICIENCY (GOITRE)

Function of Iodine:

- Helps in normal functioning of the thyroid gland.
- Signs/Symptoms of Goiter:
- Enlargement of thyroid gland which usually occurs in people living in hilly area
- Coarse features
- Disinterested and dull looking.

Treatment and Prevention:

- Iodine rich sea food e.g. fish should be added in diet.
- Use Iodized salt.
- Iodine drops to be used on doctor's prescription

CALCIUM DEFICIENCY (TETANY)

Functions of Calcium:

- It is essential for the development of teeth and bones
- It is essential for clotting of blood and contraction of muscles

Signs/Symptoms of Tetany:

- Tetany, spasm and twitching of muscles of face, hand and feet
- Perioral paresthesia
- Wrist flexion and fingers drawn together
- Depression.

Treatment and Prevention:

- Diet rich in calcium e.g., milk, butter, cheese, yogurt, egg etc. should be taken.

- Calcium supplements.

Treat the underlying cause or refer to doctor

VITAMIN DEFICIENCIES AND THEIR EFFECTS

Name of Vitamin	Minimum Daily Requirements	Effects/Deficiency Diseases
FAT SOLUBLE		
Vitamin A	20000 I.U. (International Units)	• Retardation of growth of children and lowering of body resistance • Xerophthalmia, Night blindness and Keratomalacia • Degeneration of myelin sheath of nerves
Vitamin D	200 I.U.	• Rickets and softening of bones
Vitamin E	0.2 mg	• Sterility in animals but never directly implicated in man • Threatened abortions in female
Vitamin K	1000 I.U.	• Delaying in normal blood coagulation time and profuse bleeding on slight • injury
WATER SOLUBLE		
B1 (Thiamine HCl)	1-3 mg	• Polyneuritis or Beri-Beri • Loss of appetite, depression, exhaustion and fatigue • Carbohydrate metabolism is disturbed, pyruvic acid accumulates in the blood
B2 (Riboflavin)	3 mg	• 1.Lip cracks at the corners of mouth • 2.Soreness and cracks of the tongue • 3.Redness of eyes

B3 Nicotinamide (Nicotinic acid)	10 mg	• Skin eruption • Diarrhoea • Pellagra
B6B4 (Pantothenic acid, Calcium Pantothenate)	10 mg	• Burning of palm and soles • Weak memory • Early greying of hair and baldness
(Pyridoxine)	1.5-2 mg	• Nervousness • Irritability • Weakness and difficulty in walking • Convulsive seizures in infants • Hypochromic anaemia
B12 Cytamin (Cynocobalamine)	Very minute quantity 3-5 µg	• Degeneration of liver cells causing • certain anaemias-Pernicious anaemia
C (Ascorbic acid)	50 mg (600 I.U.)	• Scurvy - Bleeding and retraction of gums • Tendency to haemorrhage from the skin capillaries • Dental caries • Anaemia and loss of appetite

VITAMIN A DEFICIENCY (NIGHT BLINDNESS)

It's found in red, orange, yellow, and dark green produce. Beta carotene can be converted to vitamin A in the body when needed. For newborn babies, the best source of vitamin A is breast milk. For everyone else, it's important to eat plenty of foods high in vitamin A. These include:

- milk
- eggs
- green vegetables, such as kale, broccoli, and spinach
- orange vegetables, such as carrots, sweet potatoes, and pumpkin
- reddish-yellow fruits, such as apricots, papaya, peaches, and tomatoes

Signs/Symptoms of Vitamin A deficiency

- Night blindness
- Frequent respiratory tract infections (low resistance to infection)

- Dull, grey colored triangular patch is seen in the conjunctiva
- The conjunctiva becomes wrinkled
- If the cornea gets affected, the child may become blind
- Skin becomes dry
- Slow growth of body.

Treatment and Prevention:

- Vitamin A drops every six months for children between the ages of 1 to 5 year.
- Yellow- and orange-colored fruits and vegetables like pumpkin, carrot, ripe mango, leafy vegetables like spinach, brinjal, gram leaves, milk and its products are rich sources of vitamin A.

VITAMIN B DEFICIENCY and Prevention:

Vit. B complex has many components whose details are given in chart below.

Vitamin	Source	Deficiency disease	Symptoms
Vitamin B 1 (Thiamine)	Cereals, pulses, legumes, oil seeds, nuts	Beriberi	Loss of appetite, indigestion flaccid with heaviness and weakness of the legs. Pinprick sensation of hands and feet.
Vitamin B 2 (Riboflavin)	Liver, milk, egg	Ariboflavinosis	Sores in the corners of the mouth.
Niacin	Liver, kidney, meat, milk, peanut, whole cereals	Pellagra	Skin infections (dermatitis), diarrhoea, loss of concentration (dementia), ulceration in mouth.
Vitamin B 6 (Pyridoxine)	Rice, liver, whole cereals, legumes, oil seeds, nuts, egg, milk, meat and fish	Deficiency is rare	Lesions on skin, eyes, nose and mouth.
Vitamin B12 (Cytamin)	Legumes, meat, fish, milk, eggs, vegetables	Pernicious anaemia	Soreness and inflammation of the tongue are commonly observed.

- Foods rich in vitamins as mentioned above must be included in daily diet.
- Vitamins are mostly water soluble and are destroyed by heat. To preserve these vitamins, remember the following points.
  - Don’t throw away coarse flour
  - Don’t rub cereals and pulses too much while washing

    - Don’t remove rice water
    - Don’t put cut vegetables in water or wash them after cutting
- Vitamin B supplements can be given.

THIAMINE (VITAMIN B-1) DEFICIENCY

Another common nutritional deficiency occurs with thiamine, also known as vitamin B-1. Thiamine is an important part of your nervous system. It also helps your body turn carbohydrates into energy as part of your metabolism.

A lack of thiamine can result in:

- weight loss
- fatigue
- confusion
- short-term memory loss

Thiamine deficiency can also lead to nerve and muscle damage and can affect the heart. Alcohol reduces the body’s ability to absorb thiamine, store thiamine in the liver, and convert thiamine to a usable form. Thiamine deficiency is a common cause of Wernicke-Korsakoff syndrome, a form of dementia.

NIACIN (VITAMIN B-3) DEFICIENCY

Niacin is another mineral that helps the body convert food into energy. It’s also known as vitamin B-3.

A severe deficiency in niacin is often referred to as pellagra. Niacin is found in most animal proteins but also in peanuts. As a result, this condition is rare in industrialized countries or in meat-eating communities.

Symptoms of pellagra include diarrhea, dementia, and skin disorders. You can usually treat it with a balanced diet and vitamin B-3 supplements.

FOLATE (VITAMIN B-9) DEFICIENCY

Vitamin B-9 helps the body create red blood cells and produce DNA. It’s often referred to as folate. Folate also helps brain development and nervous system functioning. Folic acid is the synthetic form found in supplements or fortified foods.

Folate is especially important for fetal development. It plays a crucial role in the formation of a developing child’s brain and spinal cord. Folate deficiency can lead to severe birth defects, growth problems, or anaemia.

You can find folate in the following foods:

- beans and lentils
- citrus fruits

- leafy green vegetables
- asparagus
- meats, such as poultry and pork
- shellfish
- fortified grain products
- whole grains

While beans can provide a great amount of folate, the folate content in canned beans is about half of what cooked, dried beans offer. pregnant women and women of childbearing age consume enough folate for a healthy pregnancy.

Women who are pregnant or who may become pregnant consume up to 400 micrograms of folic acid each day, over and above the folate they're getting from food naturally to help prevent neural tube defects.

Some people have genetic mutations that prevent their body from methylating folate or converting it to a form that body can use. In these cases, while folate intake might be adequate, a supplement of methylated folate may be necessary to prevent deficiency.

COBALAMIN (VITAMIN B-12) DEFICIENCY

Vitamin B-12 is a B vitamin that's responsible for assisting the body in making enough healthy red blood cells. Deficiency in this vitamin is common among people who:

- are vegans
- have had gastric surgery
- are over 60 years old
- have diabetes and take metformin (Glucophage)
- have a long history of antacid use
- lack intrinsic factor

Intrinsic factor is a transport protein secreted by the stomach cells. It binds to B-12 and takes it to the small intestine for absorption. This is the way the body is able to absorb and utilize B-12. Adequate calcium intake at meals is required for intrinsic factor to assist in B-12 absorption in the small intestine. A deficiency in this vitamin may cause pernicious anaemia. This is a type of anaemia caused by a decreased ability to absorb B-12 efficiently. Pernicious anaemia is more common in people with autoimmune disorders and inflammatory or digestive diseases.

Symptoms of vitamin B-12 deficiency include:

- fatigue and weakness in extremities
- dizziness

- shortness of breath
- weight loss
- nausea or poor appetite
- sore, red, or swollen tongue
- pale or yellowish skin

Left untreated for too long, vitamin B-12 deficiency may cause irreversible damage to the nervous system.

More severe symptoms include:

- difficulty walking
- muscle weakness
- irritability
- dementia
- depression
- memory loss

Treatment may be provided in a variety of ways, including:

- increasing vitamin B-12 sources in the diet
- taking vitamin B-12 supplements
- receiving vitamin B-12 injections
- blood transfusions

Vitamin B-12 is commonly found in red meat and animal products. Vegetarian sources include fortified plant-based milks and nutritional yeast.

VITAMIN D DEFICIENCY

About 1 billion people worldwide don’t get enough vitamin D. People with darker skin tones are at a higher risk of vitamin D deficiency and this is very common in Pakistan. Vitamin D is essential for healthy bones. It helps the body maintain the right levels of calcium to regulate the development of teeth and bones. A lack of this nutrient can lead to stunted or poor bone growth. Osteoporosis, caused by a lack of calcium and vitamin D, can lead to porous and fragile bones that break very easily.

Vitamin D is only found naturally in a few foods. Foods with vitamin D include:

- fish liver oils
- fatty fish
- mushrooms
- egg yolks

- liver

The best source of vitamin D is sunlight., Research suggests that 5 to 30 minutes of midday sun exposure twice a week on the face, arms, neck, or back can provide you with enough vitamin D. Although recommended, sunscreen does hinder vitamin D absorption from sunlight through the skin. Spend a few minutes in the sun prior to sunscreen for optimal vitamin D absorption.

VITAMIN D DEFICIENCY (RICKETS)

Function of Vitamin D:

- It makes the bones and teeth strong by deposition of calcium.

Signs/Symptoms of rickets

- Delayed closure of fontanelle and delayed teething
- The lower limbs of the child become bow shaped
- There is swelling in joints. (Knock knees)
- Nodes are formed on the ribs (rickety rosary)
- The sternum (chest bone) appears protruded (pigeon shaped chest)
  - If a woman has this deficiency during pregnancy or lactation, then her female child may face difficulty in labour as the pelvis of this child may become narrow causing difficulty in labour in her later life
  - Osteomalacia and osteoporosis in adults causes softening of bones.

Treatment and Prevention

- Child should be exposed to sunlight because the skin prepares Vitamin D with the help of sun rays.
- Food rich in vitamin D is also obtained from oil, banana, milk, milk products etc. these foods should be included in the diet.
- Vitamin A & D drops to be given.

VITAMIN C DEFICIENCY (SCURVY)

Functions of Vitamin C:

- It helps in healing of wounds
- It is essential for absorption of iron
- It is essential for healthy capillaries.

Signs/Symptoms of scurvy:

- Bleeding, swollen and spongy gums
- Painful joints

- Falling of teeth at an early age.

Treatment and Prevention:

- Sour and astringent fruits are rich sources of vitamin C; lemon, amla, orange, lime, guava and sprouted beans should be eaten in adequate quantity.
- Fermented foods are also rich in vitamin C and should be included in daily diet.
- Vitamin C gets destroyed by heat. These foods should be eaten raw (properly washed).

Vegetables such as kale and broccoli also have calcium. Many cereals and grains are calcium fortified.

4.11 FOOD HYGIENE

4.11 FOOD HYGIENE

Food is essential for growth and development and provides energy; but it may also be responsible for the spread of a number of important diseases. The commonest form of contamination is from excreta by means of fingers, flies, etc. No food remains fresh for very long. Sooner or later when left by itself it starts to decompose. It goes soft, emits a foul smell and becomes unfit to eat due to bacterial action.

What is meant by food hygiene?

Food hygiene are the conditions and measures necessary to ensure the safety of food from production to consumption. Food can become contaminated at any point during slaughtering or harvesting, processing, storage, distribution, transportation and preparation Food hygiene ensures the safety and cleanliness of the food at each step of its preparation till it is eaten and the leftovers stored properly. Food hygiene is as important as the nutritive value of the food.

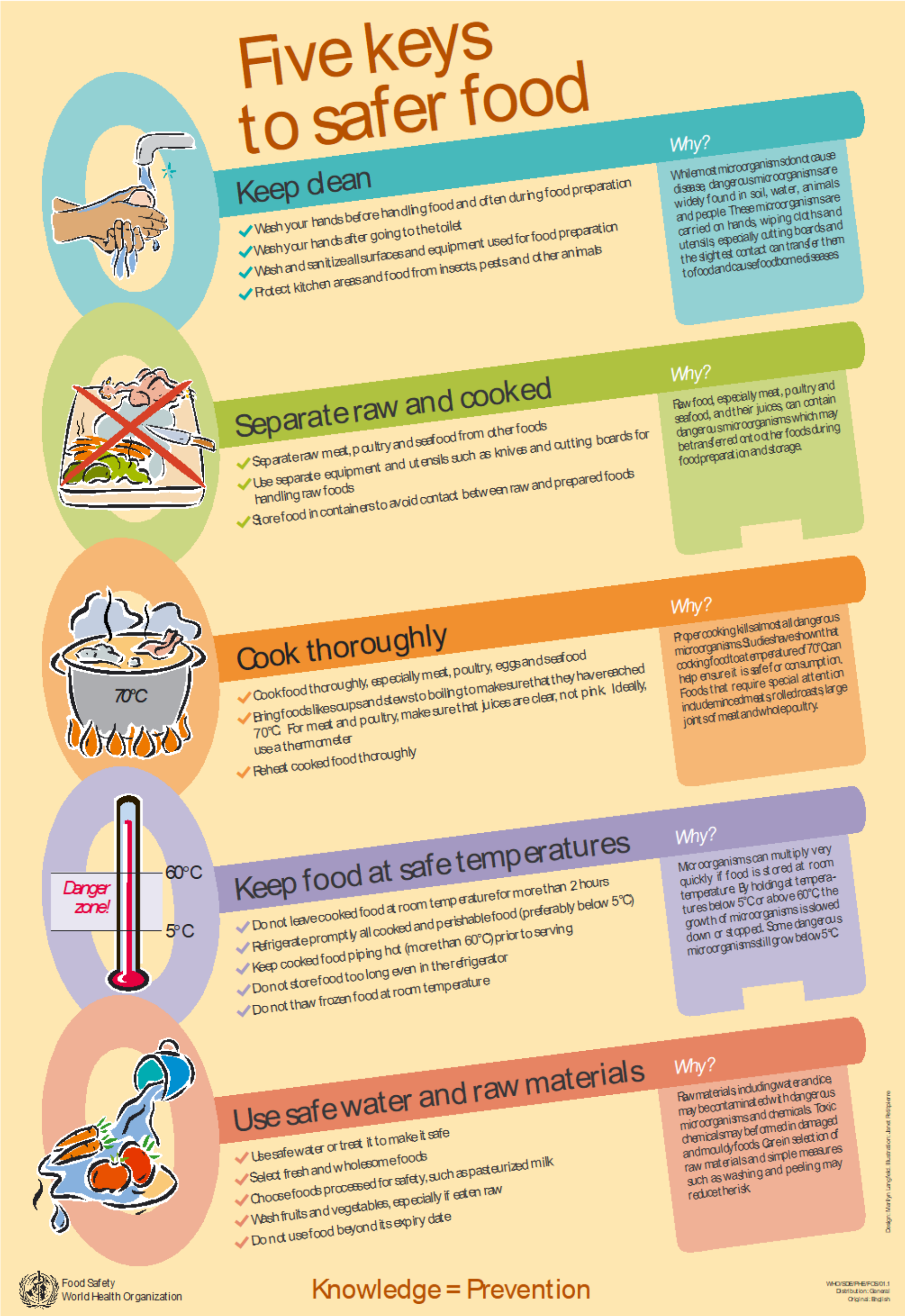
Importance of safe food handling

Each year, 1 in 10 people get ill by eating unsafe food. While food safety is a shared responsibility, individual consumers and food handlers play a huge role in preventing foodborne diseases. “Five keys to safer food” messages were therefore developed and validated by an independent body of international scientists in 2001, to empower all consumers worldwide with a simple and applicable set of actions to prevent foodborne diseases.

Overview

The core messages of the Five Keys to Safer Food were developed to educate safe food handling behaviours to all consumers and food handlers are:

- keep clean
- separate raw and cooked
- cook thoroughly
- keep food at safe temperatures; and
- use safe water and raw materials.



Major foodborne illnesses and causes

Foodborne illnesses are usually infectious or toxic in nature and caused by bacteria, viruses, parasites or chemical substances entering the body through contaminated food or water.

Foodborne pathogens can cause severe diarrhoea or debilitating infections. Chemical contamination can lead to acute poisoning or long-term diseases, such as cancer. Foodborne diseases may lead to long-lasting disability and death. Examples of unsafe food include uncooked foods of animal origin, fruits and vegetables contaminated with faeces, and raw shellfish containing marine biotoxins.

BACTERIA:

- ***Salmonella, Campylobacter, and Enterohaemorrhagic Escherichia coli*** are among the most common foodborne pathogens that affect millions of people annually – sometimes with severe and fatal outcomes. Symptoms are fever, headache, nausea, vomiting, abdominal pain and diarrhoea. Examples of foods involved in outbreaks of salmonellosis are eggs, poultry and other products of animal origin. Foodborne cases with *Campylobacter* are mainly caused by raw milk, raw or undercooked poultry and drinking water. *Enterohaemorrhagic Escherichia coli* is associated with unpasteurized milk, undercooked meat and fresh fruits and vegetables.
- ***Listeria*** infection leads to miscarriage in pregnant women or death of newborn babies. Although disease occurrence is relatively low, listeria's severe and sometimes fatal health consequences, particularly among infants, children and the elderly, count them among the most serious foodborne infections. Listeria is found in unpasteurized dairy products and various ready-to-eat foods and can grow at refrigeration temperatures.
- ***Vibrio cholerae*** infects people through contaminated water or food. Symptoms include abdominal pain, vomiting and profuse watery diarrhoea, which may lead to severe dehydration and possibly death. Rice, vegetables, millet gruel and various types of seafood have been implicated in cholera outbreaks.

Antimicrobials,

such as antibiotics, are essential to treat infections caused by bacteria. However, their overuse and misuse in veterinary and human medicine has been linked to the emergence and spread of resistant bacteria, rendering the treatment of infectious diseases ineffective in animals and humans. Resistant bacteria enter the food chain through the animals (e.g. *Salmonella* through chickens). Antimicrobial resistance is one of the main threats to modern medicine.

Viruses:

Norovirus infections are characterized by nausea, explosive vomiting, watery diarrhoea and abdominal pain. Hepatitis A virus can cause long-lasting liver disease and spreads typically through raw or undercooked seafood or contaminated raw produce. Infected food handlers are often the source of food contamination.

Parasites:

Some parasites, such as fish-borne trematodes, are only transmitted through food. Others, for example tapeworms like *Echinococcus spp*, or *Taenia solium*, may infect people through food or direct contact with animals. Other parasites, such as *Ascaris, Cryptosporidium, Entamoeba histolytica* or *Giardia*, enter the food chain via water or soil and can contaminate fresh produce.

Prions:

Prions, infectious agents composed of protein, are unique in that they are associated with specific forms of neurodegenerative disease. Bovine spongiform encephalopathy (BSE, or "mad cow disease") is a prion disease in cattle, associated with the variant Creutzfeldt-Jakob Disease (vCJD) in humans. Consuming bovine products containing specified risk material, e.g., brain tissue, is the most likely route of transmission of the prion agent to humans.

Chemicals:

Of most concern for health are naturally occurring toxins and environmental pollutants.

- **Naturally occurring toxins** include mycotoxins, marine biotoxins, cyanogenic glycosides and toxins occurring in poisonous mushrooms. Staple foods like corn or cereals can contain high levels of mycotoxins, such as aflatoxin and ochratoxin, produced by mould on grain. A long-term exposure can affect the immune system and normal development, or cause cancer.
- **Persistent organic pollutants (POPs)** are compounds that accumulate in the environment and human body. Known examples are dioxins and polychlorinated biphenyls (PCBs), which are unwanted by-products of industrial processes and waste incineration. They are found worldwide in the environment and accumulate in animal food chains. Dioxins are highly toxic and can cause reproductive and developmental problems, damage the immune system, interfere with hormones and cause cancer.
- **Heavy metals** such as lead, cadmium and mercury cause neurological and kidney damage. Contamination by heavy metal in food occurs mainly through pollution of air, water and soil.

The burden of foodborne diseases

The burden of foodborne diseases to public health and welfare and to economies has often been underestimated due to underreporting and difficulty to establish causal relationships between food contamination and resulting illness or death.

Safe food supplies support national economies, trade and tourism, contribute to food and nutrition security, and underpin sustainable development.

Urbanization and changes in consumer habits, including travel, have increased the number of people buying and eating food prepared in public places. Globalization has triggered growing consumer demand for a wider variety of foods, resulting in an increasingly complex and longer global food chain.

As the world's population grows, the intensification and industrialization of agriculture and animal production to meet increasing demand for food creates both opportunities and challenges for food safety. Climate change is also predicted to impact food safety.

These challenges put greater responsibility on food producers and handlers to ensure food safety. Local incidents can quickly evolve into international emergencies due to the speed and range of product distribution. Serious foodborne disease outbreaks have occurred on every continent in the past decade, often amplified by globalized trade.

Examples include the contamination of ready-to-eat meat with *listeria monocytogenes* in South Africa in 2017/18, resulting in 1060 cases of listeriosis and 216 deaths. In this case, contaminated products were exported to 15 other countries in Africa, requiring an international response to implement risk management measures.

Food safety: a public health priority

Unsafe food poses global health threats, endangering everyone. Infants, young children, pregnant women, the elderly and those with an underlying illness are particularly vulnerable. Every year 220 million children contract diarrhoeal diseases and 96 000 die. Unsafe food creates a vicious cycle of diarrhoea and malnutrition, threatening the nutritional status of the most vulnerable.

The International Conference on Food Safety held in Addis Ababa in February 2019, and the International Forum on Food Safety and Trade held in Geneva in 2019, reiterated the importance of food safety in achieving the Sustainable Development Goals. Governments should make food safety a public health priority, as they play a pivotal role in developing policies and regulatory frameworks and establishing and implementing effective food safety systems.

Food can become contaminated at any point of production and distribution, and the primary responsibility lies with food producers. Yet a large proportion of foodborne disease incidents are caused by foods improperly prepared or mishandled at home, in food service establishments or at markets. Not all food handlers and consumers understand the roles they must play, such as adopting basic hygienic practices when buying, selling and preparing food to protect their health and that of the wider community.

Everyone can contribute to making food safe. Here are some examples of effective actions:

Policymakers can:

- build and maintain adequate food systems and infrastructures (e.g., laboratories) to respond to and manage food safety risks along the entire food chain, including during emergencies.
- foster multi-sectoral collaboration among public health, animal health, agriculture and other sectors for better communication and joint action
- integrate food safety into broader food policies and programs (e.g. nutrition and food security)
- think globally and act locally to ensure that food produced domestically remains safe when imported internationally.

Food Infection and Food Toxemia:

There are two well recognized classes of food poisoning. Food poisoning is an acute attack of illness due to some pathogens/ toxins in food. To guard ourselves against food poisoning, we should rely on adequate cooking, if properly done it results in virtual sterilization of the final product and refrigeration prevents bacterial growth. Freshly cooked meat, fish, vegetables, fresh fruits, milk and milk products of all kinds are seldom dangerous.

Canned foods though generally very safe, are occasionally liable to contamination at the packing plant. Processed of any kind are always potentially dangerous.

Spread of infection through contaminated food and water:

Some common diseases that are transmitted through food contamination are listed as under: -

• Disease / organism	• Means of Spread		• Sources
• Bacterial Diseases			
• Cholera/ Vibrio cholerae	• Contaminated water or food, flies		• Flies and human faeces
• Dysentery/ Shigella bacilli	• Contaminated water or food, flies		
• Gastro enteritis/	• Contaminated water or food, flies		
• Staphylococci • Streptococci			
• E. coli			
• Tuberculosis/ Mycobacterium tuberculosis	• Contaminated milk, milk products & human sputum		• Infected cows & human beings
• Typhoid/ Salmonella typhi	• Contaminated food, water, milk, flies		• Human faeces
• Parasitic Diseases	• Raw vegetables, especially underground		• Farmyard • manure soil
• Amoebiasis/- Entamoeba			
• histolytica			
• Ascariasis/ Ascaris lumbricoides	• Contaminated vegetables	• Raw	• Soil
• Taeniasis/ Tape worm (taenia)	• Infected beef		• Infected cattle

PREVENTIVE MEASURES:

The control of food and water contamination should be given prime importance in Public Health for which the following measures should be taken: -

- Boiling of Water: It is important to boil water for 20 minutes before its consumption.
- Boiling of Milk: Milk may transmit many diseases if it is taken unbilled or insufficiently boiled. Let the milk boil for 20 minutes so that the living organisms are killed.
- Washing of Hands: A person should wash his / her hands with soap and water before handling any food. All the members of the household should be educated to clean their hands before they eat.
- Washing of Plates: The plates and crockery should be washed, cleansed and protected from flies before being used.
- Washing of Vegetables and Fruits: Raw vegetables and fruits when eaten without proper washing are harmful. Therefore, before making a salad or before eating, the fruits should be washed effectively under running water if possible. Never eat fruits that are spoilt or rotten and never buy cut and exposed pieces of fruit.
- Control of Flies, Cockroaches and Rats: Flies are the number one enemy of man. They sit on the faeces and filth, soil their legs and then sit on the food thus transmitting germs collected from the filth. The cockroaches living in dirty crevices and cesspits and the rats living in drains come out at night to feed, they contaminate the food left uncovered / unprotected in the kitchen.
- Protection of food: The food should not be left uncovered on the tables. It should be protected from flies by covering the food with gauze or with a cover made from local straw. Food should be eaten while still hot.
- A safe source of water supply: The supply of safe water is very important. Water taken from open tanks or wells is mostly contaminated. The water should be taken from deep tube wells. Where no such facilities are available, the drinking water must be boiled
- Sanitary disposal of excreta: The disposal of excreta should be proper and covered latrines be used which should be as far away as possible from the sources of drinking water.
- Health Education: Members of the community should be educated in how to protect the food from contamination in their homes.

4.12 EFFECT OF COOKING ON THE NUTRITIVE VALUE OF FOOD

4.12 EFFECT OF COOKING ON THE NUTRITIVE VALUE OF FOOD:

Raw foods are unpalatable and indigestible whereas cooking makes them otherwise and helps in destroying the pathogenic organism. Incorrect procedures adopted in preparing the foods result in nutrient loss even before the food is cooked.

Preparation Losses:

The skins on the fruits and vegetables protect the minerals and vitamins from oxidation. If the skins are removed, then the fruit must be eaten straight away or kept covered in a cool place to avoid the losses of vitamin A, vitamin C and Thiamine by exposure.

Green leafy vegetables must be eaten fresh. Wilted leafy vegetables lose 50% of their water-soluble minerals and vitamins. While preparing the leafy vegetables, first they should be washed, then chopped and cooked immediately, but never washed or soaked after cutting or chopping.

Certain fruits and vegetables turn brown after being cut. It is better to have them discolored than to lose their sugar, minerals, and vitamins in the water.

Fruit juices must not be left exposed. They must be taken immediately to avoid vitamin C losses. Certain dry fruits and vegetables like apricots, beans, pear, etc. need to be soaked to cut down the cooking time. The water used for soaking should be sufficient for it to be absorbed and cooked in it and must not be discarded or replaced with fresh water.

Cooking losses:

Proteins, fats and carbohydrates are not destroyed by heat unless the foods are burnt or the oil is heated too much, then it gets toxic, and fumes come off. Minerals and vitamins are destroyed by heat.

Boiling of vegetables causes nutrient loss. To avoid this loss, vegetables must be added to salted water. Just enough quantity of water should be used to cook the vegetables. Similarly, cooking of rice in excess water causes loss of thiamine, which can be avoided by cooking rice in sufficient quantity of water so that the water is absorbed and there is no excess to be discarded.

Frying of foods causes little loss. Fried food tastes better than boiled as the natural sugars are not lost due to cooking; but they should not be fried at very high temperatures which may result in over fried food and oxidation of the fat used for frying. It is a common practice to salt certain vegetables before pickling, this results in loss of flavour and the nutritive value as the juice is drawn out from the cut vegetables. Use of baking soda for cooking dried beans results in a total loss of the vitamins B and C.

Since cooking involves the application of heat, the following rules should be observed to reduce the nutrient losses:

1) While frying, keep the oil hot initially and then lower the heat.
2) While cooking, keep the heat high initially and then cook on a low flame.

3) Do not stir often and keep the pots covered to avoid vitamin losses due to exposure.

4) Do not overcook or burn the dish as the nutrients will either be destroyed or burnt.

5) For cooking dried foods, soak them over night and then cook in the same water initially on high, then a low flame with a cover on the pan.

6) Vitamin A and C are destroyed if tomatoes, leafy vegetables are poured while hot.

7) Cut the vegetables in slightly bigger pieces to avoid vitamin loss.

Effective and Economical Foods for Health:

The community should be mobilized to grow fruit trees like date-palm banana, guava, beir, papaya etc. vegetables like swanjani ki phalli , lauki, torai, palak, tomatoes, chilies, methi, dhania and podina can be grown over walls, fence and in small pots or pans.

Use plenty of dry foods like beans, peas, dals, fish, prawns, chana peanuts, dried fruits, sesame seeds (Til).

Sprout chana or moong beans can be eaten raw, sprinkled with salt and chilli powder for its vitamin B complex, vitamin C, protein, and calcium content.

Herbs, like mint, coriander and green chillies in their fresh forms are good sources of vitamins A, C, iron and calcium.

Homemade candy of jaggery and peanuts, or chana or til may be given to children as snacks or between meals; for energy, proteins, iron, calcium and vitamin A.

FOOD PRESERVATION:

Foods like fruits and vegetables are sometimes bought in bulk during the season for economy; but since they have a short shelf-life, either they must be consumed immediately or stored temporarily or permanently, without letting them spoil. Foods can be stored temporarily for 2-4 days by keeping them in a cool dry, ventilated place so that the fruits are kept fresh and are not infected with any micro-organism which causes the fruits / vegetables to rot. Foods can be stored for longer periods by preserving them. This is a traditional method, developed over the centuries, when man wished to store foods that were surplus during certain season. Foods can be preserved by the following methods:

Dehydration:

This is one of the oldest methods of preservation. The food is exposed to air and sunshine to dry or hung near the fire to dry. Drying excludes all the moisture, hence the food does not spoil. Some of the common examples of air-dried foods are dried meat, (dried near fire) fish, prawns, peas, beans, palak, methi, mint, cabbage, bhindi, cauliflower, karela, carrots, potatoes and raddish.

Method:

Clean, sort and wash all green leafy vegetables.

Peel and cut potatoes, raddish, carrots, karela, beetroot and bhindi into large pieces / strips or slices.

Shell peas, chickpeas, green channa etc. and vegetables are tied in a loose muslin cloth and immersed in salted boiling water for blanching for the time indicated:

Potatoes	---	10 minutes
Karela	---	8 minutes
Carrots	---	6 minutes
Raddish	---	5 minutes
Cauliflower	---	5 minutes
Palak	---	4 minutes
Bhindi	---	3 minutes
Peas	---	3 minutes
Methi	---	3 minutes
Cabbage	---	2 minutes

The blanched vegetable is immediately dipped in cold water and then in 1% solution of sodium meta bisulphate for five minutes, drip dried and spread over a tray and covered by a muslin cloth to protect from flies and dust for 3-4 days till they are dry. When a handful of dried vegetable are crumpled in the hand, the vegetable pieces should not adhere to each other. Pack them in clean airtight containers. Soak the dry vegetables in lukes warm water before use.

Salting:

Salt inhibits the growth of microorganisms, dehydrates the food and does not cause the food to spoil due to the action of the enzymes. Salt is added directly to the food or the food may be preserved in salt solution. Foods that can be salted and preserved are fish, meat, fresh beans, lime etc. Fish and meat are cleansed, sprinkled with salt and packed in jars alternated with a thin layer of salt and left in a cool place. The whole limes are salted, put in jars left in the sun for curing.

Sugaring:

Sugar is also an effective preservative. Fruits are preserved in sugar in the form of jams, jellies etc. Fruit pulp and sugar by equal weight are cooked together and lime juice is added if required.

Fruit juices are also preserved in the form of squashes, in which, juices, sugar and water are mixed by equal weights and a preservative is added.

Pickling:

Oil, vinegar and spices are used for preservation of certain fruits in the form of chutneys and vegetables in the form of pickles.

While preserving foods by any of the methods mentioned above, the general rules to be observed are:

- Fruit / vegetable for preservation must be fresh, firm, ripe and not over ripe or rotten.
- Fruit / vegetable must be thoroughly cleaned.
- Utensils and hands must be clean.
- Fruit/vegetable must not be preserved in metal containers. Use plastic, glass or earthenware.

Module I

POPULATION WELFARE PROGRAM

An Essential Element of Universal Health Coverage

World Health Organization