# International Classification of Functioning, Disability & Health (ICF) & its application

**UNIT 2**

## Introduction

Since ICF is inherently a health and health-related classification it is also used by sectors such as insurance, social security, labour, education, economics, social policy and general legislation development, and environmental modification. It has been accepted as one of the United Nations social classifications and is referred to in and incorporates. The Standard Rules on the Equalization of Opportunities for Persons with Disabilities. Thus ICF provides an appropriate instrument for the implementation of stated international human rights mandates as well as national legislation

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| Time needed to finish this unit | Approximately 3 weeks |

**Lessons of this unit**

Lesson 1: International Classification of functioning, disability and health (ICF), Impairment, disability and handicap

Lesson 2: Strategies to develop effective measurement tools

Lesson 3: The measurement tools

# Lesson-1: International Classification of functioning, disability and health (ICF), Impairment, disability and handicap

**Learning Objectives:**

After completion of this lesson students will be able to……

- Know details about ICF.
- Acquire knowledge about the application of ICF in disability health and rehabilitation with examples.

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| **Keywords** | ICF, Impairment, Disability and Handicap |

**Subject-matter**

## 2.1.1: Aims of International Classification of Functioning, Disability and Health (ICF)

- To provide a scientific basis for consequences of health conditions;
- To establish a common language to improve communications;
- To permit comparison of data across-
  - countries
  - health care disciplines
  - services
  - time
- To provide a systematic coding scheme for health information systems.

These aims are interrelated, since the need for and uses of ICF require the construction of a meaningful and practical system that can be used by various consumers for health policy, quality assurance and outcome evaluation in different cultures.

## 2.1.2: ICF Applications

Since its publication as a trial version in 1980, ICIDH has been used for various purposes, for example:

- **As a statistical tool –** in the collection and recording of data (e.g. in population studies and surveys or in management information systems);
- **As a research tool –** to measure outcomes, quality of life or environmental factors;
- **As a clinical tool –** in needs assessment, matching treatments with specific conditions,

vocational assessment, rehabilitation and outcome evaluation;

- **As a social policy tool –** in social security planning, compensation systems and policy design and implementation;
- **As an educational tool –** in curriculum design and to raise awareness and undertake social action.

Since ICF is inherently a health and health-related classification it is also used by sectors such as insurance, social security, labour, education, economics, social policy and general legislation development, and environmental modification. It has been accepted as one of the United Nations social classifications and is referred to in and incorporates The Standard Rules on the Equalization of Opportunities for Persons with Disabilities. Thus ICF provides an appropriate instrument for the implementation of stated international human rights mandates as well as national legislation.

**ICF is useful for a broad spectrum of different applications as……..**

- Social security,
- Evaluation in managed health care, and
- Population surveys at local, national and international levels.

It offers a conceptual framework for information that is applicable to personal health care, including prevention, health promotion, and the improvement of participation by removing or mitigating societal hindrances and encouraging the provision of social supports and facilitators. It is also useful for the study of health care systems, in terms of both evaluation and policy formulation.

### 2.1.3: An overview of ICF

| | **Part 1: Functioning and Disability** | | **Part 2: Contextual Factors** | |
|---|---|---|---|---|
| **Components** | Body Functions and Structures | Activities and Participation | Environmental Factors | Personal Factors |
| **Domains** | Body functions Body structures | Life areas (tasks, actions) | External influences on functioning and disability | Internal influences on functioning and disability |
| **Constructs** | Change in body functions (physiological) Change in body structures (anatomical) | Capacity Executing tasks in a standard environment Performance Executing tasks in the current | Facilitating or hindering impact of features of the physical, social, and attitudinal world | Impact of attributes of the person |

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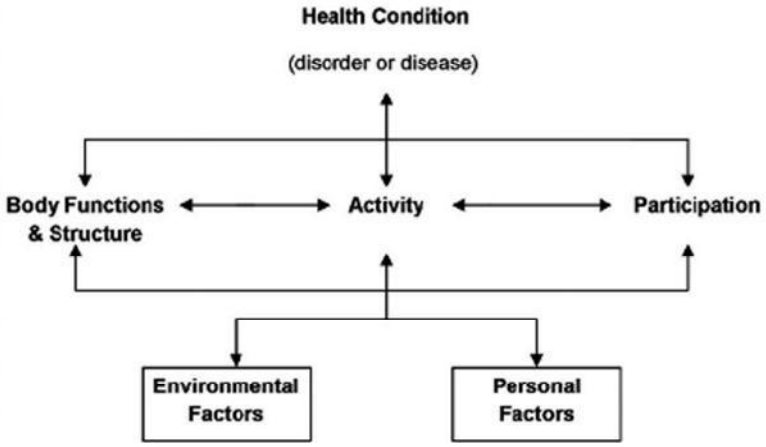
| | | environment | | |
| **Positive aspect** | Functional and structural integrity | Activities Participation | Facilitators | not applicable |
| | Functioning | | | |
| **Negative aspect** | Impairment | Activity limitation Participation restriction | Barriers/ hindrances | not applicable |
| | Disability | | | |

### 2.1.4: Interactions between the components of ICF




### 2.1.5: Foundations of ICF

Human Functioning - not *merely disability*
Universal Model - not *a minority model*
Integrative Model - not *merely medical or social*
Interactive Model - not *linear progressive*
Parity - not *etiological causality*
Context - inclusive - not *person alone*
Cultural applicability - not *western concepts*
Operational - not *theory driven alone*
Life span coverage - not *adult driven*

### 2.1.6: Definitions according to ICF

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| **Impairment** | **Loss or abnormality in body structure or function (including mental function)** |
| **Activity Limitations** | Difficulties individual may have in executing activities in terms of quantity or quality |
| **Participation Restrictions** | Problems an individual may experience in involvement in life situations |
| **Facilitators & Barriers** | Environmental factors may be a facilitator for one person & barrier for another |

### 2.1.7: ICF Components

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|---|---|
| **Body functions** | **Physiological functions of body** |
| **Body Structures** | Structural or anatomical parts of the |
| **Activities** | Execution of a task or action by an |
| **Participation** | Persons involvement in a life situation |
| **Environmental Factors** | All aspects of the external world that impact on the person's functioning |

### 2.1.8: ICF Structure

**1. Functioning and Disability**

a) Body functions and structures

b) Activities and Participation

**2. Contextual Factors**

a) Environmental factor

b) Personal factors

**Body functions (B)**

- Mental functions
- Sensory functions and pain
- Voice and speech functions
- Functions of the cardiovascular, haematological, immunological and respiratory systems
- Functions of the digestive, metabolic and endocrine systems
- Genitourinary and reproductive functions
- Neuromusculoskeletal and movement-related functions
- Functions of the skin and related structures

**Body structures (S)**

- Structures of the nervous system
- The eye, ear and related structures
- Structures involved in voice and speech
- Structures of the cardiovascular, immunological and respiratory systems
- Structures related to the digestive, metabolic and endocrine systems Chapter 6 Structures related to the genitourinary and reproductive systems
- Structures related to movement
- Skin and related structures

**Activities (a or d codes) and Participation (p or d codes):**

- Learning & Applying Knowledge
- General Tasks and Demands
- Communication
- Movement
- Self-Care
- Domestic Life Areas
- Interpersonal Interactions
- Major Life Areas
- Community, Social & Civic Life

**Environmental Factors (e codes):**

- Products and technology
- Natural environment and human-made changes to the environment
- Support and relationships
- Attitudes
- Services, systems and policies

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| **Learner's Activity** | Make different example of ICF incorporate with disability |

**Summary**

ICF framework is the fundamentals of disability measurement and functions. The implication of ICF is highly important which could help in measurement and study.

**Study Skills**

**Short Questions**

- What is ICF?
- What are the aims of ICF?
- What are the component of ICF?
- What is the structure of ICF?
- What are the application of ICF in Health and disability?

**References:**

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# Lesson-2: Strategies to Develop Effective Measurement Tools

**Learning Objectives:**

After completion of this lesson, students will be able to-

- Know about the steps of quality measurement;
- Know about analytical tools and methods of measurements;
- Strategies to develop effective measurement tools.

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| **Keywords** | Measurement tools |

**Subject-matter**

## 2.2.1: Steps of Quality Measurement

Ms. Paine described six steps to achieving a quality of measurement that complies with the Barcelona Principals:

- ***Define your goals***—identify the role of communication in reaching the goal, defining the activity metrics and determining the outcome metrics (e.g., percentage growth in program funding or recruits) in terms of the mission.
- ***Understanding stakeholders—"***Connect the dots" between stakeholders, prioritize them, and understand their need and interests.
- ***Define your benchmarks***—Compare past performance over time or compare results with those of other services. The most important entity to measure against, Ms. Paine said, is "whatever keeps the generals up at night."
- ***Define your metrics***—Pick the right metric. The ideal index is actionable, is there when you need it, continuously improves your processes, and gets the results you need.
- ***Select data collection tools***—Select the right tool(s) depending on what you are measuring.
- ***Use the data to make better decisions***—Ask "So what?" three times, in order to understand what the data actually mean in real-world terms.

## 2.2.2: Analytical Tools and Methods:

A variety of specific tools and techniques used to measure communication effectiveness were presented and discussed. The appropriate tool depends on the objectives-

- Content analysis can be used to evaluate messaging, positioning, themes, or sentiment;
- Survey research can be used to measure awareness, perception, relationships, or preference;

- Web analytics can be used to measure engagement, action, or purchases.

### 2.2.3: Strategies to develop effective measurement tools:

- Set Purpose of the Measurement tools;
- Set Programs Requiring a Measurement tools;
- Determine Roles and use of the tools;
- Assess the time of developing Measurement tools;
- Defining a Program within the Context of the Management tools use.

### 2.2.4: Evaluating Specific Programs

There are some specific things you should keep in mind when evaluating specific programs.

- **Defining Objectives** – Of course, everyone wants to know how to measure outcomes of a program. But, before you can look at the outcomes you have to first analyse your goals and objectives. This helps ensure that when setting up your reporting, your organization will really be asking the right questions. Your organization needs to make sure that the missions of its programs are clearly defined and that for each program you know how you will be measuring its success. Some of these program objectives can be qualitative, but funders will also want to see quantitative measures, so you should make sure to focus on these as well.
- **Data Collection** – Once you know what questions you are trying to answer, then you can focus on what data you will need in order to answer them. Making sure you have the right system set up for collecting this data and making sure that any case workers or other staff members who will be inputting data understand the larger picture is also an important step in this process.
- **Data Analysis** – After you know what data you need, you have to figure out what to do with it. This where you attempt to take the information you collect in step two and apply it to the objectives you set in step one. This is where a good software solution can really come in handy.
- **Data Evaluation** – Last but not least, you can't just decide how to measure outcomes of a program and then walk away. Outcomes management systems need to be evaluated regularly, generally on an annual basis to make sure they are still serving the needs of both the organization and any funders on the particular program or project.

### 2.2.5: How to Measure Outcomes of a Program with Software

Having the right software tools in place can significantly ease the process of outcomes reporting. However, even the best software tool requires a certain amount of forethought and planning.

If you don't already have a software solution in place for tracking outcomes, this should be one of the first things your organization addresses. Getting organized and effectively implementing an outcomes measurement strategy for your programs is crucial.

**Here are some of the ways that Efforts to Outcomes software can offer as you learn how to measure the outcomes of a program**

- Tracking and analysis of demographic data of program participants
- Referral management
- Participant needs and progress assessment
- Participant history information
- Attendance monitoring
- Identification and tracking of key trends
- Monitoring and assessment of program and staff effectiveness
- Determining which staff, services, programs and efforts are the most effective at achieving desired outcomes.
- Reporting capabilities that allow for the reporting of multi-funder obligations in mere minutes.

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| **Learner's Activity** | Evaluate specific program |

**Summary**

Monitoring and evaluation of specific program makes the program standard.

**Study Skills**

**Short Questions**

- What are the steps of quality measurement?
- Describe the analytical tools and methods of measurements.
- What the strategies are for develop effective measurement tools?

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# Lesson-3: The Measurement Tools

## Learning Objectives

After completion of this lesson students will be able to-

- Understand different types of disability health and Rehabilitation measurement tools.
- Acquire knowledge about Goniometer, Thermometer, Stethoscope, peak flow meter, Sphygmomanometer etc.

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| **Keywords** | Measurement tools |

## Subject-matter

### 2.3.1: Health and Rehabilitation Measuring Tools

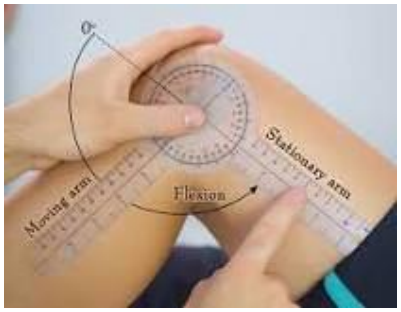
**There are several basic types**

- **Diagnostic equipment** includes medical imaging machines, used to aid in diagnosis. Examples are ultrasound and MRI machines, PET and CT scanners, and x-ray machines.
- **Treatment equipment** includes infusion pumps, medical lasers and LASIK surgical machines.
- **Life support equipment** is used to *maintain* a patient's bodily function. This includes medical ventilators, incubators, anaesthetic machines, heart-lung machines, ECMO, and dialysis machines.
- **Medical monitors** allow medical staff to measure a patient's medical state. Monitors may measure patient vital signs and other parameters including ECG, EEG, and blood pressure.
- **Medical laboratory equipment** automates or helps analyze blood, urine, genes, and dissolved gases in the blood.
- **Diagnostic Medical Equipment** may also be used in the home for certain purposes, e.g. for the control of diabetes mellitus
- **Therapeutic:** physical therapy machines like continuous passive range of motion (CPM) machines

A biomedical equipment technician (BMET) is a vital component of the healthcare delivery system. Employed primarily by hospitals, BMETs are the people responsible for maintaining a facility's medical equipment. BMET mainly act as an interface between doctor and equipment.

### 2.3.2: Goniometer

A **goniometer** is an instrument that either measures an angle or allows an object to be rotated to a precise angular position. The term **goniometry** is derived from two Greek words, *gōnia*, meaning angle, and *metron*, meaning measure. The first description of a goniometer, derived from the astrolabe, was apparently in 1538, by Gemma Frisius.




***Characteristics of Goniometer***

- Useful instrument which measures an axis and range of motion in a joint (e.g. a knee or elbow);
- Provides assessment of the patient's range of motion prior to treatment, to ensure rehabilitation is working by using the goniometer in subsequent interventions;
- The 360 degree Goniometers are manufactured in a strong, clear plastic and have three scales calibrated with the ISOM - International Standards of Measurement System;
- Available in 2 sizes: 8 inch (20cm) and 12 inch (30cm).

***Applications of Goniometer in Health & Disability Science***

- ❖ A goniometer is used to document initial and subsequent range of motion, at the visits for occupational injuries, and by disability evaluators to determine a permanent disability. This is to evaluate progress, and also for medico-legal purposes. It is a tool to evaluate Waddell's signs (findings that may indicate symptom magnification.)
- ❖ In physical therapy and occupational therapy, a goniometer is an instrument which measures range of motion joint angles of the body. This measurement instrument is a helpful, clinical tool that allows for objective measurements in order to accurately track progress in a rehabilitation program.
- ❖ When a patient has a decreased range of motion, a therapist will assess the joint before performing an intervention and will continue to use the tool to make sure that progress is made. These range of motion measurements can be taken at any joint and they typically involve some

knowledge about the anatomy of the body, particularly bony landmarks. For example, when measuring the knee joint, the axis (point of rotation) would be placed on the lateral epicondyle of the femur, while the stationary arm would be lined up with the greater trochanter of the femur. Finally, the moveable arm of the goniometer would be lined up with the lateral malleolus of the fibula and a measurement will be taken using the degree scale on the circular portion of the tool. The only problem with goniometers is the accuracy of the reading is not always the greatest. Issues with the intra-measure (between measures) and inter-tester (between clinicians) reliability seem to increase as the experience of the examiner decreases. Some studies suggest that these errors can be anywhere between 5 and 10 degrees when completing repeated measures.

- These goniometers do come in different forms that some would argue will actually increase the reliability of the tool. The universal standard goniometer is a plastic or metal tool with 1 degree increments. The arms usually are not longer than 12-inches so it can be hard to accurately pinpoint the exact landmark needed for measurement. A more reliable goniometer would be the telescopic-armed goniometer. There is a plastic circular axis as a classic goniometer but the arms extend out to as long as two feet in either direction.
- More recently in the twenty-first century, smartphone application developers have created mobile applications that are intended to perform like a goniometer. These applications (such as Knee Goniometer and Goniometer Pro) use the accelerometers in phones to calculate the angles of the joints measured. There has been a lot of research recently that supports these applications and their devices as reliable and valid tools that have just as much accuracy as a universal goniometer.

### 2.3.3: Peak flow meter

A peak flow meter is an inexpensive, portable, handheld device for those with asthma that is used to measure how well air moves out of your lungs. Measuring your peak flow using this meter is an important part of managing your asthma symptoms and preventing an asthma attack.

The peak flow meter works by measuring how fast air comes out of the lungs when you exhale forcefully after inhaling fully. This measure is called a "peak expiratory flow," or "PEF." Keeping track of your PEF, is one way you can know if your symptoms of asthma are in control or worsening.

***Why Use a Peak Flow Meter?***

Readings from a peak flow meter can help you or your child recognize early changes that may be signs of worsening asthma. During an asthma attack, the muscles in the airways tighten and cause the airways to narrow. The peak flow meter alerts you to the tightening of the airways often hours or even days before you have any asthma symptoms. By using your PEF with your asthma action plan, you will know when to take your rescue (quick acting) asthma inhaler or other asthma medicine. By following the steps in your asthma action plan, you may be able to stop the narrowing of the airways quickly and avoid a severe asthma emergency.

The peak flow meter can also be used to help you-

- Learn what triggers your asthma;
- Decide if your asthma action plan is working;
- Decide when to add or adjust asthma medications;
- Know when to seek emergency care.

It is important to know that your peak flow meter only measures the amount of airflow out of the large airways of the lungs. Changes in airflow caused by the small airways (which also occur with asthma) will not be detected by a peak flow meter. Early warning signs, however, may be present. Therefore, it is important for you to also be aware of your symptoms and early warning signs to best manage your asthma.

***Who Should Use a Peak Flow Meter?***

Peak flow meters are very helpful if you or your child have moderate to severe asthma and require daily asthma medications. Even most children ages 6 and up should be able to use a peak flow meter with good results. People with moderate-to-severe asthma should have a peak flow meter at home.

## *How Do I Use the Peak Flow Meter for Asthma?*

A peak flow meter is simple to use for tracking your asthma. Here's what you do:

1. Stand up or sit up straight;
2. Make sure the indicator is at the bottom of the meter (zero);
3. Take a deep breathe in, filling the lungs completely;

4. Place the mouthpiece in your mouth; lightly bite with your teeth and close your lips on it. Be sure your tongue is away from the mouthpiece;
5. Blast the air out as hard and as fast as possible in a single blow;
6. Remove the meter from your mouth;
7. Record the number that appears on the meter and then repeat steps one through seven two more times;
8. Record the highest of the three readings in an asthma diary. This reading is your peak expiratory flow (PEF).

To ensure the results of your peak flow meter are comparable, be sure to use your meter the same way each time you take a reading.

***How Often Should I Check my Peak Flow?***

Peak flow values are the best if they are checked at the same time each day, preferably once in the morning and again at night. Ask your doctor how often you should check your peak flow.

***How Do I Determine My "Personal Best" Peak Flow Number?***

The "personal best" peak expiratory flow (PEF) is the highest peak flow number you or your child can achieve over a two to three week period when asthma is under good control. Good control means you feel good and do not have any asthma symptoms.

Your personal best PEF is important because it is the number to which all of your other peak flow readings will be compared. Your asthma action plan, developed along with your asthma doctor, is based on this number.

To find your personal best peak flow number, take peak flow readings-

- Twice a day for two to three weeks when asthma is in good control
- At the same time in the morning and in the early evening
- As instructed by your doctor or asthma care provider

Once you have determined your or your child's personal best PEF, work with your asthma care provider to determine at what point you should start taking quick-relief drugs to relieve an asthma attack or seek emergency medical attention. These are called your asthma peak flow zones. All of this information should be recorded in your personal asthma action plan.

Then, continue to take peak flow readings each morning. Daily readings will help you:

- recognize early drops in airflow;
- know when your child's personal best improves naturally as he or she grows;

### 2.3.4: Spirometry

**Spirometry** (meaning *the measuring of breath*) is the most common of the pulmonary function tests (PFTs). It measures lung function, specifically the amount (volume) and/or speed (flow) of air that can be inhaled and exhaled. Spirometry is helpful in assessing breathing patterns that identify conditions such as asthma, pulmonary fibrosis, cystic fibrosis, and COPD. It is also helpful as part of a system of health surveillance, in which breathing patterns are measured over time. Spirometry generates pneumotachographs, which are charts that plot the volume and flow of air coming in and out of the lungs from one inhalation and one exhalation.

**Indication of Spirometry:**

Spirometry is indicated for the following reasons:

- to diagnose or manage asthma;
- to detect respiratory disease in patients presenting with symptoms of breathlessness, and to distinguish respiratory from cardiac disease as the cause;
- to measure bronchial responsiveness in patients suspected of having asthma;
- to diagnose and differentiate between obstructive lung disease and restrictive lung disease;
- to follow the natural history of disease in respiratory conditions;
- to assess of impairment from occupational asthma;
- to identify those at risk from pulmonary barotrauma while scuba diving;
- to conduct pre-operative risk assessment before anaesthesia or cardiothoracic surgery;
- to measure response to treatment of conditions which spirometry detects;
- To diagnose the vocal cord dysfunction.

**Contraindication of Spirometry**

Forced expiratory maneuvers may aggravate some medical conditions. Spirometry should not be performed when the individual presents with:

- Hemoptysis of unknown origin;
- Pneumothorax;

- Unstable cardiovascular status (angina, recent myocardial infarction, etc.);
- Thoracic, abdominal, or cerebral aneurysms;
- Cataracts or recent eye surgery;
- Recent thoracic or abdominal surgery;
- Nausea, vomiting, or acute illness;
- Recent or current viral infection;
- Undiagnosed hypertension.

### 2.3.5: Metered-dose inhaler (MDI)

A **metered-dose inhaler** (**MDI**) is a device that delivers a specific amount of medication to the lungs, in the form of a short burst of aerosolized medicine that is usually self-administered by the patient via inhalation. It is the most commonly used delivery system for treating asthma, chronic obstructive pulmonary disease (COPD) and other respiratory diseases. The medication in a metered dose inhaler is most commonly a bronchodilator, corticosteroid or a combination of both for the treatment of asthma and COPD. Other medications less commonly used but also administered by MDI are mast cell stabilizers, such as cromoglicate or nedocromil.

**Use of Metered-dose inhaler** (**MDI**)

Metered-dose inhalers are only one type of inhaler, but they are the most commonly used type. The replacement of chlorofluorocarbons propellants with hydrofluoroalkanes (HFA) resulted in the redesign of metered-dose inhalers in the 1990s. For one variety of beclomethasone inhaler, this redesign resulted in considerably smaller aerosol particles being produced, and led to an increase of potency by a factor of 2.6.

- *Asthma inhalers* contain a medication that treats the symptoms of asthma.
- Metered-dose inhalers can be used to treat COPD, both in stable state and during lung attacks.
- *Dry powder inhalers* involve micronised powder often packaged in single dose quantities in blisters or gel capsules containing the powdered medication to be drawn into the lungs by the user's own breath. These systems tend to be more expensive than the MDI, and patients with severely compromised lung function, such as occurs during an asthma attack, may find it difficult to generate enough airflow to get good function from them.
- A *nicotine inhaler* allows cigarette smokers to get nicotine without using tobacco, much like nicotine gum or a nicotine patch. Nicotine inhalers that are marketed as nicotine replacement therapy should not be confused with electronic cigarettes, which produce vapour and which are marketed mainly as devices that smokers can use in non-smoking areas. Nicotine inhalers

are also known by their nickname of “the puffer”. These devices are made of thin plastic, sometimes resembling a cigarette, or a cylinder shape. It contains a porous nicotine filled plug, located in the base of the product. When you puff on the inhaler, nicotine vapor is inhaled and absorbed in the mouth’s lining. Every inhaler delivers almost four hundred puffs of this nicotine vapor. It is also considered healthier than the traditional cigarette, as it takes about eighty puffs to get an equal amount of nicotine that is acquired through only one cigarette. The nicotine inhaler is also temperature sensitive. In cooler weather, less nicotine is delivered. The Nicotine Inhaler is considered easier to use than the electronic cigarette as it is usually disposable, and contains fewer parts than the electronic cigarette. The evidence suggests that the US Food and Drug Administration (FDA) accepted products such as a nicotine inhaler may be a safer way to give nicotine than e-cigarettes.

### 2.3.6: Pulse oximetry

**Pulse oximetry** is a noninvasive method for monitoring a person's oxygen saturation ($SO_2$). Its reading of $SpO_2$ (peripheral oxygen saturation) is not always identical to the reading of $SaO_2$ (arterial oxygen saturation) from arterial blood gas analysis, but the two are correlated well enough that the safe, convenient, noninvasive, inexpensive pulse oximetry method is valuable for measuring oxygen saturation in clinical use.

**Function of Pulse oximetry**

A blood-oxygen monitor displays the percentage of blood that is loaded with oxygen. More specifically, it measures what percentage of hemoglobin, the protein in blood that carries oxygen, is loaded. Acceptable normal ranges for patients without pulmonary pathology are from 95 to 99 percent. For a patient breathing room air at or near sea level, an estimate of arterial $pO_2$ can be made from the blood-oxygen monitor "saturation of peripheral oxygen" ($SpO_2$) reading.

**Indication of Pulse oximetry**

A pulse oximeter is a medical device that indirectly monitors the oxygen saturation of a patient's blood (as opposed to measuring oxygen saturation directly through a blood sample) and changes in

blood volume in the skin, producing a photoplethysmogram. The pulse oximeter may be incorporated into a multiparameter patient monitor. Most monitors also display the pulse rate. Portable, battery-operated pulse oximeters are also available for transport or home blood-oxygen monitoring.

### 2.3.7: Stethoscope

The **stethoscope** is an acoustic medical device for auscultation, or listening to the internal sounds of an animal or human body. It typically has a small disc-shaped resonator that is placed against the chest, and two tubes connected to earpieces. It is often used to listen to lung and heart sounds. It is also used to listen to intestines and blood flow in arteries and veins. In combination with a sphygmomanometer, it is commonly used for measurements of blood pressure. Less commonly, "mechanic's stethoscopes" are used to listen to internal sounds made by machines, such as diagnosing a malfunctioning automobile engine by listening to the sounds of its internal parts. Stethoscopes can also be used to check scientific vacuum chambers for leaks, and for various other small-scale acoustic monitoring tasks. A stethoscope that intensifies auscultatory sounds is called **phonendoscope**.

### 2.3.8: Sphygmomanometer

This is an instrument for measuring blood pressure, typically consisting of an inflatable rubber cuff that is applied to the arm and connected to a column of mercury next to a graduated scale, enabling the determination of systolic and diastolic blood pressure by increasing and gradually releasing the pressure in the cuff.

A **sphygmomanometer**, **blood pressure meter**, **blood pressure monitor**, or **blood pressure gauge** is a device used to measure blood pressure, composed of an inflatable cuff to collapse and then release the artery under the cuff in a controlled manner, and a mercury or mechanical manometer to measure the pressure. It is always used in conjunction with a means to determine at what pressure blood flow is just starting, and at what pressure it is unimpeded. Manual sphygmomanometers are used in conjunction with a stethoscope.

A sphygmomanometer consists of an inflatable cuff, a measuring unit (the mercury manometer, or aneroid gauge), and a mechanism for inflation which may be a manually operated bulb and valve or a pump operated electrically.

**Significance of Sphygmomanometer**

By observing the mercury in the column while releasing the air pressure with a control valve, one can read the values of the blood pressure in mm Hg. The peak pressure in the arteries during the cardiac cycle is the systolic pressure, and the lowest pressure (at the resting phase of the cardiac cycle) is the diastolic pressure. A stethoscope is used in the auscultatory method. Systolic pressure (first phase) is identified with the first of the continuous Korotkoff sounds. Diastolic pressure is identified at the moment the Korotkoff sounds disappear (fifth phase).

Measurement of the blood pressure is carried out in the diagnosis and treatment of hypertension (high blood pressure), and in many other healthcare scenarios.

**Use of Sphygmomanometer**

- To begin *blood pressure measurement*, use a properly sized blood pressure cuff. The length of the cuff's bladder should be at least equal to 80% of the circumference of the upper arm.
- Wrap the cuff around the upper arm with the cuff's lower edge one inch above the antecubital fossa.
- Lightly press the stethoscope's bell over the brachial artery just below the cuff's edge. Some health care workers have difficulty using the bell in the antecubital fossa, so we suggest using the bell or the diaphragm to measure the blood pressure.
- Rapidly inflate the cuff to 180mmHg. Release air from the cuff at a moderate rate (3mm/sec).
- Listen with the stethoscope and simultaneously observe the dial or mercury gauge. The first knocking sound (Korotkoff) is the subject's systolic pressure. When the knocking sound disappears, that is the diastolic pressure (such as 120/80).
- Record the pressure in both arms and note the difference; also record the subject's position (supine), which arm was used, and the cuff size (small, standard or large adult cuff).

- If the subject's pressure is elevated, **measure blood pressure** two additional times, waiting a few minutes between measurements.
- A BLOOD PRESSURE OF 180/120mmHg OR MORE REQUIRES IMMEDIATE ATTENTION!

### 2.3.9: Thermometer

This is an instrument for measuring and indicating temperature, typically one consisting of a narrow, hermetically sealed glass tube marked with graduations and having at one end a bulb containing mercury or alcohol that expands and contracts in the tube with heating and cooling.

A **thermometer** is a device that measures temperature or a temperature gradient. A thermometer has two important elements: (1) a temperature sensor (e.g. the bulb of a mercury-in-glass thermometer) in which some physical change occurs with temperature, and (2) some means of converting this physical change into a numerical value (e.g. the visible scale that is marked on a mercury-in-glass thermometer). Thermometers are widely used in industry to control and regulate processes, in the study of weather, in medicine, and in scientific research.

There are various principles by which different thermometers operate. They include the thermal expansion of solids or liquids with temperature, and the change in pressure of a gas on heating or cooling. Radiation-type thermometers measure the infrared energy emitted by an object, allowing measurement of temperature without contact. Most metals are good conductors of heat and they are solids at room temperature. Mercury is the only one in liquid state at room temperature, and has high coefficient of expansion. Hence, the slightest change in temperature is notable when it's used in a thermometer. This is the reason behind mercury and alcohol being used in thermometer.


**Medical Thermometer**

- Ear thermometers tend to be an infrared thermometer;
- Forehead thermometer is an example of a liquid crystal thermometer;
- Rectal and oral thermometers have typically been mercury but have since largely been supersceded by NTC thermistors with a digital readout.

Various thermometric techniques have been used throughout history such as the Galileo thermometer to thermal imaging. Medical thermometers such as mercury-in-glass thermometers, infrared thermometers, pill thermometers, and liquid crystal thermometers are used in health care settings to determine if individuals have a fever or are hypothermic.

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|---|---|
| **Learner's Activity** | Use of different measurement items |

| **Summary** |
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| Arrangement of the different instruments for measuring their values |

## Study Skills

### Short Questions

- What are the different health measuring tools?
- Describe goniometer / Thermometer / Peak Flow Meter / Spirometry

### References

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