ETHIOPIAN PUBLIC HEALTH ASSOCIATION

LEADERSHIP IN STRATEGIC INFORMATION TRAINING PROGRAM

MODULE 1

(LEADERSHIP, DESCRIPTIVE EPIDEMIOLOGY & DESCRIPTIVE BIOSTATISTICS)

PARTICIPANT MANUAL

June, 2014
Addis Ababa, Ethiopia

Approval of the Training Material

The Federal Ministry of health of Ethiopia has been working towards standardization and institutionalization of in-service (IST) trainings at national level. As part of this initiative the ministry developed a national in-service training directive and implementation guide for the health sector. The directive requires all in-service training materials fulfill the standards set in the implementation Guide. Accordingly, the ministry reviews and approves existing training materials based on the IST standardization checklist annexed on the IST implementation guide.

All in-service training materials shall to be reviewed and approved by the ministry accordingly; as part of the national IST standardization process, this **Leadership in Strategic Information** IST material has been reviewed based on the standardization checklist and approved by the ministry in January 2014.

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Acknowledgment

The Ethiopian Public Health Association would like to acknowledge and pass its deep appreciation to the following professional contributors for developing LSI training Participant module.

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Introduction EPHA

EPHA is a legally registered national, autonomous, non-profit and a voluntary professional association working for an optimal standard of health care for the people of Ethiopia. It promotes better health care services to the public and high professional standards through advocacy, active involvement and networking. EPHA is committed to improve the health and living status of the people of Ethiopia through the dedicated and active involvement of its members in collaboration with all concerned. In collaboration with CDC, MOH and universities, School of Public Health, EPHA has been providing the leadership in strategic information (LSI) training program in order to build the capacity of health professionals at the regional levels to strengthen the combat against HIV/AIDS epidemic.

Leadership in Strategic Information (LSI) Training Program

Whether at global, regional, country, community or individual level, every policy, strategy, program, project, job or task involves decision making. These decision makings are a process of identifying, selecting and implementing/taking alternatives. Right strategic information used at the right time, in the right form is needed to make correct decisions. This is also true for the health sector, and that is why the ministry of health (MOH) in collaboration with its partners has worked on HMIS, DHS, HIV surveillance, emergency disease survey and the like to collect and utilize strategic information for decision making. To use such strategic information and others similar inputs for decision making, the sector also needs to have capable human resources that strengthen the health system so that the sector could be able to collect, analyze , interpret and present the information for evidence based decision making.

Rational of the training:

In Ethiopia, a need exists to develop capacity in the public health sector to use strategic information to improve the needs assessment, planning, and monitoring and evaluation of the full range of interventions and activities to combat the HIV/AIDS epidemic at the sub national level. Leaders training need Epidemiological concepts like study design, and statistical methods including descriptive statistics and data analysis for evidence based decision making.

This need stems from several factors including limited experience and training in epidemiology, data management and analysis, etc. among public health personnel, limited experience with strategic planning for and monitoring and evaluation of public health programs. Furthermore, most public health personnel, working on HIV/AIDS -related activities and other health related MDGs have limited exposure to the full range ofinterventions and the overall strategy for combating the health problems. To address the experience and workforce gaps in Ethiopia's public health sector, in collaboration with in CDC, MOH and Addis Ababa, Jimma and Gondar Universities, EPHA has developed and been providing the leadership in strategic information (LSI) training program in order to build the capacity of health professionals at the regional level to strengthen the combat against the HIV/AIDS epidemic and other important public health issues and build health communities.

LSI Training Program follows skill-based and modular training strategy implemented to improve the capacity of national and regional public health personnel to build their capacity, and use strategic information for planning, implementation and monitoring and evaluation of HIV/AIDS interventions and activities based on their evidence. Additionally, these trainings lacked a field component to allow participants to practice and apply the training skills.

The Training goal: Deliver technical assistance and mentoring of trainees to build national and regional public health personnel capacity, and use strategic information for planning, and monitoring and evaluation of HIV/AIDS interventions and activities based on their evidence.

General objective: To develop capacity in the public health sector to use strategic information to improve skills for the need assessment, planning process and monitoring and evaluation of the full range of interventions and activities to combat the HIV/AIDS epidemic at the various level of the health system and to meet the MDGs as desired. This is, therefore, believed to lay down the cornerstone for national health research capacity foundation.

Core competencies

The trainees should demonstrate the following core competencies after successful completion of the training.

- Planning public health interventions
- Public health leadership
- Public health surveillance
- Management of outbreaks
- Data collection using appropriate scientific techniques
- Analysis and interpretation of health related data
- Utilization of strategic information for appropriate decision making in public health
- Monitoring and evaluation of public health interventions

At the end of the training, the participants will be able to

- Make use of the available health information in the health system
- Describe how systems thinking influence our day to day activates and achievements
- Apply the key management principle in the context of leadership
- Apply epidemiological methods in public health practice

- Apply statistical technic s in managing and analysis health related data
- Plan and implement monitoring and evaluation of health programs
- Apple to conduct public health surveillance focusing on HIV/ADIS and other health problem
- Describe how outbreaks should be investigated and managed

Training Content

The training consists of a series of three modules, each lasting two weeks, conducted over six months. Following each module, trainees worked on their field projects and produce various outputs to apply what they have learned through supervised/mentorship field activities, conducted within each trainee's region.

Modules and Their Main Topics	**Field Activity**
Strategies Leadership, Descriptive epidemiology and biostatistics	▪ Describe the management and leadership characteristics of health bureaus. ▪ Use descriptive epidemiology to identify the need for a particular HIV/AIDS intervention in the region with the application of biostatistics
Analytic epidemiology and biostastics, SPSS and Epi-Info or EpiData statistical software	▪ Develop and test a hypothesis to explain the situation in the epidemiological study.
HIV/AIDS Interventions, surveillance and outbreak Investigation, monitoring and evaluation	▪ Characterize the HIV/AIDS situation and intervention activities in the region ▪ Evaluate an HIV/AIDS surveillance activity or system in the region ▪ Develop a strategic plan for and conduct monitoring and evaluation of an HIV/AIDS intervention in the region

TARGET AUDIENCES

- Health and health related professionals working in the public health sector with a minimum qualification of first degree are eligible to participate in the training

Module 1: Strategic Leadership, Descriptive Epidemiology and Biostatistics

Overview

This module on LSI training is part of the modular package therefore, part of the modular package mainly addressing basic and pertinent issues related to leadership, introduction to biostatistics and epidemiology and their applications in undertaking health research focusing on:

The purpose of this module is to help the health sector leaders/teams understand the basic concepts, roles, styles and attributes of leadership; and its difference from the concept of strategic information and its management; the concepts and components of strategic leadership, with emphasis on situational analysis; opportunities and constraints; and implementation. Inspiring vision, systems thinking and mental models are also addressed with the application of biostatistics and epidemiology. The final session of leadership part are presented the most important concepts and tools called SMDP. This understanding will help the leaders define and use important management information and make it accessible to provide a context for integrated and strategic decision making.

Promoting knowledge and skill on how to use epidemiology on health practitioners in making a decision and answer health problems and meet the interest of regional health problem. This venture is a testimony of fruitful collaborative leadership building project undertaking based on excellent ***public private partnership*** between the Ethiopian MOH and Regional States' Health Bureaus and one hand and the Ethiopian Public Health Association and CDC on the other.

Epidemiology and biostatistics are one of the topics in Leadership in Strategic Information (LSI) Training Program. It divided in to two major parts; descriptive and analytic Epidemiology and also introduction and analytical biostatistics

- The descriptive part covers the basic concepts of Epidemiology, functions of epidemiology, infectious disease process, and measures of disease occurrence, descriptive epidemiologic designs and hypothesis generation.
- Introduction part cover the main concept of biostatistics, such as Roles of Biostatistics in public health and medicine, data quality and type, data collection method and data organization, presentation and summarization
- In the analytic part of epidemiology and biostatistics will be covered in module 2

Hence, equipping all who are involved in the system about the relevancy of leadership for strategic information is vital. That is why this Module is organized and prepared. The Module is prepared in simple, understandable and user friendly ways. It emphasizes the main areas on leadership for

strategic information and it is supported with different activities. This Module is a snap shot on information. So it is necessary to read different references and also to visit the internet to widen your scope.

Goal of the module

- To equip trainees with the capacity to use data to improve assessment, planning, surveillance, and monitoring and evaluation of health programs by applying leadership, epidemiologic and biostatistics approaches

General objective of the module

After completing this module, participants will be able to;

- Make use of the available health information in the health system
- Describe how systems thinking influence our day to day activates and achievements
- Apply the key management principle in the context of leadership
- discus the application of epidemiological methods in public health practice
- describe basic statistical techniques in managing and analysis health related data

Module Contents

The Module is organized in three parts. The first part is Leadership. Descriptive epidemiology is addressed in the second part; the third part is Introduction to biostatistics.

Part 1.Leadership

1. Strategic information for leadership in health care
2. Situational analysis and planning
3. Leadership concepts
4. Inspiring vision
5. Systems thinking
6. Mental model
7. Emotional intelligence
8. Concepts of strategic leadership
9. Strategic leadership, implementation of change
10. Process improvement

Part 2: Descriptive Epidemiology

1. Introduction
    - Definition
    - Scope of epidemiology
    - Assumptions in epidemiology

- Levels of disease occurrence
- The infectious diseases process (chain of disease transmission)

2. Measures of occurrence (incidence and prevalence)
3. Descriptive epidemiologic studies
4. Hypothesis generation

Part 3: Descriptive Biostatistics

1. Introduction
   - Definitions of terms and concepts
   - Roles of Biostatistics in public health and medicine
   - Variable, data and information
   - Data quality
   - Changing the type of data
2. Data Collection Methods
   - Introduction to data collection tools
   - Sources of data and types of data collection methods
   - Criteria to select data collection methods
   - Designing a Questionnaire
   - Steps in designing questionnaire
3. Data organization, Presentation and Summarization
   - Data organization
   - Frequency distribution
   - Graphical presentation
   - Summery measures
4. Probability and probability distributions

Sampling and sample size determination

Acronym/Abbreviation

AIDS	Acquired Immunodeficiency Virus
ART	Antiretroviral Therapy
CDC	Center for Disease Control
CDR	Crude Death Rate
CHD	Coronary Heart Disease
DHS	Demographic Health System
EPHA	Ethiopian Public Health Association
EQ	Emotional Quotient
FGD	Focus Group Discussion
HIS	Health Information System
HIV	Human Immunodeficiency Virus
HMIS	Health Management Information System
IMC	Information Management Cycle
IS	Information System
LPC	Least Preferred Co-worker'
LSI	Leadership Strategic Information
M&E	Monitoring And Evaluation
MDG	Millennium Development Goal
MIS	Management Information
MOH	Ministry of Health
SPSS	Statistical Package for Social Science
STI	Sexual Transmitted Innless
SWOT	Strength Weakness Opportunity and Treat
VCT	Voluntary Councling Testing
WHO	*World Health Organization*

Part 1:

LEADERSHIP

1. Strategic information for leadership in health care
2. Situational analysis and planning
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Session 1: STRATEGIC INFORMATION FOR LEADERSHIP IN HEALTH CARE

Session Overview

In this session you will learn about the basic concepts of information and its management systems, and HMIS. It also provides you the description of HMIS in the Ethiopian context, challenges, indicators and feedback.

Learning Objectives

After completing this session, you are expected to be able to

- Differentiate data and information;
- Use different methods of data collection and analysis;
- Make use of the available Health Information in the health care system;
- Describe Health Management Information System, HIS reform in the Ethiopian context
- Generate proper information for decision making and future use;
- Identify the major challenges of information use and find solutions;
- Identify and formulate different indicators;

Activity 1.1: Brainstorming

1. Which precede information or data?
2. List down the differences between data and information.

Basic Concepts of Data and Information

Data

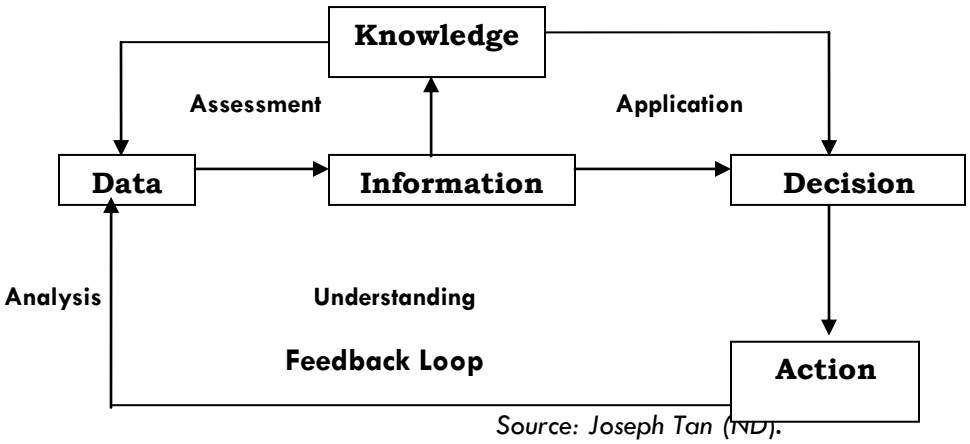
In most of the cases people are using data and information interchangeably. But that is not acceptable and not correct. They have similar purposes but they are different and one precedes the other.

Data is a collection of facts and figures, an observation of facts that requires interpretation. For example, if we conduct a study/research, what we collect from the respondents are data not information. To change data to information one has to analyze/interpret it using different methods.

Sources of Health Data

- Routine health care records: from formats, registers, etc.
- Registration of Vital events: births, deaths, marriages, migrations, etc.
- Population census
- Surveys
- Community heath reports: interviews, questionnaires, discussions, etc.

Figure 1: Data/Information/Knowledge Decision System



Source: Joseph Tan (ND).

As we can understand from the above figure, data is the base for proper formulation of information. Through assessment we will gather data. The collected data is crude and need some types of understanding and analysis using different methods to change it in to information. The information developed is knowledge that will be applied and could help the leader or manager to make evidence-based decision. Finally it will be taken to an action. The cycle will be a vicious circle when feedback is given to the source. Without feedback, this cycle will not be completed. Hence, whoever using the information have to give feedback. This has to be one of the habits of leaders or managers.

Information

Information is the end processed product of data/facts. It consists of facts/data which are organized in a form which allows conclusions to be drawn and knowledge to be gained.

Leaders or managers relay on formal and informal ways of obtaining the information they need to make decisions.

Formal information usually reaches to them in the form of routine statistical and management reports. These reports, which are generally standardized in formats and produced on a regular basis, constitute the most visible part of what is called the Management Information System (MIS).

Informal information includes rumors and unofficial discussions with colleagues. Personal experience, education, common sense, intuition, and knowledge of the political and social environment are also part of the informal means of gathering information.

Activity 1.2: Group Work

1. How is the information flow in the institution where you are working currently?
2. List the name, type and purposes of the health data collection tools that you are using currently.
3. What are the differences between routine and non-routine information? Explain by

Moving and Using Information in Your Organization

All the administrative and professional staff in the organization will need to use information to make better decisions. Once you have decided the kind of information each person or unit needs, you must determine the most efficient way to obtain and report the information. The movement of information within your organization is called ***information flow***.

Information flow depends on several factors:

- Who needs the information?
- How the information is needed?
- What level of detail is needed?
- What format should be used to present the information (tables, charts, reports).

As information moves from one user to another, the amount of detail provided and the format in which the information is presented will change. These changes in detail and format (words, numerical tables, charts, or graphs) should correspond to the needs of the user and the level at which the information will be used.

Collecting Information

After you have selected the appropriate indicators, identified the sources of information, and considered how the information will flow among your staff, you are ready to review the instruments and procedures for collecting data. Routine data are obtained from different sources using different types of data collection instruments. The types of instruments required will depend on the information you need to collect. All data collection instruments should be thought of as a package of inter-related tools that help leaders or managers to obtain the information that they need in-order to make good management decisions.

When all the data collection instruments are in final form, it is advisable to prepare a short manual on how to use each instrument. The manual should describe who should fill out the forms and how often and under what circumstances they need to be filled out, and it should provide detailed instructions on how the forms should be filled out. In addition, the manual should describe the reporting format and indicate how frequently and to whom the report should be sent. The manual should also indicate examples of how the information could be used.

All the data collection tools such as registers, tally sheets and formats should be developed, and standardized because it helps to maintain the quality and make reports comparable across all levels of the health sector.

Box 1.
Always be certain that the data collecting tools are:
S…Simple, easy to use
O…No overlap, no duplication on the data management
U…Useful for calculating indicators
R…Relevant for decision making and plans
C…Clear, easily understandable (terms used)
E…Effective in decision making.

Using non-routine information to make decisions

Sometimes leaders or mangers may need information that is not available from the records, registers, or forms that are used routinely. Special survey and research methods can be used to obtain this type of information. These methods may involve added expense and may require specialties to design and carry them out. You should ensure that you and your staff are involved in

the design and implementation of these special investigations, as well as in the analysis and interpretation of the results.

Table 1: Tools and Techniques for Non-Routine Information for Decision- making

Method	What it is?	When it is used?	What to collect	When to use it?	Who does it?
Focus Group	Guided in-depth discussion of a single topic by homogeneous group.	• To explore feelings • To obtain information on knowledge, beliefs, & practices that require probing & discussion	• Client attitudes • Community & providers attitudes • Reasons for any actions	If there is high discontinuation of activities and to learn the client's perspectives.	People who have been trained in FGD method.
Exit Interview	Short interview	• To determine the client's immediate reaction to services. • To identify potential problems in service delivery.	• Client satisfaction & dissatisfaction.	Whenever new services introduced/changed or to determine client satisfaction.	Health team and others involved.
Rapid Assessment	Small scale surveys covering a limited geographic area.	• To verify, compare, identify changes, determine services.	• New clients, continuing users of services, frequency, etc.	Whenever there are unexplained or unexpected changes.	Persons who knowledge on surveys.
Operation Research	Small research projects designed to improve.	• To identify specific operational problems. • To test solutions to specific operational problems. • To test ways of making program operations more effective or more cost-and resource-efficient..	• Supervisory procedures. • Logistics systems. • Financial and accounting systems.	• If program costs are high & excessive wastes of resources . • If clients /providers are dissatisfied.	Persons who have been trained in research design and implementation.

Source: *James A.Wolff, et al., (1991)*

Activity 1.3: Group Work

1. Show the similarities and differences of Performance Information and Operational Information.
2. Develop Performance Information and Operational Information taking HIV/AIDS prevention and control programs as an example.

Operational Information.

Performance Information is needed for planning and evaluating your programs. It is used first to formulate the goals and objectives of a program and later to determine the results and impact of that program. Look the following table as an example from the FP program.

Table 2: Performance information that can be used to measure Family Planning, Program Results and Impact

Information Categories	Data to Gather	Using the Information	Making Decisions
Socio-economic characteristics of target groups	• Income levels • Rural-urban breakdown • Educational level	• Managers can determine what variables influence acceptance of FP and utilization of services	• Allocation of effort and resources to maximize demand for and utilization of FP services.
Factors influencing fertility	• Age of marriage • Parity when contraception begins • Years married prior to contraception.	• Managers can determine whether the current users will influence population growth.	• Formulation of objectives and selection of target groups for maximum program impact.
Demand for and use of contraceptive methods	• Ratios of permanent to temporary methods. • Sources of supply for each method. • Unit costs for delivering the different methods. • Reasons for choosing contraceptives. • Reasons for practicing FP.	• Managers can determine whether the contraceptive supply and distribution system is compatible with user needs.	• Selection of contraceptive mix to achieve program objectives and satisfy users.
Discontinuation of use and contraceptive failure	• Discontinuation rates per contraceptive. • Failure rates per contraceptive. • Side effects and complications related to contraceptive use. • Reasons for discontinuation. • Results of discontinuing a method.	• Managers can determine how satisfied users are with the FP program.	• Formulating best method mix. • What types of personnel to assign. • How to balance clinic and community services.
Quality of services	• Applications of clinical protocols • Behavior, competence, and experience of staff. • Physical environment of clinic.	• Managers can take action to improve existing services.	• Formulating best method mix. • Training and supervising staff. • Choosing most effective delivery system.
Characteristics of community participation and support	• Level of community participation. • Amount of community financing. • Approaches to follow up.	• Managers can use this information to decide on the best strategy to increase community involvement and	• Assess prospects for community self-financing of FP program.

		motivation.	

Source: *James A.Wolff, et al., (1991)*

Operational Information is used to assess how well a program is functioning. It provides information on the use if time, people, money, and other material resources. Having timely, accurate, and complete operational information allows you to identify quickly any problems that might prevent you from achieving your objectives. Operational information includes information about:

- Work plan implementation;
- Costs and expenditures;
- Staffing and supervision;
- Logistics.

Table 3: Operational Information for Monitoring FP Program

Information Categories	Data to gather	Using the Information	Making Decisions
Work plan implementation	• Timing of activities. • Availability of personnel and material resources.	• Managers can ensure that staff and other resources are available for planned activities.	• Re-scheduling activities and re-deployment of staff and resources as needed.
Costs and expenditures	• Budgeted amounts, obligations, accruals and balances for personnel, contraceptives, supplies, equipment, infrastructure, maintenance.	• Managers can ensure that funds are available to execute planned program activities and can determine what services cost and how to price them.	• Authorizing expenditures. • Budget and program revisions. • Community participation in, versus government subsides of, program costs.
Staffing and supervision	• Knowledge, attitudes, and skills of staff. • Educational level of staff • Salaries, benefits • On-the-job performance.	• Managers can motivate staff, help solve their job-related problems, and advise them on career advancement.	• Placement, additional training, promotion, disciplinary action.
Commodities	• Inventories, ordering and shipments status, transport and vehicle conditions.	• Managers can ensure that contraceptive supplies regularly reach distribution points in appropriate quantities and usable condition.	• Quantities to order. • Dates on which to order. • Amount of reserves to maintain for emergency use.

Source: *James A.Wolff, et al., (1991)*

Choosing the Information that You Need

In principle, since the purpose of MIS is to help you make better decisions, the information you choose should be linked directly to the decisions you make. However, in practice, it is impossible to predict in

advance all the decisions you will have to make. There will always be many important decisions that you will not be able to anticipate. Therefore, rather than trying to identify all the specific decisions you might make, a more practical approach is to think about the types of decisions you are currently making. For these types of decisions you need information that permits you to determine whether you are achieving the kind of result that you expected.

Activity1. 4: Group Work

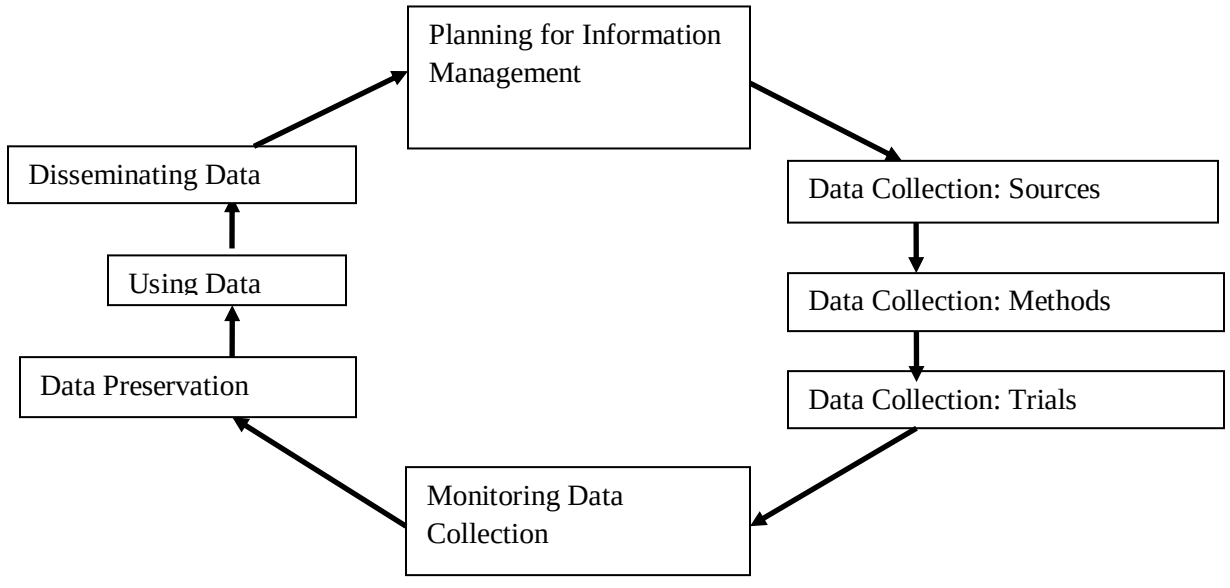
1. Develop an Information Management Cycle (IMC) for your institution.
2. What are the main components of the IMC?

Information Management

Information management is one of the main resources that need serious attention not only by leaders or managers rather it is a business of all partners. Information management is the collection and management of *information* from one or more sources and the *distribution* of the information to one or more audiences. Management means the organization of and control over planning, structure and organization, controlling, processing, evaluating and reporting of information activities in order to meet objectives and to enable corporate functions in the delivery of information.

Box 2.
Information management entails *organizing*, *retrieving*, *acquiring*, *securing* and *maintaining* information.

Figure 2: The Information-Management Cycle



Source: *Reference No. 7*

Information management:

- Has to keep its ***quality***: valid, consistent and comprehensive.
- Has to be ***efficient***: requirements –based, non-duplicative, timely and financially sound.
- Has to be ***compliance:*** that needs privacy and records management.
- Needs ***security***: confidentiality, integrity and available.
- Needs to be ***shared***: visible, understandable, accessible and interoperable.

Box 3.
Information management encompasses:

- People
- Process
- Technology
- Content

Remember:

- Information is only useful if it is organized.
- To use information, we must have the ability to recognize the information from different perspectives.

Table 4: The Ten Principles of Effective Information Management

The ten key principles to ensure that information management activities are effective and successful are:

Principles	Explanation/Meaning
I. Recognize (and manage) complexity	Organizations must stop looking for simple approaches, and must stop believing vendors when they offer 'silver bullet' technology solutions. Instead, successful information management is underpinned by strong leadership that defines a clear direction. Many small activities should then be planned to address in parallel the many needs and issue.
II. Focus on adoption	It means that projects must be carefully designed from the outset to ensure that sufficient adoption is in place.
III. Deliver tangible and visible benefits	In many cases, information management projects initially focus on improving the productivity of publishers or information managers. Instead, information management projects must always be designed so that they deliver *tangible* and *visible* benefits.
IV. Priorities according to business needs	Information management projects are targeted at the most urgent business needs or issues. These in turn are derived from the overall business strategy and direction for the organization as a whole.
V. Take a journey of a thousand steps	There is no single application or project that will address and resolve all the information management problems of an organization. This approach recognizes that there are hundreds (or thousands) of often small changes that are needed to improve the information management practices across an organization.
VI. Provide strong leadership	Successful information management is about organizational and cultural change, and this can only be achieved through strong leadership or management. The starting point is to create a clear vision of the desired outcomes of the information management strategy. This will describe how the organization will operate, more than just describing how the information systems themselves will work.
VII. Mitigate risks	These risks include:Selecting an inappropriate technology solution,Time and budget overruns,Changing business requirements,Technical issues, particularly relating to integrating systems, andFailure to gain adoption by staff.Risk management approaches should then be used to plan all aspects of the project, including the activities conducted and the budget spent.
VIII. Communicate extensively	Extensive communication from the project team (and project sponsors) is critical for a successful information management initiative. This communication ensures that staffs have a clear understanding of the project, and the benefits it will deliver. This is a pre-requisite for achieving the required level of adoption.
IX. Aim to deliver a seamless user experience	In practice, this means:Delivering a single intranet (or equivalent) that gives access to all information and tools, Ensuring a consistent look-and-feel across all applications, including standard navigation and page layouts., Providing 'single sign-on' to all applications.
X. Choose the first project very carefully	This project must be selected carefully, to ensure that it:demonstrates the value of the information management strategy, builds momentum for future activities, generates interest and enthusiasm from both end-users and stakeholders, delivers tangible & visible benefits, addresses an important or urgent business need, can be clearly communicated to staff and stakeholders, &assists the project team in gaining further resources and support.

Source: *Step Two Design Nov 1st, 2005 by James Robertson*

Activity 1.5: Group Work
In your group, discuss what we mean by IS, MIS, HIS and HMIS and present to the class

Management of Information System (MIS)

A functioning MIS is particularly important in today's economic and social environment, where leaders and managers need to make decisions concerning financial self-sufficiency, client satisfaction, and quality control. If the MIS does not produced ***complete, accurate, and timely*** information, leaders or managers may not be able to make decisions that will ensure the survival, expansion, and sustainable of their programs and organizations.

To see the MIS is effective, it would be good to analyze the following questions:

- Is the information collected on regular and on-going bases?
- Do the MIS operate at all levels of the system?
- Does the system contain a mechanism for regular feedback?
- Are reports produced in a timely fashion?

A MIS gathers together information on a variety of different functions in an organization in order to permit a leader or a manager to plan, monitor, and evaluate the operations and the performance of the program as a whole. A MIS doesn't need to be complex. It should provide you with only the information you need to help you make decisions.

Steps in Assessing MIS

1. Identify those who are or should be using each type of information;
2. Assess the short- and long term objectives;
3. Identify the information that is needed to help the different people in the program;
4. Determine which of the current forms and procedures for collecting, recording, tabulating, analyzing, and reporting information and not complicated or time-consuming ;
5. Revise any existing forms and procedures for collecting and recording information that need improvement, or prepare new ones;
6. Set up or improve the manual or computerized systems for tabulating, analyzing, and reporting information;
7. Develop procedures for confirming the accuracy of the data;
8. Train and supervise staff in using the new forms, registers, summary sheets, and other instruments to collect, tabulate, analyze, present, and use the information.

To prepare this overview of the existing MIS, start by meeting the staff, colleagues, volunteers, clients, etc. Collect the information systematically; writing down the answers clearly so they can be reviewed later on.

Analyzing the Results of Your Assessment

When you have completed the assessment, analyze the results.

Table 5:How to Analyze Data

Presenting Method	What you do to the data	Where the data come form	How you get the information	How the information is presented	What you can do with the information
Tabulating	Add up the checks in each column of the register.	Client records, registers, surveys.	Take totals and percentages	In tables, bar graphs or pie charts.	Compare different members of the same category.
Cross- tabulating	Choose two different data items to see how they are related	Client records, registers, surveys.	Break down different items in relation to another item in the Client records, registers, surveys.	In special two-by-two tables in which one item is the independent and the other one is dependent variables.	Compare different categories of data.
Aggregating	Sum up individual units to get an overall picture of a target area.	Totals	Take the totals on different items from each unit and add them together to get total for a larger area.	In tables, bar graphs or pie charts.	Compare total situation with program targets.
Disaggregating	Break down total situation into unit.	Summary forms.	Take sub-totals of particular items for specific sub-groups of the population.	In tables, bar graphs or pie charts.	Examine differences between subgroups based on different variables.
Projecting	Forecast how major indicators will change over time.	Client records, registers, inventory forms.	Calculate rates of change in specific items during a given period in the past, and examine the impact of these rates over a given period of time in the future.	In bar or line graphs.	Predict what the project outcomes will be if the situation remains unchanged and if rates are changed.

Source: *James A.Wolff, et al., (1991)*

In analyzing data we use the three epidemiological analytic tools **what,why, and how.** What and how describes the situation and how a certain program is running, why helps to assess why the figures appear that way and helps to compare between different seasons and places.

Taking actions to improve the MIS

There are a number of ways in which an information system can be improved. Most improvements will be made by:

- Eliminating unnecessary information,
- Improving the way you give feedback,
- Improving your staff in the regular use of the information for planning, monitoring, and evaluating their activities.

Keep your MIS on the right track

As you develop or improve your MIS, check periodically to see if you are on the right track. Apply the following criteria to verify that the MIS is meeting your needs: more accessible, less of a burden to staff, have a reason for collecting, more up-to-date, reliable, and accurate, If you agree with each of these statements as you work on improving your MIS, you can feel confident that you are on the right track.

The MIS needs to incorporate methods for summarizing, analyzing the data, transmitting the summarized data, and drawing conclusions and making decisions based on the reported information.

The ability to summarize data is extremely important. The first steps in summarizing data are known as ***tabulations,*** which mean adding numbers and using the totals to calculate percentages and averages. A high level accuracy is required, and those who are responsible for this task need to have basic arithmetic skills.

After tabulations, the main types of data processing are ***aggregation, disaggregation, and projection.*** These methods involve a variety of sorting techniques and mathematical skills.

Activity1. 6: In pair discuss about

1. The reporting system that you utilize in your settings.
2. What are the main characteristics of a good report?

Reporting Information

Every time you tabulate or analyze information for your own or someone else's use, you have to prepare a report. You have to plan your reporting method carefully so that the information is easily understandable and clearly relates to program performance or operational indicators. Using the checklist below will ensure that the major characteristics of a good report are present.

Box 4. Preparing a Report

- ✓ The report is clearly dated.
- ✓ The purpose of the report is clear.
- ✓ It is clear who the recipients of the report will be & how the report will be used.
- ✓ The report addresses a specific program component or objective.
- ✓ The report specifies areas or covered services.
- ✓ The report indicates the time period covered.
- ✓ The information is related to selected program indicators.
- ✓ The methods of analyzing the data are specified.
- ✓ The results of the analysis are presented.
- ✓ The amount of detail is appropriate for the recipient.
- ✓ The information is presented in an interesting and understandable way (tables, graphs, charts).
- ✓ The discussion presented in the report is necessary to explain the information.

When reviewing reports, ask the following questions:

- Has information been reported on all the key indicators?
- Have all gaps or insufficiencies been identified?
- Is the information in the reports accurate and reliable?
- Have the data been interpreted and have the conclusions been included in the report?
- Does the report indicate decisions or actions that have been taken based on the reported information?

Box 5.
Make sure you have a reason for collecting each item of information, and make sure the information you collect is up-to-date, reliable, and accurate.

Storing Information/Data

Information/Data has life spans depending on their importance and hence it needs to be stored. It can be stored in many ways depending on the availability of technology and importance. The common ways used in every level include: ***Files, Special Forms, Registers, Computers***, etc. Issues to be considered in information/data storing are ***accessibility and confidentiality***.

Health Information System (HIS)

HIS can be defined as "a set of components and procedures organized with the objective of generating information which will improve health care management decisions at all levels of the health system" (Lippeveld, Sauerborn, and Bodart2000).

The goal of an HIS is to allow decisions to be made in a transparent way, based on evidence. Therefore, the objective of the HIS is to produce relevant and quality information to support decision making (Health Metrics Network 2006). Its purposes are:

- To monitor the health status and health services of a nation;
- To improve public health care leadership and management decisions at all levels;
- To make available timely and relevant information required for rational and effective decision making;
- To enhance implementation of policy; and
- To enhance appropriate decision making for patient/ client care

As for the supply of health information, many methods and sources are available for generating data. They can be divided into those that generate ***data relative to populations as a whole*** (census, vital registration, surveys), and those that ***generate data about the operation of the services***(administrative records, service records, health and disease records). Even though the data needs are different for the management and stewardship of the health system, policy making, resource allocation and patient care, these needs are also linked along a continuum. For the HIS to work adequately, certain prerequisites need to be in place, such as information policies, financial resources, human resources, communication infrastructure, and coordination and leadership—mechanisms to effectively lead the HIS.

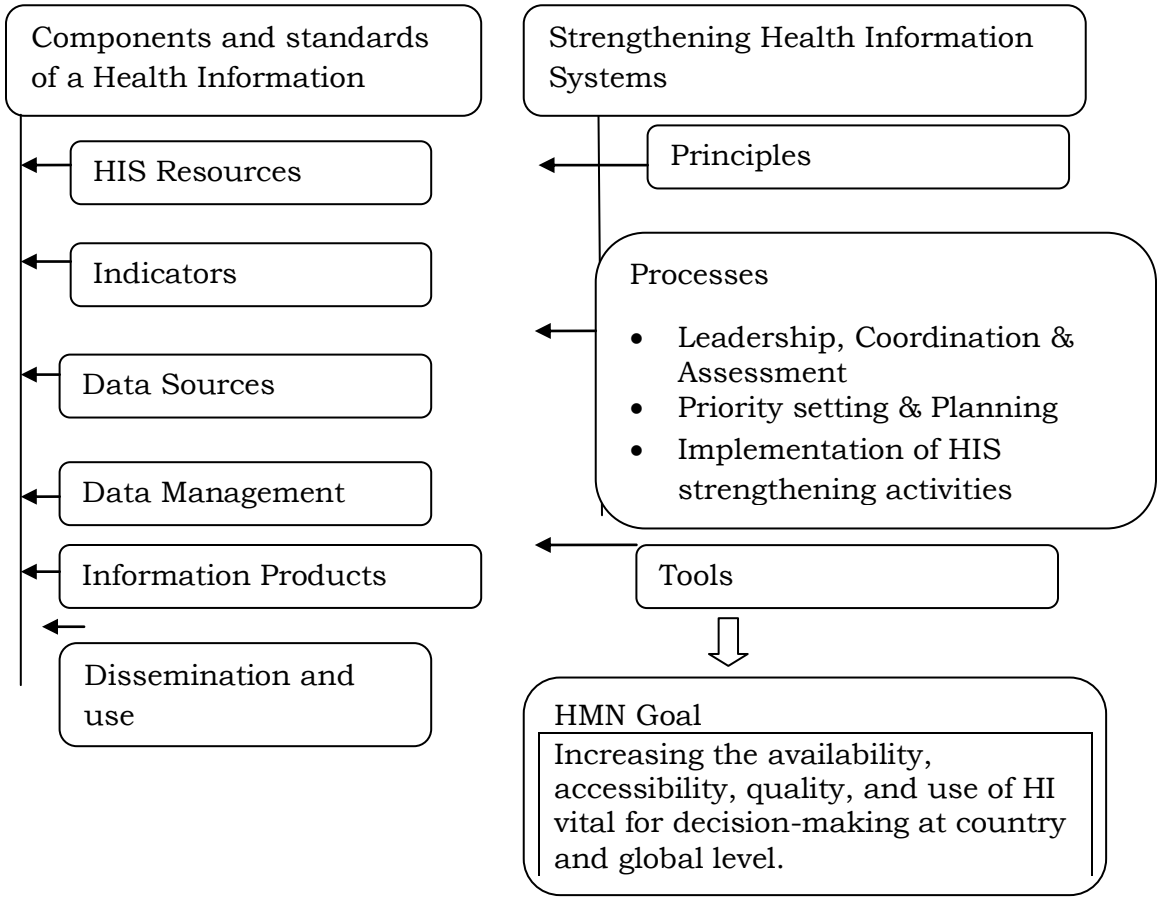
Box 6. TIP

The mapping systems in the assessment are intended to develop insight into the following questions:

- What components of an HIS actually exist and operate?
- What is the level of integration of those components?
- What is the contextual framework in which they operate?
- What are the available resources for HI?

The six components of HIS

Figure 4: The Health Metric Network Framework



Source: WHO(2007).

The importance of Information in the Health Sector

- Quantify health problems and needs, health related problems, their distribution, determinants and consequences;
- Identify health problems and needs prioritization, selection of interventions and development of plans;
- Determination of the size, distribution and other characteristics of the target population both demographically and ecologically;
- Quantifying, type and distribution of remedial services to be taken against determined available resources;
- Providing base line for monitoring, evaluation of the effect (outcome) and impact of the services on health status of the community in the planning process.

Health Management Information System (HMIS)

Management Information system including HMIS is defined as: A system designed to produce information to be presented to the management to assist in decision-making and to enable it to ascertain the progress made by the organization in the achievement of its goals.

The objectives HMIS is to review and strengthen the existing HMIS at Federal, Regional, Woreda, health facility and community levels to produce timely information for planning management and efficient decision-making.

Principles of the new design of Ethiopian HMIS Reform lie on:

- ***Standardizing***:
  - Indicators and definitions,
  - Client/patient flow and data elements,
  - Recording and reporting forms,
  - Procedure manual and information use guidelines.
- ***Simplify*** data by way of reducing data burden and streamlining data management procedures.
- ***Integrate*** data channel client/patient information at facility.
- ***Institutionalize*** data by making it facility-based/owned for better chance of implementation.

Challenges faced in relation to HMIS are lack of coordinated effort and leadership, lack of strategy and policy, shortage of skilled human resource and lack of guideline. The timeliness and completeness of HMIS reporting remains poor, and such delays contribute to the failure (at all levels) to use data as the basis for informed decision-making in planning and management. In addition, parallel reporting mechanisms persist with programmatic and donor-supported initiatives resulting in multiple reporting formats and an increased administrative workload.

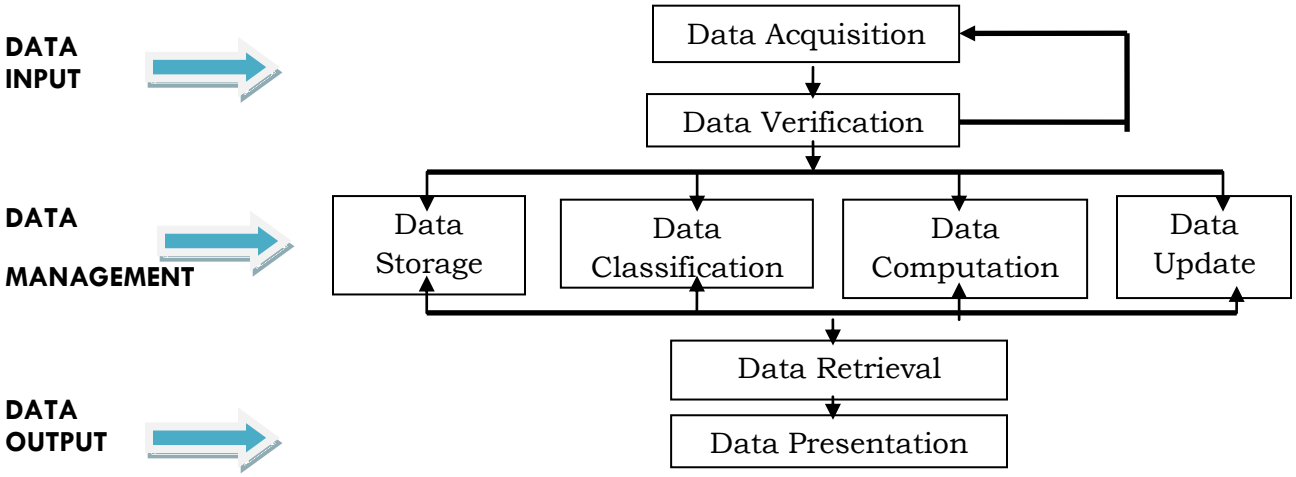
In short, at most health institutions, the HMIS do not deliver its most important product – quality information that supports monitoring and performance improvement. As a result, M&E is also weak, since it lacks the foundation of an HMIS to supply reliable data.

HMIS/M and E weaknesses manifest in several ways:

1. Incomplete institutionalization
2. Unstandardized data collection
3. Unintegrated reporting and data transmission
4. Weak information use (analysis and interpretation).
5. Limited resources for HMIS/M and E

Historically, all information systems, including HMIS, are built upon theconceptualization of three fundamental but iterative information-processing phases: ***data input, data management, and data output***. The data input phase includes data acquisition and data verification. The data management or processing phase includes data storage, data classification, data update, and data computation. Finally, the data output phase includes data retrieval and data presentation. Altogether, these eight elements and three phases define a typical information system as represented schematically in the next figure.

Figure 5: HMIS components and basic functions



Source: Joseph Tan (ND).

Activity 1.7. Group Work

1. What is the importance of giving feedback?
2. What are the main points to consider in giving feedback?
3. What are Indicators?
4. What are the characteristics of a good indicator?

Feedback

No reporting is complete without ***feedback.*** But letting the staffs know how well the reporting has been done and how useful the information is, the manager shows appreciation of the effort which the staff have made to collect and present the information. Feedback also demonstrates the value and importance of the reports to the manager. It is one of the manager's most powerful for motivating staff. Providing feedback is a great motivator of performance. You can reinforce a person's constructive action by letting the person know what specifically appreciated about their action.

When you find yourself giving critical comments about poor performance, you can balance these with these with positive comments. Consider decreasing your critical comments and increasing positive feedback to your staff. In discussion about performance, if you start with off with genuinely positive comments, your staff are less likely to grow defense and more likely to accept your suggestions. Also encourage staff members to give positive feedback to each other when their work is deserves praise.

Use proactive language. The language you use can be a self-fulfilling prophecy that helps to determine your and others' actions. To lead, it is important to use "proactive" language that enables you and others to face challenges and create the future. Reactive language does not offer space for creating new possibilities. Feedback is the way to have the MIS provides complete, timely and accurate information for decision making. When you are giving feedback, remember to:

- Talk about a specific action.
- Talk about its effect on you and the work.
- Make a specific request for a different action, and needs to be action-oriented feedback.

Activity 1.8. Exercise on Feedback

"The Warring Paradigms"
Aim: to consolidate and apply your understanding of the shift from reactive to proactive language.
The Task: Underneath you are given the features of reactive and proactive languages. The table may be incorrect, i.e. the languages may be placed wrongly in the column. Hence, it is your task to re-shuffle the answers so that they are in the right column. First do it in pairs and then discuss in plenary.

Reactive Language	Proactive Language
Let's look at what we can do	There is nothing I can do
That's is the way I am	How can I be more effective?
She makes me so mad	I can control how I feel
May be we can negotiate	They won't allow that
I have to do that	I choose to do what is appropriate
I prefer	I must
Should I?	I will
Will you?	No one will help me

Common information management problems
These include:

- Little integration or coordination between information systems.
- Range of legacy systems requiring upgrading or replacement.
- Direct competition between information management systems.
- No clear strategic direction for the overall technology environment.
- Poor quality of information, including lack of consistency, duplication, and out-of-date information.
- Little recognition and support of information management by senior management.
- Limited resources for deploying, managing or improving information systems.
- Lack of clarity around broader organizational strategies and directions.
- Internal politics impacting on the ability to coordinate activities enterprise-wide.

Session 2: SITUATIONAL ANALYSIS AND PLANNING

Session Overview

In this session you will learn about the basic principles of situational analysis, the stages and components situational analysis, and the definition and purpose of health needs assessment. The session also provides you a systematic approach of problem identification and prioritization.

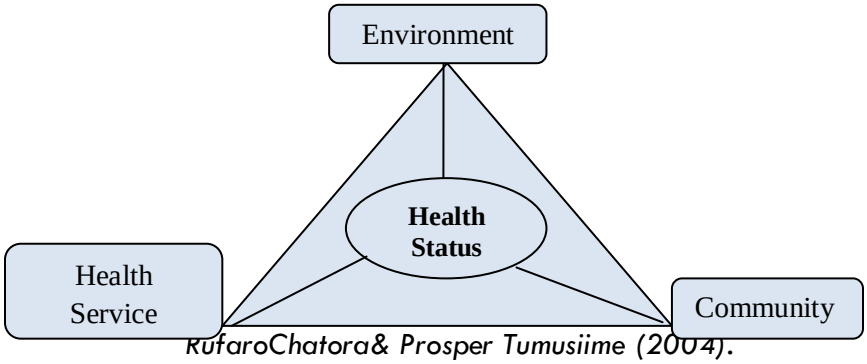
Learning objectives:

By the end of this unit you will be able to:

- Describethe principles of situational analysis HIV/ADIS and other health problem
- Describethe various stages and components situational analysis
- Define health needs assessment and its purpose
- Establish the importance of situational analysis
- discuss the objective of problem identification and priority setting
- Apply a systematic approach toward prioritization of identified problems.

Basic premises of health planning

Health planning requires a background understanding of the functioning of the health system in a given country. In any health system, there are three important elements that are highly interdependent, namely: the community, the health service delivery system and the environment where the first two elements operate.



RufaroChatora& Prosper Tumusiime (2004). Figure6:

Environment

This could be the context in which the health service delivery system operates. The contextual environment could be the political system, health-care policies and development policies. It could also include the socio-economic status or the physical environment, e.g. climatic conditions. All these elements have a bearing on the health status of the individual and the community, as well as the functioning of the health service delivery system.

Health service delivery system

This depicts how health facilities are distributed in the community, which could also have a bearing on coverage. Similarly, health services could be viewed in terms of their affordability and responsiveness to equity which contribute to the health status of the community.

Community

I the characteristics of the society, such as culture, gender, beliefs and health-seeking behavior, together with the environment and health service delivery system, determine the health status.

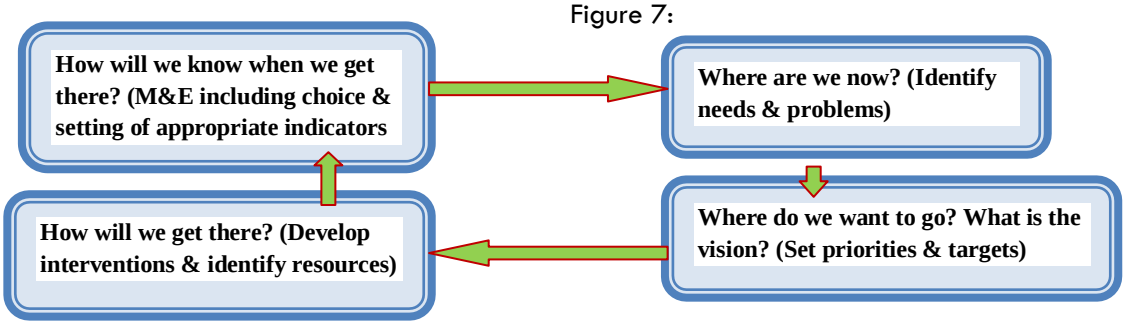
Activity 2.1
Define the terms planning and health planning.

Health planning should aim at improving the health status of a given population while safeguarding equity and fairness of access as well as responsiveness of the health system to the perceived needs of the community. The health plan should achieve this goal through the provision of efficient and effective health services, taking into account available resources and the available means and methods of health care.

The planning cycle

The planning cycle is a sequence of steps which must be followed in deciding what is to be included in the plan.

Figure 7:



Source: RufaroChatora& Prosper Tumusiime (2004)

The cycle seeks to answer the following questions:

Where are we now? This requires a situational analysis to identify current health and health-related needs and problems.

Where do we want to go? This requires the selection of priorities and identification of objectives and targets to be met in order to improve the health situation and/or service delivery.

How will we get there? This details and organizes the tasks or interventions to be carried out, by whom, during what period, at what costs and using what resources in order to achieve set objectives and targets.

How will we know when we get there? This requires the development of measurable indicators for monitoring progress and evaluating results.

[

Preparation for planning

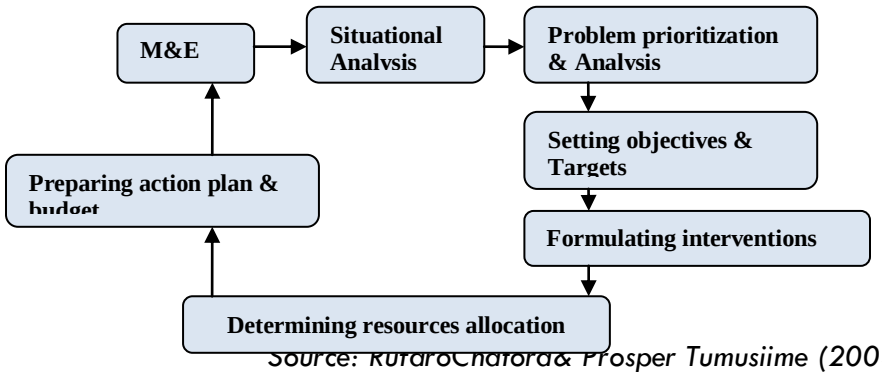
- Preparation for planning is the first step towards the development of the plan.
- Planning itself requires considerable time and resources.
- It should, therefore, be planned and budgeted for and funds made available.
- The planning team is expected to set aside adequate time for preparation.

Steps in the planning process

There are several steps in the planning process, which form a continuous cycle.

1. Situation analysis using health profile, policies and review of previous plans
2. Identify and analys health and health service problems.
3. Apply a systematic approach toward prioritization of identified problems.
4. Develop plan objectives and service targets.
5. Determine resource requirements.
6. Prepare action plans and budgets.
7. Devise monitoring and evaluation tools.

Figure 8:



Source: RutaroChatora& Prosper Tumusiime (2004)

Activity 2.2

Reflect on the way planning is carried out in your work place.

- Are all these steps being observed? If yes, do you think they are sufficient?
- If you do not follow these steps, how else do you go about planning?
- Do you think you may improve your planning process by applying these steps?

Then ask yourself:

Are these steps necessary? What if I skip any of them? Will I still be able to achieve my objectives?

Situation analysis and problem identification

This step involves assessment of the current situation from various perspectives to establish the actual health situation in terms of needs and priorities. Generally, situation analysis may answer the key question 'where are we now?' (Identification of needs and problems), and leads to the next key question 'where do we want to go'? (Setting priorities and targets)

Definition and benefits of a situation analysis

A situation analysis is a process of gathering and analyzing information to provide a synopsis of a particular situation at a given point in time that can guide strategic planning and action. In simple terms, a situation analysis is an effort undertaken by programme planners to gather and analyze information that will help them to design, implement and evaluate interventions.

In situation analysis, the kind of information collected relates to: who is affected and why or how they are affected; the severity of the problem, and resources and strategies that might be employed to produce the desired outcomes.

Example: For HIV/STI interventions, information about individuals' knowledge, attitudes and behaviour is often of key importance.

Situation analysis is useful to different audiences for a variety of purposes including policy and strategy development, advocacy, social mobilization, information exchange, stakeholder coordination and collaboration and program design.

Example: Efforts to reduce HIV/STI infection through school-based interventions are most likely to succeed when two conditions are met: they are strongly supported by policy and decision makers, the school staff and students, and parents and other members of the community; and credible information about the need for the interventions, the resources required and the outcomes expected is used to plan, implement and evaluate all aspects of the effort undertaken. Regardless of the level of programme planning (national, district or local), both the process and results of a situation analysis help meet these conditions.

A good situation analysis has several benefits. Policy-makers and decision-makers need strong arguments, especially when their actions involve allocating resources. Accurate and up-to-date information can provide a basis for discussion and justification for action, setting priorities and, identifying groups in special need for interventions, such as children living in geographical areas where HIV/STI and substance use are prevalent.

Data obtained through the situation analysis can also help that interventions are tailored to the specific needs, experience, motivation and strengths of the target community; and provide a

baseline against which to measure future trends in HIV infection rates and HIV-related behaviours. This, in turn, is essential for evaluating the results of the activities undertaken, and for making improvements to on-going programmes.

Moreover, in relation to HIV/AIDS prevention and control endeavors, situation analysis produces a map of the people who are most vulnerable to infection; noting age and gender differences in vulnerability; a description of why they are vulnerable; an approximation of the number of vulnerable people; and a description of how and where they interact in ways that increase their vulnerability to HIV infection. It also provides a description of the social, economic, political, cultural, and legal issues associated with the epidemic; and an understanding of how women and men, and girls and boys, differ in how they are affected by the epidemic as well.

Planning the planning:

This is partly about determining who should be involved in conducting a situation analysis. It deals with prerequisites that have to be in place and issues that have to be resolved before the actual planning exercise may start with the objective of ensuring that the planning process can be carried out smoothly. Before planning can start the identity and position of the planning body needs to be established. For instance, to ensure the success and sustainability of school health programmes, who should be involved in conducting a situation analysis? For effective partnership between the education and the health sector and for the active participation of students, parents and other community members in all school health promotion activities; it is essential to involve a cross-section of all of them in planning and conducting a situation analysis. In all situations determine capacities locally available and decide whether to bring expertise from outside.

Planning a situation analysis should also determine the specific objectives, organization of the process; needed information; and specific purpose of the analysis. The specific purposes of situation analysis are to: identify health problem and health (service) needs arising as a result of these problems; determine causes and circumstances underlying problems in the health situation as well as with the delivery of health services; assess availability and adequacy of resource in the light of health service needs; and identify gaps and weaknesses in the health care services, in line with health problems and service needs.

Situation analysis consists of a descriptive and an analytic part. The descriptive part describes the situation as it is at present. This helps in assessing the magnitude of the problems, which, in turn helps in prioritizing the problems. The analytical part deals with the factors that determine the existing

situation, and is used subsequently for developing appropriate interventions. The three broad areas that are assessed by a situation analysis are: health needs, health services and resources; and policy and political environment.

Health needs: Needs are based on the problems identified through the demographic situation analysis and/or perceptions of the public health professionals termed as normative needs; and those perceived by individual(s) or community termed as felt needs. While there are going to be large areas of agreement between professionals and the community in their judgments of need, there will also be some differences. Consideration of normative as well as felt needs is essential for proper prioritization of problems.

Medically perceived health needs can be measured by morbidity and morbidity rates by disease and category of group affected (for example age, sex, ethnicity, location); disability rates as well as non illness needs such as antenatal care and family planning. Community perceived health needs on the other hand, are difficult to define, and often expressed in terms of service deficiency rather than health indicators.

Information on services and resources: include socio-economic, infrastructure and geographical and topographical situation; health related services of other sectors; present health service infrastructure and pattern of health services utilization; available health service resources; and effectiveness and efficiency of current services. All communities have existing resources and assets with which they respond to the needs of individuals, families or social groups. These resources may be formal services or informal networks. It is important to assess the extent of both types of resource as part of the profile information. It is too easy to focus on the problems and needs of a community; by ignoring the strengths there is a danger that existing assets can be undermined.

Informal resources: Families deliver the greatest part of all care services in the community where the burden of care normally falls primarily on women and can have significant effects on their health status. There may be a comprehensive welfare system or a patchwork system of charitable and voluntary organizations.

Formal resources: Formal services can be provided at a variety of levels and by many agencies. A health profile should assess how effective they are and how much of the population has been reached. How accessible are services to those without transport or who are disabled? These will include both health services and those provided by other sectors that have an impact on health. For example, WHO has highlighted links between women's literacy and improvements in family health,

demonstrating that educational resources in a community are an important resource for health. Many political and religious organizations also have resources that communities use to provide economic assistance and health care.

Review and interpretation of policy and political environment:

National priorities are often set by governments and influenced by the political and economic agenda. Local priorities will reflect national priorities as well as issues identified by local groups, practitioners and communities. When undertaking a needs assessment you will need to discover what these priorities are in relation to health. Sometimes there can be a conflict between the national top-down agenda and the needs identified locally. It is, therefore, essential to review the existing policy guidelines in order to familiarize yourself with the existing directives and regulations to be followed in the course of preparing a health plan.

The purpose of review is to ensure that national policy guidelines are being adhered to and that community decisions are being interpreted and translated into appropriate actions. The following steps need to be followed:

- ✓ Review national health policy guidelines that govern the development and implementation of the plan in terms of health packages to be provided, means of implementing these packages and what problems and constraints, rules and regulations have to be followed.
- ✓ Review resources available for implementing the policy or programs in terms of human and financial resources, equipment, infrastructure and supportive services in the area.
- ✓ Review health sector reform, human resources for health development policy, PHC strategy, guidelines for the preparation of the rolling plan and forward budget and programme guidelines.
- ✓ Find out about the additional resources required within the community that may be incorporated.
- ✓ Determine both constraints and advantages that may be inherent in the overall socio-cultural environment in which the situationis analyzed.

For instance, several kinds of information are useful in a situation analysis in relation to HIV/AIDS prevention and control efforts. HIV and STI infection rates where they are available can provide evidence of potential risk. Information on sexual behaviour, unintended pregnancy and substance use rates among young people can similarly help determine the extent to which they are at risk of HIV/STI. Evidence about potential risks is very important for convincing policy-makers and the public

to justify the need for anti-HIV/STI interventions like, information about HIV/STI-related knowledge, attitudes and skills are important for planning effective education programmes.

Data sources for problem identification in situation analysis

During problem identification consideration should be given to health and health-related problems based on available data from: HMIS, community surveys, census, reports and your own experience. Literature Review of relevant and contemporary literature; institutional response (profiles of each program addressing needs of community); and perceptions of care providers (in-depth analysis of specific programmatic approaches) can also be used. Thus, health problems can either be primary or secondary.

Primary problems include illnesses identified in the community such as HIV/AIDS, malaria, and tuberculosis, as well as existing inequity, unfairness and client dissatisfaction. *Secondary problems* are also called contributory problems. These can be inadequate health resources, inefficient health delivery services or poor management skills, which cause or contribute to the primary problems.

Problem analysis and prioritization

It is important to analyse identified problems in the context of prevailing conditions, using both problem and needs trees. Problem analysis is the art of critical examination of problems against prevailing conditions of your area. The analysis is done by constructing a problem tree.

Activity 2.3: Practice the steps of problem tree construction in a group of 5-6

a) Start by writing the problem statement on a large single sheet of paper that is pinned to the wall. Each member of the group will be given cards and pens.
b) The facilitator will ask you to write down what you think are the main causes of the stated priority health problem. Write only one cause on each card and in as few words as possible.
c) For each cause, continue to ask yourself the question "BUT WHY?" & write down one answer per card.
d) The facilitator will then arrange the cards under the problem statement on the wall, thus creating a problem tree.
e) As you analyse problems and look at their causes you may realize that you wish to formulate the problem in a different way. For example, what appeared as a problem of lack of supplies for your immunization program may, when you analyse it, turn out to be a problem of health planning or communication.
f) After describing the immediate and associated causes of a problem you then describe the possible consequences of not addressing the problem. These are put above the problem and this completes the problem tree. You will realize that all the causes and consequences are described negatively.
g) The last step is to review the problem tree you have just constructed. Going through each of the causes you have identified, ask yourself *"Is this something we can change in the facility/district/region?"* you should focus on what is within your scope of power to improve, even if only in a small way.

A problem tree is a set of assumptions on causes associated with the problem and its consequences.

Priority setting

Priority setting is one of the most important issues in health care policy as no health system can afford to pay for every service it wishes to provide. This is especially true in developing countries. As a result, difficult decisions must be made as the gap increases between the need for health care services and the amount of money available to provide them.

Prioritization is a process of determining how health care resources should be allocated among competing programmes or individuals. It is making decisions on how limited resources could be best allocated to priority health problems or needs. It is ranking of goals, objectives, or activities in order of importance that guide the order and timing of decisions that management makes regarding the allocation of resources.

Priority setting is a complex interaction, and it occurs at the national level (or macro level), the regional or district level (or meso-level) and the service provision, facility level or micro level). Although there is growing interest in priority setting, there is little consensus on the best way to carry it out. Different approaches have been proposed, ranging from guidelines, checklists and minimum packages to explicit criteria.

Health priorities, whether national or district, are arrived at by using explicit criteria such as outlined below.

1. **Magnitude:** In terms of the proportion of the population affected such as women, pre-school children, school children, the elderly, etc. This basically describes how big the problem is.
2. **Severity/danger:** To the individual and the community. How serious is the condition? Does it threaten life, because major suffering, and decrease the ability to lead a normal life, reduce productivity?
3. **Vulnerability to intervention (feasibility):** If a problem is not vulnerable to intervention, it makes little sense to include it in the list of those targeted for action.
4. **Cost-effectiveness of the intervention:** These criteria should answer the question whether the problem, if addressed, is worth the financial cost involved.
5. **Political expediency (suitability):** Even if a problem fulfils all of the above criteria, if it is not recognized as politically expedient by the central authority, it is very difficult to include it among

the high priority list. This is why it is important to have an evidence base for such prioritization in order to convince the local politicians and to review and interpretation of policy documents.

6. **Community concern:** During priority setting, it is essential to include needs expressed by the community in plans as they ensure community ownership of the interventions which leads to sustainability of activities.

The following techniques may be used to prioritize a public health problem.

Nominal group technique: is a useful technique for prioritizing issues and projects within a group, giving everyone fair input into the prioritization process. This is particularly useful where consensus is important, and where a robust group decision needs to be made. Using this tool, each group participant "nominates" his or her priority issues, and then ranks them on a scale, of say 1 to 10.The score for each issue is then added up, with issues then prioritized based on scores. The obvious fairness of this approach makes it particularly useful where prioritization is based on subjective criteria, and where people's "buy in" to the prioritization decision is needed.

A-B-C priority system

A. *"Must do"*– refers to objectives which are critical to successful performance.
B. *"Should do"*– pertains to objectives necessary for improved performance.
C. *"Nice to do"* objectives which are desirable for improved performance but not critical to survival or improved performance.

Stages of Assessment

Stage-I

The first stage of Assessment, a preparatory stage, involves five steps.

Step 1: clarify the scope, program managers must define who will use the assessment information (audience), what the assessment is to be used for (purpose), and the resources available for conducting the assessment.

Step 2: Assess resources, program managers must take stock of the resources for conducting the assessment and determine whether they are sufficient and compatible with the scope of the assessment

Step 3: identify team members; program managers are responsible for assembling a team and identifying a team leader to conduct the assessment.

Step 4: develop a work plan, program managers and assessment teams create a work plan, which serves to clarify, inform, and direct the tasks associated with the assessment.

Step 5: conduct a briefing and planning meeting, discusses the importance and content of a meeting designed to restate the tasks of the assessment, to clarify roles and responsibilities, and to ensure that program managers, stakeholders, and partners are unified in their vision for the assessment

Stage-II

In this stage, you will gather the information that is necessary to the assessment. Both quantitative and qualitative data are needed. There are two steps in this stage.

Step 1: Compile existing data, programmers establish what is already known about each facet of the HIV situation and response within the assigned scope, and identify where that knowledge is located. Programmers should build on the rapid desk review that helped to define the scope and team composition in the last stage.

Step 2: collect additional information, guidance is provided on how to identify and fill information gaps.

Some of the unpublished data/information you seek have already been collected and are available from various sources. Missing data (or deficiencies in existing data) must be collected by hand using various data-gathering techniques such as written questionnaires, key informant interviews, focus group interviews, and other techniques.

Stage-III: There are three steps in this stage.

Step 1: Summarize the situation, outlines how to identify key programming areas, and the key needs within each area.

Step 2: review the response and identify the gaps, provides guidance on how to determine which needs are being met and which are not.

Step 3: Identify opportunities and obstacles, outlines how to assess existing obstacles that will need to be overcome or avoided, and the opportunities for expanding the response.

Stage-IV: This stage provides tools and direction for putting the assessment into action. There are three steps in this stage.

Step 1: Draft a report, provides guidance for writing the assessment report.

Step 2: Solicit stakeholder input, presents suggestions for sharing information with key individuals and agencies for input and support.

Step 3: Presenting results, outlines how to present and apply what was learned by continuing the programming process.

Session 3: LEADERSHIP CONCEPTS

Session Overview

In this session you will learn about the basic concepts and practices of leadership, different attributes of leadership including leadership theories, styles,skillsand roles. The session also provides you the difference between management and leadership concepts, as well as the common myths and realities about leadership.

Learning objectives:

Upon completion of this unit, you will be able to:

- Describe the definitions of leadership,
- Differentiate different leadership practices,
- Identify the different types of leadership theories, styles,skillsand roles,
- Discuss on the difference between managers and leaders,
- Explain the common myths and realities about leadership.

1. Understanding the concept and practices of leadership

Definition:

There is no single definition for leadership. There are almost as many different definitions of leadership as there are many people who defined it. Some of these definitions are presented here.

Leadership is defined as a process by which an individual influences a group of individuals to achieve common goals. Leadership as a process produces change and includes establishing direction through visioning, aligning people with the vision and strategies, and motivating and inspiring staff.

In another definition, leading an organization means marshalling the people, capital and intellectual resources of the organization to move it in the right direction. Marshaling resources involves focusing attention, organizing/collecting and empowering their use. Even when your team or organization has direction, the internal and external complexities can prevent it from advancing in the agreed-upon direction. When you are aligned or coordinated, with the rest of the organization, your staff resist going their own way and they will be more likely to work together to support the whole organization.

Leading practices:

Leaders can adapt to changing conditions in the environment and lead others to adapt as well. By using their adaptive skills, they enable the staff to achieve results despite complex conditions and scarce resources. They are well informed about opportunities and threats. Their direction is clear to staff. People and resources are aligned around a common shared vision. And because of their commitment, work groups deliver the results that leaders promised. Therefore, when you apply the following specific leadership practices, you and your team will be able to face your main challenges and work together with your organization to address them.

1) **Scanning** for up-to-date knowledge about yourself (to be aware how your behavior and values affect others), your work group, your organization, and your environment. To apply this practice, accomplish the following activities.
    - ✓ Identify client and stakeholder needs and priorities
    - ✓ Recognize trends, opportunities, and risks that affect the organization
    - ✓ Look for best practices
    - ✓ Identify staff capacities and constraints
    - ✓ Know yourself, your staff, and your organization — values, strengths, and weaknesses

    The expected organizational outcome as a result of this practice is that leaders have up-to-date, valid knowledge of their clients, the organization, and its context; they know how their behavior affects others.
2) **Focusing** staff 's work on achieving the organizational mission, strategy, and priorities;
    - ✓ Articulate the organization's mission and strategy
    - ✓ Identify critical challenges
    - ✓ Link goals with the overall organizational strategy
    - ✓ Determine key priorities for action
    - ✓ Create a common picture of desired results

    The expected organizational outcome of focusing is that your organization's work is directed by well-defined mission, strategy, and priorities.

3) **Aligning and mobilizing** stakeholders' and staff's time and energies as well as the material and financial resources to support organizational goals and priorities;
    - ✓ Ensure congruence of values, mission, strategy, structure, systems, and daily actions
    - ✓ Facilitate teamwork

- ✓ Unite key stakeholders around an inspiring vision
- ✓ Link goals with rewards and recognition
- ✓ Enlist stakeholders to commit resources

The organizational outcome of this practice is that internal and external stakeholders understand and support the organization' goals and have mobilized resources to reach these goals.

4) **Inspiring** your staff to be committed and to continuously learn how to adapt and do things better. Moving an organization to the right direction involves energizing through removing obstacles to progress, and making the changes necessary to improve performance and enabling it to learn and grow.
   - ➢ Match deeds to words
   - ➢ Demonstrate honesty in interactions
   - ➢ Show trust and confidence in staff, acknowledge the contributions of others
   - ➢ Provide staff with challenges, feedback, and support
   - ➢ Be a model of creativity, innovation, and learning with this practice, you can ensure an outcome that your organization displays a climate of continuous learning and staff show commitment, even when setbacks occur.

Therefore, leadership is based on an action that is combined with on-going learning (perseverance) and practice as opposed to a one-time effort. It is speaking and listening in a way that individuals are enabled to act to create a future that was not predictable at the time of the conversation. Leadership is concerned with the future and is critical for the development of individuals, organizations and societies. Effective leaders are expected to answer the following five key questions satisfactorily:

1. *What do we want to happen or create?* Refers to understanding where we want to go, involving the aspirational dimension of leadership, including creating a shared organizational vision, mission, and core values.
2. *What is happening now? And why is there a difference?* These questions refer to assessing where we are and analysing the gap. It is the process of collecting relevant information and making sense of the organization's competitive environment.
3. *What do we need to change?* Involves learning how to get there involves understanding and formulating the critical elements of strategy.
4. *How do we take care of change and accountability?* Refers to making the journey by translating the strategy into action through identifying and implementing tactics.

It is also about checking our progress is the continuing assessment of effectiveness. This part then leads to a reassessment at the organization's new level of performance, starting the learning cycle over again.You can make a self-assessment to see if you are an effective leader by responding to the questions: Do you believe in working in concert with others, you can make a difference as leadership is always exercised with others? Are you a critical thinker and innovative to create something of a value that did not exist before? Do you exhibit positive energy to your followers through inspiring and being a role model? Do you actualize and welcome change by matching your words with deeds?

Activity 3.1: Individual exercise

1. Think of a person whom you know and have worked with in your personal and professional life and you admire as a leader, and who has positively influenced your personal and professional life. List the characteristics of this leader.

Activity 3.2: Group exercise

1. Get into small groups of 5 to 6 participants each and choose a chair person and a speaker who will report back your work to the whole group
2. Discuss on the individual experiences in Activity 3.1.
3. List the common experiences for the questions in Activity 3.1 and present it to the whole group using flipchart.

2. Leadership Theories

Great Man Theory

In general, leadership theories have been built around assumptions. The first leadership studies were based on the study of people, mostly men, who were already great leaders. Leaders were primarily seen as coming from aristocratic families and there was a notion that leadership had to do with breeding. When the survival-of-the-fittest concept was combined with intermarriage among the nobles, a class of society that is biologically different and more advanced was produced. Great Man theory was based on the assumption that leaders are born, not made. A second assumption was that great leaders arise when there is great need.

Trait Theory

Building on the Great Man theory, if leaders were endowed with superior qualities that separate them from their followers, researchers assumed it could be possible to identify these qualities. This concept gave rise to the trait theory of leadership. Pure trait theory focused on three fundamental

assumptions. Individuals are born with inherited traits, some traits are particularly suited for leadership, and people who make good leaders have the right, or sufficient, combination of traits. Until the mid-1940s, studies on trait leadership focused on identifying what traits distinguished leaders from other people and to what extent these differences were significant. They examined almost every trait conceivable including: physical traits, intelligence, liberalism/conservatism, excitability, humor, and originality. However, for every trait that was deemed important for a leader to own, there were multiple examples of great leaders who did not possess the trait and many non-leaders who did possess the attribute.

Activity 3.3
From your understanding of leadership definitions and practices discussed above, what do you think are the key limitations to trait theories of leadership?

Behavior Theory

The behavior, or style, theory of leadership was developed in the late 1940s. The theory was based on two assumptions. Leaders can be made and is not a set of innate traits received at birth, and successful leadership is based on definable and learnable behavior. This allowed all people the opportunity to become a leader by learning a set of behaviors, by participating in leadership situations, or by seeking leadership development opportunities, rather than developing personality traits.

*Leadership styles:*Leadership style is the way in which the functions of leadership are carried out. In other words, the way in which you as a leader in a health care organization behave towards different staff members. There are many dimensions to describing such behavior – such as facilitative, dictatorial, unitary, bureaucratic, charismatic, consultative and participative – though a broad classification is suggests based on three styles:

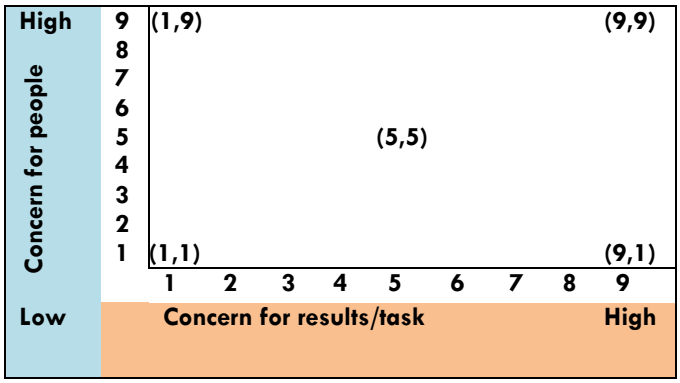
1. *Autocratic*, where power lies with the manager and the manager alone makes decisions, determines policy and controls rewards and punishments;
2. *Democratic*, where the focus of power lies in the group as a whole, so leaders must function in a consultative or participative manner;
3. *Laissez-faire*, where a leader observes that an individual or group works well on their own. In this style, a conscious decision is made to free members from managerial interference but, in the same vein, managers must be careful not to abdicate from their responsibilities.

Leadership behavioral theories differ from trait theories since they suggest that it is not personality but particular behavioral that determine whether or not a leader is successful. C*onsideration*, in which the leader establishes trust and respect through close empathetic communication with individuals and teams; and *Structure*, reflecting the way a leader defines how the groups should organize themselves to achieve goals; are the two major dimensions of leadership behaviour according to the Blake and Mouton leadership grid.

The Blake and Mouton leadership grid: Blake and Mouton developed a leadership grid which is considered to be a style approach to leadership, proposing a two-axis model to make a distinction between a concern for people and a concern for production or results(Figure 1). The scale for each component moves from one (low) to nine (high). Five leadership styles are then produced as follows:

1. *Authority-compliance management (9, 1)*, where the leader assumes a position of power by arranging work conditions efficiently and in so doing interferes minimally with the human elements.
2. *Team management (9, 9)*, where people are committed to accomplishing a task, group members are independent, and everyone holds a stake in an environment characterized by high trust, equality and respect.
3. C*ountry club management (1, 9)*, where the leader attempts to make all group members comfortable in a friendly atmosphere of work.
4. *Impoverished management (1, 1)*, where the leader extends limited effort in accomplishing the required work.
5. *Middle-of-the-road management (5, 5)*, where the leader attempts to balance behaviors that are task-oriented whilst retaining morale and drive amongst group members.

Figure 9:



The Blake-Mouton leadership/managerial grid. Source: Nick Goodwin, Reinhold Gruen& Valerie Iles, 2006.

A key issue here is the extent to which these two behavioral types are combined. Employee-centered approaches (based on consideration) might be more effective in leadership than production-centered ones (based on structure).

Contingency Theory

Activity 3.4

1. Where would you place yourself on the Blake and Mouton leadership grid? Are you:
   a) High/low in your concern for people?
   b) High/low in your concern for production?
2. Which of the five styles applies to you?
3. For each of the five leadership styles, think of at least one individual, not necessarily in health care sector, who leads in this way.
4. Which of these leadership styles is the most appropriate in health care?

Contingency theory is a class of behavior theory that contends that there is not one best way of leading and that a leadership style that is successful in one situation may not be successful in another. Some leaders are more task-oriented while others are more relations-oriented and the key to successful leadership is developing a work environment that supports their style or they adjust their style. Contingency theory assumes that the leader's ability to lead is contingent upon various situational factors, including the leader's preferred style, and the behaviors of the followers. Fiedler's andPath-Goal (Goal oriented) contingency theories are discussed bellow.

Fiedler's contingency theory: according to this model, behavior is dependent upon the favorability of the leadership situation. Fiedler developed a 'Least Preferred Co-worker' (LPC) scale (table6) asking leaders to rank the relationship between themselves and co-workers on a sliding eight-point scale indicating whether the relationship was very favorable (a high score) or very unfavorable (a low score).

Table 6: An example of Fiedler's 'Least Preferred Co-Worker' (LPC) scales

Pleasant	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**Un-pleasant**
Friendly	8	7	6	5	4	3	2	1	Un-friendly
Quarrelsome	1	2	3	4	5	6	7	8	Harmonious
Cold	1	2	3	4	5	6	7	8	Warm
Accepting	8	7	6	5	4	3	2	1	Rejecting
Distant	1	2	3	4	5	6	7	8	Close
Helpful	8	7	6	5	4	3	2	1	Frustrating
Relaxed	8	7	6	5	4	3	2	1	Tense
Unenthusiastic	1	2	3	4	5	6	7	8	Enthusiastic
Rejecting	1	2	3	4	5	6	7	8	Accepting

Source: Nick Goodwin et al. (2006).

Table 6describes ten typical relationship-based items (but could include many more). By totaling the scores for each co-worker or group, a high score reflects a leader who enjoys interpersonal

communications and is motivated by acting in a supportive and considerate manner. Conversely, a low score signifies a leader who derives more satisfaction from achieving tasks and who would be less motivated by the relational aspects to leadership. The score therefore, reflects the manager's personal style of leadership. Three variables determine the favorability of leadership in an organization:

a) *Leader–member relations* – the degree to which the leader is liked and trusted;
b) *The task structure* – the degree to which a role or action is clearly defined;
c) *Position power* – the degree to which a leader can exercise power by virtue of his or her position in the organization.

Eight combinations of these group-task situations (table 6) could be combined with scores for leadership style to determine whether leadership is either very favorable or very unfavorable or moderately favorable (mixed). A direct, controlling style of leadership works better at the two extremes but that where a mixed picture emerges, a more facilitative and participative mode of leadership is required to gain best results.

Activity 3.5

Think of an individual or group who you lead in your organization or think of the leaders in your organization and their relationship with a certain group.

1) Using Fiedler's contingency model, would you say your health care organization's situation is:
   a. Very favorable?
   b. Very unfavorable?
2) If Fiedler is correct, should health care managers be:
   a. More relationship-oriented?
   b. More task-oriented?

Write down two reasons why this may be true.

Path-goal theory: A second contingency model of leadership is the path-goal theory. It is based on the assumptions that an individual's motivation is based upon the expectation of delivering a successful outcome. This theory describes how leaders motivate subordinates to accomplish designated goals and emphasize relationships between the leaders' style and situational variables in the organization. It brings together the interactive properties of the situational and behavioral theories. Hence, performance is related to the extent to which a leader fills expectations. There are four main types of leadership:

a) *Directive leadership* manifests in telling subordinates what is expected of them and giving specific directions and tasks.

b) *Supportive leadership* involves a friendly and approachable concern to the need of others – or 'consideration' in the Ohio model described earlier.

c) *Participative leadership* involves consultation and evaluation of opinions before decisions are made.

d) *Achievement-oriented leadership* sets challenges, seeks improvement and shows confidence in the ability of others to do well.

Path-goal theory suggests that leaders should use one of the three styles depending on the personal characteristics of the subordinate (how they might react to the leader) and the nature of the task (whether it is simple or routine, or complex and unstructured).

Activity 3.6
Using the table below, identify and reflects on a range of situations in which you as team leader used these styles or in which your team leader used these styles.

	Leadership style			
	Supportive	Directive	Achievement-oriented	Participative
Situation where this style worked well (preferably in your own experience)				
Impact on staff members concerned				
Outcome				

Situational Theories

Situational theory of leadership is similar to contingency theory as both are situationally based. While situational leadership examines leadership styles in view of the development level of the follower, contingency theory looks solely at the leader's task- or relationship-orientation. The motivation and the capacity of the follower is the primary driver of the leader's behavior under the situational theory. As a subordinate's maturity and knowledge levels increase, the supervisor moves from a "telling" behavior all the way to a "delegating" behavior. While situational leadership theory draws on behavior theory, it is important to see that its focus is on when to use which behavior with followers at different levels of readiness.

Hersey and Blanchard's situational leadership theory:A major component of this theory is that different managerial styles need to be adopted according to the task readiness of the people that the leader is attempting to influence. The level of readiness (or maturity) has four levels:

- ***R_1***– *low follower readiness*, where followers lack commitment and motivation and may be unwilling and/or unable.
- ***R_2***– *low/moderate follower readiness*, where followers can be motivated to make an effort but lack ability; in other words, willing but unable.
- ***R_3***– *moderate/high follower readiness*, where followers are able and have the ability to perform but are unwilling or less ready to apply their ability.
- ***R_4***– *high follower readiness*, where followers are both able and willing, commit ted to the task.

For each of the four levels, the most appropriate style of leadership is related to a combination of '*task*' and '*relationship*'behavior. *Task behavior* is the extent to which the leader provides direction for the actions of followers, for example through setting goals and protocols for delivery. *Relationship behavior* is the extent to which the leader engages in two-way communication with followers, for example to discuss options or examine stakeholders' views. The combination of task and relationship behaviors derives four leadership styles:

- ***S_1***– *telling,* where leaders provide guidance or orders to be performed but do not engage in close relationships with staff. This style of leadership is most appropriate where an employee has low follower readiness (R_1).
- ***S_2*** – *selling,* where leaders 'sell' a direct task through engaging with staff, an approach most suited to moderate follower readiness (R_2).
- ***S_3*** – *participating,* which emphasizes a high amount of two-way communication with no prescribed guidance, an approach most suited to moderate to high follower readiness (R_3).
- ***S_4*** – *delegation,* where leaders provide little direction to staff since they are already motivated, competent and mature, an approach most suited to high follower readiness (R_4).

This model draws attention to the different leadership styles that need to be adopted with different stakeholders or staff reflecting their level of maturity, knowledge and willingness to work to organizational goals and tasks.

Activity 3.7

1) Think of the members of your own team. Are they high or low in 'task readiness?
2) Which leadership style should you adopt for each of them?
3) Is your own task readiness high or low?
4) Which leadership style should your line managers adopt with you?
5) How could you encourage them to do so? You may find it helpful to envisage a situation in which you will meet your team members (individually) over the next few days. Imagine adopting the leadership style you have identified as the most appropriate. How could you put into practice your suggestions in response to Question 4?

Transactional and Transformational Leaderships

These are among the many additional leadership theories, which bring together two or more of the other theories discussed above.

*Transactional Leadership:*ismore common leadership approach where an exchange process involves the leader and followers agreeing to do or provide things to accommodate each other's' needs. A transactional leader motivates through reward and punishment where a trade or transaction is made for the followers' support. The transactional leader works through creating clear structures whereby it is understood what is required of their subordinates, and the rewards that they get for following orders. Punishments are not always mentioned, but they are also well-understood and formal systems of discipline are usually in place. Under transactional leadership, there is a virtual contract between the leader and follower that states the follower gives all authority to the leader and is willing to do what the leader requests. Transactional leadership should not be viewed as negative; it is just a relationship between a leader and follower that is more focused on performing work than the growth, development, and understanding of the follower.

*Transformational Leadership:*To effectively lead professional staff, transactional leadership will probably not be enough to achieve outstanding performance. It should be augmented by the use of transformational leadership, which includes idealized influence, inspirational motivation, intellectual stimulation, and individualized consideration. A transformational leader asks followers to transcend their own self-interest for the good of the group or organization. The followers need to consider the long-term needs to develop themselves rather than just react to the needs of the moment, ultimately becoming aware of what is truly important. The leader activates the motivation of followers by appealing to their higher level needs, values and ideals. The leader transforms and motivates

followers by (1) making them more aware of the importance of task outcomes, (2) inducing them to transcend their own self-interest for the sake of the organization or team, and (3) activating their higher-order needs.

Transformational leadership theory interweaves trait, behavior, and situational leadership theories. It is built on four fundamental factors: charismatic leadership, inspirational leadership, intellectual leadership, and individual consideration. Charismatic leadership is the personal display of charm and grace that attracts followers with a level of admiration. Inspirational leadership sends a clear message of purpose and mission to the followers. It gives them a sense of passion and confidence to achieve their goals. Intellectual leadership gives the followers an idea that the leader is more interested in ideas than in process. A transformational leader looks to their followers to be part of the problem-solving effort not just an end-user following direct orders. Individual consideration is a level of empathy created by the leader who cultivates intense one-on-one relationships with their followers. This individual attention keeps the follower motivated and constantly engaged with the organization's mission.

3. Leadership skills

The skills approach suggests that leadership abilities can be developed, whereas traits are more inherent in an individual. This approach is most prominent in leadership development programs that focus on identifying specific competencies that are important in a leadership setting. Leadership competencies are the specific mindset, skills, and knowledge that help managers lead more effectively. Strong and effective leadership creates a high degree of involvement and shared commitment that stimulates people to overcome obstacles to achieve maximum results. Different leadership skills are discussed below.

Visioning and conceptual skills

Vision drives mission. A vision is a future, an image of hope, of something your organization truly wishes to create. A mission is what your organization does every day to move toward that future, i.e., the purpose of its existence. While vision is the light at the end of the road that you are driving to, mission is the road you take to reach your vision and values are what drive you along the road of your mission. All leadership activities start with "the end in mind," that is, with results that justify the organization's existence. It is the mental ability of leaders to see the big picture to understand the complexities and issues within an organization and the role and strength of leadership within it to act according to the goals of the organization as whole, rather than to a specific department. It is looking beyond a narrow focus to take into account conditions outside your immediate area of work.

Thus, effective leadership requires the skill to choose, and then translate, the right strategy into action and sustaining the momentum. The ability to see the second and third order consequences of decisions and non-decisions also requires conceptual skill.

Technical skill

Leadership is the key factor differentiating the "average" from the "excellent". Under effective leadership there is visible progress towards the realization of a vision, which requires technical skill to lead implementation of the change process. It is the ability of a leader to use knowledge, methods, processes and techniques necessary for leading change and managing resistance to change. Such skills include: self-mastery or self-awareness of leaders, i.e., being aware of their impact on others, managing their emotions effectively, using their strengths, and work on their shortcomings; enabling work group to own challenges, enlist stakeholders, and navigate through unstable conditions; and the skill to use strategic or scientific methods of problem solving.

Communication skill

Good leaders are excellent communicators. Each of the leadership practices requires good communication skills. Leaders must be able to convey meaningful, compelling and inspiring messages and transmit or exchange information with a variety of people inside and outside the organization. They should hold conversations focused on outcomes; balance advocacy with inquiry; and clarify assumptions, beliefs, and feelings within yourself and others. Good communication is critical for leaders who want to involve the members of their team, department, or organization to face challenges successfully. It is also important to align expectations. Irritations and frustrations between organizational units, between individuals, or between collaborating organizations often arise from miscommunications or disconnect in expectations.

Key communication skills that are important for leadership include the ability to:

- Articulate points of view in a manner that allows for productive dialogue
- Relate positively with people at all levels of the organization
- Create messages that inspire others to support the organization's goals and work together
- Convey hope during times of turbulence
- Present clear and compelling points of view to individuals and groups
- Select a channel that is a appropriate for the message and the receiver

- Consider how culture (your own, and that of your colleagues, staff, partners, etc.) impacts your communication. As much as possible, communicate in a way that is culturally appropriate.

Activity3. 8

1) Think of a specific conversation or meeting that resulted in conflict or negative feelings, perhaps a time when you had to tell a work group that they needed to improve their performance.
2) Identify the person or people you spoke to and the purpose of your conversation.
3) For each step, write your answers for the following questions:
   a) Objective level—what did you observe?
   b) Reflective level—what did you feel? What did you assume about the other's feelings?
   c) Interpretative level—what new insights can you get from this review?
   d) Decisional level—what immediate action can you take? What do you need to explore further?

Negotiation skill

The underlying philosophies of negotiation or conflict management can be understood in four key ways: Win/Win, Win/Lose, Lose/Win, Lose/Lose and No Deal. There are situations in which each of these may be appropriate; however, in most cases the win/win approach is the only viable option to produce sustainable agreements without damaging relationships. In the long run, if it isn't a win for both parties, both parties lose.

a) *Win/Win approach:* is an approach that seeks mutual benefit to all parties. It is a cooperative approach, based on the idea that one person's success is not achieved at the expense or exclusion of the success of other people.
b) *Win/Lose approach:* is an authoritarian thinking: "if I get my way, you don't get yours." Leaders use position, power, credentials, possessions, or personality to get their way. There is a place for win/lose thinking in very competitive and low-trust situations; however, most of life is not competitive, and this mentality can do damage to our relationships.
c) *Lose/Win approach:* this mentality has no standards, demands, expectations or vision. This thinking is quick to appease and capitulate. It is easily intimidated, and very vulnerable to other parties who are approaching negotiation from a "win/lose" philosophy. Lose/Win can often breed resentment from the losing party over time.
d) *Lose/Lose approach:* is the philosophy of war. It is adversarial conflict that sees the other party as an enemy. This approach focuses on "getting even" or "getting back." It does serious damage to relationships.
e) *No Deal approach:* is a "way out" to "save face", where no one wins and no one loses.

Selecting a strategy to reach a negotiated agreement

As you prepare for the negotiation, remember that the outcome of your negotiation depends partly on how you negotiate. There is the aspect of the substance of the negotiation (what you are negotiating about) and then there is the relationship between you and the other party. Use advocacy (presenting your own point of view) to establish your voice in the negotiation and use connection to establish and nurture your relationship with the other person. Decide which is more important as you plan your strategy to reach a negotiated agreement. Recognize, however, that sometimes the other party is playing by different rules and is unwilling to engage in negotiation with you. Sometimes the power imbalance between you and that person is so great that you must give in. If so, show appreciation for being invited to the table, so you at least receive a hearing and may receive a hearing in future situations.

The philosophical approaches to negotiation discussed above can be summarized in the following matrixto helps you select an appropriate negotiation strategy. Use it to clarify what you want to accomplish and how to do this and determine the stance you want to take so that you can select the right approach to reach your goal.

Table 7: Matrix of negotiation strategies

<table>
<tr><td colspan="2" rowspan="2"></td><td colspan="2">Connection</td></tr>
<tr><td>Low</td><td>High</td></tr>
<tr><td rowspan="2">Advocacy</td><td>High</td><td>Bargaining
When you want to get the best possible deal
for yourself:
✓ Start with opening offers that camouflage real desires;
✓ Bargain back and forth between offers that start far apart. Gradually approach the other's offer, until you both arrive at a compromise (although it may not really be one).
Result: One party's win is the other's loss, or both lose a little bit through compromise.</td><td>Creative problem solving
When the cost of alienating the other person is high and the relationship is important:
✓ Use the People, Interests, Criteria, Options (PICO) method of negotiation. PICO solves a problem while maintaining a good relationship with the opposite party/person.
Result: If the negotiation concludes well, both parties walk away satisfied that their interests have been served and the relationship is preserved.</td></tr>
</table>

	Low	**Take it or leave it** When you have no significant stake in the negotiation: ✓ Offer the other a person the choice of taking your offer or not getting an opportunity. **Result:** You withdraw your offer or, sometimes, you unexpectedly win. The relationship may be damaged.	**Mutual learning** When both parties want to move beyond an instrumental concern for the other party and beyond enlightened self-interest: ✓ Explore mutual and separate needs. **Result:** You risk not fully resolving the issue. New perspectives on the issue may make it less or more important and require a new strategy. The relationship is probably strengthened.

Source: Management Sciences for Health (2008)

Activity 3.9

*Source: Management Sciences for Health (2008)*Use the PICO worksheet given bellow to plan your negotiation to achieve intended results.

People—Separate the people from the problem *Consider the background factors that may have contributed to their current positions.*	
Interests—Look for the interests hidden behind the positions *Put yourself in the others' shoes: what motivates the others, where do your interests agree, and where do they differ?*	
Criteria—Agree on objective criteria to test if an agreement has been reached *Define objective criteria for evaluating possible options, for example, what would be a fair outcome?*	
Options—Look for alternative solutions *If anything is possible, what are the best solutions, and how would these benefit you and the other person?*	

Team development skill

Effective leadership allows active participation of all team members with a clear sense of purpose and mutual support. It is about enabling ordinary people to do extraordinary things in the face of adversity, and to constantly turn out superior performance for the long-term benefit of all. In such circumstances, team members of the organization gain experience and qualify themselves for promotion and advancement. The organizational results and goals are thus satisfactorily met.

The top priority for leadership development in the healthcare sector is to improve the ability to lead employees and work in teams, creating an organizational culture of collaboration. Effective team leaders set clear goals and expectations; are able to resolve conflict, motivate team members and help individuals understand how their work fits into the goals of the organization. They select the right mix of people for the team; bringing together people who collectively have the expertise, knowledge and skills needed to complete an assigned task or ongoing work.

The following are some of the key advantages of being on a team:

- Motivation and flexibility in work environment
- Shared responsibility for and more ownership of tasks
- Effective delegation of workloads
- Opportunities for professional skills development
- Proactive approach to problems
- Improved self-worth of employees

There are also some drawbacks and frustrations with working in a team. It can take long time to discuss ideas and issues and reach agreements in a team. Group dynamics sometimes can feel uncomfortable and disagreements between team members can lead to conflict. It may require people to change, or to go along with something they are not comfortable with; and also require good leadership to be successful.

Effective teamwork is rare and powerful. Despite the above limitations, teamwork offers a competitive advantage for leaders and their organizations. To be effective in a team, members and leaders must have courage, discipline, emotional energy, and persistence.

Roles in teamwork

In groups that learn well together, people generally assume different team roles. Some common roles in teams are that of initiator, follower, opposer, or observer. When faced with a difficulty, someone initiates an idea or action to address the situation. Another follows or accepts the idea so it gains momentum. A third person opposes or questions the idea, which encourages the group to refine the idea by exploring its drawbacks. Finally, someone observes and gives feedback on the group's progress. Groups can become stuck on less-than-optimal solutions when one or more persons dominate the discussion while others tend to follow, or when someone constantly disagrees. In such a climate, much of the team's creative talent remains untapped. To function well, a group needs to find a balance for all four roles.To help you apply these roles, you will exercise activity 10 belowto discover ways to improve team members' interactions. By continually modeling commitment, maintaining trust, acknowledging accomplishments, developing support processes, and learning with your staff, you create a climate that maintains group dedication to results. Before you begin your

effort to build a more positive work climate, you may want to assess the climate of your group. This assessment will give you a basis for determining the effects of the changes you introduce.

Activity 3. 10

- Divide into small groups.
- Each groupwill select a topic or challenge to be discussed that is sufficiently real to generate a spirited conversation. This topic should relate to your work, so that you won't be self-conscious.
- Select two people in each group to act as "observers." It is good to choose natural "initiators" for this role, because it gives you a challenge to stay quiet and observe.
- The observers will write the four team roles (Initiate, Follow, OpposeandObserve) on a piece of paperand mark on the paper when they see members of their team playing one of these roles.
- In plenary, the observers will share what it was like to be only an observer (Was it difficult? What did you observe? Did you see each of the four roles played?

Time management skill

This skill helps create a shared vision and sense of urgency to others so that they could be able to envision a better future, use this vision to focus on priority issues by putting first things first. As you can see the time management matrix below many activities compete for our time in our daily lives. We usually spend time in one of the four ways illustrated in the matrix. How will we find the time for everything we need to do?

Table 8: Time Management Matrix

	URGENT	NOT URGENT
IMPORTANT	**Quadrant-I: Activities** ✖ Crises ✖ Pressing problems ✖ Deadline-driven projects or activities	**Quadrant-II: Activities** ✖ Crisis prevention, planning ✖ Relationship building ✖ Recognizing new opportunities
NOT IMPORTANT	**Quadrant-III: Activities** ✖ Interruptions, some calls ✖ Some mail, some reports, some meetings ✖ Proximate, pressing matters ✖ Popular activities, e.g., opening ceremonies	**Quadrant-IV: Activities** ✖ Some mail ✖ Some phone calls ✖ Time wasters ✖ Pleasant activities

(Source: Covey SR., 1989)

Activity 3.11

- Describe a typical work that you did individually in the most recent week before you came to this training and calculate the time you spent working on activities in each quadrant. For example, if you work a total of 40 hours in a week and you spent 20 hours in Quadrant I that would mean that you spent 50% of your total work week doing urgent and important things (Quadrant I).
- Once you have finished working on your matrix, turn to the person next to you and share your results.
- In pairs, discuss how you can shift the percentages so that there is more time for the important stuff (putting first things first). (Discuss what you could do differently to focus more on important priorities.)

4. Leadership roles

Roles of leaders can be summarized in to three major areas: visionary and strategist, challenger of processes in a changing environment; and enabler of others to act.

Visionary and strategist role: Leaders must have a clear vision that they are passionate about. They must firmly believe that they can make a difference. A vision only seen by the leader is not enough to mobilize and animate groups.

Challenger of processes in a changing environment: Leaders are change agents. Their task is to challenge the status quo. They must constantly seek out opportunities to grow and improve. To do this, they must take risks and experiment, continually learning from their mistakes and moving forward. As a leader it is important to recognize that people will not change unless they can see how a new policy, process or program fits with their personal needs. It is the leader's task to find ways to get "buy in." The change should come from within and not outside. In other words, people should feel in charge of change. Leaders must also recognize that because change takes time, they must move one step at a time. Leaders should set achievable goals and have the courage to persist despite the setbacks and challenges they may face.

Enabler of others to act: This role also involves other roles such as: resource mobilization and its effective utilization, team building, effective communication, empowerment, partnership/collaboration/networking, dialoguing and negotiating roles for broad-based action. Leaders must align their vision with a common vision in order to enlist others in their dreams. They

help others recognize the ways in which their dreams can be realized by working towards a shared vision. Leaders understand that they cannot achieve anything alone. They know that collaboration is essential for success. They build spirited teams, promote shared goals and build trust. Leaders must create an environment of respect and a sense that "we're all in this together." Good leaders make sure they connect their constituents (supporters) and their constituents connect with each other. Leaders must strengthen others by sharing power and providing choice. As a leader, you want your constituents to be competent and confident. Constituents must feel a sense of accountability and ownership for their achievements.

5. Management vs. Leadership

Management is the process of designing and maintaining an environment in which individuals, working together in groups, and teams to achieve some results. Management applies to any kind of organization and is concerned with productivity i.e. effectiveness and efficiency. It is the process of achieving organizational goals by planning, organizing, and controlling organizational resources such as people and cash. From these definitions management is by and large concerned with the *control of resources and reporting back on how such resources have been used.*

Leadership is a function of knowing yourself, having a vision that is well communicated, building trust among colleagues, and taking effective action to realize your own leadership potential. Leadership is a process of influencing on a group in a particular situation at a given point in time, and in a specific set of circumstances through stimulating people to strive willingly to attain organizational objectives, giving them the experience of helping attain the common objectives and satisfaction with the type of leadership provided.

Leaders manage and managers lead, but the two activities are not synonymous. Management functions can potentially provide leadership; leadership activities can contribute to managing. Nevertheless, some managers do not lead, and some leaders do not manage. They overlap, but they are not the same. A distinction between the style of leaders and managers can be seen according to their primary focus. The respective positions of leaders and managers on a number of issues are listed in the following table.

Table 9: Distinction between the style of leaders and managers

SUBJECT	LEADER	MANAGER
Essence	Change, challenge	Stability, maintenance
Focus	People	Organization & structure
Have	Followers	Subordinates
Seeks	Vision	Goals & oobjectives
Detail	Policy - sets direction	Procedures - plans detail
Power	Personal charisma	Formal authority
Appeal to	Heart	Head
Energy	Passion or inspiring trust	Directing &control
Dynamic	Proactive	Reactive
Persuasion	Sells what & why	Tells how and when
Style	Transformational,democratic	Transactional,autocratic
Exchange	Excitement for work	Money for work
Risk	Takes risks as opportunity	Minimizes/avoids risks
Rules	Breaks rules- enabling	Makes rules-restraining
Conflict	Uses conflict	Avoids conflict
Direction	New roads or innovative	Conforms to existing roads
Blame	Takes blame	Blames others
View	Longer range	Shorter range

6. Myths and realities of leadership

There are many managers who still believe that leadership is a born talent, leadership is a rare skill, only for top management and one should have an inbuilt charismatic personality to be a leader; and the like. The five great myths of leadership in practice are discussed below.

a) *Leadership is rare skill:* But the fact is that many people possess leadership competency within them. We realize this when opportunities are extended to them to demonstrate their leadership prowess. Leadership has to take place every day. It cannot be the responsibility of the few, a rare event, or a once-in-a-lifetime opportunity.

b) *Leaders are born, not made:* Biographies of great leaders and stories surrounding them create a picture that leadership is a born talent. Yet, you can learn to lead asmany leadership skills and competencies can be learned and developed. Leadership practices improve through a process of facing challenges and receiving feedback and support. By using this process, managers develop the leadership abilities of their staff.

c) *Leaders are charismatic:* There is a tendency to think that one need to be stylish, smart, ad charming in appearance to become a leader. In reality, successful leadership practices and behaviors contribute for a leadership rather than charisma self-leading a person to effective leadership behavior.

d) *Leaders exist only at the top of an organization:* Organizations have played into this myth by focusing leadership efforts only on top management. The fact is that leadership is required at every level of operation in the organization. One has to be a good leader even in a single person operation to excel in that. Therefore, there must be multiplication of leadership roles.

e) *The leader controls, directs and manipulates:* Leadership is a role of empowering the followers as opposed to popular misnomer leadership as power seeking role. Leadership is epitome of equity, fairplay and sacrifice and not the act of manipulation. Effective leaders ensure rewards to others at the cost of self comfort. Further, facilitation is what leaders engage in and not controlling and directing.

Session 4: INSPIRING VISION

Session Overview

Inspiring or motivating others is a very important ingredient of leadership with a vision. Vision can be defined as the capacity to create effective plans for an organization's future based on a clear understanding of trends, uncertainties, risks, and rewards. Vision is the picture of the future we seek to create. It paints the picture of what we want to create. It becomes a living force only when people truly believe they can shape their future. Some might call it the art of developing strategy. But inspiring and building shared vision is actually only one piece of a larger activity: developing the "governing ideas" for the enterprise, its vision, purpose or mission, and core values. If a vision is not consistent with values that people live by day by day will not only fail to inspire genuine enthusiasm, it will often foster outright cynicism.

Highly effective leaders who have strength of vision will position their organizations to take advantage of the trends they are discerning. For example, in healthcare, visionary leaders may see new clinical and technological advances long before they are prevalent and may commit their organizations to adopt them as they become available. They can see the future clearly, anticipate large-scale and local changes that will affect the organization and its environment, are able to project the organization into the future and envision multiple potential scenarios or outcomes, have a broad way of looking at trends, and are able to design competitive strategies and plans based on future possibilities.

Exceptional visionary leaders have the capacity to identify the trends that make sense strategically and to adopt them early, before others copy them. Organizations who have visionary leaders tend to be

more successful. They are usually the first to market with new ideas and technology; as a result, they often have better profitability, which allows them to attract higher-quality physicians and, ultimately, better serve their communities. Although visioning is best thought of as an ongoing process, there is a definable sequence associated with that process. The quality of vision relies on a solid awareness and understanding of broad trends and their implications. From these, a vision slowly takes shape, tempered (but not stifled) by the critical thinking of the key people needed to pursue it and communicated to those needed to implement it. Highly effective leaders use necessary skills to accomplish each of these elements of the visioning process.

Learning objectives

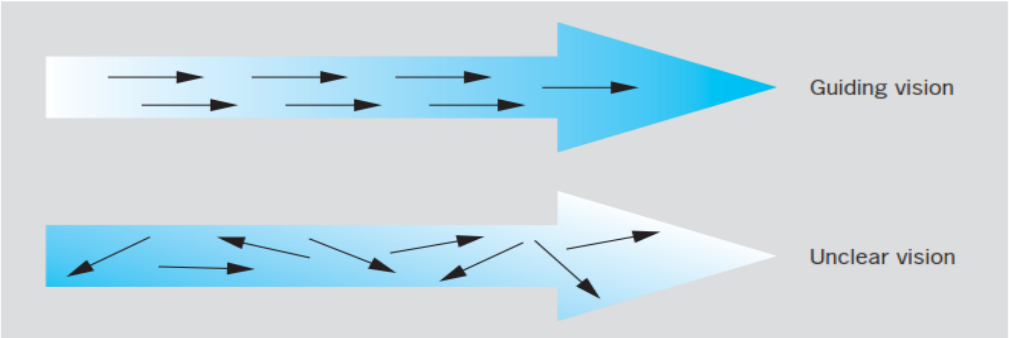
At the completion of studying this unit you should be able to:

- Define the concepts of inspiring and shared vision,
- Identify areas in which you can apply inspiring and shared vision in your organization
- State how inspiring and shared vision influence your day to day activities and achievements

Effective vision

A powerful vision is an essential starting point for empowerment because it helps people to make choices with an end result in mind. Vision is not the same as goals and objectives. It is a more idealized picture of what the organization, or your area of responsibility, might become. Remember the American civil right leader Martin Luther King Jr., he described his vision of a world where people live together in mutual respect. In his 'I Have a Dream' speech, he described a world where his children 'will not be judged by the color of their skin, but by the content of their character.' He created powerful and specific images from the values of brotherhood, respect, and freedom for all. His speech evoked vivid images and strong feelings. This is important because it is the pictures and feeling rather than the goal itself that infect people with energy and commitment.

Guiding vision is like a spear head directed towards one direction; while unclear vision is ambiguous and more confusing than guiding direction towards unified goal. There are plenty of examples of non-fruitful vision or which we can call 'lip service' vision or statements developed as promotional tools. They might be hung publicly in entrance lobbies and used with investors and customers, but in reality they do not summon any emotion or sense of commitment amongst those who work in the organization and do little to guide their actions.



According to Doherty and Hone, 2002, for a vision to be effective, it needs to be:

- ✓ Inspirational, clear and challenging
- ✓ Focused, providing a sense of purpose
- ✓ Future oriented
- ✓ Guiding, providing direction without removing freedom
- ✓ Enduring, providing a long term aim. It should stretch expectations and aspirations and encourage people to move out of their comfort zone.

Activity 4.1

1. State as many ideas as you could for earning five dollars by the end of daily work in your organization.
2. Explain any if any of the ideas presented so far could earn someone a million dollars.

When an organization is lacking vision, it can look like any of the following:

1. Focusing too much on tactical operations where control of day-to-day activities and "fires" take precedence over long-range planning. Long-term perspectives are not structured into regular operations.
2. Restricting focus to healthcare in which social and professional networks and information sources reside almost entirely within the healthcare industry, other potential areas of focus will be forgotten or there is little intellectual curiosity about broader trends or changes.
3. Relying on external counsel where the analytic work of others is heavily relied on, and conclusions are not questioned. The organization follows the leader and does whatever the other healthcare organizations are doing, with inadequate analysis as to whether it is appropriate or not.
4. Undervaluing divergent perspectives where staff go along with a vision simply because they want to stay on the leader's good side. Concerns and ideas about the future are not discussed.

In developing organizational vision it is advisable to involve key stakeholders and focus on key areas. Quinn (2002) suggests that a vision statement should cover three key areas:

- ✓ First is the case for change.
- ✓ Second is an ideal goal or goals – these are not as specific as to define the final outcomes but should paint a picture of the future.
- ✓ Third is a focus on people, both internal and external stakeholders, how the vision supports them and the role that they play.

Often vision is painted as the inspiration of a single heroic leader, the pathfinder, but it is rarely this way in practice. Generally speaking the more stakeholders buy into the vision, the more likely you are to achieve the outcomes you want, and so it's important to involve at least your more important stakeholders in the vision forming process. It comes down to ownership. Those stakeholders who feel that they have a stake in the vision will work harder to ensure that the outcomes are achieved.

Connecting people to vision

With the vision in place, you need to build a sense of commitment. People need to find meaning and a sense of purpose in the vision and this is exactly what effective leaders and managers enable people to do. This might be on a 1:1 basis or through a workshop or presentation. What is essential is that you paint a picture that is sufficiently vivid that it enables people to sense through their imagination what the future might look like. You are communicating the feelings that go with the vision with the intention of inspiring the same feelings in others.

Stories are an excellent tool for communicating with people, and are something that you can prepare in advance and practice until the words come naturally. Stories are powerful because they engage with people's feelings and help them to learn, absorb, remember and share information and ideas. They don't have to be long or funny, they just need to convey a message.

Leaders must engage various stakeholders to make them understand the rationale for change; leaders must, in essence, create a compelling call to action. To illustrate this point, consider this statement based on Greek history: When Pericles spoke, people said, "how well he speaks." But when Demosthenes spoke, they said, "let us march." Developing and using vision as an instrument of organizational change requires effective communication of that vision—turning a set of strategic and often complex concepts into a compelling "story" of where the organization is, where it will go, and how it is going to get there.

Communicating vision throughout any change process is essential to its success. At the same time, it is also incredibly challenging to effectively pull off. Most leaders routinely underestimate the amount of communication necessary to drive change efforts; as a result, many employees inevitably feel lost and confused in the change process and may stick even more closely to their old but familiar habits.

Communicating vision means that you distill complex strategies into a compelling call to march, inspire and help others see a core reason for the organization to make change, talk beyond the day-to-day tactical matters that face the organization, show confidence and optimism about the future state of the organization, and engage others to join in. Spending time communicating future vision also helps ensure that "everyone is on the same page." It aids in collaboration and enhances the coordination of work effort.

During connecting people to vision and communication in the realm of strategic vision it is important to be cautious not to fall short for any of the following reasons:

1. Lacking clarity, focus, or information where by a visual picture is not created either because it is unclear or it contains too many elements and lack of thought about how the vision sound far-fetched;
2. Lacking meaning for the audience that means the importance of individual roles is not adequately addressed; and
3. Communicating infrequently where by the vision is rolled out and then rarely referred to again.

Even though cautious approaches in connecting people to vision and communicating are well taken care of failure may come from ineffective communication. When your communication is ineffective, regardless of frequency, one of the following is most likely the cause:

1. Communicating vision as an "end" rather than a "means." That means communication is emphasized at the expense of implementation and time is spent talking about doing instead of actually doing.
2. Viewing vision as the "program du jour" which means motivation building rather than direction setting is the primary goal. So, visions change too frequently and are thought of as gimmick programs; and
3. Communicating too specifically and setting a timeline for the vision will eventually force the need to develop a new vision, then vision becomes something that can be proved or disproved.

Activity 4.2

Use this activity to reflect on the previous section and to think about your vision for your team and how you can help people to connect with it.

1. As a task write what is your vision for the future of your area? How does it fit with your organization's vision as a whole? How does it serve your stakeholders?
2. How well connected are people around you to the vision? How could you help them to be more connected?

Shared vision

When there is a genuine vision as opposed to the familiar "vision statement" which we observe in most of our organizations, people excel and learn, not because they are told to, but because they want to. Many organizational leaders have personal visions that never get translated into shared visions that galvanize the organization. Nowadays, "vision" is a familiar concept in leadership. But when you look carefully you

find that most "visions" are one person's or one group's vision imposed on an organization. Such visions, at best, command compliance—not commitment. The practice of shared vision involves the skills of unearthing shared "pictures of the future" that foster genuine commitment and enrollment rather than compliance.

A shared vision is a vision that many people are truly committed to, because it reflects their own personal vision. A shared vision is not an idea. It is not even an important idea such as freedom. It is, rather, a force in people's hearts, a force of impressive power. It may be inspired by an idea, but once it goes further and if it is compelling enough to acquire the support of more than one person then it is no longer an abstraction. It is palpable. People begin to see it as if it exists. Shared visions emerge from personal visions. This is how they derive their energy and how they foster commitment. Organizations intent on building shared visions continually encourage members to develop their personal visions.

If people don't have their own vision, all they can do is "sign up" for someone else's. The result is compliance, never commitment. On the other hand, people with a strong sense of personal direction can join together to create a powerful synergy toward what all truly want. When more people come to share a common vision, the vision may not change fundamentally. But it becomes more alive, more real in the sense of a mental reality that people can truly imagine achieving.

The first step in mastering the discipline of building shared visions is to give up traditional notions that visions are always announced from an organization's institutionalized planning processes. In the traditional hierarchical organization, no one question that the vision emanated from the top. Often, the big picture guiding the organization is not even shared rather people needed to know where their "marching orders," so that they could carry out their tasks in support of the larger vision. In the process leaders learn the counter productiveness of trying to dictate a vision, no matter how heartfelt and may master the discipline of shared vision.

Similarly sometimes, managers expect shared visions to emerge from an organization's strategic planning process. But for all the same reasons that most "top-down" visioning processes fail, most strategic planning also fails to nurture genuine vision. This is not to say that visions cannot emanate from the top. Often, they do. But sometimes they emanate from personal visions of individuals who are not in positions of authority. Sometimes they just "bubble up" from people interacting at many levels. The origin of the vision is much less important than the process whereby it comes to be shared. Building shared vision must be seen as a central element of the daily work of leaders. It is ongoing and never-ending.

Session 5: SYSTEMS THINKING

Session Overview

A system is a collection of components that work together to achieve a common objective and systems thinking is the ability to look for invisible connections between seemingly isolated components or events and to understand the patterns of those events. Understanding these invisible connections helps to anticipate not just the intended consequences of a change but also possible unintended consequences.

Systems thinking help you how you can see the dynamics, interconnections and deeper patterns of systems and see beyond isolated events. Researches from various scientific disciplines recognize that all things and events, and the experience of them, are parts of larger wholes. This does not deny the importance of the individual elementary parts or events. But the focus shifts from the parts to the wholes, namely to the systems to which the parts belong. This gave rise to a new way of thinking that is systems thinking. In systems thinking something to be explained is viewed as part of a larger whole, a system, and is explained in terms of its role in that system.

Systems thinking gained popularity in relation to the concepts of learning organizations. A learning organization is one that continually expands its capacity to create its own future. For this creation of the future five disciplines are necessary. These disciplines are systems thinking, mental models, shared vision, personal mastery and team learning. Systemic thinking is the discipline that binds together all the other disciplines as one. In addition to these disciplines another discipline which is important for the creation of an organization's future is a leadership's emotional intelligence.

In recent years the health system started to adopt systems thinking to effectively and creatively solve health problems of complex nature such as obesity, tuberculosis, tobacco control and HIV/AIDS. This new mode of thought has immediate consequences for decision making within a systems context, namely that for effective action in terms of the system as a whole it may not be sufficient to use reductionist and cause-and-effect thinking by studying the individual parts or aspects in isolation. In order to get a true picture, it is essential to study their role in the system. In this unit the disciplines of systems thinking, mental models, shared vision and emotional intelligence are introduced for you believing that they will have much greater impact in your work life and role in your organization.

Learning objectives

At the completion of studying this sessionyou should be able to:

- Define the concepts of systems thinking,
- Identify areas in which you can apply systems thinking in your organization
- State how systems thinking influence your day to day activities and achievements

Essentials of systems thinking

Essential features of systems thinking include the legitimacy of holism as opposed to reductionism. Reductionism may be considered as the process of simplifying the complex to define a specific event or experiment and provide a minimum explanation and analysis of a problem, component by component. Within the concept of reductionism the whole is nothing more than the sum of its parts whereas within the concept of systems thinking the whole is greater than the sum of its parts. The sum produces emergent properties. The concept of emergent properties is the notion that a system will display at least one emergent property that none of its constituent parts can display individually. A simple example of is a bicycle. A bicycle is made up of a number of different systems: the gear system, the braking system, the transmission system, etc. Each of these systems has an emergent property associated with its purpose. Depressing the brake lever will cause the brake blocks to close on the wheel rim and stop the wheel turning. None of these systems has the emergent property of the bicycle which is the whole system, which is a machine that enables a human being to travel from place A to place B.

Besides to the essential concept of emergence there is the concept of hierarchy in systems thinking. Hierarchy is the concept of systems within systems. The Earth is a system within the Solar System, within the Milky Way, within the Universe. Within the Earth, the human being is a system. Within a human being are the respiratory, circulatory, integumentary and other systems. Within these systems are the systems of molecules, and within these, systems of atoms. Hierarchy in a systems sense does not imply ranking. It is simply an order of connectivity between systems.

Unlike systems thinking which tries to define how we can see the dynamics, interconnections and deeper patterns of systems and beyond isolated events, non-systems thinking- reductionism, which is the usual approach, looks at the parts in order to try to understand the whole. However, this does not imply that we should discard reductionist and cause-and-effect thinking in favor of systems thinking. Both approaches are in fact complementary. We cannot conceive of parts if there is no system to which they belong, nor can we talk of a whole unless there are constitutive elements that make up the whole.

Reductionism gives attention to the details of each component, while systems thinking give attention to their systemic role in the system. More often than not, both modes of thinking are needed to gain a fuller understanding of a system. When we emphasis one, the other is implied. They are like the object and its shadow. But it is crucial that systems are governed by a feedback loop. Change in one part of the system causes a change in the second part of the system. Their being self-organizing, constantly changing, tightly liked and networked with interdependence and underlying infrastructure of knowledge are unique elements of system thinking.

Common characteristics of a system

From the above discussion we can cite the following characteristics of a system:

1. A system is an organized assembly of components. 'Organized' means that there exist special relationships or connections between the components. These connections are hierarchies of the system.
2. The system does something, i.e. it exhibits behaviors that are unique to the system. These behaviors are emergent properties of the system.
3. Each component contributes towards the behavior of the system and its own behavior is affected by being in the system. No component has an independent effect on the system. A part that has an independent effect and is not affected by the system is an input. The behavior of the system is changed if any component is removed or leaves.
4. Groups of components within the system may by themselves have properties (1), (2), and (3), i.e. they may form subsystems.
5. The system has an outside an environment which provides inputs into the system and receives outputs from the system.
6. The system has been identified by someone to be of special interest for a given purpose.

Systems thinking in healthcare

In the introduction section of this module systems thinking is defined as an approach to problem solving that views problems or events as part of a wider, dynamic system. Systems' thinking involves much more than a reaction to present outcomes or events. It demands a deeper understanding of the linkages, relationships, interactions and behaviors among the elements that characterize the entire system. One of the systems in our environment is the health system in which we are working in. A health system according to the World Health Organization is a system which consists of organizations, people and actions whose primary intent is to promote, restore or maintain health. Understanding relationships of these elements of the health system requires systems thinking.

Innovative leadership and management using systems thinking in the health sector shifts the focus to:

1. The nature of the relationship among the elements or building blocks of the system
2. The space between the elements or the building blocks and understanding what happens in that space
3. The synergies emerging from interactions among the elements of the system. Applying systems thinking in the health sector and focusing on the nature of the relationship among the elements, space between the elements and emerging synergies can accelerate realistic understanding of what works or doesn't work and under what circumstances.

Activity 5.1
Think of your healthcare organization and visualize the internal and external environment. From your visualization focus only in the internal environment and list elements or building blocks of your organization which makes it capable of functioning as a system.
1) What does their dynamic interaction and interconnectedness look like? Put the dynamic interaction and interconnectedness in a graph.

The Benefits of Systems Thinking

Systemic thinking may empower people by enabling them to begin to appreciate rather than be confused by the interrelated nature of the world and how this might cast insights into their experiences. Systems' thinking has a number of far-reaching benefits, providing you with an overall framework for making sense out of life's complexities and its many systems. This framework allows you to detect patterns and relationships between systems, and between systems and their levels, leading to better problem solving. It takes a forest thinking approach which enables you to believe that knowing something requires understanding the context of relationship unlike the tree-by-tree thinking approach which believes that knowing something means focusing on the details.

It is a clearer way to see and understand what is going on in any organization or any system and its environment. Complex problems become easier to understand, as do the interrelationships of parts and multiple cause-and-effect cycles. It views causality as an ongoing process, not a onetime event, with effect feeding back to influence the causes and the causes affecting each other. It avoids straight line thinking which views causality as running in one direction, ignoring the interdependence and interactions between and among causes.

Having a view of the dynamic interactions and relationships of a system's elements and the collision of the system with other systems; you can thus make better decisions, with a clearer understanding of the consequences of your action. In this dynamic thinking of systems you will be able to frame a problem in terms of a pattern of behavior over time rather than focusing on a particular event as in static thinking. It provides you a way to manage complex systems by focusing on the whole, its components, and the

interrelationships of the components, rather than by focusing on supposedly isolated and independent parts and problems. This is an approach of systems as a cause thinking rather than system as effect thinking. Systems thinking approach as a cause thinking places responsibility for a behavior on internal actors who manage the policies and plumbing of the system. On the other hand the usual approach –system as effect thinking- views behavior generated by a system as driven by external forces.

Additionally it provide you a way to learn new things more easily, a better approach for integrating new ideas within the systems context and a new and better way to create strategies, problem solving, and find leverage points—keeping the outcome, vision and goal of your organization in mind at all times. Systems' thinking is a way to engage teams and people in a deeper thought process, analysis, and definition of root causes, thus leading to longer-lasting results. It enables groups to generate multiple choices and different solutions, rather than just quick-fix answers, when working with difficult problems. Systems thinking is a method for getting at the deeper structure and relationship of process issues—things that are missed by the "quick-fix" mentality. Therefore generally, it provides you a common framework and model for thinking and communicating, so people in your organization can work together better to make positive change in any system and achieve the desired outcomes.

Activity 5.2

1. List healthcare interventions or administrative measures in your work area with system wide effects
2. Mention some system level interventions with an effect on other systems

In summary being a systems thinker you need to have systems thinking skills which refer to the whole system and the interaction of its parts. This is a critical skill for you as a manager, leader or policymakers. Being a systems thinker you are also responsible for designing effective systems and processes that enable people to carry out their work effectively. Process skills are one subset of system skills: understanding that how you do something has an effect on the results.

Seeing the systems can help you understand better how the organizational culture and work climate affect performance and how features of the management systems and external environment shape staff attitudes and motivation.

Session 6: MENTAL MODEL

Session Overview

Mental models are deeply ingrained assumptions or generalizations that influence how we understand the world and how we take action. They are deep-seated in us, as tendencies and predispositions, pictures or images that we seldom pay attention to them. Any mindset consists of mental models, or concepts, that influence interpretation of situations and predispose to certain responses. They are conceptual structures in the mind that drive cognitive processes of understanding. Mental models influence people's actions because they mold people's appreciation of what they see. People therefore observe selectively. Mental models most often invisibly define our relationship with each other and with the world in which we find ourselves. Very often, we are not consciously aware of our mental models or the effects they have on our behavior. These models, which are full of beliefs and assumptions strongly, determine the way we understand the world and act in it.

Learning objectives

At the completion of studying this unit you should be able to:

- Define the concepts of mental model,
- Identify areas in which you can apply mental model in your organization
- State how mental model influence your day to day activities and achievements

Importance of Mental Models

Why are mental models so powerful in affecting what we think and do? In part, because they affect what we see.Two people with different mental models can observe the same event and describe it differently, because they have looked at different details. When you and I walk into a crowded outpatient department, we both take in the same basic sensory data, but we pick out different faces. As psychologists say, we observe selectively. The way mental models shape our perceptions is no less important in management. They are very important to know how others in an organization understand and interpret managerial actions and do things in a different way.

The problems with mental models lie not in whether they are right or wrong—by definition, all models are simplifications. The problems with mental models arise when the models are tacit—when they exist below the level of awareness. So the discipline of working with mental models starts with turning the mirror inward; learning to unearth our internal pictures of the world, to bring them to the

surface and hold them rigorously to scrutiny. It also includes the ability to carry on learning meaningful conversations that balance inquiry and advocacy, where people expose their own thinking effectively and make that thinking open to the influence of others. Therefore, the objective of working with mental models is to focus on the openness needed to unearth shortcomings in our present ways of seeing the world. Managers must learn to reflect on their current mental models until prevailing assumptions are brought into the open. Mental models can be simple generalizations such as "people are untrustworthy," or they can be complex theories, such as assumptions about why members of an organization interact as they do. But what is most important to grasp is that mental models are active—they shape how we act. If we believe people are untrustworthy, we act differently from the way we would if we believed they were trustworthy.

Developing managerial and an organization's capacity to work with mental models involves both learning new skills and implementing institutional innovations that help bring these skills into regular practice. Institutionalizing reflection and surfacing mental models require mechanisms that make these practices unavoidable. Two approaches that have emerged to date involve recasting traditional planning as learning and establishing "internal boards of directors" to bring senior management and local management together regularly to challenge and expand the thinking behind local decision making. Strategic managerial leadership exercising the discipline of mental models aims to train people to appreciate that mental models do indeed occupy their minds and shape their actions. People need to discover mental models currently at work that shape their patterns of reasoning. They must learn to manage them. This will involve developing skills of inquiry, for example, bringing assumptions of mental models to the surface and testing advocacy with inquiry.

Activity 6.1
What do you think the top three priorities of action to the functionality of the healthcare system in reducing maternal mortality in Ethiopia?

Forces influencing mental models

Different forces or influencing factors can shape our mental models. Cultural, political, social and economic forces are just few to mention. Cultural forces shape people's cognitive processes. That is, they influence mental models that people share and often employ without knowing. Cultural forces are an extremely potent, albeit invisible, form of control system. Political, social and economic forces may enter the process of decision-making or determine how we act. On the other hand systems thinking which consider these forces are equally important to working with mental models effectively. Contemporary research shows that most of our mental models are systematically flawed. They miss critical feedback

relationships, misjudge time delays, and often focus on variables that are visible or salient, not necessarily high leverage.

Another force which influences mental models is system structure. Systemic structure is the domain of systems thinking and mental models. At the structural level, leaders must continually help people see the big picture: how different parts of the organization interact, how different situations parallel one another because of common underlying structures, how local actions have longer-term and broader impacts than local actors often realize, and why certain operating policies are needed for the system as a whole. Thus methods for reflection and inquiry are considered central to the discipline of mental models. Systemic thinking helps further by testing if mental models are systemically flawed in the sense that they neglect critical feedback or delay, or miss points of high leverage. It helps to expose assumptions mental models are making about the dynamic nature of reality and to evaluate the validity of the assumptions. The aim is to better understand and indeed to improve our mental models of the world, for the betterment of work life and high achievement. By capturing chains of cause-and-effect relationships in a causal loop diagram, systems thinking makes explicit our mental models, our fundamental beliefs about how the world works, the fundamental beliefs that underpin our decisions and our actions. This in turn enables our own mental models to be compared to the mental models of our colleagues, so providing a better basis for high-performing teams.

Activity 6.2

1. Different explanations are given for poor achievement of healthcare systems in most developing countries. One prominent root cause is believed to be availability of adequate resources. Do you think this is plausible explanation? Use the concept of mental models to justify your answer.
2. Similarly at the household level there are factors which influence household health production function, and household members may act in unison or in a certain way for the sake of their good health. What do you think will determine household decision making during illness?

Ways of Improving Mental Models

Mental models may empower people by educating them through discussion and dialogue where different views are presented and defended in a search for a best view to support a decision that must be made. Thus, some mental models will be suspended and other models may become common big picture for a shared vision and organizational objective.

Differences expressed in discussions and dialogue are important, because they underpin our attitudes and our actions, and one of the games we all play is to second-guess how our colleagues will react in any particular situation. If you are discussing budget in reducing maternal mortality, for example, someone who sincerely and passionately believes that improving infrastructure such as building roads is the single most powerful way of reducing maternal mortality will argue vociferously to increase the infrastructure budget; someone else, who holds the equally valid, but different, belief that the best way to decrease maternal mortality is to increase access and build more healthcare facilities and ensure they are equipped with necessary resources, will argue equally strongly to allocate the funds to build more healthcare facilities.

In principle these two beliefs are irreconcilable, since they are based on totally different concepts of how the world behaves. The advocate of infrastructure believes the strongest driver of maternal mortality is unavailability of well-constructed roads; the advocate of building healthcare facilities thinks availability and accessibility of resources is the strongest driver of maternal mortality. These two people have different views—different mental models—regarding the cause-and-effect relationships underpinning how best to reduce maternal mortality and, as a result, they would draw different structures in a causal loop diagram seeking to capture that particular "reality.

Mental models are fundamental drivers of behavior. If we wish to understand and appreciate the behavior of others, we need to understand and appreciate their mental models; and, by the same token, if others are to understand and appreciate us, they have to understand and appreciate our mental models. If managers believe their world views are facts rather than sets of assumptions, they will not be open to challenging those world views. If they lack skills in inquiring into their and others' ways of thinking, they will be limited in experimenting collaboratively with new ways of thinking.

Moreover, if there is no established philosophy and understanding of mental models in an organization, people will misperceive the purpose of systems thinking. Deep within the mental models of managers in many organizations is the belief that managers must know what's going on. It is simply unacceptable for managers to act as though they do not know what is causing a problem. Those that reach senior positions are masters at appearing to know what is going on, and those intent on reaching such positions learn early on to develop an air of confident knowledge.

In general mental models run very deep. They underpin our actions, behavior, and choices. The extent to which mental models naturally overlap determines whether or not a group of people is merely a group of people or a high performing team. Causal loop diagrams make mental models explicit and one of the

most powerful ways of building a team is to compile a shared mental model, one to which all the members of the team say, "Yes, I see the world that way too."

Since purposes emanate from the human mind, attention also has to be given to the different mental models that people bring to their roles. These mental models are made up, in each case, of a mix of the understanding and values that individuals have gathered through their experiences and education. The facts and values that they use in interpreting the world can perhaps themselves be understood in systems terms. The discipline of managing mental models requires organizations continually to question the taken-for-granted assumptions that underpin the world views governing their current behavior. Shared vision requires unearthing visions of the future that inspire consensus and commitment.

Session 7: EMOTIONAL INTELLIGENCE

Session overview

Understanding and working with other people's emotions while understanding and managing your own emotional responses requires emotional intelligence. That is why as a leader you need to develop the skills besides to systems thinking, mental models and inspiring vision. The most effective leaders have a deeper understanding of their emotions. Possessing emotional intelligence means you recognize personal strengths and weaknesses; see the linkages between feelings and behaviors; manage impulsive feelings and distressing emotions; are attentive to emotional cues; show sensitivity and respect for others; challenge bias and intolerance; collaborate and share; are an open communicator; and can handle conflict, difficult people, and tense situations effectively.

Learning objective

At the completion of studying this unit you should be able to:

- Define the concepts of emotional intelligence ,
- Identify areas in which you can apply emotional intelligence in your organization
- State how emotional intelligence influence your day to day activities and achievements

Leadership and Emotional Intelligence

Highly effective leaders regularly find themselves in circumstances where emotions run hot. Unlike being burn out this time is an opportunity because an emotional charge can be a productive energy

source, and emotional intelligence can spell the difference between putting this energy to good use and watching it burn out of control.

We can easily understand this concept by conceptualizing these circumstances in terms of polarities we all face in leadership roles. In each polarity, the optimal approach will involve a balance. Our effectiveness in achieving that balance will be determined by the combination of two forces: (1) our natural orientation toward others and (2) our ability to tweak that orientation. This combination is sometimes called our emotional Quotient (EQ).

In terms of these forces highly effective leaders tend to achieve the most optimal balance between leadership's most critical polarities, a few of which are briefly described below. When a leader's emotional intelligence is not as strong as it could be, a leader may be described in the following ways:

1. Lacking concern for others by which individual needs of others are not recognized and self-absorption prevents the leader from respecting others.
2. Needing approval in which approval rather than personal conviction drives action.
3. Being volatile where staff cannot predict what will set off their leader. In such situations emotions are in control of the leader rather than the leader being in control of his or her emotions.
4. Mistrusting others which demands that everything has to go through the leader before anything can get done. In this type of emotional intelligence weakness work is not delegated, and staff is not empowered.

On the other hand if a leader overuses this competency, it can result in the following problems:

1. Getting by on one's good graces which means formidable social networks prevent performance problems from being addressed and underperformance is often overlooked and rarely confronted.
2. Overextending the emotional role resulting in contribution as a facilitator, negotiator, or interpersonal problem solver becomes oversubscribed. So, direct reports are not encouraged to work through their own challenges or develop their own emotional intelligence.
3. Avoiding non-interpersonal aspects of work in which social aspects of the role are overemphasized. The less people-focused, more "mundane," but still critical aspects of the role are neglected.

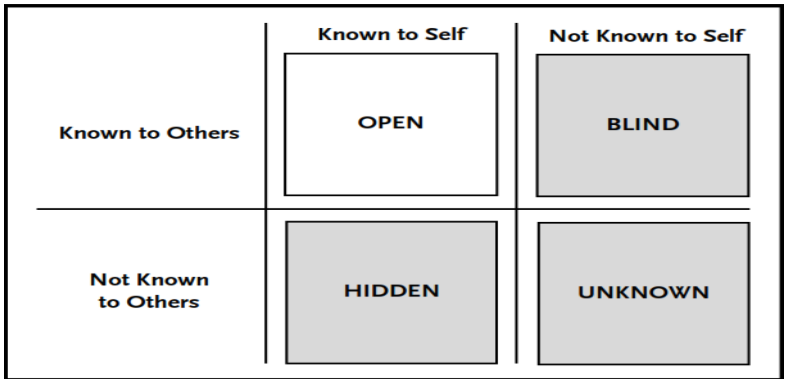
Therefore, to achieve the best balance and the best way to improve your EQ is to improve the quality of the feedback you receive about yourself and your relationships. This is self-awareness. The opposite of self-awareness is blind spots, and we all have them to a greater or lesser degree. The only way to surface these blind spots is to receive feedback about them and to be willing to

internalize what that feedback means. You can improve the quality of the feedback you receive in a variety of ways. These ways are:

1. Developing more structured ways of getting feedback (e.g., use of 360-degree programs, ask subordinates to provide input to third parties about how they feel about you).
2. Improving your ability to "hear" feedback (e.g., work with a facilitator or a coach).
3. Creating a climate which is more conducive to feedback (e.g., conduct staff training or build feedback reviews into the ongoing work that you do).

The Johari Window

A usual suggestion in developing emotional intelligence that has been used in literature on this topic the Johari Window. This concept helps leaders better identify blind spots and develop ways to address them.



The Johari Window

The Johari Window, which was named after the first names of its inventors, Joseph Luft and Harry Ingham from Westinghouse, describes the process of human interaction. A four-paned "window" divides awareness into four quadrants: open, hidden, blind, and unknown. The lines dividing the four panes can move as awareness changes.

The four quadrants represent the following:

- ✓ The open section represents things that you know about yourself and that others know about you. The knowledge that this window represents includes factual information, feelings, wants, needs, and desires. As you continue to get to know people, the sections move to place more information into the open window.
- ✓ The blind section represents things that others know about you but that you are unaware of. Blind spots can affect the level of trust between individuals; the challenge here is to get this information out in the open because people may not be willing to share with for some reason.

- ✓ The hidden section represents things that you know about yourself but that others do not know. With higher EQ comes a more refined understanding of what you should keep hidden and what you should disclose to build trust with others.
- ✓ The unknown section represents things that neither you nor others know about you. Growing in this area is the most sensitive but often the most helpful for higher-level leadership growth.

Developing emotional intelligence

The Johari window model is a successful tool for self-management. It is a useful tool for self-understanding, awareness, and personal growth. It can be used to identify your strengths, blind spots and areas for improvement. The goal of the model is to expand the open area as large as possible and the easiest way to expand this areas is to move into the hidden area which can be done through self-disclosure. Expanding the open area to the blind area is another way of increasing the open area it involves asking for and receiving constructive feedback. Self- disclosure and receiving constructive feedback will provide you with shared knowledge that will make you able to move more and more into the unknown area. Greater trust, feedback and sharing information continues to enlarge the open area which is crucial for self-management and emotional intelligence.

The first step in gaining emotional intelligence is developing self-awareness. Self-awareness entails paying attention to one's inner state and includes attention both to our moods and thoughts about our moods. Self-awareness contributes to emotional intelligence because it allows individuals effectively to turn that self-awareness into actions that translate into positive self- and social management.

Self-management requires that we have an understanding of what factors contribute to our behavior. Both intellectual capacity and emotions contribute to how we act toward and interact with others. Much of the time spent in formal academic experiences focuses on developing intellectual capacity, which leads to such skills as knowledge synthesis and critical thinking. Little attention is paid to developing emotional intelligence. Research has demonstrated that intellectual capacity alone cannot account for success and goal achievement.

Emotional intelligence has been identified and described as at least as important as intellectual capacity in managing life's journey. Intellectual capacity and emotional intelligence provide two fundamentally different ways of knowing and learning about the world. The emotional and rational minds are semi-independent parts that have physiological and neural connections to each other. The

emotional and rational minds are distinguished in folklore as the dichotomy between "heart" and "mind."

Enhancing our emotional intelligence can have many benefits in the work environment because emotional intelligence is a key component to being a successful professional. An employee who is attuned to the feelings of others and is able to handle disagreements so they do not escalate is recognized as a valuable asset. Emotional reactions and feelings are very complex, and there can be many reasons for these feelings.

Activity 7.1

1. To what extent are you aware of your emotions? To what extent do you understand rationally why you react the way you do?
2. Do you see the linkage between your emotions/feelings and your behavior?
3. To what extent can you manage your emotions? Can you control anger? Can you focus frustration? How effective are you at engaging others even when you are upset, mad, or irate?
4. To what extent would you describe yourself as open, approachable, and sincere?

Session 8: CONCEPTS OF STRATEGIC LEADERSHIP

Learning objectives:

Upon completion of this unit, you will be able to:

- Describethe concepts of strategy, elements of strategy and strategic leadership
- Differentiate between leadership and strategic leadership
- Describe the strategic leadership tasks,
- Understand the concept ofstrategic learning,
- Discuss the elements of strategic learningprocess(i.e., strategic thinking, strategy influencing, andstrategic acting),
- Describe the concept and principles of work process redesign.

Session Overview

In this session you will learn about the basic concepts underlying a strategy and its elements; the conceptual difference between leadership and strategic leadership; and strategic leadership tasks. The session also provides you the concept elements of strategic learning process; and work process redesign.

1. Strategy

Strategy involves a series of choices which links purpose and action. It is a comprehensive plan stating how the organization will achieve its mission and objectives and it maximizes competitive advantage and minimizes competitive disadvantage. If an organization's strategy does result in superior performance, it is said to have a competitive advantage (the advantage over rivals achieved when an organization's profitability is greater than the average profitability of all firms in its industry.

2. Elements of a strategy

The first element of strategy is ***strategic intent***, which is characterized as the fit model of strategy making. This is because it attempts to achieve a fit between the internal resources and capabilities of an organization and external opportunities and threats in the industry environment. It is an obsession or ambition of achieving sustained success over long period (10-20 years) at all levels of an organization. Thus, underlying the concept of strategic intent is the notion that strategy should be based on setting an ambitious vision and goals that stretch an organization and then finding ways to build the resources and capabilities necessary to attain the vision and goals.

The second element is the organization's ***strategic opportunity***that is identified through the analysis of its external operating environment. It requires an assessment of the competitive structure of the organization's industry, including its competitive position and its major rivals. It also requires analysis of the nature, stage, dynamics, and history of the industry or sector.

The third element is ***systematic action*** which involves internal analysis to pinpoint organizational strengths that lead to superior performance. This component focuses on such issues as identifying the quantity and quality of a company's resources and capabilities and ways of building unique skills. The central purpose of systematic action is to identify the strategies that will create an organization's-specific business model that will best align, fit, or match an organization's resources and capabilities to the demands of the environment in which it operates.

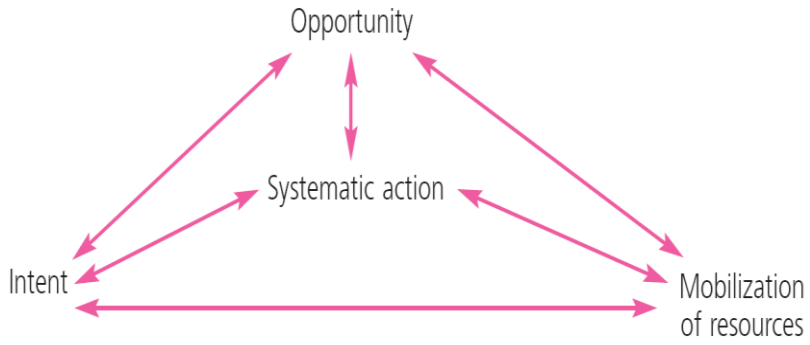
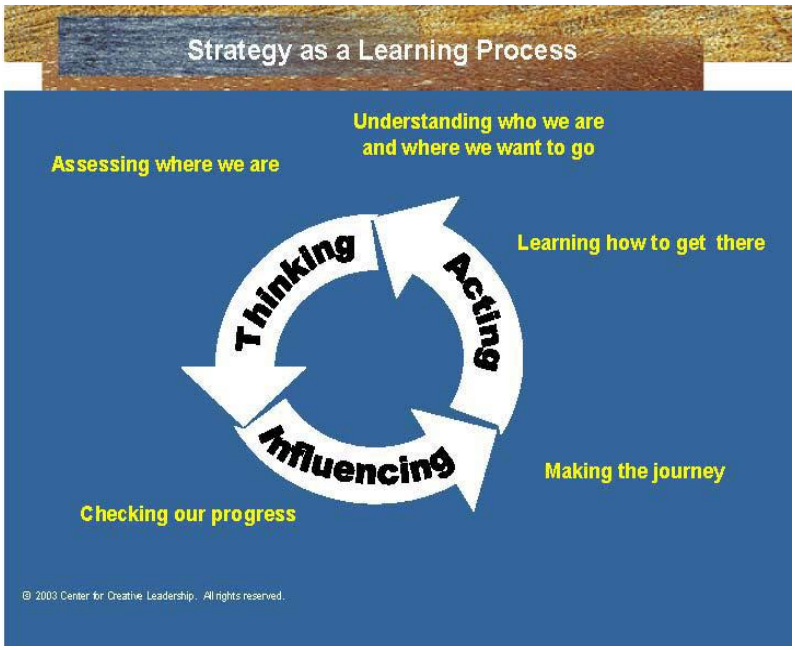


Figure10: Elements of strategy, adapted from Charles W. et al (2009).

3. Strategic learning process

For organizations to develop sustainable competitive advantage, it's important to have great individual strategic thinkers and individuals who influence one another's thinking, deepening and enhancing their collective understanding and insight. Strategic learning is about strategic leadership and the process involves strategic thinking, strategic influencing and strategic acting strategic leadership. Strategic thinking and strategic acting have a close connection to one another and to strategic influencing.



Assessing where we are refers to the process of collecting relevant information and making sense of the organization's competitive environment. The kind of understanding of strategy that develops within organizations is significantly affected by how managers influence each other's perceptions of the strategic situation," so effective influence here clearly has implications for the organization. Consider, for example, the task of doing a SWOT analysis.

To the extent that the group doing that analysis is open with one another and members feel free to look at strengths and weaknesses honestly, the SWOT might or might not be productive. How unfortunate it can be for the organization if one of the leaders in the group has a critical strategic perspective but cannot influence the rest of the group to see that point of view.

Understanding who we are and where we want to go refers to the aspirational dimension of organizational strategy, including the organization's vision, mission, and core values. The purpose of this element is to identify and hold true to a purpose for the organization. Influencing a change in the mission, vision, or values of the organization is quite difficult, as these elements define the identity, or the core, of the organization.

Learning how to get there involves understanding and formulating the critical elements of strategy. In the strategy process, organizations must also engage in learning how to get there through an exploration of their strategic drivers, and by setting business and leadership strategies to satisfy those drivers. Influence here must be in the context of collaborative learning to co-develop deeper business insight—that is, to make common sense. Strategic leaders need to balance their influence attempts with their own openness to accepting influence.

Making the journey involves making sure people understand the strategy and how their work fits into it; translating the strategy into action by identifying and implementing tactics. It also involves keeping people on track when potential distractions arise, whether those distractions are external to the organization (for example, a move by a competitor) or internal to the organization (for example, a downsizing).During this phase of the strategy process, the strategic leader typically emphasizes efforts to build and sustain momentum.

Checking our progress is the continuing assessment of effectiveness. Consider the influencing power of various measures in your own organization. What key measures do you track? How were they chosen? In what ways are they (or aren't they) aligned with your strategy? As organizations and strategic leaders strive to accomplish the checking our progress step, they must pay careful attention to ensure that they are using the few best measures possible.

The concepts of strategic leadership, thinking, acting, and influencing are discussed indetailbelow.

Strategic leadership is *thinking*, *acting*, and *influencing* in ways that promote the sustainable competitive advantage of an organization. It is the ability to anticipate and envision the future, maintain flexibility, think strategically, and initiate changes that will create a competitive advantage for the organization in the future. Activities often associated with strategic leadership include making strategic decisions; creating and communicating a vision of the future; developing key competencies

and capabilities; developing organizational structures, processes, and controls; managing multiple constituencies; selecting and developing the next generation of leaders; sustaining an effective organizational culture; and infusing ethical value systems into an organization's culture.

The essence of strategic leadership involves the ability to learn, the ability to change, and managerial wisdom, which includes social intelligence and the ability to take the right action at the right time. Without strategies, vision is a dream. Leadership and vision are focused on end results, and organizational strategies can provide a road map for reaching them. Strategic leadership, in this sense, is largely the use of a comprehensive strategic planning process. There can be a leadership dimension to this as well, using participative approaches to leadership by involving staff in the strategic planning process.

*What is the difference between 'leadership' and 'strategic leadership'?*When discussing sustainable competitive advantage as the focus of strategic leadership, you may ask, 'Isn't that just leadership?' 'If you are a good leader, why aren't you by definition, a good strategic leader?' There are important differences between the two. Strategic leadership is exerted when the decisions and actions of leaders have strategic implications for the organization, meaning: strategic leadership is broad in scope; its impact is felt over long periods of time; and it often involves significant organizational change than just leadership.

Strategic Thinking: Formulates effective strategies that take into account the external influences on an organization from a national and global perspective. It examines policy issues and strategic planning with a long-term perspective leading to a compelling organizational vision. It also determines objectives, sets priorities and builds upon strengths; and anticipates potential threats or opportunities.Strategic thinking deals with convergent problems (those with one solution) and divergent problems (those with a number of possible solutions). Strategy demands from the strategist(s) creativity (lateral thinking), often applied to divergent problems; and rationality (vertical thinking), often applied to convergent problems.

Since, you might not have had much opportunity to practice or observe certain kinds of strategic thinking at work; you can get an idea about that by just scanning the two groups of words in the following table to see whether one set captures the typical kind of strategic thinking in your organization more than the other.

Table 10: Words of thought process

Traditional strategic thinking words	Contemporary mode strategic thinking words
Observe	Reflect
Compare	Connect
Test	Create
Data	Pattern
Discuss	Visualize
Plan	Illustrate
Identify	Brainstorm
Assess	Represent
Define	Imagine
Outline	Demonstrate
Analyse	Synthesize
Classify	Associate
Manage	Integrate
Evaluate	Simulate

Source: Richard L.H. and Katherine C.B. (2005).

If you are like most managers, the set on the left is more characteristic of the kinds of thinking words people in your organization are accustomed to using. Nonetheless, both kinds of thinking competencies are required of strategic leaders today. The rest of this chapter is about developing these less developed competencies.

Developing strategic thinking competencies

Activity 8.1

- Reflect back to your work and identify what aspects of strategy are most challenging as a learning process, which are most helpful for leaders to understand and learn to apply. (What are the specific strategic thinking competencies that challenge your strategic leadership?)
- List the responses on the flip chart and discuss.

1. Scanning

Though the strategic learning process can actually begin anywhere, it typically begins with assessing where the organization is.

This involves examining the organization's current strategic situation, and it includes an analysis of the opportunities and threats in the industry as well as the strengths and weaknesses inside the organization. This is commonly called a SWOT analysis; the acronym stands for strengths, weaknesses, opportunities, and threats. A more detailed description of a SWOT analysis is presented in the next unit.

For the individual leader, scanning as a strategic thinking competency involves attending to the informational horizon beyond one's own job, team, division, function, company, or even industry. Unlike an organizational SWOT analysis, which tends to be relatively systematic, individual scanning is apt to be quite nonlinear. The point is to be looking all around, to be vigilant for potentially useful information anywhere. Good strategic thinkers scan their environments for data, trends, or ideas that could potentially have significance for their organization's future competitiveness.

Application of SWOT analysis tool for scanning

A SWOT analysis is a useful starting point for situation analysis. It enables you to analyze both the internal and external environment of your organization. Identifying strengths and weaknesses is the first step of- a SWOT analysis identifies strengths and weaknesses that are internal to a system and opportunities and threats from the external environment. The following table describes each quadrant of the SWOT tool.

Table 11: Description of a SWOT analysis

	STRENGTHS	**WEAKNESSES**
INTERNAL	• Strengths are elements of the health system that work well, contributing to the achievement of system objectives and thereby to good system performance. • Examples are the existence of training programs to improve human resource capacity or strong facility-level data collection and reporting capacity. • Recommendations should build on the strengths of the system.	• Weaknesses are attributes of the health system that prevent achievement of system objectives and hinder good system performance. • Examples are lack of public health sector partnerships with the private sector, health worker dissatisfaction with salaries, or extensive staff turnover. • Recommendations should suggest how to resolve system weaknesses.

	OPPORTUNITIES	THREATS
EXTERNAL	• Opportunities are conditions external to the health system that can facilitate the achievement of system objectives. • Examples are planned increases in donor funding or the existence of a vibrant private health sector with which to form partnerships. • These factors can be leveraged when planning interventions.	• Threats are external conditions that can hinder achievement of health system objectives. • Examples are inadequate budget allocations to health or a currency devaluation that will depress health worker income. • Recommendations should suggest how to overcome these threats.

Source: (Health Systems 20/20, 2012)

2. *Visioning*is one of the competencies required forstrategicthinking(refer to unit 4).

3. *Reframing (Focusing)*

Reframing involves the ability to see things differently, including new ways of thinking about an organization's strategic challenges and basic capabilities. It involves questioning or restating the implicit beliefs and assumptions that are often taken for granted by organization members. It plays a critical role in the formative phases of the strategic learning process from assessing where we are through learning how to get there. Reframing is particularly useful during the earlier stages of strategy formulation and is an essential part of resolving an organizational dilemma as well.

How to develop a strategic reframing? Prompt your own reframing of strategic leadership issues by asking yourself questions like the following:

- What would we do differently if we really listened to our customers?
- What are some different ways we can think about what quality means in our work?
- What could we be the best in the world at doing? How might doing that change the nature of our organization?
- Have certain processes and activities in our organization merely become ends in themselves rather than means to an end?
- Is our structure serving our strategy, or is our strategy serving our structure?

4. *Making common sense*

In the long run it is often more constructive to make common sense of the situation, i.e., to create a shared understanding of the situation, not to assume one person's interpretation of it is correct. Strategic leadership requires making common sense amid complex and ambiguous conditions. The dynamic challenges facing organizations today contribute to a common experience of lack of clarity about direction and alignment, and a sense of disorganization and confusion.

Strategic leadership involves giving some coherence to what could otherwise feel like confusing and contradictory communications and signals at work. Like reframing, making common sense is particularly useful during the earlier stages of strategy as a learning process. That is why it is placed at the fourth step of the eight steps for successful change management as discussed in the last section of this unit.

5. *Systems thinking*isanother required competency for strategic thinking (refer to unit 5).

Strategic acting

It is the second element of strategic learning process.In most organizations, translating strategic thinking into priorities for action is one of the most challenging aspects of strategic leadership.

Activity 8.2
What is strategic acting? Is it different from what most managers probably spend most of their working day in an acting mode by constantly doing something: making decisions, taking a call, hurrying to one meeting after another, finishing almost-overdue reports, and so on?

Strategic acting is important in every aspect of strategy as a learning process, but it is a critical part of learning how to get there, making the journey, and checking our progress. To transform thinking into action, strategic leaders must be ready to act in the face of uncertainty. They must set clear priorities, act with short- and long-term interests in mind, and allocate resources that match the strategic choices the organization makes. They must also create conditions under which others can be effective, including ways they and others can learn from their individual and collective actions.

The nature of strategic action may be different. It's one thing to have a strategically compelling idea whereas, it's quite another to take action based on that idea. That's why it is said in one word that 'decisiveness' is what makes a good manager or leader. You can use the fanciest computers to gather the numbers, but in the end you have to set a timetable and act. There may be a certain kind of tension between thinking and acting but, when such thinking is prolonged, it delays action. There may also be another kind of tension which can occur when continuous action precludes critical thinking.

There are six general competencies that make up strategic acting

1. Set clear priorities.

2. Create conditions for others' effectiveness: balance direction and autonomy; and reward appropriate risk-taking
3. Make strategy a learning process: learn from your actions.
4. Act decisively in the face of uncertainty.
5. Act with the short term and the long term in mind.
6. Have the courage of your convictions.

Strategic influence

It is the third element of strategic learning process.Just as not all leadership has strategic implications, not all influence is strategic in nature. Strategic influence is how leaders engender commitment to the organization's strategic direction and learning. It is absolutely essential to sustaining competitive advantage in contemporary organizations. However, the complex, chaotic environment in which organizations operate makes it difficult for their leaders to set a plan, get others on board, and implement a strategy in some lockstep fashion. Strategic leaders often know the path to pursue (through their strategic thinking) and might be decisive and confident enough to walk that path despite the uncertainty (through the courage of strategic acting), but enlisting others in the effort can be much more difficult. It is often the most critical element of building sustainability.

In summary, strategic leadership is crucial to meet organizational objectives, patient expectations and strive with excellence in the 21st century. From our lesson on strategy as a learning process, the following implications are drawn about strategic leadership. Strategic leadership is not reserved for those at the top. It's not enough to be a good strategic leader yourself; you have to foster strategic leadership in others, too. Strategic leaders blend the skills of thinking, acting, and influencing to drive strategy as a learning process in their organizations.

Activity 8.3

In small group of 5 to 7 members discuss the following situations in Ethiopia and come up with a strategy that shows what you can do as a strategic health leader for the next few decades.

A) Hospital health care service
B) Health extension program
C) Cancer treatment and diagnosis
D) Military health service

4. Work process redesign

In light of today's competitive pressures and a rapidly changing environment, to not change is to give way to one's competitors. To be able to lead change effectively, it is important to understand the difference between routine problems and complex conditions. No problem can be solved from the same level of consciousness that created it, as Albert Einstein said. As a leader, you need to encourage people to think of new ways to approach their work that are responsive to changing conditions, and support them as they try out new approaches. People, who stick rigidly to outdated practices and continue to apply old rules to new situations, will have the most difficulty functioning in this rapidly changing environment.

Process redesign

In general terms, process redesign is an approach to mapping, reviewing and redesigning the patient journey to meet demand and ensure that care is safe, effective and efficient. Simplifying the journeys patients make through our healthcare institutions can:

- Reduce errors
- Improve patients' access to services
- Lower costs
- Make better use of existing resources.

Process redesign may also be used to improve the secondary processes that impact on the patient journey, for example, processes that involve the movement of goods, equipment or objects. Services, such as pathology or pharmacy services, may involve all three of those elements.

Key principles of process redesign

There are a number of key redesign principles that should guide all redesign programs:

1. *The centrality of the customer: adopting the patient's eye view:* Healthcare facilities are complex places, with care being delivered by many different groups of people. Process redesign supports the adoption of a patient's eye view by using a variety of techniques to ensure that the journeys patients make through health services are brought into view so that they can be understood and improved.
2. *Describe and redesign work processes:* The aim of healthcare is to improve patients' physical or mental well-being. The care that achieves this is delivered via a series of acts and actions. A Work Process is a term used to describe those acts and actions organized into operational sequences where value is created by improving physical or mental wellbeing. Process redesign concentrates on improving the sequences required by different groups of patients. Sometimes, it

is possible to bring a number of sequences together into broader streams of work, and to then redesign those broader streams to make it easier to provide them with the high-quality care they require.

3. *Measure components of the process:* Measurements relevant to the specific service areas where the change initiative is being implemented.
4. *Recognize the expertise of the people who work on the front line:* Healthcare organizations are filled with staff dedicated to providing the best possible care; ignoring their expertise is wasteful and demoralizing. Sustainable change is only possible when front line staff are full partners in the improvement program.

Session 9: STRATEGIC LEADERSHIP, IMPLEMENTATION OF CHANGE

Session overview

Form the discussions so far on various aspects of strategic leadership; you have understood that strategic leadership is largely the use of a comprehensive strategic planning process, where there can also be a leadership dimension as well using participative approaches to leadership by involving staff in the strategic planning process. If you keep on doing what you have always been doing, you will keep on getting what you have always gotten. Great ideas to make improvements and bring about change often come to a halt during implementation. In many cases, the real problem is not inappropriate activities but poor execution. Here again leadership and management are critical. You can't always use the same old systems and processes when you are approaching your challenges in new ways.

Learning objectives:

At the end of this session, you will be able to:

- Define the key management practices in the context of leadership.
- Describe the eight steps to successful change management
- Describe the levels of resistance to change and their management

Implementing action plan:

This refers to applying leading and managing practices to stay on course. Planning is one of the four key managing practices and implementing a plan is another. The other six leading and managing practices will help you stay on course:

- Scan continuously so that you can anticipate potential problems or changes in the environment that could impact your work;
- Focus on specific challenges and set new priorities as needed;
- Align your team members to work together to deal with problems as they arise, mobilize new resources, and align new stakeholders as needed;
- Organize people to do the work in the most efficient and effective way, and re-assign duties or redistribute work or resources as needed;
- Monitor progress along the way and make sure you have a feasible evaluation plan;
- Inspire and motivate people to stay engaged

Often during implementation, the priorities you have set compete with other urgent work that arises. These competing priorities can divert you and your team from what is most important, requiring effective management practices.

Management practices refer to the common elements of a well-managed organization. These organizations have clear plans, clear reporting structures for decision making, and well organized systems and work processes. Personnel carry out their assigned activities efficiently, follow the process to the desired results step by step, and assess whether they have been successful. Therefore, effective managers carryout the following four essential management practices: they plan, organize, implement and Monitor and Evaluate (M&E).

How are these practices carried out in daily life?

Plan: Health professionals who lead plan how to achieve desired results and document these activities in a format that helps staff do their work and fulfill their responsibilities in a timely manner. They also have to be able to plan quickly as windows of opportunities in open and anticipate what is needed to move their programs ahead.

Organize: Health professionals who lead make sure those sufficient resources are available to implement the planned activities, and that the necessary structures, systems and processes exist and run smoothly to facilitate the work. Organizing in the context of conflicts requires special attention to shifting alliances, uneven resource flows.

Implement: Health professionals who lead execute and delegate execution of planned activities, coordinating multiple efforts to achieve desired results. This includes the capacity to work under pressure, the ability to improve with resources that are available (and do without the ones that no longer are) and in spite of conflict and insecurity, get the work done.

M&E: Health professionals who lead track activities, outputs and results and compare them with what was planned, collecting feedback and information from a variety of sources to see whether the intended results were obtained or not. They fine tune their plans and learn from the errors to achieve the intended results. They look for ways to show others that results were achieved, and in doing so, motivating them to join in or support future work.

You can see that the implementation practice cross-cuts to all other management practices. Those specific activities listed under the implementation practice such as delegating execution of planned activities and coordinating multiple efforts are also required for organizing and M&E for instance.

In addition, implementation of organizational change initiatives has already been addressed in detail as one of the key competencies of strategic leadership ("strategic acting"). The following six general competencies are required for strategic acting (refer to section 2.6 above for more information):

1. Set clear priorities.
2. Create conditions for others' effectiveness: balance direction and autonomy; and reward appropriate risk-taking
3. Make strategy a learning process: learn from your actions.
4. Act decisively in the face of uncertainty.
5. Act with the short term and the long term in mind.
6. Have the courage of your convictions.

Managing change initiatives

The discussions of leadership so far have generally focused on a leader's role in ongoing operations of an organization. An increasingly important role for a leader in an organization is that of a change. This section will briefly discuss specifics of change leadership, with particular emphasis on organizational change and on creating a high-performance organizational culture. The problem with all failed change initiatives is not only wasted time and other resources, but, more importantly, the wasted good will of employees. Failed change efforts create cynicism, and cynicism acts like a virus in an organization: it spreads rapidly and makes future change initiatives less likely to be embraced and supported by the staff.

Activity 9.1: Applying the factors of success in leading change

This activity is based on the Kotter's eight factors of success in leading change assuming that you are the team leader responsible for a change initiative. Each member of the group should fillout the questions providing an explanation for their answers in the column marked "Comments."

Questions	Comments
Have we communicated urgency of the change effort by framing the challenge clearly?	
Have we built a strong core team?	
Do we have a shared vision of the end result of the change initiative?	
Are we including key stakeholders in planning & implementation activities?	
Do we have examples of obstacles that we have overcome together as a result of the change initiative?	
Are we sufficiently focused on results?	
Do we have periodic celebrations of short-term wins?	
Do we have continued senior leadership support for facing ongoing challenges?	
Are new behaviors and values becoming increasingly visible at work?	
Are changes incorporated in routine organizational processes and systems?	

Creating a climate that encourages change

Any successful change process—whether it is a single practice or an organization-wide system—relies foremost on leader's desire to make changes. The leader needs to be willing to reflect on his/her own values and behaviors. This proactive attitude is a prerequisite to leading any change effort. Indeed no significant changes are made that don't begin with a change in oneself. Change requires that you think about and be willing to question long-held beliefs, since often our beliefs are the biggest obstacles to change. Managers also need to help staff examine their own attitudes and behaviors so that they can respond appropriately to changing conditions. Change is a learning process and requires that you have the ability to question assumptions and test new ways of acting. You will be much more credible as a leader of change if you show in your daily life that you are also making the changes you request of others

Kotter's eight steps to transforming your organization

These eight steps are also called success factors for effectiveness of change management. The effectiveness of a manager and a workgroup in creating successful change is based on careful planning, not chance. It requires skill, drive, and desire on a manager's part to balance the interests of all stakeholders. Below are eight steps to manage successful change, how to accomplish each step, and the downside of not accomplishing all steps. The first four stages are meant to "prepare the soil" so that it can accept "the seeds of change." The next three steps provide a set of new practices that will help establish the desired new status. The final step is to make sure that the change is sustainable over time. Each new step is built on the previous ones, so that if a lower step is weak, the next one

will also be weak and there is a risk of collapse. Thus, it is important to make sure that each stage is completed properly.

Table 12: The eight steps of successful change and possible results if not implemented

Step	How	Keys to Success	Possible results from not implementing the step
Establish a sense of urgency	• Analyzing your competition & changes in the market; tracking the speed of change &determining what your organization has to do to keep up with it.	The urgency rate is not high enough until 75% of management is honestly convinced that business-as-usual is totally unacceptable.	• Complacency • Disowned
Forming a powerful guiding coalition	• Assembling a group with enough power to lead the change effort • Encouraging the group to work together as a team	More is usually required. Efforts not having a powerful enough guiding coalition can make apparent progress for a while but, opposition stops it.	• Turf protection • Passivity
Creating a vision	• Developing strategies that will serve as a bridge from the present to future state • Package the future into a short story image or visual language that promise new valuable benefits	Simplify until you develop a picture of the future that communicates the vision in 5 minutes or less- and gets both understanding and interest.	• False starts • Misalignment
Communicating the vision	• Using every vehicle possible to continually communicate the new vision and strategies • Teaching new behaviors by the example of the guiding coalition & senior leaders	Successful transformation efforts use all existing communication channels to broadcast the vision-with words & deeds.	• Confusion • Rumors • Distortion
Empowering others to act on the vision	• Getting rid of obstacles to change • Changing systems or structures that seriously undermine the vision • Encourage risk taking and non-traditional ideas, activities & actions	Communication is never sufficient by itself. Renewal also requires the removal of obstacles. The worst obstacles of all are bosses who refuse to change and who make demands that are inconsistent with the overall effort.	• Feeling overwhelmed • Burned-out • Frustrated
Planning for & creating short term wins	• Planning for visible performance improvements • Creating those improvements • Recognizing and rewarding employees involved in the improvements	Real transformation takes time & a renewal effort risks losing momentum if there are no short term goals to meet & celebrate. Commitments & compelling evidence within 12-24 months help keep the urgency level up.	• Cynicism • Stall out
Consolidating improvements & producing still more change	• Using increased credibility to change systems, structures & policies that don't fit the vision • Hiring, promoting & developing employees who can implement the vision • Re-invigorating the process with new projects, themes & change agents	Until change sinks deeply into a company's culture (5-10 years), new approaches are fragile and subject to regression. Leaders of successful efforts use the credibility of short term wins to tackle bigger problems.	• Subtle sabotage • Half-efforts • Isolation
Institutionalizing new approaches	• Articulating the connections between the new behaviors & corporate success • Developing the means to ensure leadership development &succession that could sustain the change	Change sticks when it becomes "the way we do things around here." Understand why performance increases & ensure the next generation of top management really does personify the new approach.	

Source: John Hopkins Health System Corporation (ND).

Model changes to influence others: Change begins with oneself

As a leader, you model your attitudes and values (sometimes even without knowing it) and influence how others act and respond. If you show that you want to learn and adapt, that you are willing to admit when you are uncertain, do not know the answer, or when you are wrong, then, in time, others will do the same. Setting an example will support a climate in which people are engaged in thinking and working together to address challenges and achieve results.

Model changes to influence others as change begins with oneself

When a work unit or organization is undergoing a change, people will have a range of responses. Some adapt quickly to new changes and seek them out. Others are more reluctant and need time to understand and accept the changes before they can commit to them. People have to absorb what the changes mean to them and make their own shit s in attitudes and behaviors before the change will take hold in their daily work. The important job of those leading a change effort is to understand these responses, recognize where people are in the change process, and know how to work with them so that they can help support and institutionalize the changes in the long term.

As a leader, you model your attitudes and values (sometimes even without knowing it) and influence how others act and respond. If you show that you want to learn and adapt, that you are willing to admit when you are uncertain, do not know the answer, or when you are wrong, then, in time, others will do the same. Setting an example will support a climate in which people are engaged in thinking and working together to address challenges and achieve results.

When people are in a place of…

Denial: Provide them with more information so that it becomes difficult to stay in denial.

Resistance: Create opportunities for people to express their feelings. Resist the impulse to explain or defend, which will make things worse. Show empathy for and understanding of the losses people experience.

Exploration: Make available opportunities and resources for discovering what is possible in the new situation. Encourage people to get together and support one another.

Commitment: There is no need to "manage" the change process at this point, since people will manage themselves. Get out of the way.

Address resistance to change

Resistance is a common response to change. People usually resist change because they view it as losing something that is important to them. They may oppose changes and seek to sabotage them because they weren't included in the decision-making that led to the changes. People also resist change if the proposed changes strongly contradict their ideas or appear to threaten their survival. When you run into resistance, allow people to express their fears and feelings of loss. Don't rush them into seeing things your way, but consider how the change appears to them.

How to Deal with Resistance?

Use reason: Make the case (as in a legal argument) for the change you propose, by pointing out the pros and cons of the change, showing the consequences of not addressing it.

Debunk myths: Directly (but tactfully) challenge myths stemming from long-held beliefs, wrong or outdated ideas, or misinformation passed on by others.

Reinforce the desired new behaviors or practices: Provide resources and rewards (which may be publicity, public recognition, awards, extra resources, or opportunities for growth) to those who apply the new behaviors or practices.

Describe the vision in a variety of ways: Provide opportunities for people to "try on" the new vision for themselves using one or more of the following ways.

a) Tell a compelling story about the vision and show how the changes are inevitable.
b) Recognize that people take in information in different ways. Some need to see numbers presented in graphs or tables. Others prefer to see pictures or hear or see quotations.
c) Use movies, poetry, or visual arts to help people understand the benefits of the change.
d) Look at yourself. Reflect on your habitual ways of communicating, of telling the story. Maybe something you do needs to change. Your own style may be strengthening the resistance!
    - Maybe you are moving too fast and are too impatient.
    - Maybe you need to use a different way of communicating with people. Presenting slides from a podium may not be the right way. Consider sitting around a table and exploring the implications of the change with those whose support you need most.
    - Spend less time communicating your point of view and more time listening.
    - Practice what you preach. If the change involves setting and maintaining high standards, then you too should live up to those higher standards. If you tell people that treating clients with respect is your message, then show respect in every interaction; if you made a mistake, admit it, apologize, and move on.

e) Expose the resisters to other people or places. Arrange meetings with other people who have been through significant changes. Take staff to visit clinics to see or talk with clients to make the impact of the change visible. These contacts will help demonstrate the (possible) positive effects of the changes you are proposing.

f) Address slow changers indirectly. Studies on the diffusion of innovations show that a small percentage of almost any groups will lag behind in making a change. Do not focus your efforts on this group, sometimes called "slow changers," but let improved results speak for themselves. When a change in practice becomes official, changes in standards will eventually motivate these slow changers to adopt the new practice.

Session 10: PROCESS IMPROVEMENT

Session overview

Process improvement is a systematic, data-based method for improving the quality of work processes. It uses team decision-making to improve processes that affect the quality of services or products for a customer. The operational definition of quality used in this process improvement training is satisfying the customers' wants and needs for service, while at the same time achieving the technical standards for public health practice.

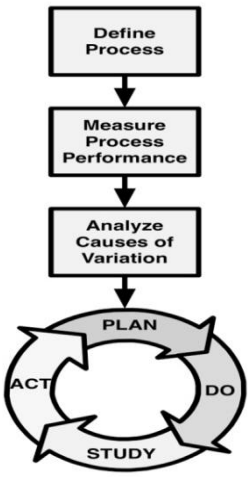
Learning objective

After completing this session you will be know:

- Define of process improvement
- Define the main types of process improvement
- Use different types of process improvement skills
- Analyze Causes of Variation
- Be able to use the result of change accordingly

The Seven Step Approach

Process improvement comprises a seven-step method.



Step

1. Define Process.
2. Measure Process Performance.
3. Analyze Causes of Variation.
4. Generate &**Plan** Improvement Ideas.
5. Implement Change (**Do**).
6. **Study** Results of Change.
7. **Act** Accordingly.

This unit takes you through the seven-step method using 11 tools applied to a case example of an antiretroviral therapy process for HIV infection.

Case Example

To learn how to apply the process improvement steps and tools, and to understand how they link together, we will use one case example throughout.

We will work through the seven-step method using the example of the delivery of Antiretroviral Therapy (ART) for Human Immunodeficiency Virus (HIV) infection in a community health center.

Acquired Immunodeficiency Syndrome (AIDS) is a disease of the body's immune system caused by the human immunodeficiency virus (HIV). The death of infection-fighting white blood cells leaves the body vulnerable to life-threatening conditions such as infections and cancers.

Voluntary Counseling and Testing (VCT) for HIV usually involves two counseling sessions: one before taking the HIV test, known as pre-test counseling, and one following the test, when the results are given, often referred to as post-test counseling.

VCT centers and counselors often use rapid HIV tests that only require a drop of blood or some cells from the inside of one's cheek.

CD4 cells are one type of infection-fighting white blood cells. The CD4 cell count is a measure of the number of CD4 cells in a sample of blood. The CD4 cell count is one of the most useful indicators of the health of the immune system and the progression of HIV/AIDS.

ART is a treatment with drugs that inhibit the ability of retroviruses, such as HIV, to multiply in the body.

The case example deals with the process of customers attending VCT clinics and receiving counseling and testing.

Identify Processes

If their test is positive, patients may be eligible for ART based on the CD4 count and other criteria defined in the guidelines for ART from the World Health Organization. If eligible for ART, patients will receive regular supplies of ARV drugs and counseling to ensure adherence.

Step 1: Define Process

Introduction

- You will begin by identifying all the processes for which you are totally or partially responsible.
- Within your group you will then work to identify the most important work processes using a list of criteria.
- Now you can define your customers and the products and services they receive from your selected process.
- Finally you can show in detail how you organize your work process to deliver products and services to the customers of the process.

The questions you will answer in step one is as follows.

1. "What do I do?"
2. "For whom do I do it?"
3. "What products and services do I provide?"
4. "What do they want and need from me?"
5. "In detail, how do I create the products and services?"

Activity 10.1: The Tennis Ball Game

1.As one group you will play the Tennis Ball Game.
2.Your trainer will guide you through the instructions.
3. Reflect on the experience as a group.

In the game you experienced creating a process and then you improved it several times.

We define a process as a repetitive sequence of activities leading to desired outcomes for the benefit of customers. The inputs to the process are transformed to achieve products or

services.

A customer is any person who receives a product or service. The term is used broadly—no financial transaction need occur.

VCT Example of Process

1. Person arrives at clinic.
2. Person registers.
3. Counselor provides pre-test counseling.
4. Counselor takes blood sample.
5. Laboratory staff conducts rapid HIV test.

What is the process in the scenarios listed below?

In a district hospital people are experiencing long wait times at the pharmacy.

The process is:

In a clinic pregnant women are not being tested for HIV.

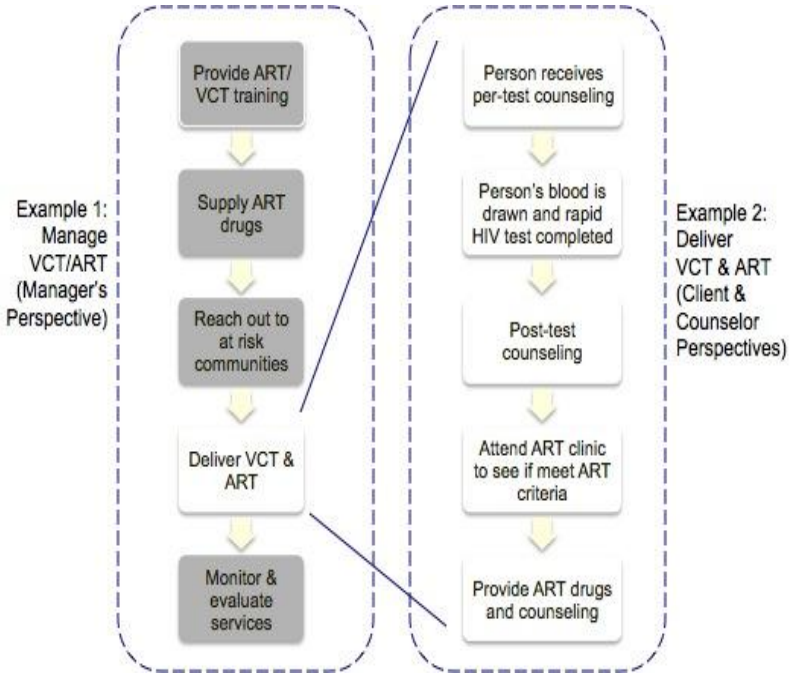
The process is:

Process Levels and Boundaries

Whatever we do, our processes can always be improved. Process improvement is a systematic, data-based method for improving the quality of work processes. It enables staff to identify opportunities and creates a culture of continuous improvement. It also improves communication, reduces departmental barriers, increases pride in work, and leads to more efficient and effective services.

When describing a process, it is important to set limits and boundaries. Frequently your process is, in fact, a component of a larger process. Define and communicate the boundaries of the process you are working on to better focus your efforts.

ART Levels and Boundaries



Select Process

Which process should you improve?

In some cases it might be very obvious. Your team may already know where in your organization you fail to meet customers' needs and reasonable expectations. Perhaps other stakeholders' requirements or technical standards are not being met. There may also be excessive waste that you know about. If the priority is not shared then a selection process should be completed.

You can now evaluate the potential impact of improving your processes on the following four criteria:

1. Customer satisfaction.
2. Satisfaction of other stakeholders.
3. Reduction of wasted time, money and materials.
4. Compliance with technical standards.

Other important questions to consider when choosing a process to improve are:

- Does the team have the authority to make improvements?
- Are resources available to achieve improvement?
- Can significant improvements be achieved quickly and easily?

Activity 10.2: List Processes
As a team, list the common processes for which you are responsible.

If the answer to any of these questions is "no," the process improvement work might not be successful.

Activity 10.3: Select Process to Improve
1. Review your list of processes from activity9.2.
2. Consider each one's potential impact on the four criteria (previous page).
3. Decide which process is going to be the group's focus for the rest of the training.

Define Customers

A customer is any person who receives a product or service from a process. The term is used broadly—no financial transaction need occur.

As public health workers, we serve the people who receive our services or products; they are considered our customers.
The people we serve can be external to the organization, such as clients and families, or they can be internal, such as work colleagues.

ART Customers
- People living with HIV/AIDS,
- Friends, family, relatives, and
- The local community.

Activity 10.4: Define Customers
As a group, list the customers of your chosen process.

Services

Products and services can be tangible or intangible—a thing, information, knowledge, a procedure, or a function.
Examples of ART Products and Services:
- ART medications
- CD4 count test results
- Condoms
- ART treatment information
- On-going counseling

Activity 10.5: Identify Products and Services
1. What are the products and services generated by your chosen process for your customers?
2. List them below.

Definition of Quality

Quality is defined as satisfying the customers' wants and needs for service while at the same time achieving the technical standards for public health practice.

The *voice of the customer* is what the customers say about their wants and needs and the quality of the service.

It is not what other people interpret for them; and it is not necessarily fair or accurate, but it is what they feel and believe.

Understand Customer Wants and Needs

Activity 10.6: List Customer Wants and Needs

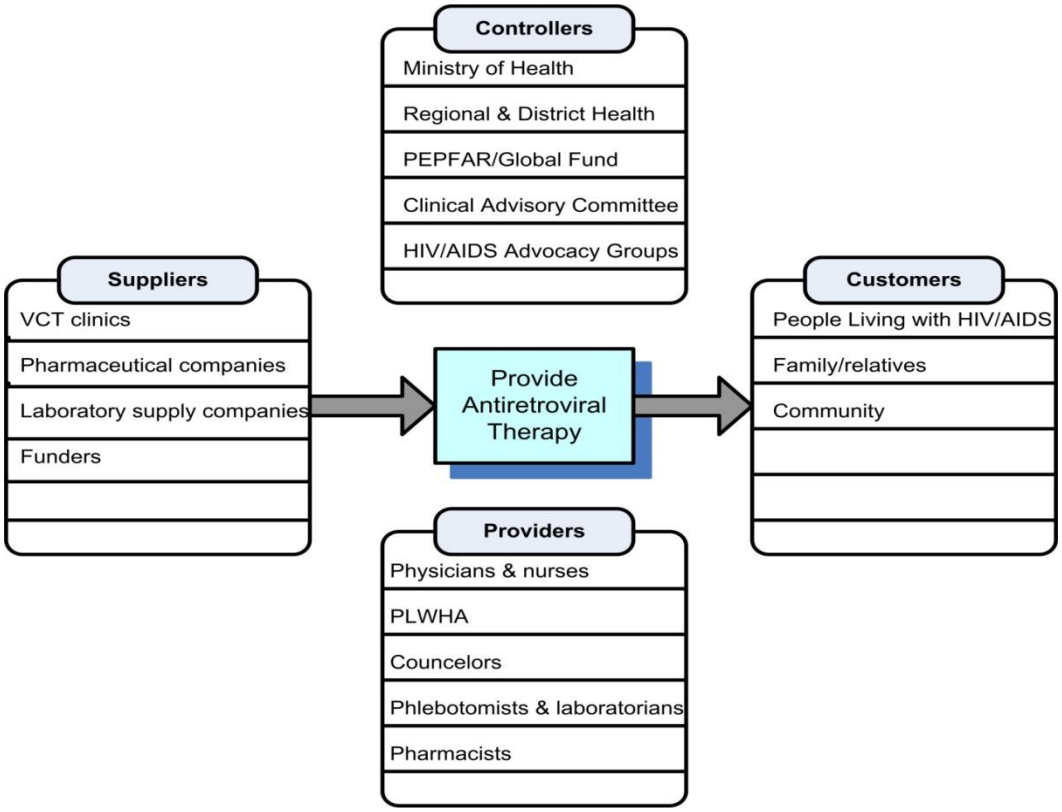
1. Select an important customer from activity9.4.
2. Identify all their wants and needs of the products & services identified in the previous exercise.
3. Record your answers below.

Identify Other Stakeholders

A **stakeholder** is one person, or group of persons, having an interest or concern in a particular process resulting from some direct or indirect involvement. They can generally be categorized as customers, suppliers, controllers, and providers.

- **Customers** receive a product or service. The term is used broadly—no financial transaction need occur.
- **Providers** comprise key staff, including professionals, managers, partners, and subcontractors, who carry out the process.
- **Suppliers** provide goods, services, and information to the organization or process but do not carry out the work.
- **Controllers** define, regulate, and influence the organization or process. Controllers include regulators, legislators, funding agencies, expert advisory committees, and trustees. Technical standards are often set by controllers.

ART Case Example: Stakeholder Analysis



Activity 10.7: Identify Stakeholders

1. Select a spokesperson in your team to present back to the whole group.
2. Identify the people who have a stake in your chosen process.
3. Use the stakeholder analysis template to help you.
4. How can you involve your stakeholders in improvement activities?
5. List your ideas on the next page.

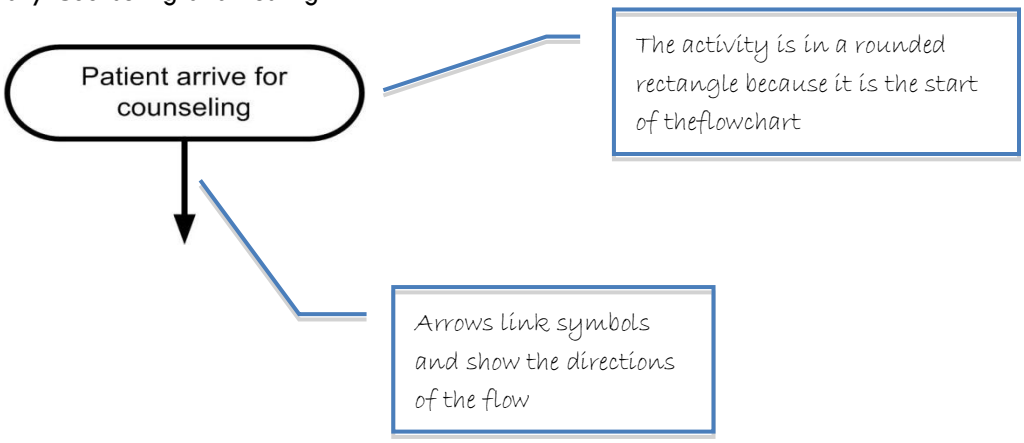
Flowchart

Use a flowchart to:

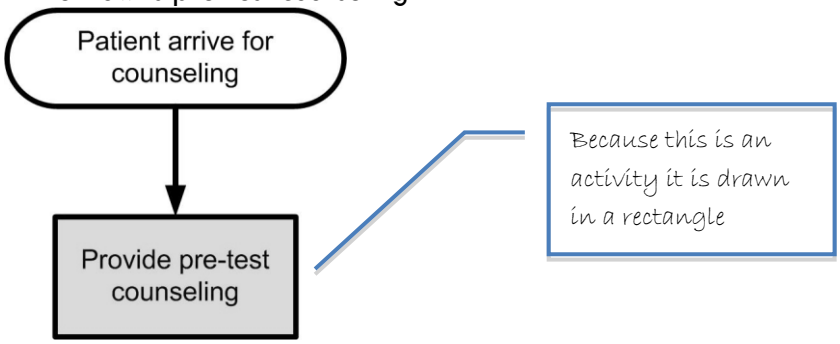
- Understand the current process.
- Identify where there are opportunities for improvement.
- Design improvements to the process.

The flowchart will also illustrate the level of the process and allow your team to clarify its focus.

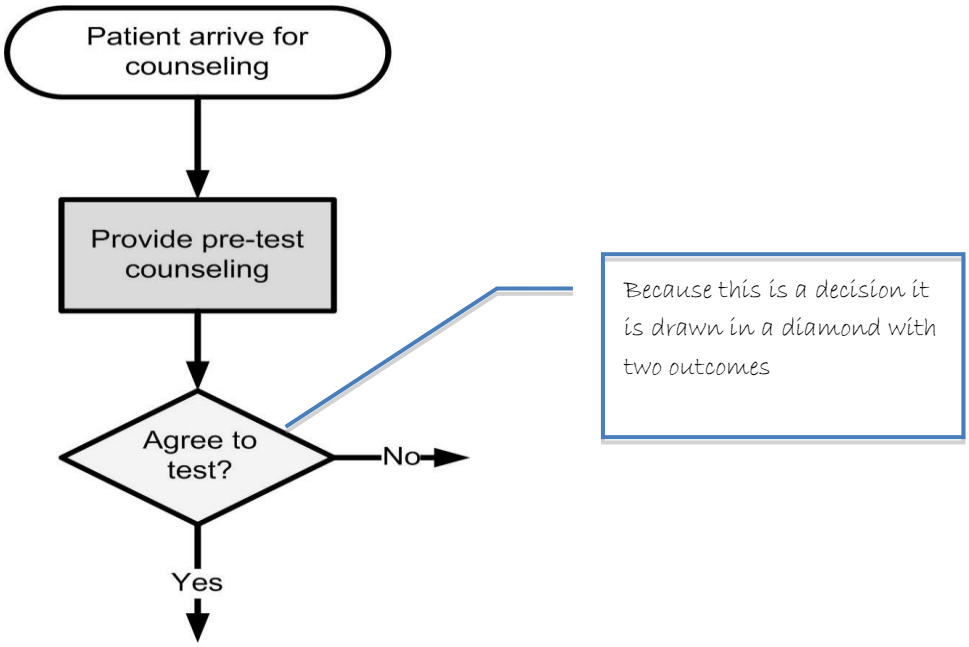
HIV/AIDS Voluntary Counseling and Testing

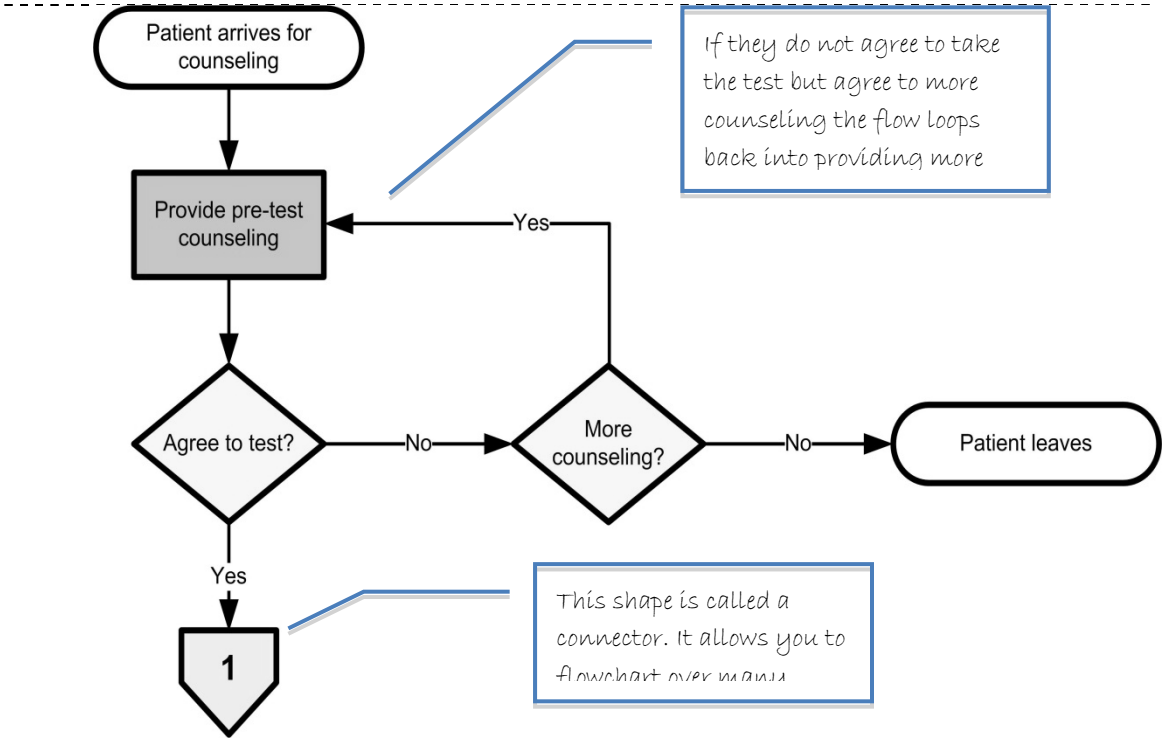


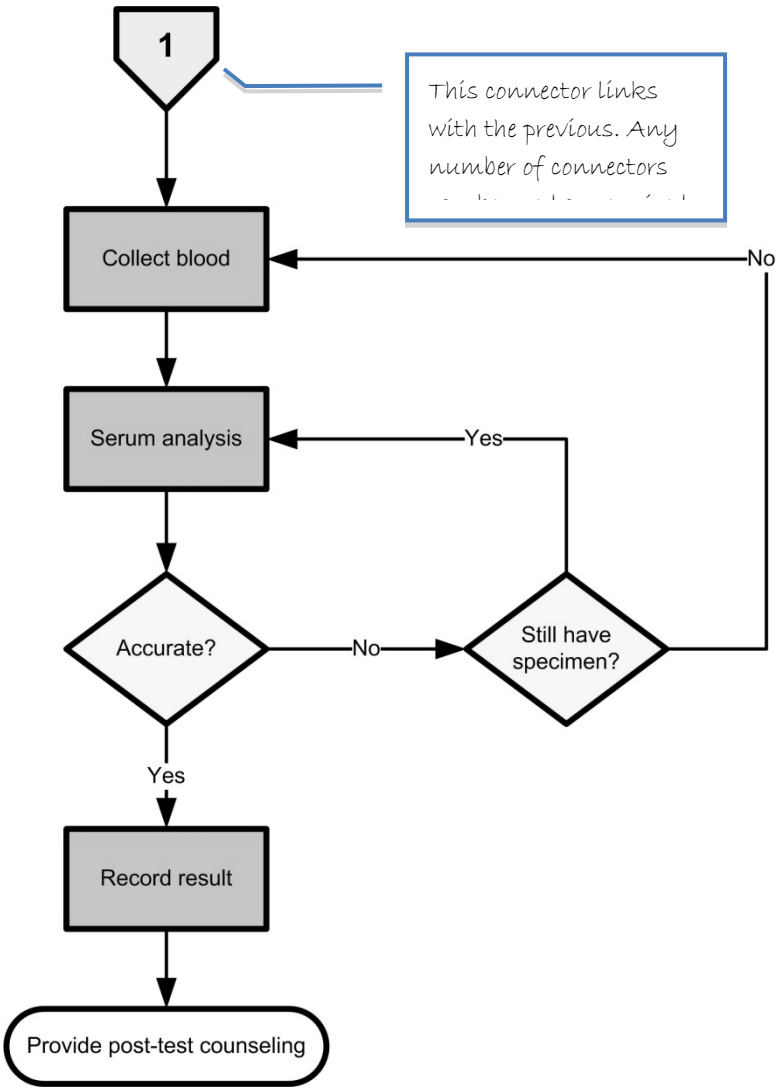
The next activity in the flow is pre-test counseling.



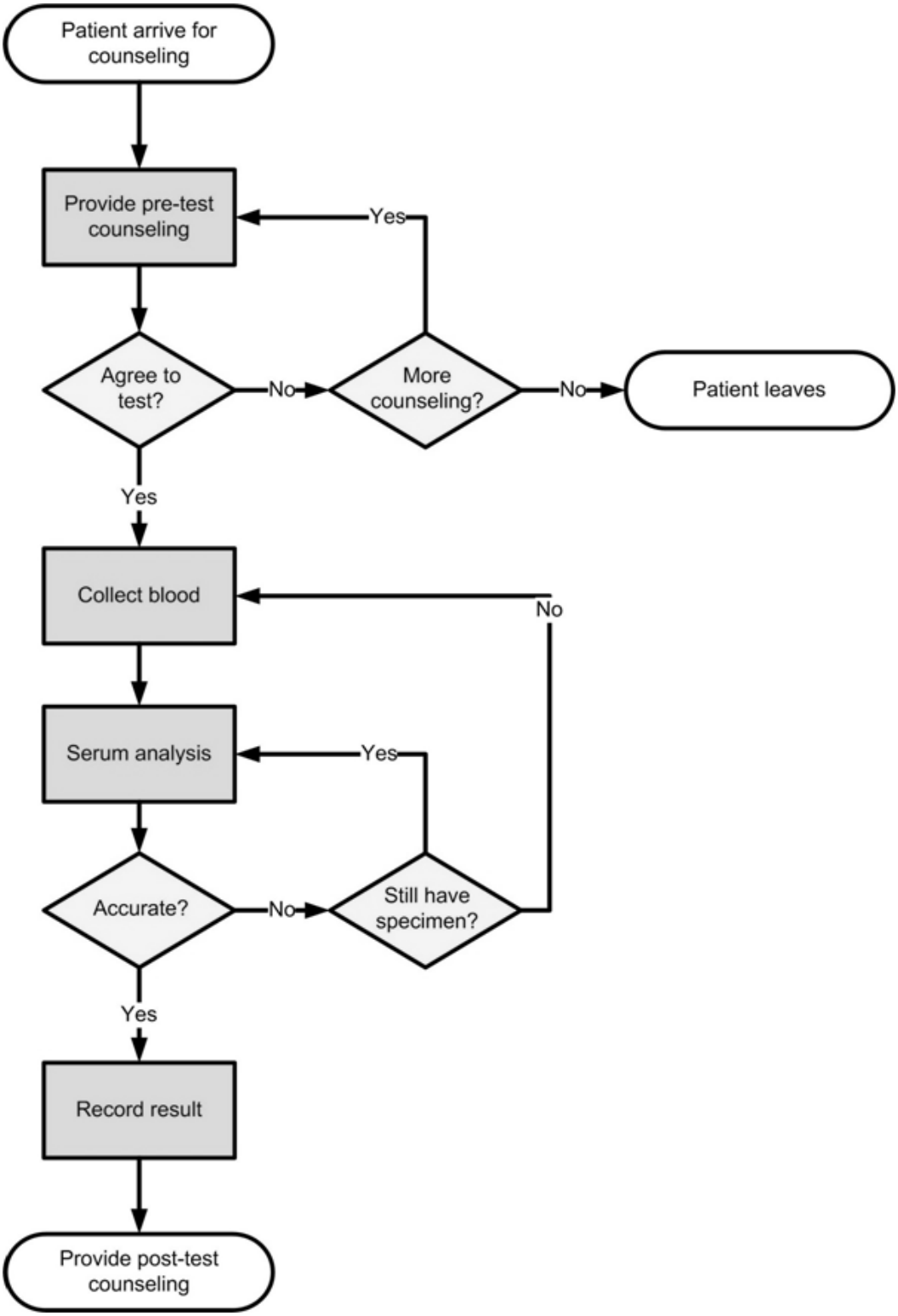
Next there is the first of four key questions. The first question is whether the patient agrees to the test. This is a question which has to be answered either yes or no.


Patient arrive for counseling
Provide pre-test counseling
Agree to test?
No
Yes
Because this is a decision it is drawn in a diamond with two outcomes


Patient arrives for counseling
Provide pre-test counseling
If they do not agree to take the test but agree to more counseling the flow loops back into providing more
Yes
Agree to test?
No
More counseling?
No
Patient leaves
Yes
1
This shape is called a connector. It allows you to flowchart over many



Example: Complete Flowchart


Patient arrive for counseling
Provide pre-test counseling
Yes
Agree to test?
No
More counseling?
No
Patient leaves
Yes
Collect blood
No
Serum analysis
Yes
Accurate?
No
Still have specimen?
Yes
Record result
Provide post-test counseling

Activity 10.8: Flowchart Your Process

1. Use your chosen process.
2. Define the beginning and the end—the boundaries of the process.
3. Write the beginning steps of the process in an oval.
4. Ask yourself "What happens next?" Add the step to the flowchart in a rectangular box.
5. Continue mapping out the steps and connect them with one-way arrows.
6. When a decision point is reached, write the decision in the form of a question in a diamond & develop the decision result paths. Each path must reenter the process or exit somewhere.
7. Repeat steps 4 to 6 until the last step in the process is reached.
8. Write the ending boundary/step in an oval.
9. Select a spokesperson in your team to present back to the whole group.

Step 2: Measure Process Performance

Introduction

Now that you have defined the process, it is to time to understand how well it is performing. The customers' and stakeholders' wants and needs guide you in what to measure. So do the technical standards. In this way Step 2 is driven by the results of Step 1.

But before we start the detail let us take time to review measurement good practice, which yo read about last night.

Measurement Good Practice

- Measure what is important, as defined by customers' needs, stakeholders' needs and technical standards, whether it is easy or difficult.
- Make sure data to be collected and analyzed represent exactly what your operational definition states as the measure.
- Keep measurement simple if you can. The purpose is to gain insight into the real operation, or the "voice of the process."
- Data gathering should not interfere with normal work as little as possible.
- The data gathered should provide a reasonable representation of the process as it operates under normal conditions. For example, do not gather data over a holiday, or only on a Monday night shift.

- Don't reinvent the wheel. If the data you require already exist in a usable format, then use them. If the data exist, but are not in a usable format, you need to aggregate the data into a usable format.
- If there are no data you can use to better understand your process, you will need to design a method for gathering the data.
- If there are no agreed-upon definitions of what should be measured to meet customer needs and technical standards in your process, you will need to create these.
- You should record and report raw numbers and percentages. If you have very low numbers, show the raw numbers, not percentages, in graph form, otherwise your report will be misleading.

Example: In a team of five people, one person is trained (20%). After improvement, two out of the five are trained (40%). The improvement has doubled the percentage of persons trained from 20% to 40%, however; only one additional person was trained. Don't average percentages.

Example: If in January 30% (3/10), in February 10% (2/20), and in March 2% (2/100) of the Disease Surveillance Reports in District X had errors, the percentage for the first quarter is not 14% (the average of 30%, 10% and 2%). The percentage per quarter must be calculated from the original data, in this case 7/130, which results in 5.4%.

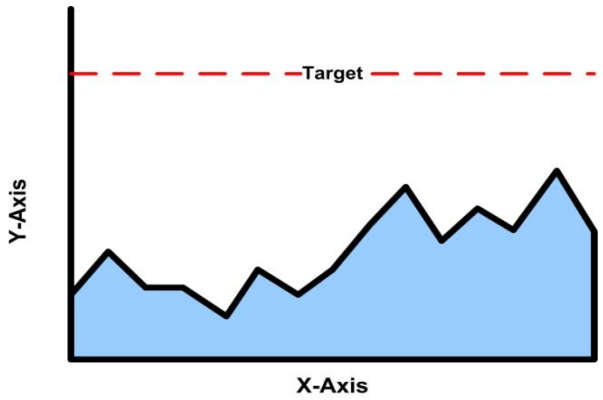
The Performance Gap

Measures show how well we are meeting our technical standards and customer needs. They help us to manage with facts.

They highlight the gap between current process performance and the desired process performance or target.

Good measures help your organization make decisions and take actions based on data and agreed-upon facts.

Measures should be reviewed regularly because technical requirements and the needs of our customers change.



Definitions

A useful measure can be generated only from a clear definition. If the definition is useful and shared between stakeholders then it is often referred to as operational.

Sources of Measures

The flowchart helps you identify critical points at which to measure within the process.

Measures are generated from:

- The customers' wants and needs,
- Other key stakeholders' requirements,
- The technical standards, and
- Within the process.

Remember, process improvement is a systematic, data based method for improving the quality of processes.

You will base your decisions and actions on data from the process you are improving.

Customer measures are generated from the voice of the customers and their wants and needs. These typically include effective treatment, a safe environment, timely care, confidentiality, respect and dignity.

Stakeholder measures are generated from key stakeholders' wants. Often it is the funding agencies' measures that receive priority.

Technical measures are generated from best practices as defined by scientific research. These measures are often disease-specific and based on medical protocols.

Process measures are taken at key points in the process. They are not usually of direct interest to customers and other stakeholders. They are selected because they have a significant impact on the process outcomes. Examples include the availability of medical supplies, the number of people trained in a topic, availability and correct functioning of critical equipment, and the turnaround times for laboratory tests.

Some of your measures will be more important than others. Some, such as patient safety and effective treatment, should be pre-requisite.

Their importance may vary over time. During the start-up of a program, meeting the technical measures may be more important than the stakeholder ones. Throughout the program certain customer measures will always be important. As the program matures, showing the funding agencies that their measures are being achieved will be critical to further funding.

Case Example: Table 13, ART Measures

Type of Measure	Measure	Operational Definition
Customer Measure/s	Effectiveness of treatment	CD4 improvement above target
	Timeliness of training	Time from testing positive to receiving appropriate ART regimen if meeting criteria
Stakeholder Measure/s	Number of new patients	Initiated ART during the reporting period in a program
	Number of current patients	Individuals on ART at the end of a reporting period
	Number of cumulative patients	The total number of individuals ever on ART since the start of the Emergency Plan
Technical Measure/s	Compliance with rapid test protocol	Follow laboratory quality assurance protocol
Process Measure/s	Referral time from VCT to ART	Time in days from post-counseling referral for individuals tested positive to first attendance at ART clinic
	Laboratory turn around time	Time in hours or minutes from specimen collected to when results presented to physician
	Adherence rates	Percentage of ART patients who self-report adherence to the prescribed regimen over the last three months

Activity10.9: Identify Measures

1. As a group, refer back to your flowchart.
2. Consider customer measures first. What would you wish to measure? Put your choices and reasons for selection in the table below.
3. Now do the same for stakeholder, technical and process measures. Remember to record the operational definition.
4. Limit yourself to no more than one or two measures of each type.
5. Summarize your measures in the table below.

Process:			
Type of Measure	**Measure**	**Operational Definition**	**Reason for Selection**
Customer Measure/s			
Stakeholder Measure/s			
Technical Measure/s			
Process Measure/s			

Selecting Measures

Often it is tempting to collect too many measures. For a relatively simple process there could be many customer, stakeholder, technical, and process measures. Focus on the important ones. Remember data collection costs money. If used to drive process improvement, it is an investment. If not, it is wasted money.

Selecting measures to monitor will depend on some or all of the following factors:

- The difference between your actual and your desired performance.
- The feasibility of making a dramatic improvement.
- The importance set by customers, and other stakeholders, such as a funding agency.
- The impact that an improvement could have on the overall performance of the process.
- The feasibility of measurement. Is it possible? Do you have data? Will it take a lot of time?

Activity 10.10: Select Measures

1. Review your table of measures.
2. Consider each measure against the five criteria on the previous page.
3. As a team agree on one measure to be the focus of the rest of the Workshop.

Now you have selected a single measure for your process, you need to consider how to analyze and present the data. You have to be able to understand what the data are telling you.In the ART case example we chose self-reported adherence because the clinic's performance is well below the 70% target. Also non-adherence can also lead to drug resistance and treatment failure. The data were readily available for the last two years.

Collect Data

If data are not available for the process performance measures you have selected, you will need to design a method for gathering the data.

Check Sheet

A check sheet is a simple table that is used to gather data. It enables you to answer the question "how often are certain events happening?" The check sheet is often the first tool in interpreting data, helping you move from opinions to facts. It should be designed to be easy to use.Below is an example of a check sheet that gathers data on the number of people missing their ART appointments per week at five clinics?

People who missed ART appointments	Time period – weekly Data collected by ART Administrators									
	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Totals	Total # appts missed	Percent missed
Clinic A				𝍸				8	70	11.4
Clinic B			𝍸					7	75	9.3
Clinic C		𝍸	𝍸	𝍸	𝍸	𝍸	𝍸	16	64	25.0
Clinic D	𝍸		𝍸		𝍸	𝍸	𝍸	12	76	15.8
Clinic E			𝍸		𝍸			11	97	11.3
Totals # people who missed appointments	6	2	26	5	6	5	4	54		
Total # appointments booked for week	50	65	45	52	61	49	60	382		
Percent missed	12.0	3.1	57.8	9.6	9.8	10.2	6.7	14.1		

You may already have data that are reported frequently—daily, weekly or monthly. These data can be plotted over time. If historical data are not available, at least six data points will need to be collected before improvement ideas are tested.

In other cases it may be too costly, or too disruptive, to gather data frequently. You may have to use fewer data points. These may be annual or semi-annual, and in some cases, generated by sample measurement techniques.

If you collect data before improvement and then after an idea is implemented, remember the following:

You must collect the data that measure the process in the same way. Use the same method, a comparable time period for the measurements, and the same data collection tool.

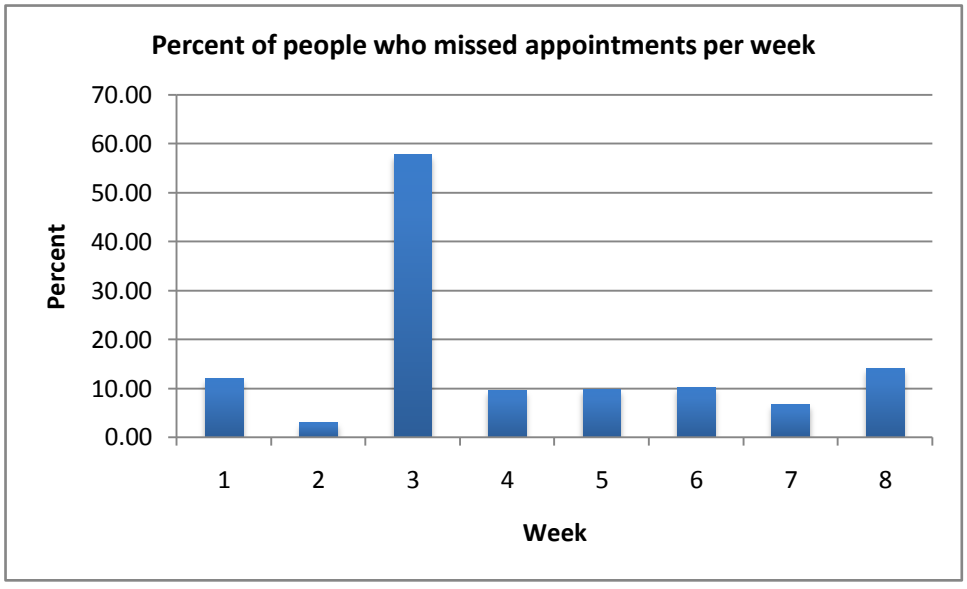
If there is seasonality in the process, or perhaps local variations such as holidays, collect data at the same time of the year.

Stratification

To analyze the collected data on a process problem we often use stratification, a technique used to divide a set of data into meaningful subgroups (strata) of data about the problem.

Think about what kind of subgroups might have a meaningful influence on the data results. They could include, for example, age, gender, time, or geographical location.

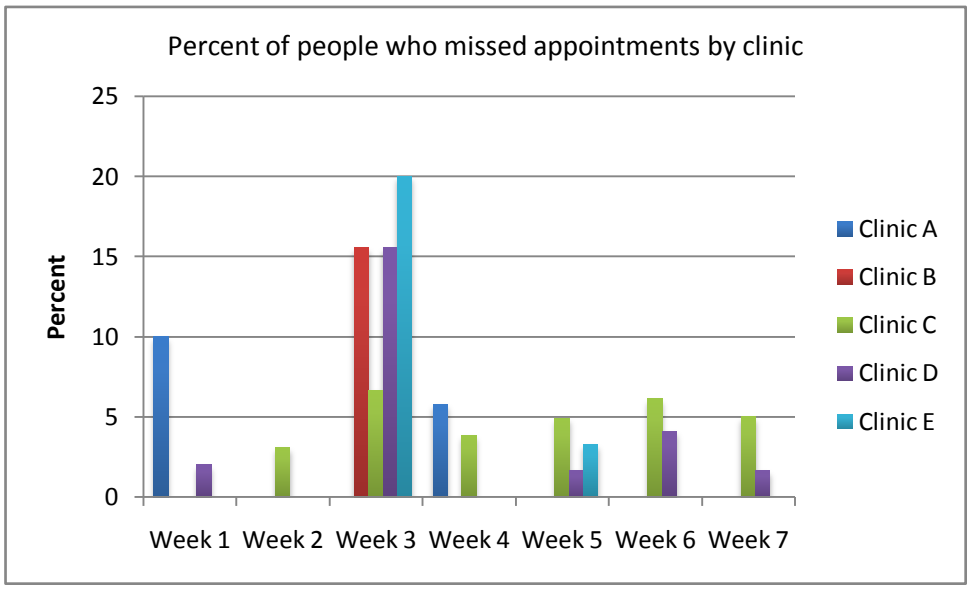
In the bar chart below, people missing ART appointments are reported weekly.



In this example you would want to see the data for each clinic. You would stratify by clinic (see next page).

Once we stratify the percent of people not attending the appointments we can start to ask more focused questions.

For example why did clinics B, D and E experience higher non-attendance on week three? Are they in a similar geographic location? What else could link them? Another question is why does clinic B have 100% attendance, except during week three? Does clinic B have a different system that the other clinics might adopt?



In this case stratification by clinic helps get more information from the data.

Pareto Chart

A Pareto Chart is a special type of bar chart in which the values being plotted are arranged in descending order and the cumulative value is shown on the chart as a line.

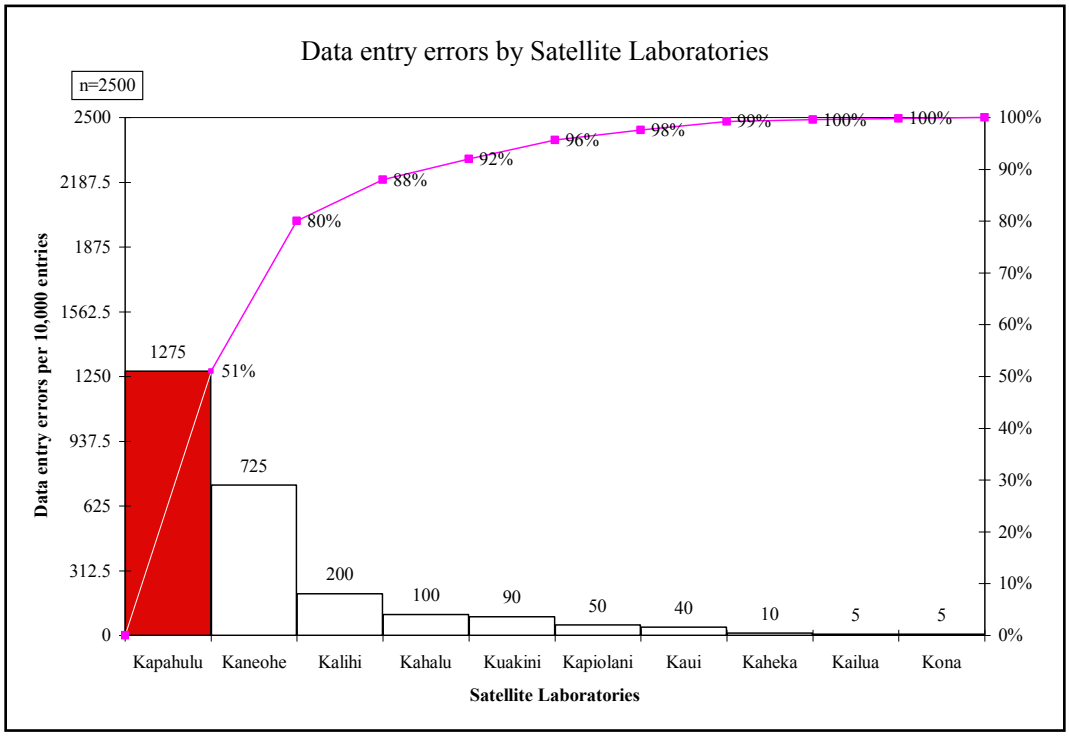
We use the Pareto Chart to highlight the most important factors, or critical few, among many. There are many examples of the Pareto principle in different organizations. Here are three examples:

- 20% of a dentist's patients require 80% of the dental work.
- 20% of your customers generate 80% of revenue.
- 80% of supplies are procured from 20% of your suppliers.

In process improvement, we use the fact that typically a majority of the problems, often approximately 80%, originate from a minority of the causes, often approximately 20%. These are the critical few causes.

A few improvements often reduce the problem the most.

Below is a Pareto chart showing the distribution of data entry errors per 10,000 by different satellite laboratories.



Only two laboratories account for approximately 80% of the data entry errors per 10,000.

Variation

In process improvement we refer to two types of variation.

Common causes are due to the process itself. They are inherent in the design, implementation and operation of the process. Common cause variation remains the same from day-to-day.

Special causes come from sources outside the process. They relate to some special event. It is sensible to investigate the actual reason for the variation. That reason may be operator error, extreme weather conditions, or some other condition that does not occur regularly within the process.

The majority of critical causes come from the process—common causes. Unless these common causes are addressed there will be no long-term improvements.

Special causes can also give us information about the process, but the way we address them is different. We don't want to overreact to a special cause.

Sometimes a special cause can give us ideas for improvement that when implemented will reduce common causes.

If you mix up special and common causes, you may take actions that will increase variation.

Run Charts

Run charts help us monitor the process and distinguish between special and common causes of variation.

They also provide the evidence as to whether an implemented improvement idea has been successful or not.

A run chart is just a graph in which a process measure is plotted over time. A "run" exists when a number of consecutive points lie on one side of the mean.

Count the number of points in each run. If any are unusually long, this might be a signal of a special cause, or the beginning of a common cause shift.

Whether a run is unusual or not depends on the number of data points plotted.

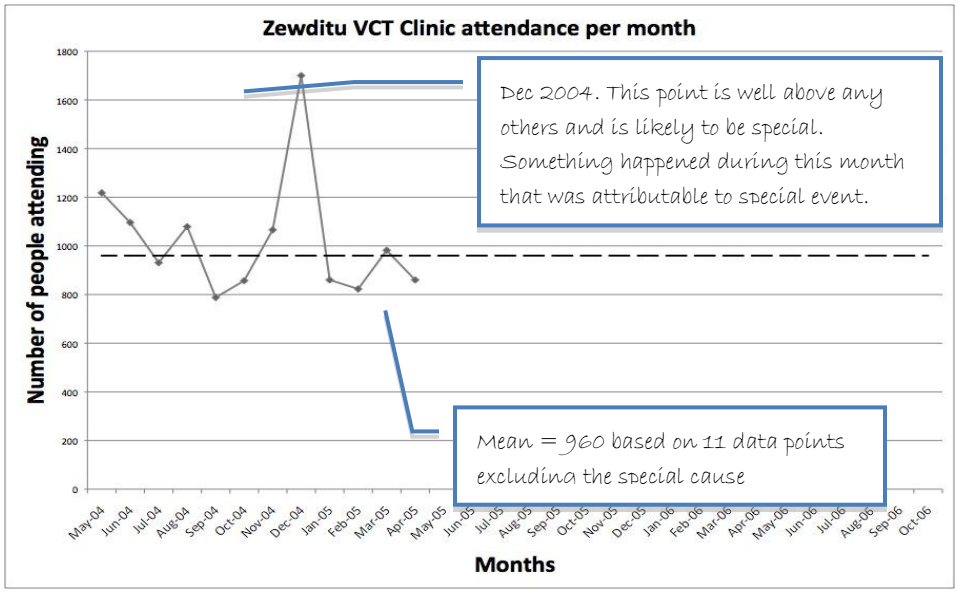
Number of Data Points	Run length is significant if there are this many consecutive data points above or below the mean
10	5
20	7
30	10

If the run continues longer than this it is strong evidence that the system has changed because of a common cause shift.

You want ensure that your improvements address common causes leading to long-term improvements.

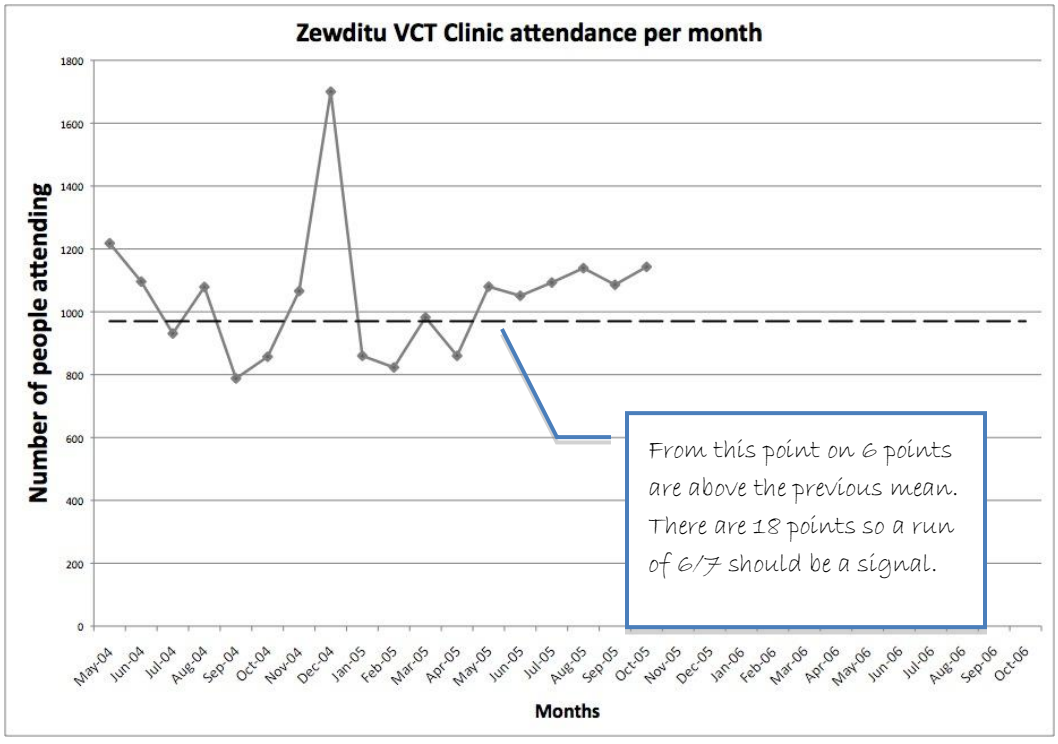
We are now going to analyze a real run chart.

The data are from a VCT clinic. The measure is the number of people attending per month. There are 30 data points in total.

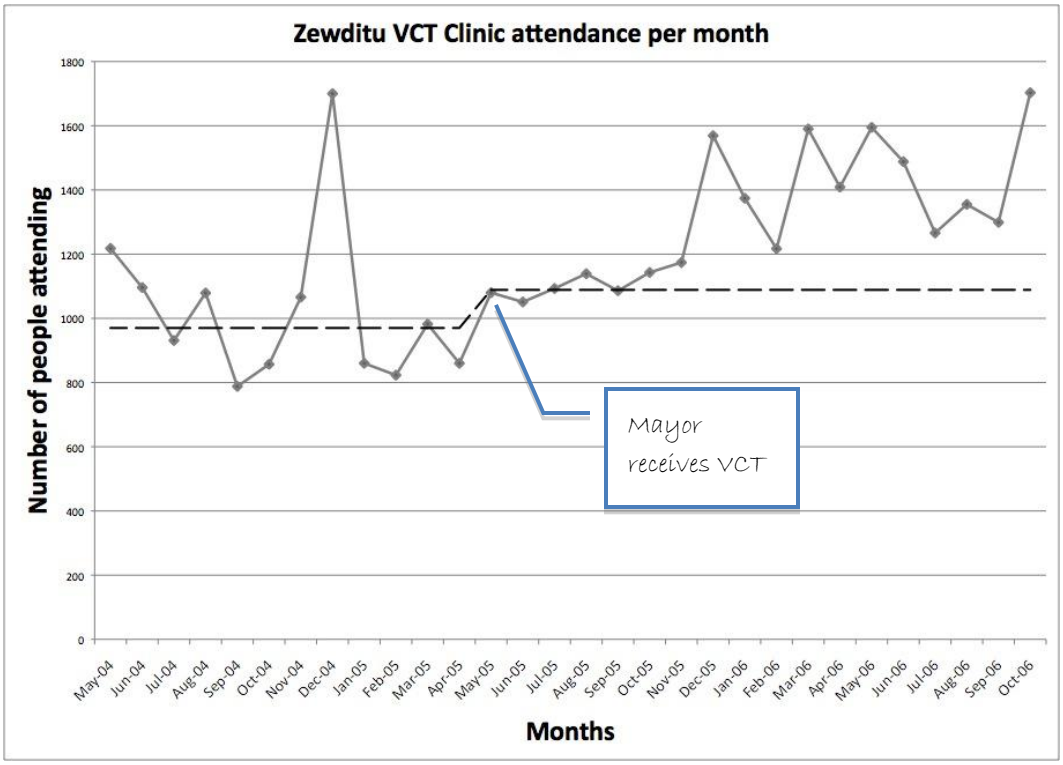


December 2004 is well above any others and is likely to be special. Something happened during this month that was attributable to more patients being tested.

This data point is excluded from the calculation of the mean to avoid distorting the result.



If we project the mean from April 2005, all of the following data points are above the mean.

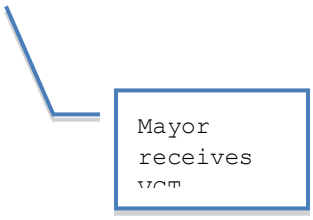


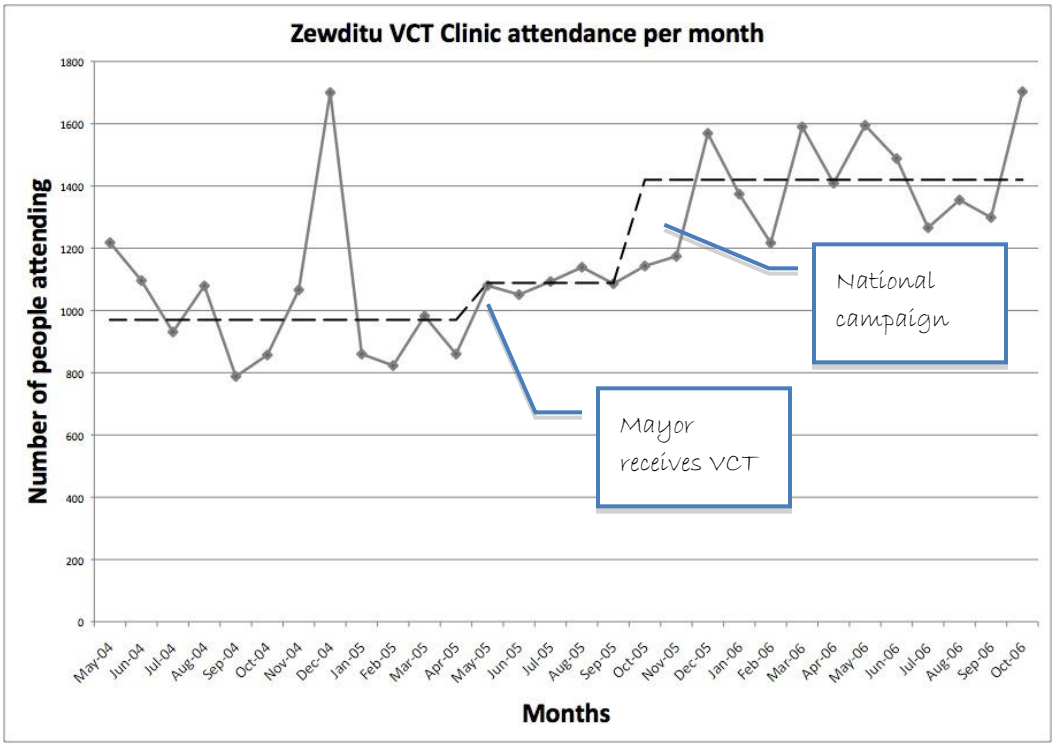
Around April 2005, a signal occurred. This could be a temporary special cause or, if sustained, a common cause shift leading to a larger number of people attending the clinic.

This was when the mayor of the city was shown on television receiving pre-test counseling and a rapid HIV test.

The data run was maintained so we could conclude that the promotion of an important official receiving a test contributed to a sustained increased in people coming forward for voluntary testing.

If we move forward in time, it appears that something significant may have occurred around October 2005.





This coincided with a new national HIV awareness campaign. The run chart shows an association between this campaign and a sustained, common cause, improvement.

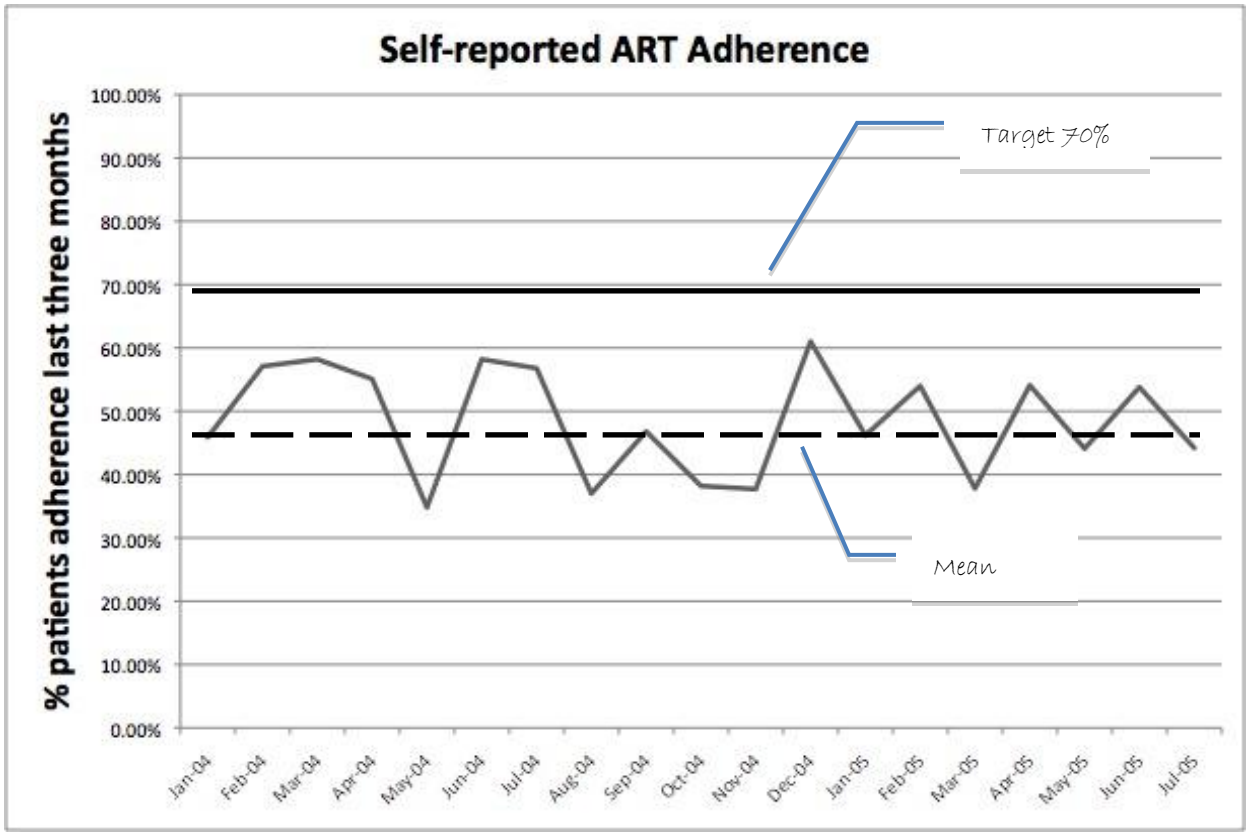
Overall the run chart shows that the data contain two common cause changes, which increased the attendance.

The run chart is a heuristic (rule of thumb) tool to help distinguish special and common causes. It was developed in the early 20th Century.

Case Example: ART Adherence Run Chart

Month	Patients 3 Months Adherence	# Patients End of Month	% Adherence
Jan-04	83	181	45.9%
Feb-04	105	184	57.1%
Mar-04	107	184	58.2%
Apr-04	103	187	55.1%
May-04	65	187	34.8%
Jun-04	113	194	58.2%
Jul-04	113	199	56.8%
Aug-04	74	200	37.0%
Sep-04	94	201	46.8%
Oct-04	78	204	38.2%
Nov-04	77	204	37.7%
Dec-04	125	205	61.0%
Jan-05	97	210	46.2%
Feb-05	115	213	54.0%
Mar-05	82	217	37.8%
Apr-05	118	218	54.1%
May-05	97	220	44.1%
Jun-05	119	221	53.8%
Jul-05	99	224	44.2%
Aug-05	86	225	38.2%
Sep-05	135	225	60.0%
TOTALS	**2085**	**4303**	

Case Example: ART Adherence Run Chart



Problem Statement

The data show the gap between current process performance (baseline) and the desired process performance.

You will now state this gap as a problem.

The problem statement should concisely communicate the process problem so that all the stakeholders can understand.

The problem statement states:

Problem Statement
Who?
What?
When?
Where?
How Many?

If you are using percentages in the problem statement to state "how many," also document the raw numbers, so others will understand what those percentages represent.

Example:

Problem Statement	
Who?	Clinic's patients.
What?	Self-reported adherence to ART.
When?	Jan-04 to Aug-05.
Where?	Our clinic.
How Many?	48.5%.
From Jan 04 to Aug 05 only 48.5% of our clinic's patients reported adhering to ART when the technical standard specifies 70%.	

Improvement Objective

Objectives describe your intent in measurable terms and allow you to evaluate your progress. Objectives should be written in such a way that they answer the questions:

Improvement Objective
What is the problem?
Where is it?
What do we want to do?
By when?

Example:

Improvement Objective	
What is the problem?	Current ART self-reported adherence is 48.5% (mean).
Where is it?	Our clinic.
What do we want to do?	Improve self-reported ART adherence to 70% (mean).
By when?	End of May 2006.
We will improve the ART self-reported adherence for our clinic from a mean of 48.5% to 70%	

Step 3: Analyze Causes of Variation

Activity10.11: Your Problem Statement and Improvement Objective

As a group, write a problem statement. Use your own data if you have access to them. If not, just for training purposes, use estimates. The problem statement must be based on accurate data.
Then write a precise improvement objective.
Present these for discussion.

Problem Statement		
Who?		
What?		
When?		
Where?		
How Many?		

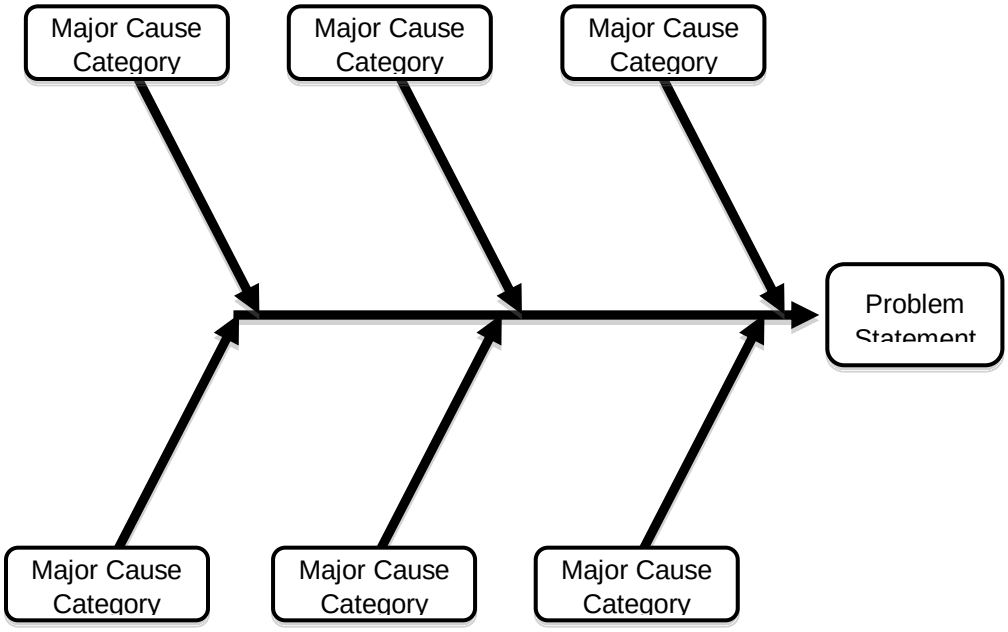
Improvement Objective
What is the problem?
Where is it?
What do we want to do?
By when?
by the end of May 2006.

Cause and Effect

Asking "why?" is the basis of cause-and-effect analysis.

A useful tool for analyzing cause and effect is the fishbone diagram.

Your problem statement is written into the "head" of the fishbone diagram. Possible causes are shown on the "bones" of the major cause categories.



First we generate lots of possible causes through group techniques, such as brainstorming. We then group similar causes on the bones of the fishbone diagram. Finally, we give each of the bones a name to represent the major cause category.

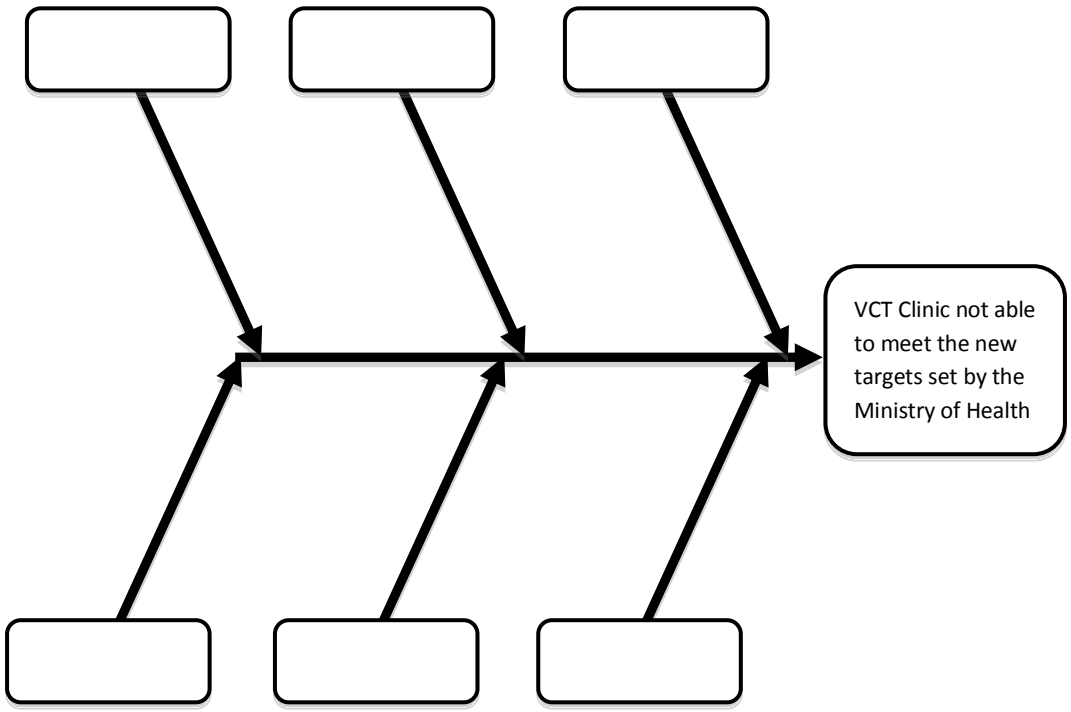
Example of Creating a Fishbone Diagram

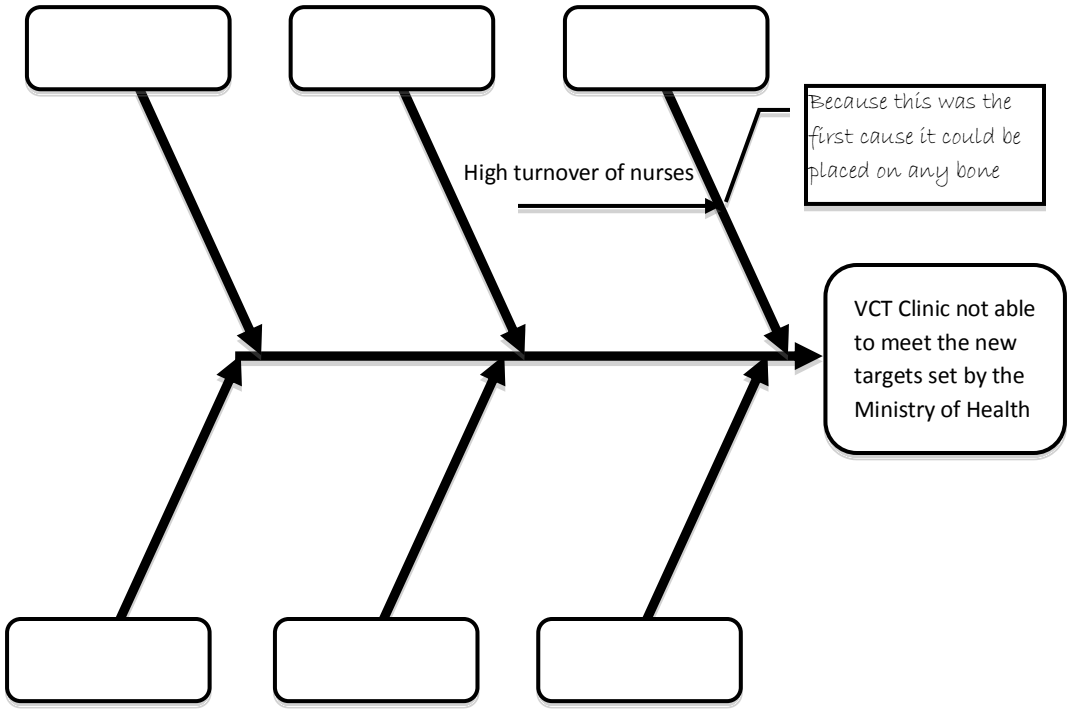
An HIV/AIDS Voluntary Counseling and Testing (VCT) team brainstormed why they were not meeting the new attendance targets set by the ministry of health.

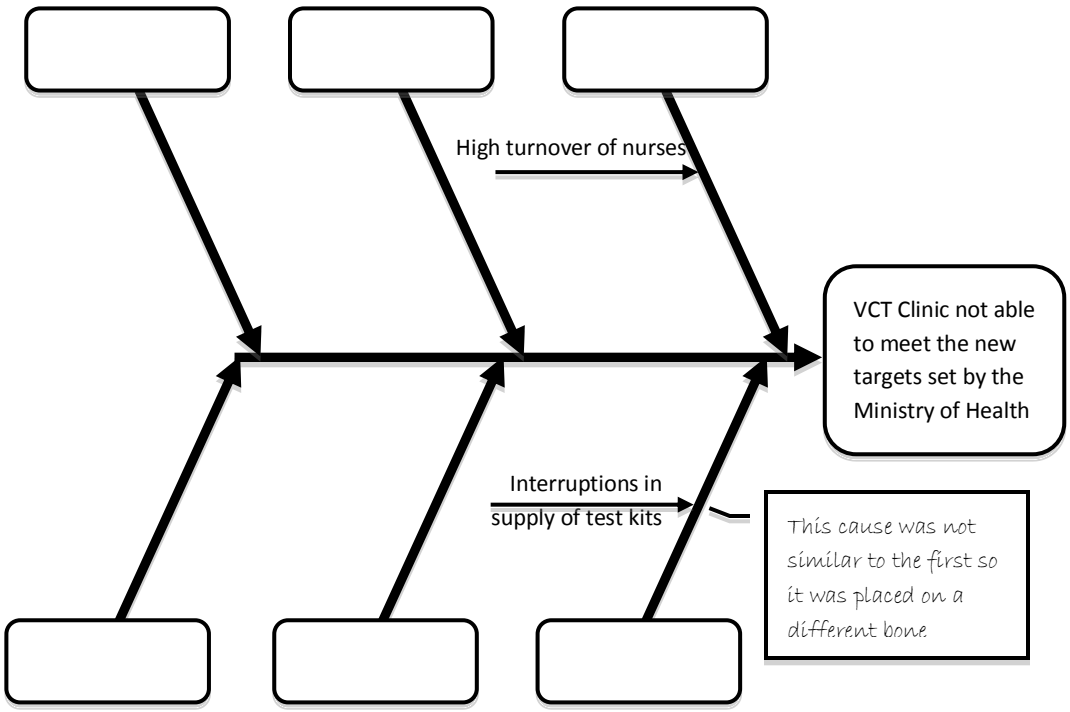
In ten minutes they generated 30 possible causes. Here are just a few.

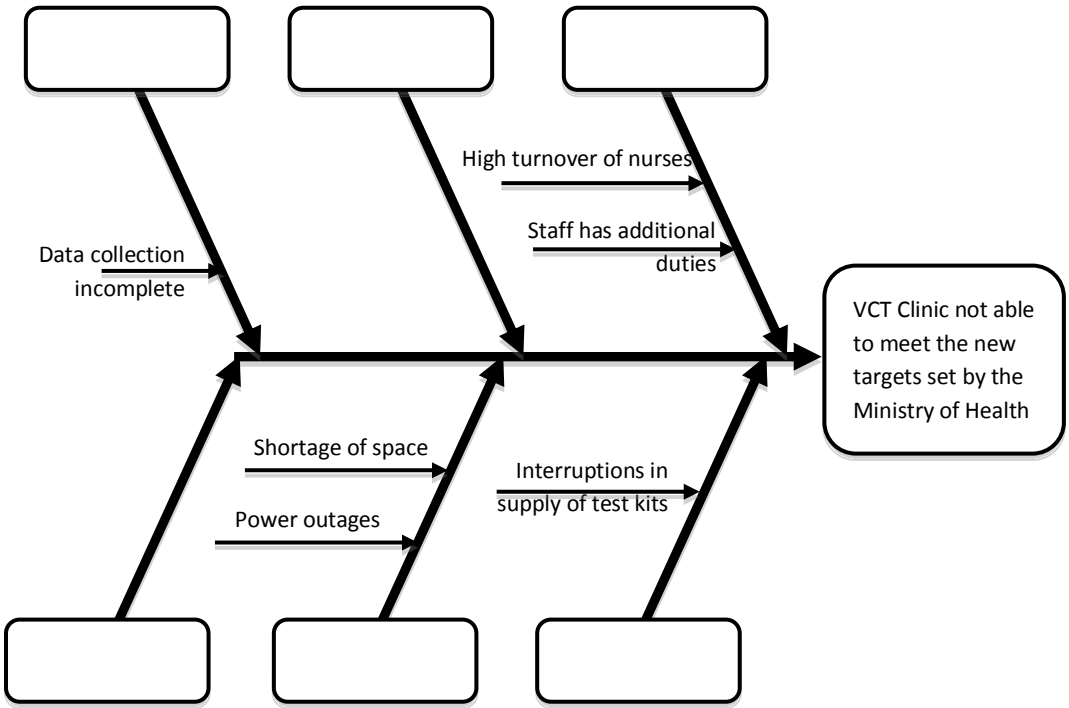
1. High turnover of nurses.
2. Interruptions in supply of test kits.
3. Reagent shortages.
4. Shortage of space.
5. Power outages.
6. Staff has additional duties.
7. Data collection incomplete.

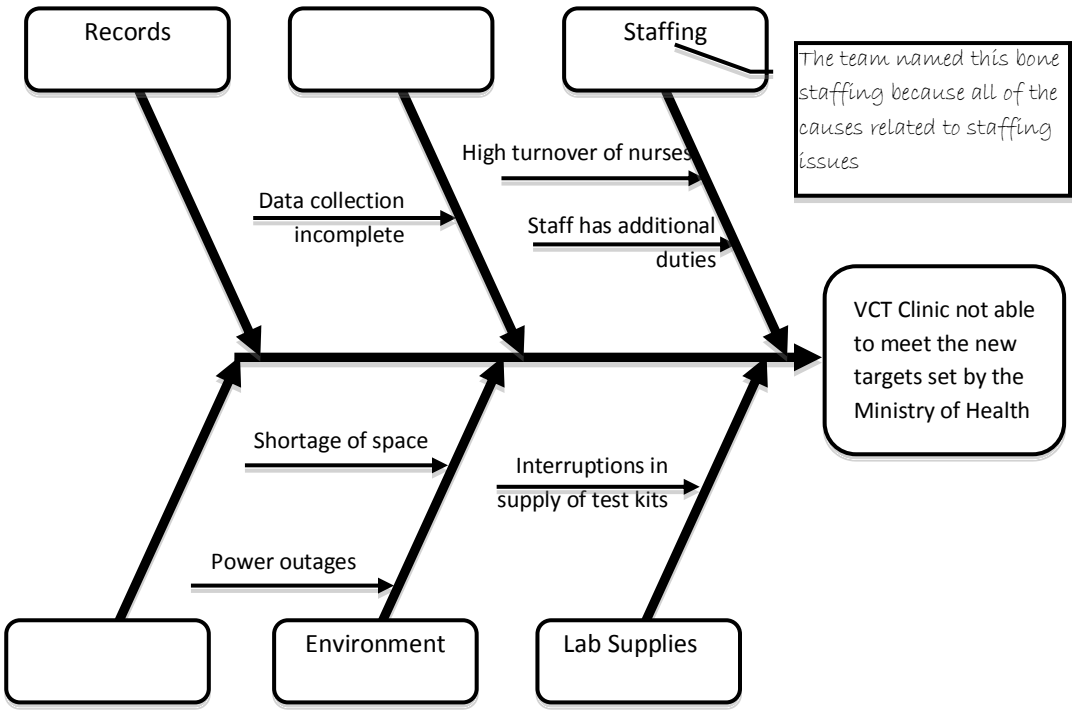
The team then drew a fishbone with six bones and wrote the problem statement in the head.






High turnover of nurses
VCT Clinic not able to meet the new targets set by the Ministry of Health
Interruptions in supply of test kits
This cause was not similar to the first so it was placed on a different bone


High turnover of nurses
Staff has additional duties
Data collection incomplete
VCT Clinic not able to meet the new targets set by the Ministry of Health
Shortage of space
Interruptions in supply of test kits
Power outages



The next step was to identify the causes on which to focus.

You can use this method, TPN, to reduce the causes from the fishbone diagram to a more manageable and relevant list.

TPN is designed for you to select those causes over which you have most control.

Your team decides whether an individual cause is totally (T) within its control to improve, partially (P) or not (N).

It is better to focus on causes over which you have total (T) or partial control (P). Those causes over which you have no (N) control can be assigned to other teams or individuals.

In the ART case example we made the following decisions.

- High turnover of nurses (N),
- Interruptions in supply of test kits (N),
- Reagent shortages (P),
- Shortage of space (N),
- Power outages (N),
- Staff has additional duties (P) and,
- Data collection incomplete (T).

This represented the team's view at the time, with the current team membership, and their responsibilities.

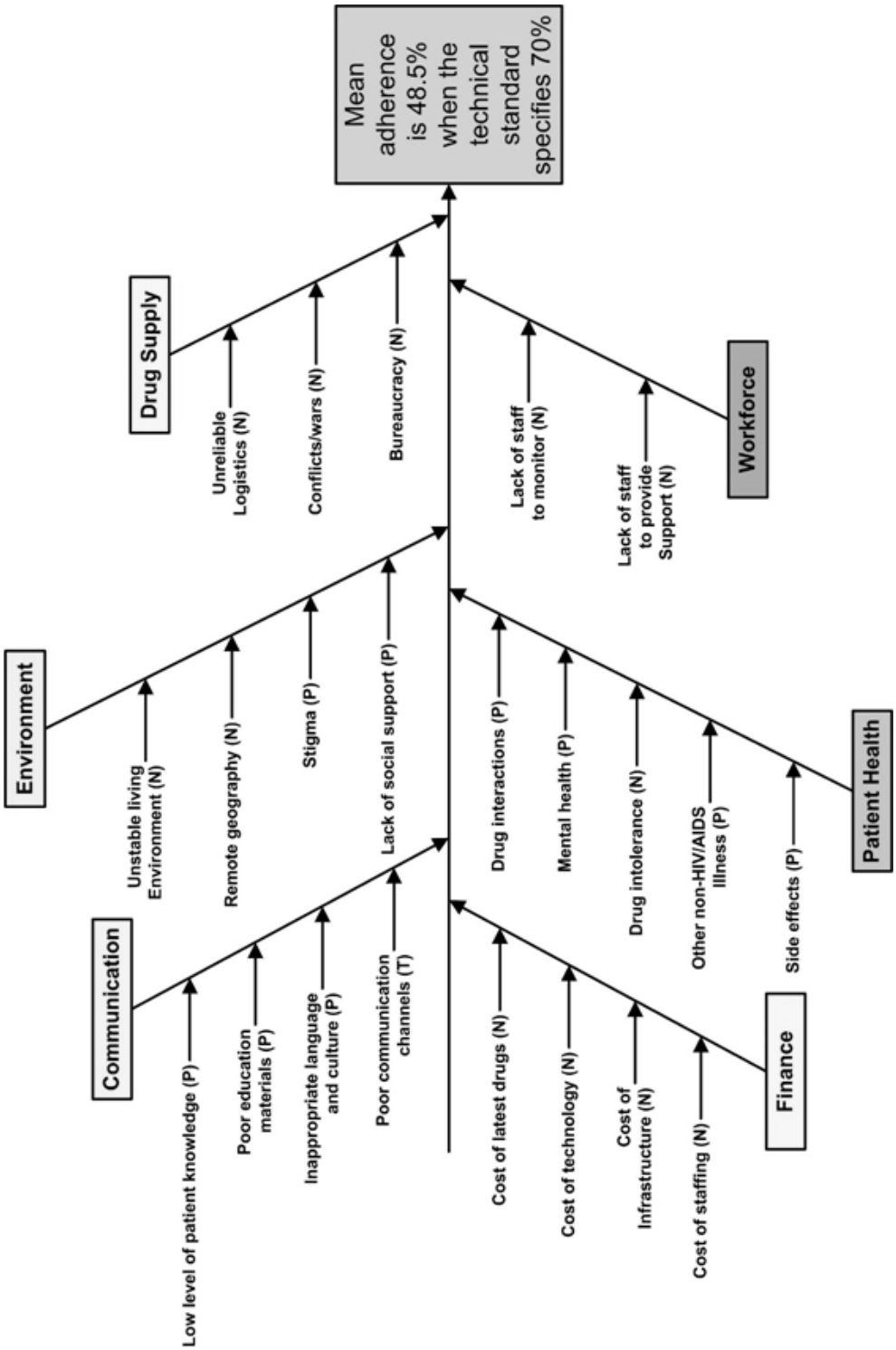
Out of the original thirty causes brainstormed they now had ten, which were totally (T) or partially (P) in their control.

The team used multivote to identify which cause they were going to address first. This was that data collection was incomplete.

They then prepared a flowchart of how data were gathered and reported to the region and then to the ministry.

Doing the flowchart showed where data were being lost and how they were reporting lower numbers than were actually justified.

Case Example: Possible Causes of Lack of Adherence



Activity 10.12: Explore the Causes

You are now going to prepare a fishbone diagram addressing the team's agreed-upon problem statement. Later you will explore a critical cause in more detail.

1. Review the problem statement and improvement objective from Step 2.
2. Look at the original flowchart again. Make sure you have a detailed understanding about where the problem is occurring in relation to the process itself. If necessary, create a more detailed flowchart.
3. Looking at the process, brainstorm all the possible causes of the problem. Don't judge or criticize. Strive for quantity of ideas. Write each idea onto a separate sticky note or card.
4. After completing the brainstorm, draw the fishbone structure using four to six bones.
5. Write the problem in the head of the fish.
6. Group the sticky notes on the bones.
7. Once the grouping is complete, decide on names for the bones that represent all the causes on that bone.
8. Consider each cause in turn and decide whether it is totally in the team's control (T), partially (P) or not at all (N). Mark each sticky note accordingly.
9. Select a spokesperson to present your fish and the causes that are totally or partially in your control.

Once again you are faced with the need to be selective. Unfortunately you are unlikely to have the resources to tackle all of the causes. You need to select the few that if improved will have the largest impact on the problem. These are the critical few causes.

Before starting a multivote you must make the voting decision clear. In this case it is "which are the critical few causes of a problem?"

Record the list for everyone to see on a flipchart.

Eliminate duplications.

Each member is allowed a number of votes equal to approximately one third the number of causes.

Provide individuals with sticky dots/small Post Its – one per vote.

Each individual uses their dots to select the items they consider important. All dots can be placed on one item or spread across a number of items.

ART Example

Item (Process/Measure/ Cause/Improvement)	**Votes**	**Number**
Lack of social support	☻ ☻ ☻ ☻	4
Stigma	☻ ☻ ☻ ☻	4
Drug interaction	☻ ☻ ☻	3
Mental health	☻ ☻	2
Other non HIV/AIDS related illnesses	☻ ☻ ☻	3
Side effects	☻ ☻ ☻ ☻	4

Low-level of patient knowledge	☻ ☻ ☻	3
Inappropriate language or culture	☻ ☻ ☻ ☻ ☻ ☻	6
Poor communication	☻ ☻ ☻	3
Poor education materials	☻ ☻ ☻ ☻ ☻ ☻ ☻ ☻	8

The team comprised ten people each with 4 votes.

You can see the priority, in this example is "poor education materials."

If there are several items with similarly high scores, lower items could be eliminated and the process repeated once more with a shortened list.

Activity 10.13: Select a Critical Cause

1. As a team, conduct a full multivote using the causes you identified from your fishbone diagram, which are totally (T) or partially (P) in your control.
2. Combine any obvious duplicates.
3. Fill in the multi-vote table.
4. Each member is allowed a number of votes equal to approximately one third the number of causes.
5. Add up the votes and enter the totals in the multivote table.

Verify Cause

After you have agreed a point of intervention, it is important to verify the cause in order to avoid the time and expenses of implementing a less than optimal improvement.

You should collect more data to support your analysis.

When data are not available, interview other process stakeholders not involved on the team.

Conducting and verifying the cause-and-effect analysis enables the team to understand the underlying causes of the symptom and to focus their improvement efforts in the most effective way.

This further analysis enables you to be more specific in your improvement ideas.

Step 4: Generate & Plan Improvement Ideas

Introduction

Now that the critical causes of variation have been identified we can start to explore possible improvements.

We want to make sure that we explore innovative and creative ideas. This involves broad thinking in which we try to generate as many ideas as possible.

Keeping your mind open at all times is likely to increase the chances of finding successful solutions.

We will use a number of tools to generate many possible improvement ideas.

We will then select one or two changes to the process and plan their implementation.

Activity10.14: Generate Ideas

1. Brainstorm all the possible ways to address your critical causes.
2. Group similar ideas.
3. Check that these groupings don't overlap.
4. List these on a flipchart
5. Conduct a multivote to select the one or two improvement ideas, which will have, if implemented, the most impact on reducing the critical cause of the problem.
6. Remember—no judgment or criticism!

If you only have a small number of improvement ideas, all of which you may implement, than it is not necessary to do another multi-vote. In this case you can proceed to planning.

Plan, Do, Study, Act

Now that you have one or two improvement ideas, you can take the remaining steps. Steps 4 to 7 are based on the internationally recognized Shewhart-Deming circle for continuous process improvement. The circle is typically applied to an improvement idea.

Plan how to implement your improvement idea.
Do it, preferably first on a small scale.
Study the results. What did you learn from studying your results? Did the idea work?
Act on the study results.

If the improvement idea was successful, standardize this new way of working and communicate it to others.

If it wasn't successful, either revise your improvement idea or abandon your idea altogether and try something else.

We now need to think about how to implement the selected improvement idea(s).

It is possible to apply several improvement ideas to a process at one time, but then it is hard to understand which ideas are responsible for the results.

Generally it is best to apply one change at a time and certainly no more than two.

To plan the change we use good project management disciplines, such as breaking down the task into smaller ones, deciding who will do what, and in which order. If the change is not complex we might use simple lists. If it is more complicated we might need to use work breakdown structures and task lists.

Breaking Down the Task

In planning a project the first step is to start with the end in mind. What is your goal? What will it look like when your task is complete?

The project, in this case an improvement idea, needs to be well defined.

For process improvement planning, tools like the Work Breakdown Structure (WBS) are usually sufficient.

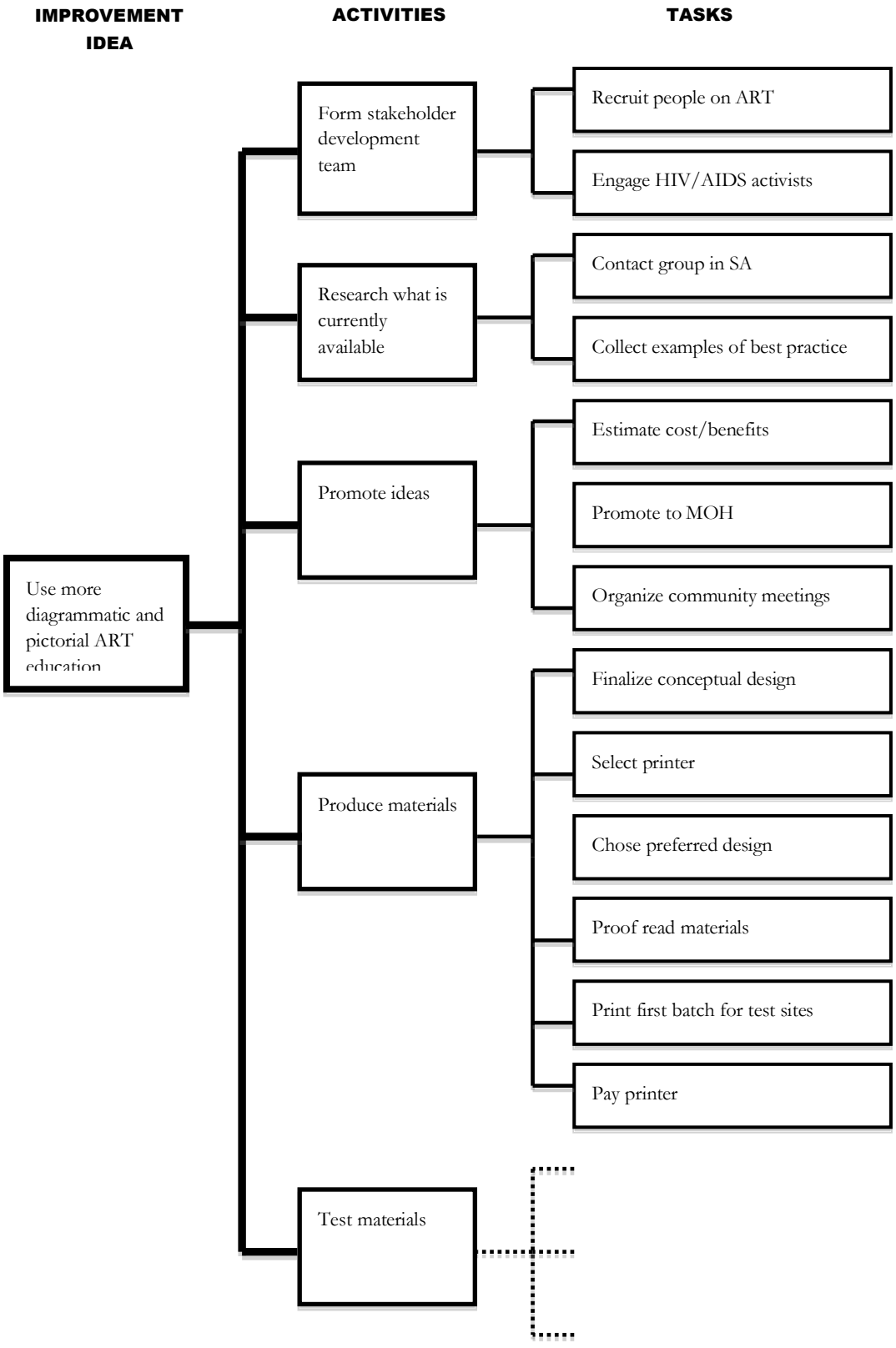
The WBS organizes and defines exactly what work needs to be done to successfully implement your improvement idea.

You will create a WBS by dividing your project into manageable activities and tasks that can be easily implemented and monitored by the improvement team.

An activity is an action in a WBS that requires effort, resources, and time. It comprises a series of tasks, which in turn may comprise more tasks.

The WBS also shows when the activities and tasks must be completed and who will complete them.

Case Example: ART Improvement Idea WBS



Case Example: ART Improvement Idea WBS

Activity: Produce materials			
Task	**Who**	**By When**	**Comments**
Finalize conceptual design	Tekeste	7/1/05	Select several alternatives
Select printer	Petros	7/1/05	Use local business
Chose preferred design	Tekeste	8/1/05	Involve whole team
Proof read materials	Ashenafi	8/14/05	Sign off
Print first batch for test sites	Printer	9/1/05	500 copies for testing
Pay printer	Carolyn	9/1/05 & 11/1/05	Fee: 50% upfront. 50% on delivery

Task Table List

Activity:			
Task	**Who**	**By When**	**Comments**

Step 5: Implement Change

Introduction

You are now in a position to implement your team's improvement idea, based on the plan developed in Step 4.

All the people involved in the implementation should know what they are doing and why.

Communication is central to an effective implementation plan.

Data will be gathered throughout the implementation to be used in the next step—study.

When you collect data you must do the following:

- Collect the data that measure the process in the same way.
- Use the same collection method.
- Use a comparable time period for the measurements.
- Use the same data collection tool.

If there is seasonality in the process, or perhaps local variations such as holidays, collect data in a similar time period.

You must choose an appropriate frequency of measurement. Are you going to measure daily, weekly, monthly or even quarterly? The choice will depend on issues such as volume of data and convenience of collection.

Step 6: Study Results of Change

Introduction

After a set time, stated in the improvement objective, the team will study the results of its improvement idea to see whether it really is an improvement or not.

The run chart is critical in highlighting whether there has actually been an improvement.

If there is a run of consecutive points on one side of the mean that take the data in the direction of the improvement target, this could be a signal that your change has resulted in improvement.

If the change to the process has resulted in a long-term improvement on the run chart, we have the evidence that the idea was a real improvement.

If the team was unable to find appropriate measures, and as a result could not use run charts, then qualitative means will have to be used to study results. Surveys or focus groups could be used with stakeholders to see if they perceive a real improvement.

We always strive for quantitative data but in its absence we may have to rely on qualitative methods of evaluation.

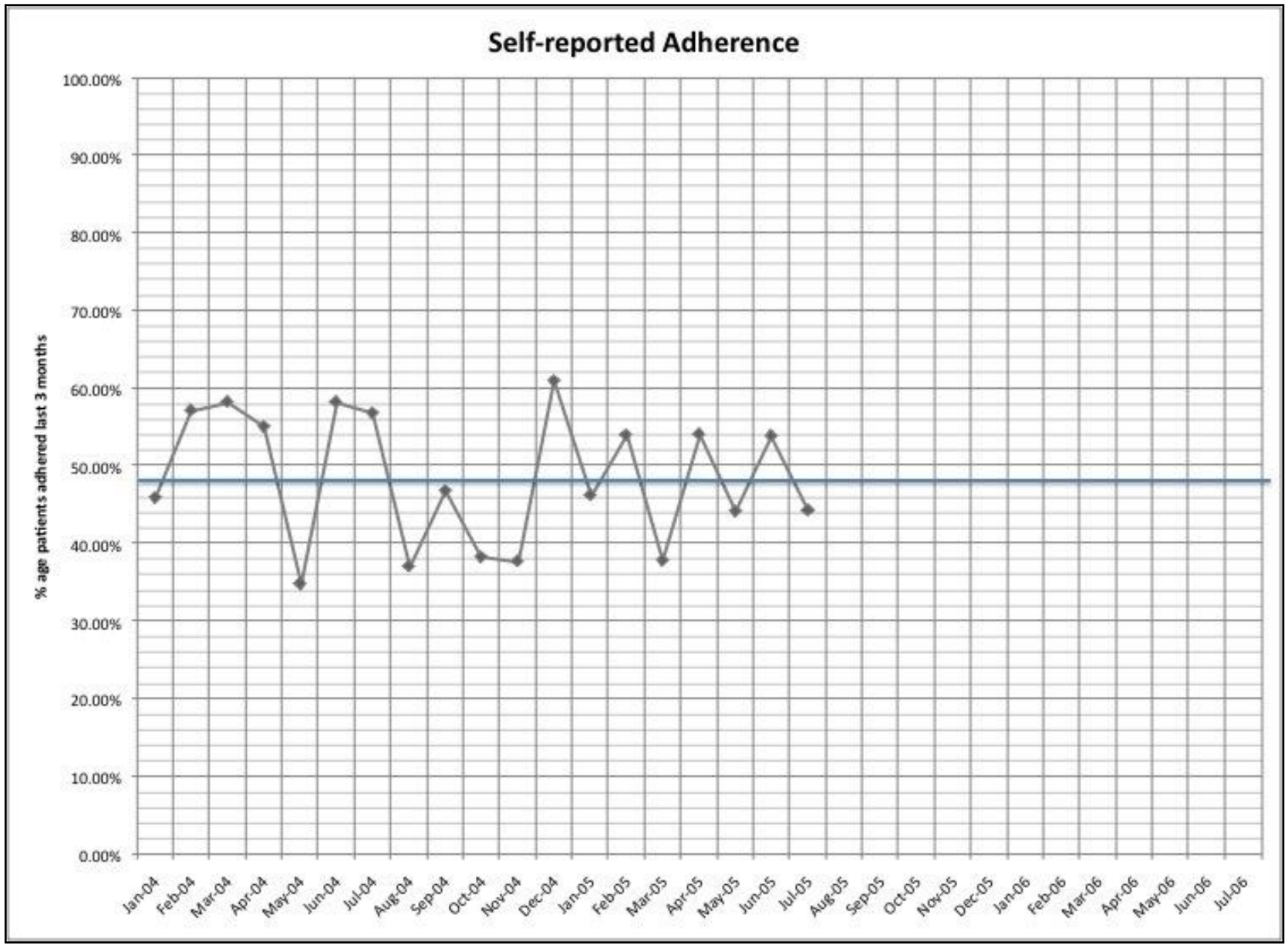
Case Example: Implementing the New Educational Material

Improvement Objective:

We will improve the ART adherence rate for our clinic from a mean of 48.5% to 70% by the end of May 2006.

Activity 10.16: How Well Do You Do?

1. The new educational material for ART was introduced to the clinic in September 2005.
2. You will be handed an envelope, which contains data for the months after you implemented this change.
3. Plot the data on the Run Chart below.
4. Interpret how successful your improvement was.
5. Present your interpretations.
6. What are you going to do next?


Self-reported Adherence
% age patients adhered last 3 months
100.00%
90.00%
80.00%
70.00%
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
0.00%
Jan-04
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
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Sep-05
Oct-05
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Jan-06
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Mar-06
Apr-06
May-06
Jun-06
Jul-06

Step 7: Act Accordingly

Introduction

The final step in the seven-step Process Improvement approach is using what you learned from the previous six steps to inform your future decisions.

There are three possible outcomes of the Plan-Do-Study steps.

The first possible outcome is that the improvement idea has been fully successful and the improvement objective achieved. The team has data to support the fact that the idea is a sustained improvement.

In this case, the first thing to do is to use the idea to make improvements elsewhere in your work environment, monitoring that the improvements are replicated.

You will certainly want to consider modifying your standard operating procedures to include the improved way of working.

Also communicate your success to all the other stakeholders. This will enable them to learn from your improvement and apply it to similar processes without having to repeat all your team's work.

You may require a plan to share the new procedure with all the appropriate departments and organizations.

The process improvement tools, such as flowcharts, run charts, and fishbone diagrams, are very powerful for communicating what the team has done and why. Flowcharts can be used to display revised operating procedures.

The second possible outcome is that your team achieved some improvements but not so much as indicated in the improvement objective. The team will need to revisit the improvement ideas. You might modify the idea and the implementation plan. You can then conduct another PDSA circle and hopefully achieve the desired improvement objectives.

This is why Plan-Do-Study-Act is a circle. You keep going around the circle, learning each time, improving compliance with technical standards and increasing customer satisfaction.

The third possible outcome is that no improvement was achieved. Hopefully the team has learned from the experience. The team members should revisit the cause-and-effect analysis and select another cause to address. In some cases they may even focus on another process altogether.

Remember innovation is rarely achieved without failure. If you experience the third outcome, don't be discouraged; document what the team learned and continue. This is the nature of continual improvement.

Activity 10.17: Storyboard
Instructions:
1. As a team, gather all the flipchart pages that show the work you have done during the training on the process you chose at the start of the course.
2. Put them in the order of the seven-steps (20 minutes).
3. Select a spokesperson.
4. This person will now give a brief overview of the work done and the main points learned to all the participants (5 minutes).

Applied Learning Project
About This Section

This section of the workbook is intended to assist you as you practice your process improvement skills. Use the checklists and questions to help you manage an existing project or begin a new project.

Keep a record of your process improvement project to track your progress and the methods and tools that are most helpful for you. Include documentation and tools that you use to define, plan, implement, and close your project, including the materials you use from this workbook. Use this information to review your progress with your supervisor.

Questions are provided at the end of each process improvement step. Use these questions to think about your own experiences and to identify methods you may use in the future.

My Project

Project Title
Project Description
Project Start Date

Process Improvement Checklists

Define Process

Activities Checklist

This section provides a checklist related to the *Define Process* step. You can use the checklist to assure that the project has completed the activities related to effective definition of a public health process. Use the tools if you need them based on your project's requirements.

Define Process Check List		
☐	Processes identified.	
☐	A process selected.	
☐	Customer defined.	
☐	Products and services identified.	
☐	Customers' wants and needs understood.	
☐	Other Stakeholders identified.	
☐	Existing process is understood.	*Flowchart*

For reflection after you have completed this step:

What methods and tools did you use to manage the *Define Process* step of your project?

What difficulties did you encounter during this step?

What will you do differently in the future?

Measure Process Performance

Activities Checklist

This section provides a checklist related to the *Measure Process Performance* step. You can use the checklist to assure that the project has completed the activities related to accurate analysis of process performance. Use the tools if you need them based on your project's requirements.

Measure Process Performance Check List

☐	Measures identified.	
☐	Measure selected.	
☐	Data collected.	*Check sheet*
☐	Data analyzed and presented.	*Pie, Bar, Pareto & Run charts*
☐	Problem stated.	
☐	Improvement objective stated.	

For reflection after you have completed this step:

What methods and tools did you use to manage the *Measure Process Performance* step of your project?

What difficulties did you encounter during this step?

What will you do differently in the future?

Analyze Causes of Variation

Activities Checklist

This section provides a checklist related to the *Analyze Causes of Variation* step. You can use the checklist to assure that the project has completed the activities related to effective analysis of process quality. Use the tools if you need them based on your project's requirements.

Analyze Causes of Variation Check List		
☐	Many possible causes of variation generated.	*Brainstorm, Fishbone Diagram*
☐	Critical cause agreed.	*Multivote*
☐	Critical cause has been verified where possible.	

For reflection after you have completed this step:

What methods and tools did you use to manage the *Analyze Causes of Variation* step of your project?

What difficulties did you encounter during the Implement & Control phase?

What will you do differently in the future?

Generate & Plan Improvement Ideas

Activities Checklist

This section provides a checklist related to the *Generate & Plan Improvement Ideas* step. You can use the checklist to assure that you are thinking broadly and exploring innovative and creative ideas. Use the tools if you need them based on your project's requirements.

Generate & Plan Improvement Ideas Check List		
☐	Many improvement ideas have been generated.	*Brainstorm*
☐	One or two critical improvement ideas have been selected.	*Multivote*
☐	A plan exists for implementing these ideas.	*Work Breakdown, Structure*
☐	Required tasks are distributed to team members.	

For reflection after you have completed this step:

What methods and tools did you use to manage the *Generate & Plan Improvement* step of your project?

What difficulties did you encounter during this step?

What will you do differently in the future?

Implement Change
Activities Checklist

This section provides a checklist related to the *Implement Change* step. You can use the checklist to help you as you put the improvement ideas into practice. Use the tools if you need them based on your project's requirements.

Implement Change Check List		
☐	Changes communicated.	
☐	Training conducted if needed.	
☐	Change implemented.	
☐	Data collected.	

For reflection after you have completed this step:

What methods and tools did you use to manage the *Implement Change* step of your project?

What difficulties did you encounter during this step?

What will you do differently in the future?

Study Results of Change
Activities Checklist

This section provides a checklist related to the *Study Results of Change* step. You can use the checklist to assure that you are taking the time to analyze the effectiveness of the improvement. Use the tools if you need them based on your project's requirements.

Study Results of Change Check List		
☐	Improvement objective reviewed.	*Improvement Objective*
☐	Data analyzed.	*Run Chart*
☐	Findings communicated.	

For reflection after you have completed this step:

What methods and tools did you use to manage the *Study Results of Change* step of your project?
What difficulties did you encounter during this step?
What will you do differently in the future?

Act Accordingly
Activities Checklist

This section provides a checklist related to the *Act Accordingly* step. You can use the checklist to support continuous improvement in your organization. Use the tools if you need them based on your project's requirements.

Act Check List		
☐	Improvement successful?	
☐	Findings disseminated widely and rapidly.	
☐	Procedures updated.	
☐	Training delivered if required.	

For reflection after you have completed this step:

What methods and tools did you use to manage the *Act Accordingly of Change* step of your project?

What difficulties did you encounter during this step?

What will you do differently in the future?

Conclusion

Now that you have completed your project using the skills and tools you have learned, take time to reflect on your experience. Use the following questions to guide your reflection and discuss your thoughts with your supervisor.

1. Of what portion of the project are you the most proud?
2. Of what portion of the project are you the most disappointed?
3. Of all that you learned in Process Improvement training, what method helped you the most?
4. Which tools were most useful?
5. Which tools were not very useful?
6. What will you do differently with your next process improvement project?
7. What will you share with your colleagues about quality and process improvement?

References

AED Global Health, Population and Nutrition Group (2002).Introducing Antiretroviral Therapy (ART) on a Large Scale: Hope and Caution.

AETC—National Resource Center (2002).Measuring Clinical Performance: A Guide for HIV Health Care Providers.
Associates in Process Improvement.www.apiweb.org/API_home_page.htm
Bennis, W. (1999). The leadership advantage. Spring.
CDC AIDS Prevention.www.cdc.gov/hiv/dhap.htm
Center for Creating Leadership. (2011). Addressing the leadership gap in healthcare. Retrieved May 23, 2013, from www.ccl.org
Charles W. et al. (2009). Esentials of strategic management. USA: Southwestern.
Daft R. (2005). The leadership experience. Toronto: Southwestern.
Deming, W. E. (1986). Out of the Crisis.Cambridge University Press.
Health Systems 20/20. (2012). The health system assessment approach: a how to manual. Retrieved June 11, 2013, from www.healthsystemsassessment.org/
HIV Clinical Resource.www.hivguidelines.org/Content.aspx
HIV/AIDS Bureau Collaborative - Improving Care for People Living with HIV/AIDS Disease.http://hab.hrsa.gov
J.David Hunger et al. (2011). Essentials of strategic snagement. USA: Prentice Hall.
John Hopkins Health System Corporation. (ND). Change Management Toolkit; Office of Organization Development & Training.
Johnson CH. (2002). Passing the torch. USA.
Lussier R. & Achua C. (2004). Leadership theory. Minnesota:
Management Sciences for Health. (2005). Toolkit: Resources to support managers who lead, A Handbook for Improving Health Services Cambridge, MA.
Marsh, J. (1998). A Stake in Tomorrow.BT Batsford.
McManus, J. (2006). Leadership: Project & human capital management. UK: Elselvier Ltd.
Ministry of Health, Governement of Pakistan. (2002). District Health Planning Mannual. Pakistan.
MSH. (2005). Managers who lead: A Handbook for improving health services. USA.
Nanus B. & Dobbs S. (1999). Leaders who make a difference. San Francisco: Jossy-Bass.
Nick Goodwin et al. (2006). Understanding public health: Managing health services. London: Open University Press.
Pyzdek, T., (2003).The Six Sigma Handbook.McGraw-Hill.
Richard L.H and Katherine C.B. (2005). Becoming a strategic leader. USA: Jossey Bass.
Richard L.Hughes & Colarelli Beatti. (2005). Becomin a strategic leader. USA: Jossey-Bass.
Rufaro Chatora & ProsperTmusiime. (2004). District Health Management Trianing Modules; Management, leadership and partnership for health, module-2. Brazaville: WHO.
Source http://aidsinfo.nih.gov/GlossarySouthwestern.
Steven, C. (2004). The 7 habits of highly effective people. New York: Free Press.
Sustainable Management Development Program (2000). Healthy Plan it™ - a tool for planning and managing public health programs. Atlanta: Centers for Disease Control and Prevention.
Wheeler, D., J. (1993). Understanding Variation—The Key to Managing Chaos. SPC Press.
World Health Organization (2004). An approach to rapid scale-up: Using HIV/AIDS treatment and care as an example.
World Health Organization. (2001). Community Health Need Assessement. Copenhagen: WHO.
Centers for Disease Control and Prevention/Center for Global Health. CDC's Sustainable Management Development Program: Advancing Global Health Leadership and Management; Division of Public Health Systems and Workforce Development, July 2010; Atlanta, Georgia 30333, USA.

Rolle et al. Leadership in strategic information (LSI) building skilled public health capacity in Ethiopia; BMC Research Notes, 2011, 4 :292. Available at: http://www.biomedcentral.com/1756-0500/4/292]
David Osborne and Ted Gaebler. Improving Mission Performance through Strategic Information Management and Technology: Learning from Leading Organizations, Executive Guide; New York: Addison-Wesley Publishing Company, Inc., 1992. GAO/AIMD-94-115
James A. Wolff, Linda J. Suttenfield, Susana C. Binzen, MSH, The Family Planning Manager' Book: Basic skills and Tools for Managing FP, 1991.
Health Systems Assessment Approach: A How-To Manual, WHO.
Joseph Tan, Foundation Concepts of Health Management Information Systems, Jones and Bartlett Publishers, LLC.
MANAGERS WHO LEAD: A Handbook for Improving Health Services, 3rd Edition, MSH, 2005
WHO.Framework& Standards for Country HIS, Geneva, WHO, 2007.http:/www.healthmetricsnetwork.org.
James Robertson, Information Management Article, Nov. 1, 2005; retrieved fromhttp://www.steptwo.com.au/papers/kmc-effective on August/2013.
Working notes for information management in Mine Actions, Geneva International Center for Humanitarian Demining, 2013.
Don de Savigny and Taghreed Adam (Eds).Systems thinking for health systems strengthening. Alliance for Health Policy and Systems Research, WHO, 2009
Hans G. Daellenbach, Donald C. McNickle Management science decision making through systems thinking PALGRAVE MACMILLAN, 2005
Stephen G. Haines, The manager's pocket guide to systems thinking & learning, HRD PRESS Amherst, Massachusetts, 1998
Dennis Sherwood, Seeing the Forest for the Trees, A Manager's Guide to Applying Systems Thinking, Nicholas Brealey Publishing in 2002
Senge, Peter M. The fifth discipline: the art and practice of the learning organization, Doubleday Publishing, New York, 1994
Robert Louis Flood., Rethinking The Fifth Discipline: learning within the unknowable, Routledge 1999
Carson F. Dye and Andrew N. Garman, Exceptional leadership: 16 critical competencies for health executives, Foundation of the American College of Healthcare Executives, 2006
John H. Zenger, Joseph R. Folkman and Scott K. Edinger. The inspiring leader unlocking the secrets of how extraordinary leaders motivate, McGraw-Hill, Chicago 2009
Reldan S. Nadler, Leading with emotional intelligence hands-on strategies for building confident and collaborative star performers, The McGraw-Hill Companies, Inc., New York 2011

Part2:

DESCRIPTIVE EPIDEMIOLOGY

1. Introduction
    - Definition
    - Scope of epidemiology
    - Assumptions in epidemiology
    - Levels of disease occurrence
    - The infectious diseases process (chain of disease transmission)
2. Measures of occurrence (incidence and prevalence)
3. Descriptive epidemiologic studies
4. Hypothesis generation

This session gives overview of the purposes of a epidemiology, the common types of epidemiological concept. This session will enable you to answer the questions: why are epidemiology study designs needed? How do they work and what are their types?

Learning Objectives:

- Define epidemiology
- List the uses of epidemiology
- Describe the interactions between host, agent, and environment

Definition of Epidemiology:

Epidemiology comes from the Greek words: "Epi" = on or upon, "Demos" = people or population and "Logos" = study of.

Hence, Epidemiology is the study of occurrences in a specified population

1. In more modern terms, Epidemiology is defined as; "the study of the frequency, distributionand determinants of health and other health related statesor events in specified human populations and its application to the prevention and controlof diseases and other health related problems."[Last JM, 2001].It is a discipline that approaches problems systematically and quantitatively.

Key words in the definition of Epidemiology:

- **Frequency –** Shows epidemiology is mainly a quantitative science. Frequency of diseases is measured by morbidity rates and mortality rates.
- **Distribution** - Refers to how disease is distributed throughout the population with respect to **time, place,** and **person.**
- **Determinants**- Refers to the 'why' and 'how' diseases occuri.e the causes and risk factors of diseases.
- **Population-** Epidemiology focuses on populations rather than individuals. So, the epidemiologist's "patient" is the community.
- **Application -** Epidemiology is both the science and the practice. It is knowledge for action to prevent and /or control diseases and other health related problems.

There are two basic assumptions in epidemiology. These are:

1. Nonrandom distribution of diseases i.e. the distribution of disease in human population is not random or by chance and
2. Human diseases have causal and preventive factors that can be identified through systematic investigations of different populations.

➢ Since distribution of diseases is not random or by chance, we need to identify what factors lead to the higher level of occurrence of a disease in one area as compared to others.

Epidemiology is also based on the assumption that diseases have causal and preventive factors and these can be identified by studying human populations at different places and times.

Uses of Epidemiology

The following are the main uses of Epidemiology:

- Determine the magnitude and trends
- Identify the etiologyor causes of disease
- Determine the mode of transmission
- Identify risk factors or susceptibility
- Determine the role of the environment
- Evaluate the impact of the control measures

Core Functions ofEpidemiology

- Public health surveillance
- Investigation of an outbreak
- Data analysis (both descriptive/ analytic)
- Evaluation of programs
- Communication
- Management and teamwork

Basic Approches in Epidémiologie

Epidemiology is broadly divided into two: descriptive and analytic epidemiology. Descriptive Epidemiology deals with describing diseases and other health related events through counting, and describing them by person, time and place. Analytic epidemiology, however, uses the descriptions and answers the reasons of why and how diseases occur.

In short, what descriptive epidemiology presents an input for analytic epidemiology where there is a continuum in between describing events, generating and testing hypothesis.

Levels of Disease Occurrence

These are different levels of diseases based on the magnitude of the disease affecting people.

Sporadic: Occurring at irregular intervals; having no pattern or order in time;appearing singly or at widely scattered localities, as a plant or disease.

Endemic: A disease (or anything resembling a disease) constantly present to greater or lesser extent in a particular locality; the background rate of disease; "diseases endemic to the tropics"; "endemic malaria"; "food shortages and starvation are endemic in certain parts of the world“

Epidemic - Spreading rapidly and extensively by infectingand affecting many individuals in an area or a population at the same time: an epidemic outbreak of influenza.

Pandemic- Is an epidemic over a wide geographical area; "a pandemic (outbreak) of malaria", existing everywhere. It is an epidemic that is geographically widespread; occurring throughout a region or even throughout the world.

Levels of Disease Occurrence

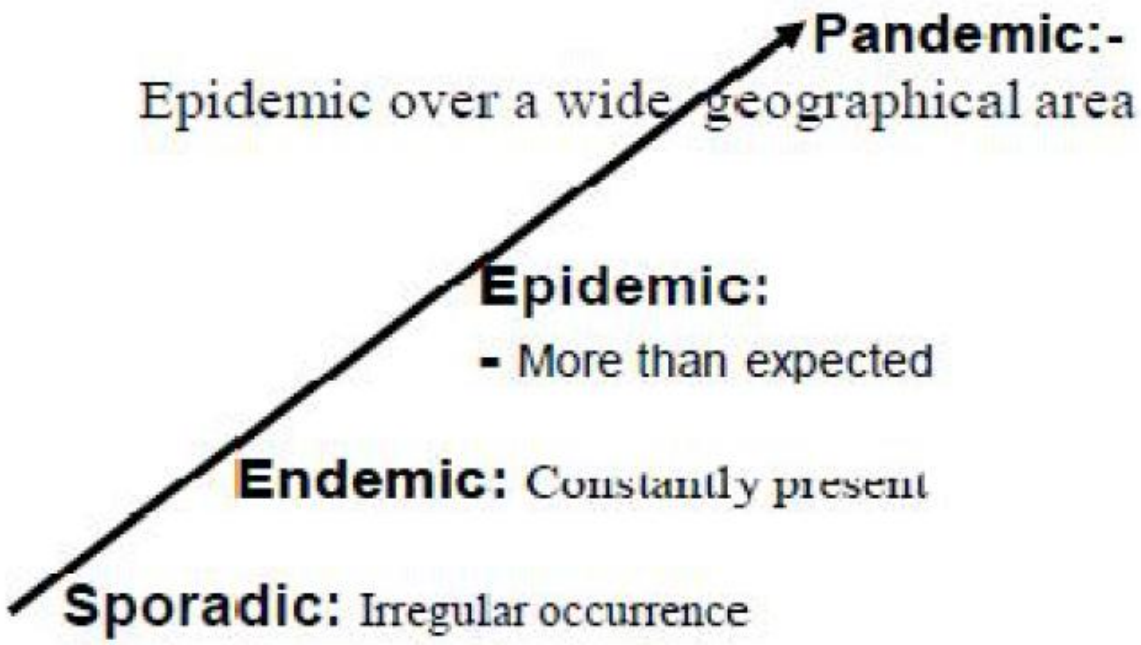


Figure 1: Shows the increasing level of disease occurrence by hierarchy

Another way of looking at transmission of disease is through a chain of infection model. This model allows us in infectious disease epidemiology to pinpoint how to control a disease. Usually there is a reservoir of disease and the disease is transmitted to a host and the chain continues.

Communicable diseases

- Illnesses due to specific infectious agents or its toxic products
- Arise from transmission of agents or toxic products
- By direct or indirect mode of transmission through an intermediate host, vector or inanimate object.

Chain of disease transmission (components of infectious process)

Definition: Logical sequence of factors or links of a chain that is essential to the development of infectious agent and to propagation of disease.

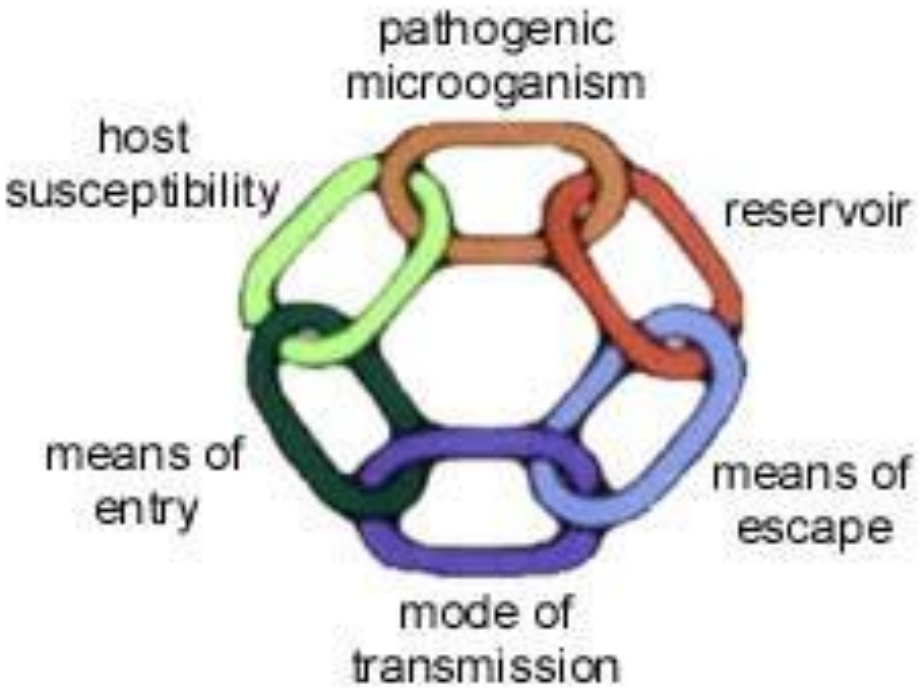


Figure 2: The chain of infectious process

The infectious process (components of infectious disease process) includes the following 6 components:

1. The agent
2. The reservoir
3. portal(s) of exit from the reservoir
4. Mode(s) of transmission
5. Portal(s) of entry in to the new host and
6. The presence of susceptible host.

Session 2: Measures in Epidemiology

Session overview:

This session gives overview of the purposes of measurement of disease occurrence. This session will enable you to answer the questions: why is Ratio, rate and proportion needed and how to measure the occurrence of disease frequency. How do they work and what are their types?

Epidemiology is a quantitative science. We speak of diseases and their occurrences in terms of measurements such as the frequency which can be in the form of counts, ratios, proportions or rates. Ratios, proportions and rates are used to relate the number of cases of outcome to the size of the source population inwhich they occurred.

- To describe the pattern of disease or identify its determinants, it is necessary to measure the frequency of disease or other outcome of interest, counting being the simplest methods of measuring. The key in epidemiology during measuring an event is relating the number of occurrences i.e. the frequency (numerator) to the appropriate population (denominator).

- Just counting the event/object of interest or measure is commonly a descriptive measure which is the first step in understanding it, calculating rates and essential for decision making.

To strengthen this, here is a scientists saying; "I often say that when you can measure what you are speaking about, and express it in numbers, you know something about it; but when you cannot express it in numbers, your knowledge is of a meager and unsatisfactory kind; it may be the beginning of knowledge, but you have scarcely, in your thoughts, advanced to the stage of Science, whatever the matter may be." Lord Kelvin (Kenneth Rothman, Modern Perspectives in Epidemiology, 1st ed. Boston, Little Brown, 1986, page 23)

Learning Objectives:

- Describe the measurement approaches of disease occurrence

Common Measures of Frequency

A **ratio** is the relative size of two quantities, calculated by dividing one quantity into another in which there is no specific relationship between the numerator and denominator. The two

quantities could be related or totally independent i.e. numerator not necessarily included in the denominator.

A **proportion** is one number divided by another number in which those two are related in a way that the numerator is included in the denominator. A proportion ranges from 0-1, or 0-100% when expressed as a percentage.

A rate is a measure of the frequency with which an event occurs in a defined population in a defined time (e.g., number of deaths per hundred thousand Ethiopians in one year). Unlike a proportion, rate has a time dimension.

When we call a measure a **ratio** we usually mean a **non-proportional ratio**. When we call a measure a **proportion**, we usually mean a proportional ratio that doesn't measure an event over time. When we use the term **rate**, we frequently refer to a proportional ratio that does measure an event in a population over time.

The following figureclearly depicts the three terms, i.e. ratio, proportion and rate.

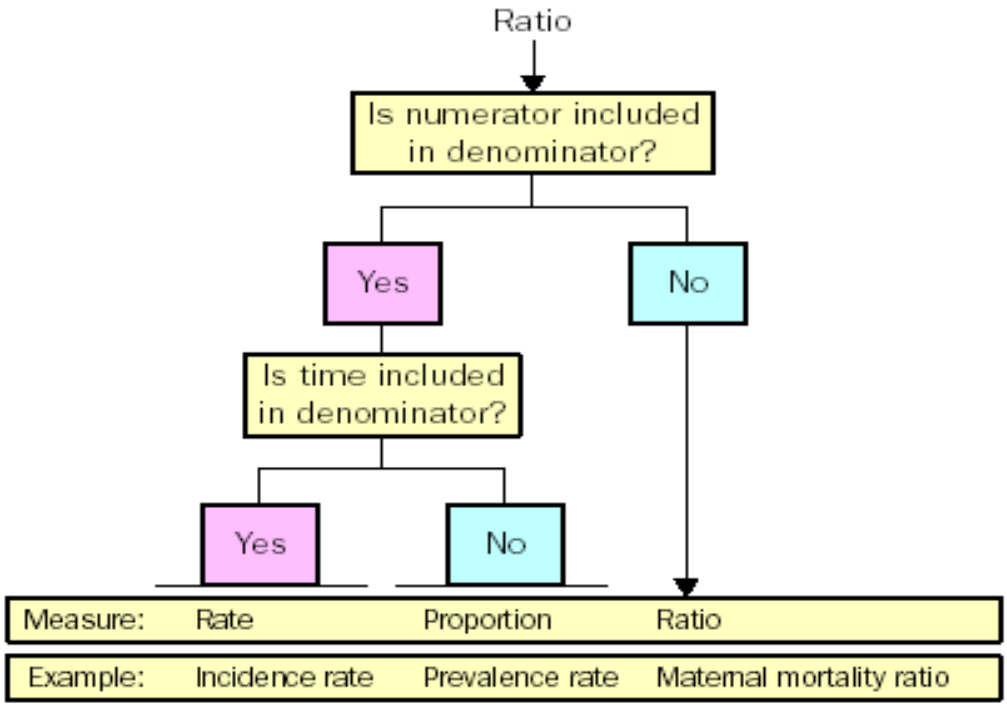


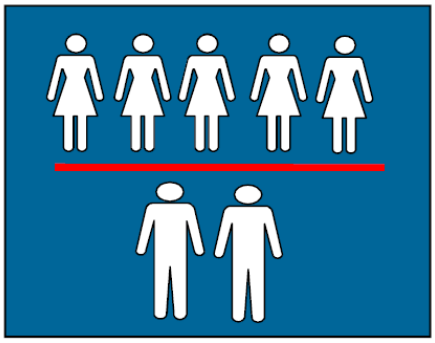
Figure3.A figure presenting the concepts of proportion, ratio and rate

Elaborative examples

Ratio: Example- sex ratio i.e the ratio of males to females

In this population of seven people of whom five are females the sex ratio will be

$$\frac{\#\ \text{Females}}{\#\ \text{Males}}$$

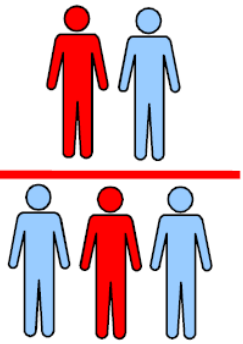


= 5 / 2 = 2.5:1 = 2.5

Example 2: A city of 4 million people has 400 clinics. Calculate the ratio of people per clinic.

Ratio = 4,000,000/400 = 10,000 persons/clinic)

Proportion: Example; The proportion of HIV positive TB case among all TB cases diagnosed at a hospital

Proportions =  **$= (x / y) \times 10^n$**

Where x = numerator
y = denominator
10^n = constant (1, 100, 1000, etc.)

Rate: is a proportion with time element. It tells how quickly something happens. There are different epidemiological measures which are actual rates; to mention some, attack rate, case fatality rate, incidence rate, etc.

Incidence rate: The number of new events, e.g., new cases of a disease in a defined population within a specified period of time. Suppose one wished to know how many people in a given population newly develop diabetes in a certain period of time. Let us say all people were screened at the start of the calendar year and 10% of 10,000 are found to be diabetic. The rest 9,000 people are non-diabetic or "healthy" were again screened for diabetes after one year and 90 people were found diabetic. Then the one year incidence of diabetes in this population is 10% (90/9,000). Estimating incidence has a longitudinal (follow-up) component in it (as compared to prevalence which has a cross-sectional component in it). One cannot estimate incidence by just measuring disease at one point in time. That is why prevalence figures are more easily available than incidence figures.

In general, incidence is usually used in short durations, acute illness while prevalence is used to quantify chronic illness. Epidemiologically speaking, incidence figures are more sophisticated and descriptive than prevalence figures. Incidence figures are particularly useful when causal associations are being explored. When incidence rates are not obtainable, prevalence figures may give clues as to possible variation of incidence.

Types of Incidence

When we calculate incidence we have to consider the nature of the population whether it is a **fixed or a dynamic population.** Based on the nature of the population, there are two ways of calculating incidence: Incidence rate and incidence risk

- Incidence risk = Cumulative incidence
- Incidence rate = Incidence density

In both types, the numerator is the number of new events that occur over a defined period of time.

Incidence risk or Cumulative incidence is: the proportion of people who become diseased during a specified period of time and is calculated as:

CI = Number of new cases during a specified period of time

Total Population at risk in the specified period of time

- It is a measure of the **probability** or **risk** of disease, i.e., what proportion of the population will develop illness during the specified time period.

Example: During a 1-year period, 100 out of 1,000 "at risk" persons develop the disease of interest.

CI =100/1000=0.1 or 10%

- It is a simpler measure compared to incidence rate. However, it is less useful than incidence rate that tells us something about the speed at which events are occurring.
- The denominator is only those people who are there and free of the disease in the population at the beginning of the study.

Incidence density (Risk):

- Measures the rate at which new cases of disease occur in the population at risk during a defined period
- The population at risk is dynamic and each person in the population contributes the amount of time that they remained under observation and free from disease (person-time)
- The numerator is still the number of new cases, but the denominator is the sum of the time each person is observed, totalled for all persons.
- For incidence density, the denominator is measured in person-time units rather than persons at risk of developing the disease

$$\text{Incidence Risk} = \frac{\text{No. of new cases of disease during a given period}}{\text{Total "person-time" of observation}}$$

What is "**person-time**"?When we observe a group of individuals for a period of time in order to ascertain the DEVELOPMENT of an event, the actual time each individual is observed will most likely vary.

To calculate the person time of observation in a follow-up study, we follow each person until onset of disease, death, loss to follow-up or end of the study period and then we add up the time each person was followed.

Example: Calculate the total person years of follow up from the following case

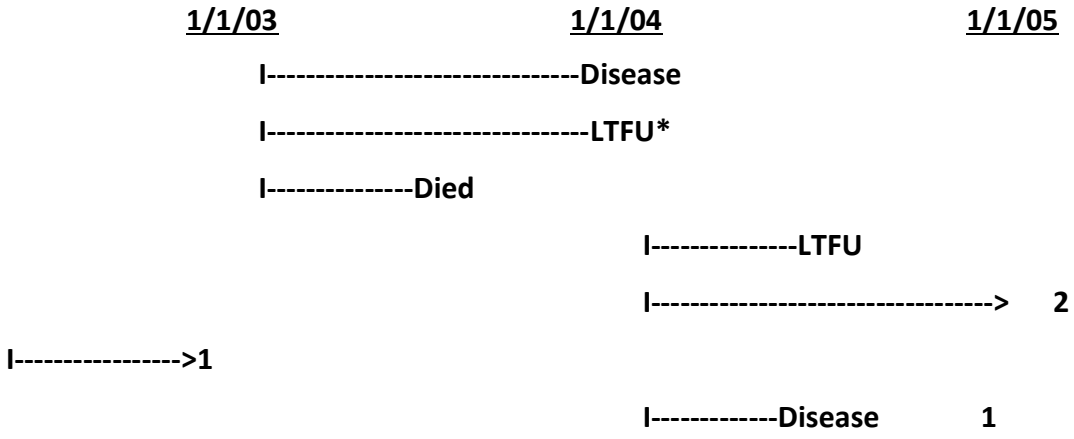


Figure 4: Follow up study presenting the concept of person-time at risk

* LTFU = Lost to follow-up & PY=Person Year

Attack rate: The attack rate or case rate, refers to the cumulative incidence of infection over a period of time. This is typically used during an epidemic. Sometimes, the time period may not be indicated, but would typically refer to the period of the outbreak: "During the influenza outbreak the attack rate was 12%".

Case Fatality rate: The proportion of people with a specified condition who die within a specified time. The time frame is typically the period during which the patient is sick from the disease. This

works for an infectious disease but can be problematic for a chronic disease like a cancer that may remit for a period and then prove fatal after a recurrence. In such instances we tend to speak of mortality or survival rates rather than case fatality.

Prevalence: It answers the question of "How many people actually have the disease at any point in time?" Hence, prevalence indicates the number of people with the disease at a given time / Number of people at risk. It is thus a proportion, rather than a rate, although you may sometimes see it called a "rate." Prevalence is influenced by the incidence and by the duration of the condition, and provides a good way to indicate the burden of disease in a population.

Prevalence can be a point, period and life time prevalence.

Point prevalence is the number of cases present in a population at a single point in time.

Point prevalence = All cases orfactors of interest at a given time x 10^n

Total population

Period prevalence = All cases (old & new) during the time period x10^n

Average population during the given period of time

Lifetime prevalence (cumulative lifetime frequency): proportion of the population that has a history of a given disorder at some point in time.

Life time prevalence= **# who ever had the factor of interest during lifetime** x 10^n

Population at risk (at the beginning of the time period)

Relationship between incidence and point prevalence

Since point prevalence rate includes both new and pre-existing cases, it is directly related to the incidence rate. Point prevalence rate is directly proportional both to the incidence rate and to the average duration of the disease.

Point Prevalence rate ~ IR x D

Prevalence as depicted in the figure below depends on:

- Severity of illness
- Duration of illness
- The number of new cases

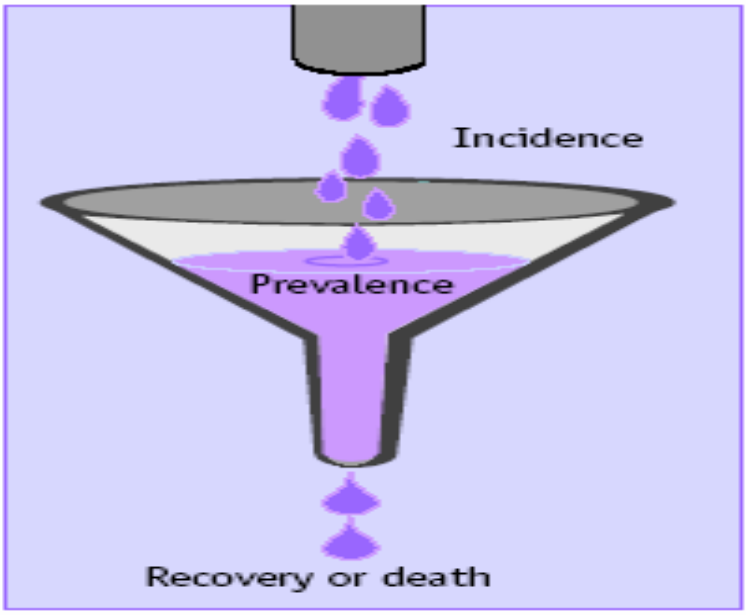


Figure 5: Prevalence as a function of incidence and duration of disease

Measurements of Mortality: mortality rates and ratios

Mortality rates and ratios measure the occurrence of deaths in a population using different ways. Rates whose denominators are the total population are commonly calculated using either the mid - interval population or the average population. This is done because population size fluctuates over time due to births, deaths and migration.

Below are given some formulas for the commonly used mortality rates and ratios.

Crude Death Rate (CDR) = Total no. of deaths reported during a given time interval X 1000
Estimated mid interval population

Age- specific mortality rate = No. of deaths in a specific age group during a given time X1000
Estimated mid interval population of sp. age group

Sex- specific mortality rate = No. of deaths in a specific sex during a given time X 1000
Estimated mid interval population of same sex

Cause- specific mortality rate = No. of deaths from a specific cause during a given time X 10^5
Estimated mid interval population

Proportionate mortality ratio = No. of deaths from a sp. cause during a given time x 100
Total no. of deaths from all causes in the same time

Summary:

Ratio:Common descriptive measure

- Numerator and denominator can be unrelated
- Either numerator or denominator usually set to 1

Proportion:

- Common descriptive measure
- Numerator must be included in the denominator
- Can be expressed as a fraction, decimal, or percentage

Incidence (Risk):

- how quickly disease occurs in a population
- Used commonly in surveillance, vital statistics
- Only new cases in numerator
- Expressed per person-years, or per person per year
- Not everything called a rate is a rate (attack rate, case-fatality rate)
- probability of developing the disease during the specified period
- Only new cases in numerator
- "Attack rate" used in outbreak setting

Prevalence:

- Provides snapshot of disease burden or attribute in population
- Numerator includes both new and pre-existing cases
- More practical than incidence for many chronic diseases

Session 3: Descriptive Epidemiologic Studies

Session overview:

This session gives overview of the different types of study design. This session will enable you to answer the questions: how to apply descriptive study design and approaches of descriptive epidemiology during data collection and analysis

Learning objective

- Discuss the different types of descriptive designs
- Apply the descriptive approaches during data collection and analysis

Definition of design

Design is an arrangement of conditions for the collection & analysis of data that leads to the most accurate answer to the research question and in the most economical way.

Classification of Epidemiologic study designs

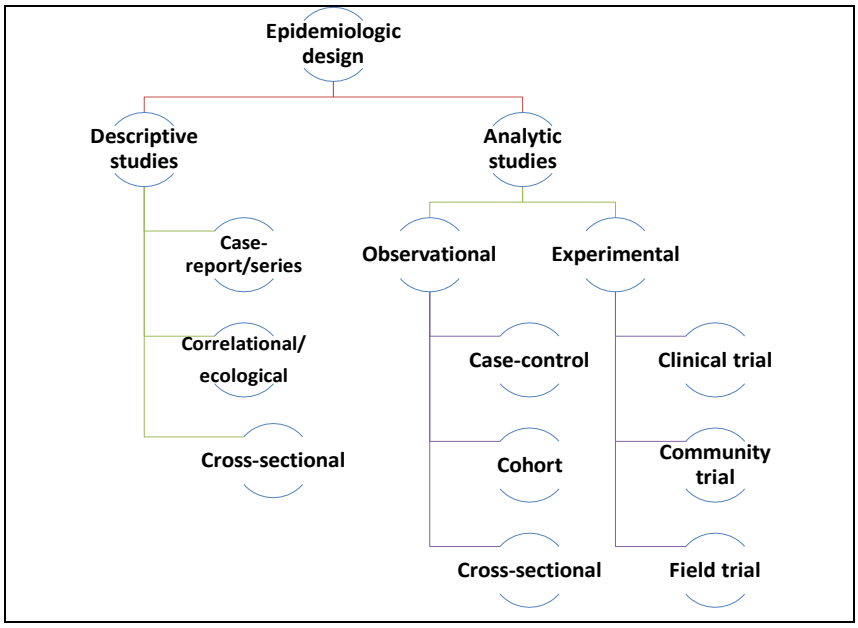


Figure 6: Classification of epidemiological study designs

Descriptive study designs

Purpose and characteristics of descriptive study Designs

- Mainly concerned with the distribution of diseases with respect to time, place and person.

- Useful for health managers to allocate resources.
- Important for hypothesis generation.
- They are less time consuming and less expensive (use routinely collected information).
- Descriptive studies are the most common study designs used by epidemiologists.

Types of descriptive study designs

1. **Case report and Case series**

1.1. Case report:

- consists of a careful, detailed report by one or more clinicians of the profile of a single patient
- more emphasis is given for unusual findings
- very useful for hypothesis generation
- report is based on a single or few patients which can happen just by coincidence
- There is no comparison group

Example: Case report in 2010

A 53-year-old woman who works as an office manager who was treated for breast cancer on her right breast presented with breast cancer on her left breast after 7 years.

1.2. Case series:

- describes the characteristics of a number of patients with a given disease (same diagnosis)

Example: Five young, previously healthy homosexual men were diagnosed as having pneumocystis carinii pneumonia at 3 Los Angeles hospitals during a 6 month period in 1980 to 1981

2. **Ecological (Correlational) studies**

The units of analysis are populations or groups of people rather than an individual. Use data from the entire population to compare disease frequencies between different groups during the same period of time, or in the same population at different points in time.

Rates are commonly used to quantify disease occurrence in groups. To conduct ecological studies, average exposure level of the communities is required, not exposure status of each individual.

Example: Zamani et al assessed the correlation between ethnic diversity and HIV prevalence taking ethnicity data from sub-Saharan nations (calculate as ethnic diversity score for each nation

as the independent variable) and HIV infection rates from WHO data for the same countries as the dependent variable. They found correlation between ethnic diversity correlates with lower HIV prevalence in Africa, i.e countries having more ethnic diversity had lower HIV prevalence and the vice versa.

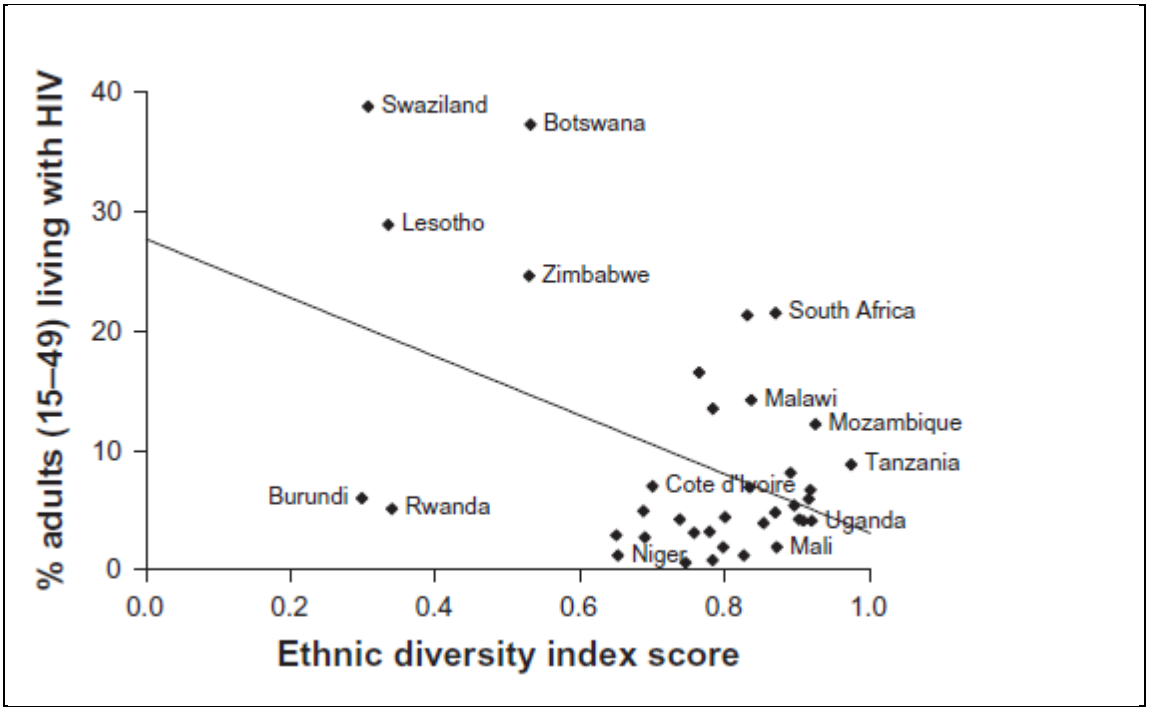


Figure 7: Correlation between ethnic diversity index and HIV prevalence, adapted from Zamani et.al. HIV/AIDS – Research and Palliative Care 2013:5 75–80)

Disadvantage: Ecological fallacy

3. Cross sectional studies (surveys)

Cross-sectional studies are Epidemiological studies in which information about the status of an individual with respect to the presence or absence of exposure and disease is assessed at a point in time. Such studies also show the picture of social, environmental, or other problems or events in a population. The point in time may be as short as few minutes or as long as two or three months. The time frame of "point in time" is based on the speed of data collection. Cross sectional studies are useful for raising the question of the presence of an association rather than for testing hypothesis. But for factors that remain unaltered over time such as sex, race, blood group, cross sectional studies can provide evidence of a valid statistical association.

Advantages of cross-sectional studies:

- Are a one-stop, one-time collection of data

- Are less expensive & more expedient to conduct

- Provide much information useful for planning health services (and medical programs?)

- Show relative distribution of conditions, disease, injury and disability in groups and populations

- Studies are based on a sample of a major population and do not rely on individuals that present themselves for medical treatment

Disadvantages of cross sectional studies

- It is difficult to know which occurred first, the exposure or the outcome. This is known as "chicken or egg dilemma".

- It may not show strong cause-effect relationships if sample size is small.

Session 4: Hypothesis Generation

Session overview

This session gives overview of the hypothesis generation, the common types of outbreak investigation and steps of outback investigation and hypothesis testing. This session will enable you to answer the how to generate hypothesis.

Learning Objectives

- Describe the importance of hypothesis generation
- Describe the approaches to generate hypotheses for a field investigation of an outbreak

In epidemiology, a hypothesis is:

- a supposition, arrived at from observation or reflection, that leads to refutable predictions
- any conjecture cast in a form that will allow it to be tested and refuted
- In other words, a hypothesis is an educated guess about what is going on. It is usually based on knowledge, thought, or specific information. It should be testable, since testing hypotheses (or at least evaluating their plausibility) is the next step of an investigation.
- There is an important difference between questions and hypotheses. During outbreak investigations, you may have many questions that need to be answered, but it's the answers to those questions that lead you to a small number of hypotheses.

In the context of an outbreak investigation, a hypothesis may address several factors depending on what you want to know:

- The agent itself – e.g., the outbreak was caused by salmonella
- Source of the agent – e.g., the potato salad was the source
- Mode of transmission (and vehicle/vector) – e.g., hepatitis C was spread by sharing needles

- Exposures that increase risk of disease – e.g., immune-compromised patients were at higher risk of disease

Hypothesis generation is an important step of any outbreak investigation.Without good hypotheses, epidemiologic studies are likely to be fruitless.

A good hypothesis helps to focus your investigation. It helps you decide

- what to investigate,
- what questions to ask, and
- what samples to take.

However, you need to be careful not to focus too much too early on in the investigation because you may miss important information.

There are five common ways that hypotheses are generated in an outbreak setting:

1. Subject-matter knowledge
2. Talk with patients
3. Talk with local officials
4. Review the descriptive epidemiology, i.,e., the main patterns
5. Look at the outliers

Let us now look at these five ways in further detail.

1. **Subject-matter knowledge**

Knowledge of the disease is probably the most common way of developing hypotheses.

For a disease without a confirmed diagnosis, ask yourself what kinds of agents can cause this clinical presentation?

For a known disease but unknown source or reservoir or vehicle, ask;

- What are the agent's usual reservoirs?

- How the agent isusually transmitted?
- What are the most common vehicles for transmitting this agent to humans?
- What are the known risk factors?

You may already have the subject matter knowledge that you need. If not, there are several places to look (e.g. reading, consulting others, browsing online sources, etc.).

2. Review the descriptive epidemiology, i.e. the main patterns

Descriptive epidemiology is an important source of hypothesis generation to be tested by analytic epidemiologic studies. An important step in an outbreak investigation is to look at the data in terms of person, place, and time. To think of possible hypothesis, you have to answer the following questions from the descriptive data.

- **Time:** Depict the Epidemic curve and assess if its shape hints at mode of transmission? Does narrow peak point to a particular time of exposure?

To do so:

First, you can see the size or magnitude of the epidemic, including how large it is in comparison with the background or endemic rate.

Second, the shape of the epidemic curve can provide clues to the type of epidemic and pattern of spread, such as point source, or person-to-person, etc.

Third, you can see where you are in the epidemic – on the upswing with more cases expected tomorrow, or on the down slope, or perhaps after the epidemic is over.

And finally, you can easily see outliers – cases that occur much earlier or much later than the majority of cases. Sometimes these outliers can provide important clues.

- **Place:** If possible draw the spot map demonstrating the number of cases by geographic area (place) and see if there are higher attack rates in one place. In the following spot map, cholera cases were mapped in Ormoiya region during the 2006 epidemic and it was found that the epidemic clustered around the Genaleriver.

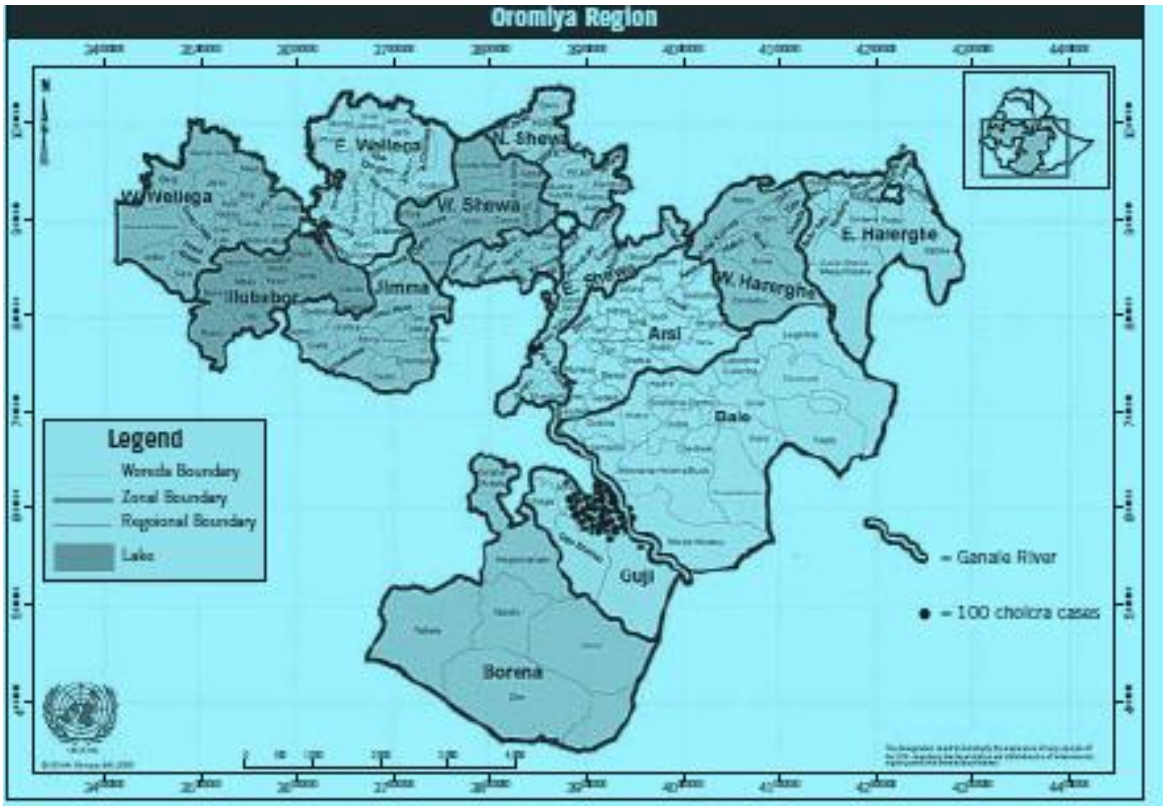


Figure 8: Spot map (**Adapted from; Susan A. Bartels; P. Gregg Greenough; M. Tamar; Michael J. Van Rooyen. Investigation of a Cholera Outbreak in Ethiopia's Oromyia Region. Disaster Med Public Health Preparedness.2010;4:).**

- **Person:** Tabulate frequencies or draw graphs as necessary and answer the question of "which group(s) — by age, sex, occupation, etc. — have highest rates?"

Sometimes the shape of the epidemic curve hints at the type of epidemic spread.

- A common, point source outbreak usually has a single peak, sometimes with a steeper upslope and more gradual downslope.
- An outbreak caused by common persistent source rises but stays high.
- An outbreak caused by a common intermittent source has intermittent cases.

A propagated source outbreak such as measles usually has successive waves of cases, as shown in the lower left (Look at the following graphsbelow).

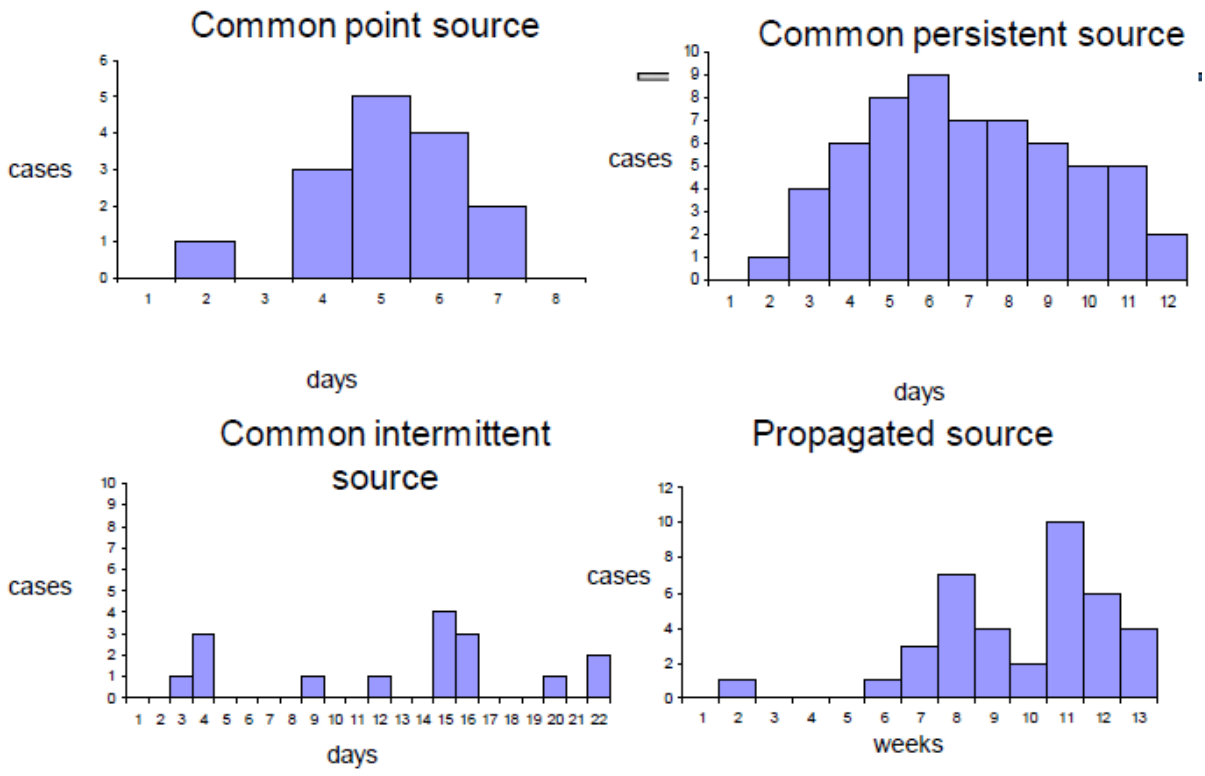


Figure 9: Sample epidemic curves

Note that these are classic epidemic curves, and real world epidemic curves may not be as classic as these illustrations.

Figure 10 depicts an epidemic curve from an outbreak of hepatitis A.

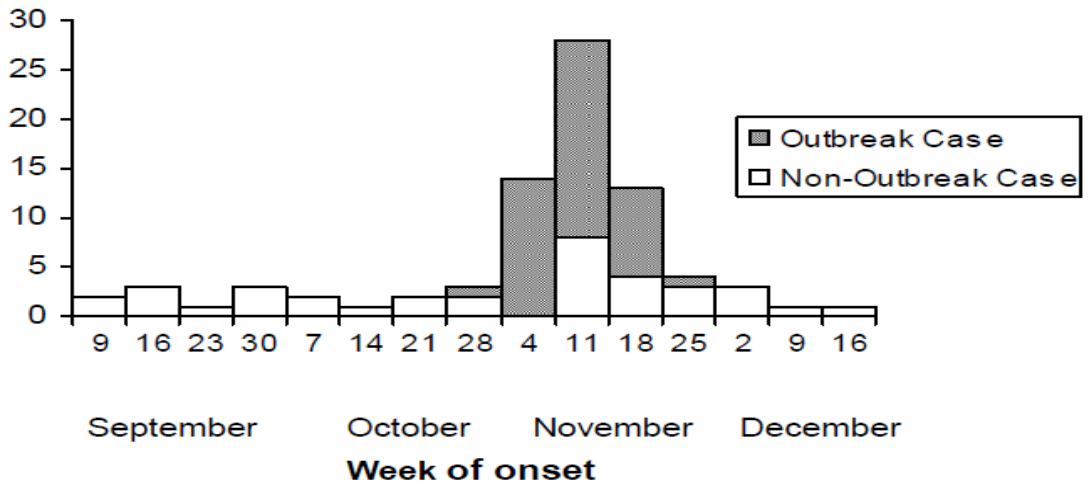


Figure 10: An epidemic curve of Hepatitis A outbreak

From epidemic curves, clues can be obtained on the nature of the epidemic, its agent, mode of transmission and incubation period of the infectious agent can also be estimated.

Exercise:

1. From the above epidemic curve can you tell the incubation period for hepatitis A?
2. Is this epidemic curve consistent with a point-source epidemic? (That is, do all of the cases occur with one incubation period?)
3. What is the peak of the outbreak?

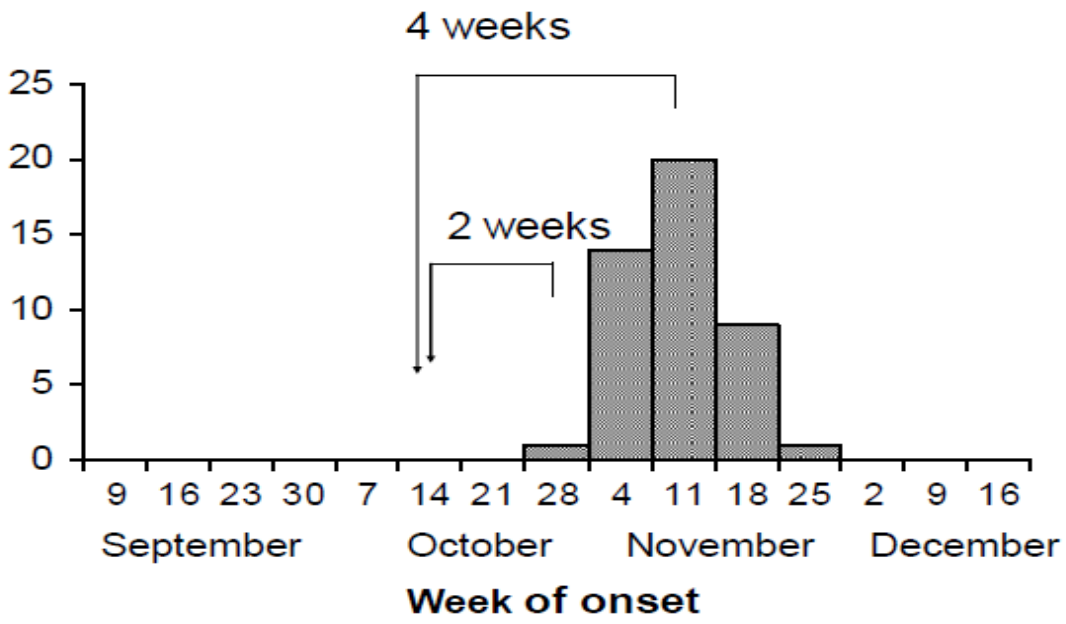


Figure 11: An epidemic curve of Hepatitis A outbreak.

References

Carr S, Unwin N and Mulloli PT. An Introduction to Public Health and Epidemiology, 2nd Ed. England: Open University Press, 2007.

Bonita R. Beaglehole R and Kjellstom T. Basic Epidemiology.WHO, Geneva, 2000.

Last JM, editor.Dictionary of epidemiology. 4th ed. New York: Oxford University Press; 2001. p. 61.

Fletcher M. Principles and practice of Epidemiology. 1992

Kebede Y, Woldemichael K, Lulu K. Epidemiology for Health Science Students Lecture Note Series. 2003

Part 3:

INTRODUCTION BIOSTATISTICS

1. Introduction
   - Definitions of terms and concepts
   - Roles of Biostatistics in public health and medicine
   - Variable, data and information
   - Data quality
   - Changing the type of data
2. Data Collection Methods
   - Introduction to data collection tools
   - Sources of data and types of data collection methods
   - Criteria to select data collection methods
   - Designing a Questionnaire
   - Steps in designing questionnaire
3. Data organization, Presentation and Summarization
   - Data organization
   - Frequency distribution
   - Graphical presentation
   - Summery measures
4. Probability and probability distributions

   Sampling and sample size determination

Session overview

This session gives overview of the introduction to biostatistics and the role of statistics in public health, and the types of biostatistics in the application of public health.

Learning objectives

At the end of this session, the trainees are expected to:

- Define statistics/biostatistics
- Explain the role and main uses of statistics and statistical methods in health sciences
- Identify types of data/variables

Definition of terms and concepts

Statistics: is a field of study concerned with data collection, organization and summarization, and drawing of inferences about a body of data when only a part of the data is observed. Statistical principles provide an orderly and objective approach to collecting and interpreting research data. In nearly all areas of research, the proper use of statistics is crucial to the validity of the conclusions.

Biostatistics: is the application of statistics and statistical methods to the body of data concerned with public health, medicine and biology. It is the scientific treatment given to the medical data derived from **group of individuals** or **patients.**

Statistics can be broadly divided into descriptive and inferential biostatistics.

Descriptive statistics is concerned with *describing the sampled data,* e.g. "in a sample the observed proportion of patients having made a suicide attempt in the past 2 years was 8%".

Descriptive statistics is used to:

- explore data (errors, outliers)
- communicate with the data effectively
- describe the data using summary statistics and diagrams

Inferential statistics deals with making statements about a wider populationusing sample data.

The **basic aim** of all statistical inference is to employ sampled data **to infer to a target population** from which the sample was drawn.

Example: "the percentage of suicide attempts in the last two years in the population of female anorexia sufferers was estimated to be 8% with a standard error of 3%".

Uses of Biostatistics in public health and medicine

Biostatistics can play role in the identification andunderstanding the determinants of disease risk among healthy persons, with a particular interest in modifiable risk factors, such as dietary or physical activity patterns, or environmental exposures. In this regard, the statistical methods aim to enhance the likelihood that associations between study subject characteristics or exposures and disease risk are causal, thereby providing reliable concepts for disease prevention.

Biostatistics also plays important roles in public health functions such as assessment, policy setting, and assurance and evaluations. For instance, the following are some of the role of Biostatistics in assessment: decide which information to gather, find patterns in collected data, and make the best summary description of the population and associated problems. In addition, it can play roles in policy setting which might include developing mathematical tools to measure and prioritize health problems, quantify the extent and significance of associations of risk factors with health problems, predict the effect of policy changes, and estimate costs of programs, including monetary and undesirable side effects of preventive and curative measures. It uses the evidence from a sample to study the factors related to a give outcome or response of the population.

Population and sample

The totality of all the units under study constitutes population. Equivalently, we may think of the population as representing all conceivable observations or measurements on variable X, whereas a sample is simply a subset of the population, that is, a given collection of observations or measurements taken from the population. By convention, for a finite population, we denote the population size by N and the sample size by n, where obviously $n \leq N$.

Moreover, if X depicts a population variable, then the observations or measurements within the population can be listed as X: $X_1, X_2, X_3, \ldots, X_N$.

And if X represents a sample variable, then the collection of sample items can be written as X: $X_1, X_2, X_3, \ldots, X_n$.

Examples of population include:

1. All individuals diagnosed with AIDS as of January 1, 2000.
2. All females age 45 and 64 years diagnosed with MI.

Examples of sample include:

1. A random sample of 100 individuals diagnosed with AIDS as of January 1, 2000.
2. A random sample of 150 females' age 45 to 64 years diagnosed with MI.

Parameter and statistic

The term *parameter* (say μ) is used to represent any descriptive measure of a population, whereas a *statistic* (say $\overline{X}$) is any descriptive measure of a sample. Here $\overline{X}$ serves as an *estimator* of (the unknown) μ. The $\overline{X}$ actually obtained by the estimation process will be called an *estimate* ofμ. If $\overline{X}$ *represents* a single numerical value, then it is termed a *pointestimator*ofμ. An *interval estimator* of μ enables us to state just how confident we are, in terms of probability, that μ lies within some range of values.

Variable, data and information

Variable: It is a characteristic that takes on different values in different persons, places, or things.It can also be defined as the generic characteristics being measured or observed, e.g., HIV status, heart rate, the heights of adult males, the weights of preschool children, the ages of patients seen in a dental clinic, etc.Prior myocardial infarction status classified as either yes or no, CD4 lymphocytes per liter of peripheral blood, and blood pressure measurements are examples of variables.

Data: The raw material of Statistics is data. Data may be defined as sets of values or observations resulting from the process of counting or from taking a measurement.

For example:when a hospital administrator counts the number of patients, when a nurse weighs a patient, when a researcher asks patients for their smoking status.

Information: It is the result of a processed data and ready for use

Example: If a sample of 560 individuals are tested for HIV and recorded as positive or negative, then the information that can be generated from this data indicated that 2% of the individuals were HIV positive

Data quality

Data quality is not linear and has many dimensions like Accuracy, Completeness, Consistency, Timeliness and Auditability. Having data quality on one dimension is as good as 'no quality'.None

of the Data Quality dimensions is complete by itself, and many a times dimensions are overlapping.

- **Accuracy of data** is the degree to which data correctly reflects the real world object OR an event being described.

Examples of Data Accuracy: The temperature recorded in the thermometer is the real temperature.

- **Completeness of data** is the extent to which the expected attributes of data are provided.

Example, a temperature data is considered as complete if temperature is measured among all patients in a clinic

- **Data Completeness** definition is the 'expected completeness'. It is possible that data is not available, but it is still considered completed, as it meets the expectations of the user. Every data requirement has 'mandatory' and 'optional' aspects.

Example: patient's residential address is mandatory and it is available and because patient's office address is optional, it is OK if it is not available.

- **Consistency of Data** means that data across the clinic should be in synch with each other.

Examples of data in-consistency: A male patients is recorded as having cervical cancer

- **Data Timeliness *'Data delayed' is 'Data Denied'***

The timeliness of data is extremely important. The timeliness depends on user expectation. An online availability of data could be required for researchers, but an overnight data might be required for emergency situations.

Example of Data not being timely:

- Data sent from health institutions on a yearly basis to control malaria epidemic
- **Data Auditability:**Auditability means that any transaction, report, etc. can be tracked to its originating body. This would need a common identifier, which should stay with a transaction as it undergoes transformation, aggregation and reporting.
- **Example**s of non-auditable data: A surgery report cannot be linked to the Doctor ID of preliminary diagnosis OR the pathologist ID.

The first step, before any calculations or plotting of data, is to decide the type of data one is dealing with. The types of analyses used will depend on the type of variable being studied. The

basic distinction is between quantitative variables (for which one asks "how much?") and categorical variables (for which one asks "what type?").

Quantitative variables can be *continuous* or *discrete*. Continuous variables, such as height, can in theory take any value within a given range. Examples of discrete variables are: number of children in a family, number of attacks of asthma per week.

Categorical variables are either nominal (*unordered*) or ordinal (*ordered*). Examples of nominal variables are male/female, alive/dead, blood group O, A, B, AB. For nominal variables with more than two categories the order does not matter. For example, one cannot say that people in blood group B lie between those in A and those in AB. Sometimes, however, people can provide ordered responses, such as grade of breast cancer, or they can "agree", "neither agree nor disagree", or "disagree" with some statement and classification of people into socio-economic groups (ordinal), In this case the order does matter and it is usually important to account for it.

Changing the type of data

Data is sometimes rearranged to change type, e.g., age (continuous) is often re-classified into age group: < 1, 1-4, 5-9, 10-14 … 65+. The number of clinic visits (discrete) may become: 0, 1-5, 6-10, 11+ (ordinal).

Type of data determines which types of analyses are appropriate: continuous vs. categorical data analysis.

Practice Problem 1:

A study investigates effect of weight gain on coronary heart disease (CHD) risk. A sample of women 30-55-years of age, all free of CHD, were followed over 14 years to determine CHD occurrence. Measurements on the following variables were taken from sample of women:

1. Smoker (current, former, no)
2. CHD onset (yes or no)
3. Family history of CHD (yes or no)
4. Non-smoker, light-smoker, moderate smoker, heavy smoker
5. BMI (kgs/m^2)
6. Age (years)
7. Weight presently
8. Weight at age 18

Classify the above variables according to their type.

References:

1. Daniel, W. W. 1999. Biostatistics: a foundation for analysis in the health sciences. New York: John Wiley and Sons.
2. C.R. Cothari. Research Methodology: Methods and Techniques. 2nded. New Age International (P) Ltd, Publishers, New Delhi, 2004.
3. Morton RF, Hebel JR, McCarter RJ: A Study Guide to Epidemiology and Biostatistics, 4th ed. Gaithersburg, Maryland, Aspen Publications, 1996.
4. Norman GR, Streiner DL: Biostatistics: The Bare Essentials, 2nd ed. Hamilton, Ontario, B.C. Decker, 2000.
5. Pagano M, Gauvreau K: Principles of Biostatistics, 2nd ed. Pacific Grove, CA, Duxbury Press, 2000.
6. BMJ. Statistics at Square One.
7. Kline et al. *Annals of Emergency Medicine* 2002; 39: 144-152.
8. Johnson R. *Just the Essentials of Statistics*. Duxbury Press, 1995.

Session 2: Data collection

Session Overview

Before we go for answering our research question/problem, data should be collected. The collection of data should be systematically in a way that follows the techniques of statistics to obtain optimal quality of data. The task of data collection begins after a research problem has been defined and research design/ plan chalked out. While deciding about the method of data collection to be used for the study, the researcher should keep in mind two types of data viz., primary and secondary. The primary data are those which are collected afresh and for the first time, and thus happen to be original in character.

The secondary data, on the other hand, are those which have already been collected by someone else and which have already been passed through the statistical process. The researcher would have to decide which sort of data he would be using (thus collecting) for his study and accordingly he will have to select one or the other method of data collection. The methods of collecting primary and secondary data differ since primary data are to be originally collected, while in case of secondary data the nature of data collection work is merely that of compilation. We describe the different methods of data collection, with the pros and cons of each method.

Such techniques of data generation are observing, interviewing, conducting focus group discussion, administering/sending questionnaires to respondents, and using available data. Depending on the type of variable and the objective of the study different data collection methods can be employed.

Scientific studies can be broadly divided into quantitative, qualitative and mixed researches. Quantitative research techniques are used to quantify the size, distribution, and association of certain variables in a study population. It gives answers to the following important questions: 'How many?', 'How often?' and 'How significant?' The answers to questions can be counted and expressed numerically.

Qualitative researches allow collection of detailed data from smaller number of subjects. They produce qualitative data that is often recorded in narrative form. Often qualitative researches are applied if little is known about the topic or issue being studied.

Though the designs of data collection methods for most biomedical and public health researches tend to be quantitative, there are also situations which necessitate qualitative approaches in their

designs. Hence, the data collection methods that we are dealing in this module will be the methods applied to both quantitative and qualitative research approaches

Learning Objectives:

At the end of this session, the trainees are expected to:

- Identify the different methods of data collection,
- Describe the criterion for the selection of a method to collect data ,
- Design a questionnaire.
- Identify the different steps of designing a questionnaire,

Sources of Data

- **Primary data**: Data that has been collected from first-hand-experience is known as ***primary data***. Primary data has not been published yet and is more reliable, authentic and objective. Primary data has not been changed or altered by human beings therefore its validity is greater than secondary data.
- **Secondary data**: Data collected from a source that has already been published in any form is called as secondary data. The review of literature in nay research is based on secondary data. Mostly from books, journals and periodicals.

Primary data collection techniques

- Observation
- Face-to-face and telephone interview
- Self-administered and mailed questionnaire interview
- Web based interview
- Focus group discussions
- In-depth interview

1. Observation

Observational data collection method involves systematically selecting, watching and recording *behavior* and *characteristics* of living things, objects or phenomena. It ranges from simple visual to the use of high level machines and technologies. Observation of human behavior is a much-used data collection technique. It can be undertaken in different ways:

- Participant observation: the observer takes part in the situation s/he observes.
- Non-participant observation: the observer watches the situation, openly or concealed, but does not participate.

Observations can give additional, more accurate information on behavior of people than interviews or questionnaires. They can also check on the information collected through interviews especially on sensitive topics such as alcohol or drug use, or stigmatizing diseases.

- For example, whether community members share drinks or food with patients suffering from feared diseases (leprosy, TB, AIDS) are essential observations in a study on stigma.

Observations can also be made on objects.

- For example, the presence or absence of a latrine and its state of cleanliness may be observed.

Observations of human behavior can form part of any type of study, but as they are time consuming, they are most often used in small-scale studies.

Advantages of observational data collection methods

- Gives more detailed and context-related information
- Permits collection of information on facts not mentioned in an interview
- Permits tests of reliability of responses to questionnaires

Disadvantages observational data collection methods

- Ethical issues concerning confidentiality or privacy may arise
- Observer bias may occur (observer may only notice what interests him or her)
- The presence of the data collector can influence the situation observed
- Thorough training of research assistants is required

2. Face-to-face Interview

Interview involves oral questioning of respondents, either individually or as a group. Answers to the questions posed during an interview can be recorded by writing them down (either during the interview itself or immediately after the interview) or by tape-recording the responses, or by a combination of both. Interviews can be conducted with varying degrees of flexibility.

High degree of flexibility: High degree of flexibility interview is useful if a researcher has as yet little understanding of the problem or situation he is investigating, or if the topic is sensitive. It is frequently applied in exploratory studies. The instrument used may be called an interview guide or interview schedule.

Low degree of flexibility: Low degree of flexibility interview is useful whenthe researcher is relatively knowledgeable about expected answers or the number of respondents being interviewed is relatively large.

Advantages

- Is suitable for use with both literates and illiterates
- Permits clarifications of questions
- Has higher response rate than written questionnaires
- Permits collection of in-depth information and exploration of spontaneous remarks by respondents

Disadvantages

- The presence of the interviewer can influence responses
- Reports of events may be less complete than information gained through observations
- The interviewer may inadvertently influence the respondents
- Analysis of open-ended data is more difficult and time consuming

3. Administering written questionnaire

This technique can be done by administering written questions that are to be answered by the respondents in written form. Often, administered in different ways, such as by:

- Sending questionnaires by mail with clear instructions on how to answer the questions and asking for mailed responses;
- Gathering all or part of the respondents in one place at one time, giving oral or written instructions, and letting the respondents fill out the questionnaires;
- Hand-delivering questionnaires to respondents and collecting them later

Advantages

- Is less expensive
- Permits anonymity and may result in more honest responses
- Does not require research assistants
- Eliminates bias due to phrasing questions differently with different respondents

Disadvantages

- Cannot be used with illiterate respondents
- There is often a low rate of response
- Questions may be misunderstood

Choosing a Method of Data Collection

Decision-makers need information that is ***relevant, timely, accurate and usable.*** The cost of obtaining, processing and analyzing these data is high. The challenge is to find ways, which lead to information that is cost-effective, relevant, timely and important for immediate use. Some methods pay attention to ***timeliness and reduction in cost.*** Others pay attention to ***accuracy and the strength of the method*** in using scientific approaches.The selection of the method of data collection is also based on practical considerations, such as:

- The need for personnel, skills, equipment, etc. in to what is available and the urgency with which results are needed.
- The acceptability of the procedures to the subjects – the absence of inconvenience, unpleasantness, or untoward
- The probability that the method will provide a good coverage, i.e. will supply the required information about all or almost all members of the population or sample

Designing a questionnaire

A questionnaire is a set of questions that follow a predetermined sequence and arranged in some order used to collect data. The questions that are incorporated in the questionnaire can be either open-ended or closed (with pre-categorized answers).

I. Open-ended questions

Open-ended questionsallow for completely open as well as partially categorized answers.It permits free responses which should be recorded in the respondents' own words.Such questions are useful for obtaining in-depth information on:

- facts with which the researcher is not very familiar,
- opinions, attitudes and suggestions of informants, or
- Sensitive issues.

Examples

1. 'What is your opinion on the services provided in the ANC?' (Explain why?)
2. 'What do you think are the reasons that some adolescents in this area start using drugs?

Advantage

- Allow you to probe more deeply into issues of interest being raised.

- Information provided in the respondents' own words might be useful

Disadvantages

- Incomplete recording of all relevant issues covered in the discussion.
- Difficulty during analysis; time-consuming and requires experience.

II. Closed-ended questions

Closed-ended questions have a list of possible options or answers from which the respondents must choose. Closed questions are most commonly used for background variables such as age, marital status or education,

Examples,

1. 'Women who have induced abortion should be severely punished.'
2. Did you eat any of the following foods yesterday?' (Circle yes if at least one item in each set of items is eaten.)

Advantages

- It saves time
- Comparing responses of different groups, or of the same group over time, becomes easier.

Disadvantages

- In case of illiterate respondents, bias will be introduce

Steps in designing a questionnaire

1. **Content:** take your objectives and variables as a starting point.

Decide what questions will be needed to measure or (in the case of qualitative studies) to define your variables and reach your objectives. When developing the questionnaire, you should reconsider the variables you have chosen and, if necessary, add, drop or change some. You may even change some of your objectives at this stage.

2. **Formulating questions:** Formulate one or more questions that will provide the information needed for each variable.

Take care that questions are specific and precise enough so that different respondents don't interpret them differently.

For example, the question

'Where do community members usually seek treatment when they are sick?' is general and each respondent may have something different in mind when answering the question:

One informant may think of measles with complications, and say he goes to the hospital, another of cough, and say he goes to the private pharmacy. Even if both think of the same disease, they

may have different degrees of seriousness in mind and thus answer differently. In all cases, self-care may be overlooked.

The question therefore, as a rule, has to be broken up into different parts and made so specific that all informants focus on the same thing. For example, one could concentrate on illnesses that have occurred in the family over the past 14 days and ask what has been done to treat these from the onset.

Check whether each question measures one thing at a time.

For example: the question,

'Do you think that the war situation leads to mental problems that require treatment by health staff?' brings three topics, which should be split up in

- mental problems resulting from the war,
- treatment required, and
- who should provide the treatment.

Avoid leading questions:

A question is leading if it suggests a certain answer.

For example:

'What action did you take the last time when your child had diarrhea?' presupposes the child has had diarrhea.

A better set of questions would be:

'Has your child ever had diarrhea?' If yes, 'When was the last time?'

'Did you do anything to treat it?' If yes, 'What?'

Avoid words with double or vaguely defined meanings or that are emotionally laden.

- Concepts such as dirty (clinics),
- Lazy (patients), or
- Unhealthy (food), for example, should be omitted.

Ask sensitive questions in a socially and culturally acceptable way:

Questions relating to abortion, sexual practices of adolescents, or AIDS and mental illness in the family are usually sensitive.

For example:

- 'Many teenagers have had abortions for unwanted pregnancies.
- Do you know girls who had this problem?
- Have you ever had an abortion?'

Another way to deal with sensitive questions (as indicated by the respondent's hesitation in answering the question) is by asking the question *indirectly*.

For example, you could ask:

'If your friend was considering abortion for her daughter who became pregnant while in school, what would you advise her?'

3. **Sequencing the questions:** Design your interview schedule or questionnaire to be 'informant friendly'

Design your interview schedule or questionnaire to be 'informant friendly'.

- At the beginning of the interview a limited number of questions concerning 'background variables' (e.g., age, education, marital status) may be asked.
- As informants may be reluctant to provide 'personal' information and may become worried about confidentiality, or bored by a list of unrelated and, to them, senseless questions, you should restrict yourself to an essential minimum. Religion, socio-economic status/ occupation, income questions/ can also better be postponed until later
- Start with an interesting but non-controversial question (preferably open) that is directly related to the subject of the study. This type of beginning should help to raise the informants' interest and lessen suspicions concerning the purpose of the interview.
- Pose more sensitive questions as late as possible in the interview (e.g., questions pertaining to income, political matters, sexual behavior, or stigma experienced in case of stigmatizing diseases).
- Use simple, everyday language.
- If interviews are carried out in English (or any other secondary language), local terminology should be used for crucial concepts that do not have the exact equivalent in the secondary language.

4. **Formatting the questionnaire:**

When you finalize your questionnaire, be sure that:

- A separate, introductory page is attached to each questionnaire, explaining the purpose of the study, requesting the informant's consent to be interviewed and assuring confidentiality of the data obtained.
- Each questionnaire has a heading and space to insert the number, date and location of the interview, and, if required, the name of the informant. You may add the name of the interviewer, to facilitate quality control.

- Layout is such that questions belonging together appear together visually. If the questionnaire is long, you may use subheadings for groups of questions.
- Sufficient space is provided for answers to open-ended questions, categories such as 'other' and for comments on pre-categorized questions.
- Boxes for pre-categorized answers are placed in a consistent manner (e.g., on the right half of the page).

5. **Translation:** translation to local language and back to the original language in which the questionnaire was prepared, often English.
    - If interviews will be conducted in one or more local languages, the questionnaire should be translated in order to standardize the way questions will be asked.
    - After having it translated you should have it retranslated into the original language by a different person. You can then compare the two versions for differences and make decisions concerning the final phrasing of difficult concepts.
6. **Pre-test:** pre-testing the questionnaire to detect any problems associated with administering the questionnaire, the tool itself and the reactions of respondents to the questions posed with about 20-30 subjects or in some instances with 5% of the sample size.

Focus Group Discussion (FGD)

A **focus group** is a form of qualitative research in which a group of people, usually 8-12, are asked about their perceptions, opinions, beliefs, and attitudes towards a product, service, concept, advertisement, idea, or packaging. Questions are asked in an interactive group setting where participants are free to talk with other group members.

In-depth interview

In-depth interviews are a useful qualitative data collection technique that can be used for a variety of purposes, including needs assessment, program refinement, issue identification, and strategic planning. In-depth interviews are most appropriate for situations in which you want to ask open-ended questions that elicit depth of information from relatively few people (as opposed to surveys, which tend to be more quantitative and are conducted with larger numbers of people).

Secondary data sources

Mortality reports, Morbidity reports, Epidemic reports, Reports of laboratory utilization (including laboratory test results), Reports of individual case investigations, Reports of epidemic

investigations, Special surveys (e.g., hospital admissions, disease registers, and serologic surveys), and Demographic and health survey and census data. In order to retrieve the data from available sources, the researcher will have to prepare an instrument such as a checklist or data compilation sheet. In preparing such instruments, it is important to inspect the layout of the source documents from which the data are to be extracted.

Advantages

- Is inexpensive
- Permits examination of trends over the past

Disadvantages

- Data are not always easily accessible
- Ethical issues concerning confidentiality may arise
- Information may be imprecise or incomplete
- Purpose difference
- Differences in size
- Change in definitions

We search for suitable data to serve as the raw material for our investigation.Such data are available from one or more of the following sources:

1. **Routinely kept records:**For example, hospital medical records contain immense amounts of data on patients and hospital accounting records contain a wealth of data on the facility's business activities.
2. **External sources:**The data needed to answer a question may already exist in the form ofpublished reports, commercially available data banks, or the research literature, i.e. someone else has already asked the same question.
3. **Surveys:**The source may be a survey, if the data needed is about answering certain questions.For example, if the administrator of a clinic wishes to obtain information regarding the mode of transportation used by patients to visit the clinic, then a survey may be conducted among patients to obtain this information.
4. **Experiments:**Sometimes the data needed to answer a question are available only as the result of an experiment.For example: If a nurse wishes to know which of several strategies is best for maximizing patient compliance, she might conduct an experiment in which the different strategies of motivating compliance are tried with different patients.

Practice Problem 2:

Directions: Identify and modify the problems in each of the questions by mentioning the principle in questionnaire design being violated.

1. How many cups of coffee or tea do you drink in a day?
2. What brand of computer do you own?

   (A) IBM PC (B) Apple
3. Have you had pain in the last week?

   [ ] Never [ ] Seldom [ ] Often [ ] Very often
4. Where did you grow up?

   [ ] Country [ ] Farm [ ] City
5. Are you against drug abuse? (Circle: Yes or No)
6. Which one of the following do you think increases a person's chance of having a heart attack the most? (Check one.)

   [ ] Smoking [ ] Being overweight [ ] Stress
7. (1) Do you currently have a life insurance policy? (Circle: Yes or No)

   If no, go to question 3.

   (2) How much is your annual life insurance premium?

Solutions on practice problem 2:

1. Principle: Ask for an answer in only one dimension.
   Solution: Separate the question into two –
   (1) How many cups of coffee do you drink during a typical day?
   (2) How many cups of tea do you drink during a typical day?
2. Principle: Avoid hidden assumptions. Make sure to accommodate all possible answers.
   Solutions:
   (1) Make each response a separate dichotomous item
      i. Do you own an IBM PC? (Circle: Yes or No)
      ii. Do you own an Apple computer? (Circle: Yes or No)
   (2) Add necessary response categories and allow for multiple responses.
      iii. What brand of computer do you own? (Circle all that apply)
         1. Do not own computer
         2. IBM PC
         3. Apple
         4. Other
3. Principle: Make sure question and answer options match.
   Solution: Reword either question or answer to match.
   How often have you had pain in the last week?
   [ ] Never [ ] Seldom [ ] Often [ ] Very Often

4. Principle: Avoid questions having non-mutually exclusive answers.

Solution: Design the question with mutually exclusive options.

- Where did you grow up?
    - House in the country
    - Farm in the country
    - City

5. Principle: Write questions that will produce variability in the responses.

   Solution: Eliminate the question.

6. Principle: Encourage the respondent to consider each possible response to avoid the uncertainty of whether a missing item may represent either an answer that does not apply or an overlooked item.

   Solution: Which of the following increases the chance of having a heart attack?

   - Smoking: [ ] Yes [ ] No [ ] Don't know
   - Being overweight: [ ] Yes [ ] No [ ] Don't know
   - Stress: [ ] Yes [ ] No [ ] Don't know

7. Principle: Avoid branching as much as possible to avoid confusing respondents.

   Solution: If possible, write as one question.

   a. How much did you spend last year for life insurance? (Write 0 if none).

References

1. *Corlien M. Pathmanathan, V, I. Brownlee, Ann.* Designing and conducting health systems research projects: vol (1). 2003.
2. C.R.Cothari. Research Methodology: Methods and Techniques. 2nded. New Age International (P) Ltd, Publishers, New Delhi, 2004.
3. Degu, Getu. Tessema, Fasil. Biostaistics Lecture Notes for the Health Professionals. A.A. 2002.
4. Stewart, A. Basic Statistics and Epidemiology: A practical guide. 2002.
5. Belle, G. V. Fisher, L. D. Heagerty, P. J. Lumley, T. Biostatistics: A Methodology for the Health Sciences. Second Edition, 2004.
6. Bland JM, Altman DG: Statistics notes: Measurement error and correlation coefficients. BMJ 313:41-42, 1996.

Session 3: Data organization, Presentation and Summarization

Session overview:

This session gives overview of the purposes of data presentation how to summarized row data using table and graph. How do they work and what are their types?

Learning Objectives

At the end of this section the trainees are expected to:

- Explain the purpose of descriptive statistics
- Arrange data sets using frequency tables
- Present the data using a variety of diagrammatic methods
- Compute and interpret measures of central tendency and dispersion
- Identify the types of skewness
- Explain the impact of skewness on the measures of central tendency and dispersion.
- List the strengths and weaknesses of summary measures.

3.1. Data Organization

Data of all types, but especially those that involve observations on a large number of participants are difficult to interpret unless they are organized in a way that shows patterns and tendencies. Collected data from most survey are raw and need to be arranged/ or sorted so that the information they contain can be analyzed and interpreted. A first and important way of organizing data to obtain an overview of the patterns they display is to construct a frequency distribution tables. To this end, there are various ways of data organization such as order arrays and tables for arranging data sets into frequency distributions. The use of tables for organizing data involves grouping the data into mutually exclusive categories of the variables and counting the number of occurrences (frequency) to each category. In addition to the frequency counts, the relative frequency is used to clearly depict the distributional pattern of data. It is percentages of a given frequency count. Based on the purpose for which the table is designed and the complexity of the relationship, a table could be either of **simple frequency table** or **cross tabulation**. **Simple frequency table** is used when the individual observations involve only to a

single variable **cross tabulation** is used to obtain the frequency distribution of one variable by the subset of another variable.

Table 3.1: TT immunization of women of childbearing age, Assendabo town, Jimma Zone, 1996 .

Immunization status	number of women	**Percent**
Immunized	**231**	**31.8**
Not Immunized	**496**	**68.2**
Total	**727**	**100.00**

A two way table is a table constructed for two variables simultaneously. Consider the following examples as illustrations of two way tables (two way cross tabulations).

Table 3.2: TT immunization by marital status of the women of childbearing age, Assendabo town, Jimma Zone, 1996

Marital Status	**Immunization Status**				**Total**
	Immunized		**Non Immunized**		
	n	%	**n**	%	
Single	58	24.7	177	75.3	235
Married	156	34.7	294	65.3	450
Divorced	10	35.7	18	64.3	28
Widowed	7	50.0	7	50.0	14
Total	231	31.8	496	68.2	727

Table 3.3: Distribution of willingness of participants in a study of a vaccine to prevent HIV infection by educational status of respondents

Educational level	Willingness to participate (n(%))				
	definitely not	probably not	Probably	Definitely	Total
< high school	52 (7.4)	79 (11.3)	342 (48.9)	226 (32.3)	699
high school	62 (6.9)	153 (17.1)	417 (46.6)	262 (29.3)	894
College or above	150 (4.6)	629 (19.4)	1669 (51.2)	809 (24.8)	3257
Total	264 (5.4)	861 (17.8)	2428 (50.1)	1297 (26.7)	4850

Table 3.4: The distribution of BCG vaccination by age and leprosy status of participants of case-control study

	Leprosy cases		Healthy controls	
Age	BCG scar	No BCG scar	BCG scar	No BCG scar
0-4	1	1	7,593	11,719
5-9	11	14	7,143	10,184
10-14	28	22	5,611	7,561
15-19	16	28	2,208	8,117
20-24	20	19	2,438	5,588

25-29	36	11	4,356	1,625
30-34	47	6	5,245	1,234

Frequency Distributions

Once data are collected, they can be organized into a frequency distribution table, or graph of frequency of occurrence. Frequency distribution table is arrangement of data sets using classes and frequencies of occurrence of values in each class. Frequency tables are used for displaying information about categorical variables or continuous variables chopped into categories.

Tables are used to constrcut frequency distributions by arranging data using class and frequencies. Frequency tables are used to arrange the distribution using **values** and their **frequencies.** That is, it shows the values a variable can take, and the number of people or records with each value. The **frequency**or the **frequency count** for a data value is the number of times the value occurs in the data set. Relative frequency is obtained by dividing the frequency of each class by the total frequency.

Values are measurements/or counts for numeric data or categories for categorical data. A class represents categories of a categorical variable or values of ungrouped or grouped quantitative variable. Ungrouped frequency distribution table is less common as the values tend to be large thereby stretching the frequency table and becoming less informative. Construction of frequency table involves counting the number of occurrence of values class. Despite the advances of electronic computation, you may sometimes (or often) find yourself doing enumeration by counting the frequency of data in a set of nominal, ordinal, or binary categories called tallying. Doing it manually can be done if you have a relatively small amount of data.

General principles of constructing tables

The exact form of a table will depend on the purpose for which it is designed as well as on the complexity of the material. There are no hard and fast rules for constructing tables, but it is best to follow a few simple guidelines to be consistent and to ensure that the table maintains its purpose:

1. The table should be relatively simple and easy to read.
2. The title, usually placed above the table, should be clear, concise, and to the point; it should indicate what is being tabulated.
3. The units of measurement for the data should be given.
4. Each row and column, as appropriate, should be labeled concisely and clearly.
5. Totals should be shown, if appropriate.

6. Codes, abbreviations, and symbols should be explained in a footnote.

7. If the data are not original, their source should be given in a footnote.

Frequency tables for numeric data

Continuous variables can be summarized in frequency tables but must be categorized in meaningful ways. Simply lists the data values with the corresponding number of times or frequency countwith which each value occurs.

Table 3.5: Distribution parity for women with Ovarian Cancer, Centers for Disease Control, December 1980-September 1981

Parity	Number of Cases
0	45
1	25
2	43
3	32
4	22
5	8
6+	4
Total	**179**

Grouped Frequency Distributions

A grouped frequency distribution is obtained by constructing classes (or intervals) for the data, and then listing the corresponding number of values (frequency count) in each interval. In constructing a frequency table for grouped data, we first determine a set of class intervals that cover the range of the data (i.e., include all the observed values). The class intervals are usually arranged from lowest numbers at the top of the table to highest numbers at the bottom of the table and are defined so as not to overlap.We then tally the number of observations that fall in each interval and present that number as a frequency, called a class frequency.

Choice of cutpoints

- Even intervals (e.g. 10-year age categories)
- Meaningful cutpoints related to a health outcome or decision

  Example: a list of temperature measurements in degrees centigrade can be grouped into dichotomous categories of **'afebrile'** (oral temperature below 37°C) or **'febrile'** (oral temperature of 37°C or more).
- Equal percentage of the data falling into each category (e.g. quartiles – 25% each, quantiles – 20% each).

The following table lists 120 values of body mass index data from the 1998 National Health Interview Survey. The body mass index (BMI) is defined as [Weight (in kilograms)/Height (in meters) squared].

Table 3.7: Distribution of body mass index for 120 participants from the 1998 National Health Interview Survey

BMI Levels	Number of participants	Relative Frequency (%)
18.0 – 20.6	4	3.3
20.7 – 23.3	24	20.0
23.4 – 26.0	28	23.3
26.1 – 28.7	27	22.5
28.8 – 31.4	18	15.0
31.5 – 34.1	6	5.0
34.2 – 36.8	8	6.7
36.9 – 39.5	5	4.2
Total	**120**	**100.00**

3.8. Data presentation

Data prsentation refers to displaying the shape of frequency distributions. It means that the shape of a frequency distribution can be described by drawing graphs. Translate the data from frequency tables into a pictorial representation. In this subsection of the module, we will look at displaying frequency distributions.

Importance of Displaying Data

- Facilitate comparison.
- Reveal unsuspected patterns in a complex set of data and may suggest directions in which changes are occurring.
- Generate hypothesis
- Help in deciding analysis strategy

Principles of Drawing Graphs

There are no rule of tumbs regarding the construction grahps, but will consider the following conventional principles:

1. Have a descriptive title (**what, when and where?**) and placed below the graph
2. properly labeled axes:

- **The horizontal axis:** the value (scale) of the variable
- **The vertical axis:** the frequency or relative frequency

3. An indication of the **units of measurement**.
4. **Legends** or **keys** should be used to differentiate variables if more than one is shown.

Displaying Categorical Frequency Distributions

Bar graphs and pie chartsare useful tools for presenting categorical data.

Bar graph

Bar Graphs are used for categorical variables to show frequency or proportion in each category. The data type to be represented by bar graph are nominal/ordinal: graphical equivalent of a categorical frequency table. Th horizontal axis is the categories of the variable and the vertical axis is frequency or relative frequency of each categories of the variable. The height of bar corresponds to frequency of category. As an illustration, consider the percent distribution of CD4 counts among HIV positive individuals

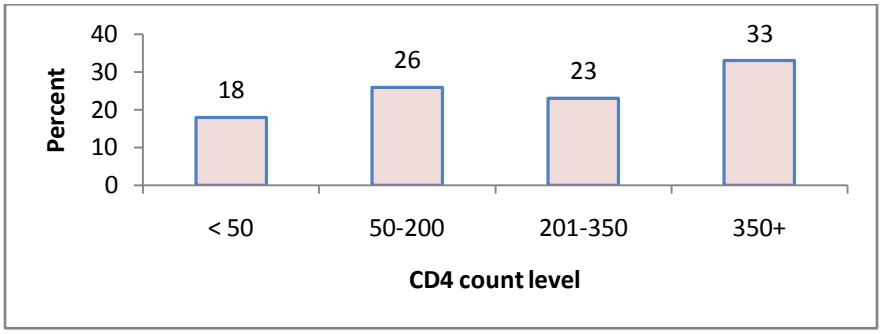


Fig. 3.1: Simple bar chart displayingCD4 counts of HIV positive individuals

In a study of willingness to participate in a study of a vaccine to prevent HIV infection if the study was to start tomorrow, the responses of participants in a certain community on their education and willingness to participate in the study are given above.

Table 3.10: Distribution of responses of participants in a certain community on their education and willingness to participate in the study

Education	**Willingness to participate (%)**			
	definitely not	probably not	Probably	definitely
< high school	7.4	11.3	48.9	32.3

high school	6.9	17.1	46.6	29.3
above college	4.6	19.4	51.2	24.8

The following graph is the representaion of the above corss classified data on the responses of participants regarding their education and willingness to participate in the study.

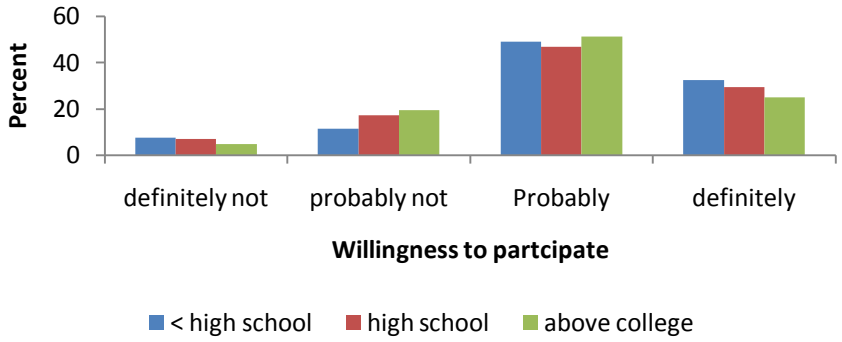


Fig. 3.2: Multiple bar graph displaying distribution ofresponses in a certain community by their education and willingness to participate in the study.

Component bar graph

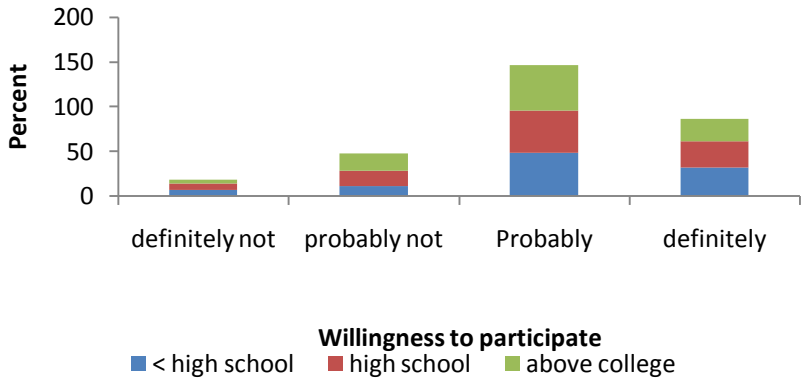


Fig. 3.3: Education versus willingness to participate in a study of a vaccine to prevent HIV infection if the study was to start tomorrow.

Percentage component bar chart

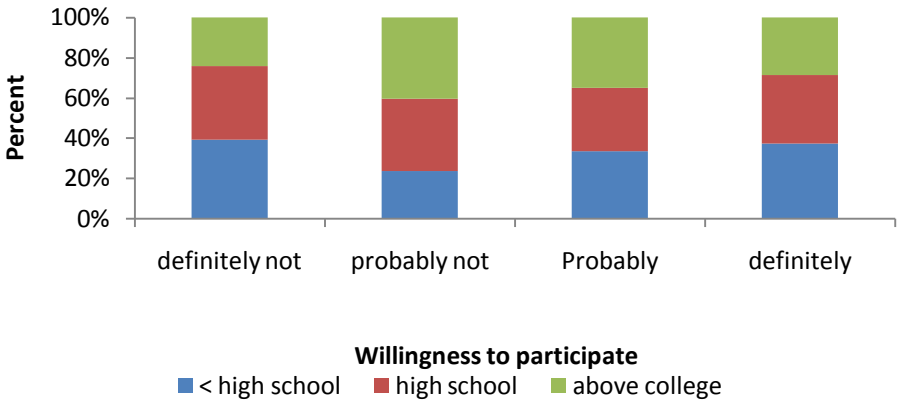


Fig. 3.4: Education versus willingness to participate in a study of a vaccine to prevent HIV infection if the study was to start tomorrow.

Pie-Chart

Pie charts depict the same information as do bar graphs, but in the shape of a circle or pie. The circle is divided into sectors, one for each category of the data. The area of each sector is proportional to the frequency or relative frequency of each category of the variable.

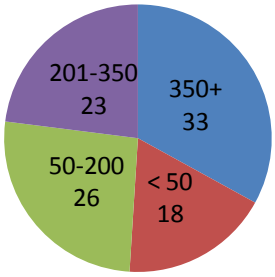


Fig 3.4: Pie chart for CD4 cell counts (per mm^3) of newly diagnosed persons with HIV at University of Gondar, Ethiopia (N=268).

Displaying Numeric Data

Histogram

A graph of continuous (Interval/Ratio) variable in which the vertical scale represents the frequency or relative frequency in each interval and the horizontal scale represents the value of the variable marked at interval boundaries/or real limits. Therefore, rectangles of a histogram touch with each other and keep rectangles widths constant.

They are used for data measured on an interval scale.The visual picture obtained depends on the width of the class interval used, which is to a large extent arbitrary. It is usually best to choose a

width which results in a total of 10–20 classes.If the observations within each class interval are too few, a histogram gives a poor representation of the distribution of counts in the population.

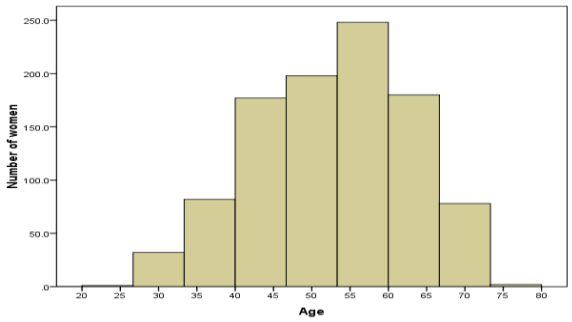


Fig. 3.5: Distribution of women participated in cancer studyby age

Line diagram

Useful for the study of some variables according to the passage of time. The time, in weeks, months or years is marked along the horizontal axis, and Values are marked on the vertical axis. Data on the prevalence of malaria and pnuemonia among out-patients at the Butajira Health center in a give year was collected.

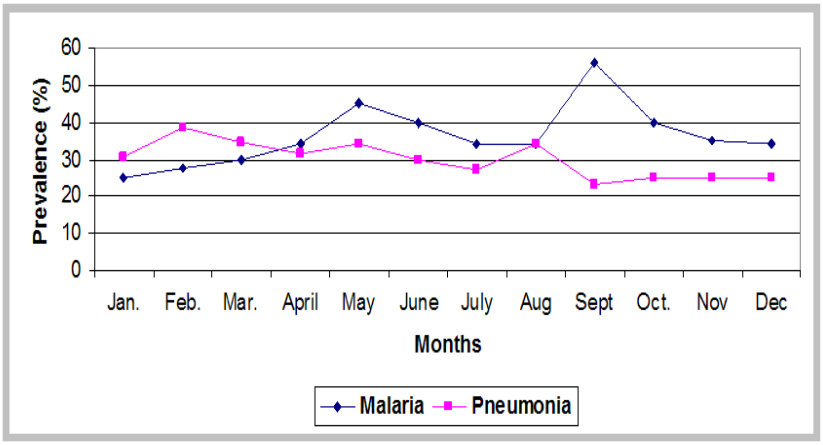


Fig 3.6: Line graph representing seasonal variation of malaria and pneumonia in Butajira Health Center among OPD patients.

3.3. Summrizing Data

In this subsection, we will look at summarizing categorical and numeric data.

Summaries for categorical data

Categorical data can be summarized using methods like Frequency counts – how many are in each category, percent, Ratios, Rates and Mode

Summarizing numerical data

Numerical data are commonly summarized using measures of central tendency and dispersion. Commonly used measures of central tendecy includes the arithmetic mean, median and mode and that of measures of variation are range, inter quartile range, standard deviation (variance) and coefficient of variation.

Suppose that we have n measurements in a data set: $\{x_1, x_2, \ldots, x_n\}$

1. What is the typical value of the data set?
2. Is there variation within the data set? Are the measurements equal?
3. What percent of the measurements are below a specified value? Relative standing of values within data sets.

Measures of center/or location (Arithmetic Mean, Median, Mode)

Mode

It is the value (or range of values) that occurs most frequently. Sometimes there is more than one mode in a given distribution (data sets), e.g., a bi-modal distribution (both modes do not have to be the same height). The mode makes sense most for categorical data. For continuous data you can find the mode if you group the data. Mode can be easily detected from graphs.

Properties of mode:

- Not unique,
- Not affected by to small or large values in data set called outliers or extremes,
- Not calculated based on all the values in the data set, hence, tends to loose information

The following bar graph presents lifetime number of sex partners in school adolescents.

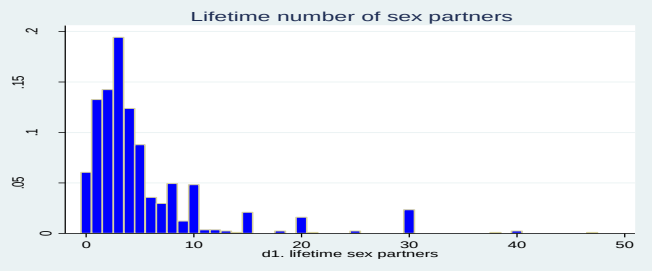


Fig 3.7: Bar graph of the lifetime number of sex partners

What type of variable is this? What is the mode?

Median

The value within a given data set that divides the data set into two equal parts, i.e., half of the data set (50%) will lie below the median value and half of the data set (50%) lie above the median value. Median is also known as the 50th percentile (the middle value). Mathemathically, the median is computed as:

If n is odd, the median is the (n+1)/2 observations of ordered values. That is, $\tilde{X} = \frac{(n+1))}{2}$.

e.g. if n=31 then median is the 16th highest observation.

If n is even, the median is the average of the two middle observations. That is, $\tilde{X} = \frac{(\frac{n}{2} + (\frac{n}{2}+1))}{2}$

e.g., if n=30 then the median is the average of the 15th and16th observation.

Data on gestational age of women at their first ANC visit at a Health Center of one of the regions of Ethioipa in 2012

Serial No	Gest Age	Serial No	Gest Age	Serial No	Gest Age	Serial No	Gest Age
1.	30	11.	31	21.	37	31.	34
2.	34	12.	38	22.	34	32.	31
3.	32	13.	32	23.	30	33.	40
4.	37	14.	35	24.	35	34.	40
5.	32	15.	37	25.	32	35.	35
6.	33	16.	33	26.	34	36.	36
7.	37	17.	32	27.	30	37.	31
8.	29	18.	39	28.	30	38.	40
9.	35	19.	29	29.	40	39.	28
10.	29	20.	31	30.	30	40.	30

Comput the median gestational age of the mothers. Median gestational age = 32.5

Properties of Median

- Unique,
- Not affected by to small or large values in data set called outliers or extremes,
- Not calculated based on all the values in the data set, hence, tends to loose information

Mean

Mean – is usual used to refer average. Means are sensitive to very large or small values

$$\text{Mean}: \quad \bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i \text{ where, } \sum_{i=1}^{n} x_i = x_1 + x_2 + \ldots + x_n$$

Examples: For the gestational age data, the mean is 33.5

Properties of Mean

- Uniqueness and calculated based on all the values in the data set,
- means of means (weighted mean) can be calculated from different data of the same variable
- The sum of the square of the devations is always minimum if devations are calculted from the mean
- But affected by too small or too big values in data set called extremes values,

Summaries for measuring spread include:

Range – crude measure, Percentiles and Interquartile range (IQR), Variance, Standard deviation and Coefficient of variation

Range

Defined as the difference between the maximum and the minimum values in the data set. That is, range = Maximum value – minimum value. Range is crude measure.

Measures to partition distribution

Where does 50% of the distribution lie? Below which value 25% of the distribution lie?
Measures of position (relative standing) provide you with the answers to the above questions. Percentiles and quartiles are most commonly used measures of relative standing.

Percentiles and quartiles: These measures partitions data into approximately equal parts.
Percentiles: They dived data into approximaely hundred equal parts. The p^{th}percentile of a distribution is the value such that p percent of the observations fall at or below it.
The p^{th} percentile is defined by

1. The $(k+1)^{th}$ largest sample point if np/100 is not an integer (where k is the largest integer less than np/100)
2. The average of the $(np/100)^{th}$& $(np/100 + 1)^{th}$ largest observation if np/100 is an integer.

Quartiles

These measures partitions data into approximately four equal parts. Quartiles are defined as

1^{st} quartile = The $\{(n+1)/4\}^{th}$ observation

2^{nd} quartile = The $\{2(n+1)/4\}^{th}$ observation

3^{rd} quartile = $\{3/4\ (n+1)\}^{th}$ observation

The second quartile is the median and the interquartile range is the difference between the first and the third quartiles.

Example 3.3.5: Suppose the following sample consists of birth weights of all liveborn infant born at a private hospital in San Diego, California, during a 1-week period:

2069 2581 2759 2834 2838 2841 3031 3101 3200 3245 3248 3260 3265 3314 3323 3484 3541 3609 3649 4146

- Compute the 25^{th}, the 50^{th} and 75^{th} percentiles. For the birth weight data
- 1^{st} quartile = The $\{(20+1)/4\}^{th}$ observation = $(5.25)^{th}$ observation
  = 5^{th} + 0.25 (6^{th} - 5^{th} observations) = 2838 + 0.25 (2841-2838) = 2838.75
- 2^{nd} quartile = The $\{2(20+1)/4\}^{th}$ observation = $(10.5)^{th}$ observation
  = 10^{th} + 0.5 (11^{th} - 10^{th} observations) = 3245 + 0.5 (3248-3245) = 3245.75
- 3^{rd} quartile = $\{3/4\ (20+1)\}^{th}$ observation
  = $(15.75)^{th}$ observation = 15^{th} + 0.75 (16^{th} - 15^{th} observations)
  = 3323 + 0.75 (3484-3323) = 3443.75

Variance and Standard Deviation

The standard deviation is a summary measure of the differences of each observation from the mean. If the differences themselves were added up, the positive would exactly balance the negative and so their sum would be zero. Consequently the squares of the differences are added.

The sum of the squares is then divided by the number of observations minus one to give the mean of the squares, and the square root is taken to bring the measurements back to the units we started with. (The division by the number of observations minus one instead of the number of observations itself to obtain the mean square is because "degrees of freedom" must be used. In these circumstances they are one less than the total.

To gain clear understandung for degrees of freedom, consider choosing an orange from a basket of n oranges. Every time we come to choose an orange we have a choice, until we come to the last one, and then we have no choice. Thus we have n-1 choices, or "degrees of freedom".

Sample variance

Amount of spread around the mean, calculated in a sample by

$$\text{Sample variance } (S^2) = \frac{\sum_{i=1}^{n}(X_i - \bar{X})^2}{n-1}.$$

Steps in the calculation of variance:

1. Find the mean of the data ($\bar{x}$) and compute the deviations of each of the values from the mean ($x_i - \bar{x}$),
2. Square the deviations $(x_i - \bar{x})^2$ and sum/or add the squaresdeviations $\sum(x_i - \bar{x})^2$
3. Divide the sum by the number of values (n) minus 1, that is, n – 1.

Example 3.3.6: The calculation of the variance is illustrated in with the 15 readings of urinary lead concentrations. The readings are set out in column (1). In column (2) the difference between each reading and the mean is recorded. The sum of the differences is 0. In column (3) the differences are squared, and the sum of those squares is given at the bottom of the column.

Table 3.3.3: Calculation of standard deviation

	Lead concentration (x) µmol/24hr	**Differences from mean ($x-\bar{x}$)**	**Differences squared $(x-\bar{x})^2$**
	0.1	-1.4	1.96
	0.4	-1.1	1.21
	0.6	-0.9	0.81
	0.8	-0.7	0.49
	1.1	-0.4	0.16
	1.2	-0.3	0.09
	1.3	-0.2	0.04
	1.5	0	0

	1.7	0.2	0.04
	1.9	0.4	0.16
	1.9	0.4	0.16
	2.0	0.5	0.25
	2.2	0.7	0.49
	2.6	1.1	1.21
	3.2	1.7	2.89
Sum	**22.5**	**0**	**9.96**
			n= 15, $\bar{x}$ = I.5

The sum of the squares of the differences (or deviations) from the mean, 9.96, is now divided by the total number of observation minus one, to give the *variance*. Thus,

$$\text{Variance } (S^2) = \frac{\sum_{i=1}^{n}(X_i - \bar{X})^2}{n-1}$$

$$S^2 = \frac{9.96}{14} = 0.7114\,(\mu\text{mol/24h})^2$$

Finally, the square root of the variance provides the standard deviation: $S = \sqrt{\frac{\sum_{i=1}^{n}(X_i - \bar{X})^2}{n-1}}$ from which we get $\text{Standard deviation } (S) = \sqrt{0.7114\,(\mu\text{mol/24h})^2} = 0.843\mu\text{mol/24h}$

Note that the standard deviation is an absolute measure and has the same unit of measurements as the raw data and mean.

Coefficient of variation (CV)

CV is relative spread around a mean; the standard deviation relatively expressed in terms of mean.

$$CV = \frac{S}{\bar{X}} \times 100\%$$

For the same relative spread around a mean, the variance and standard deviation will be larger for a larger mean. It is used to compare variability across measurements that are on a different scale (e.g. IQ and head circumference)

Example 3.3.8: The following table summarizes the gestational age and birth weight data. Calculate the CV for each of the data and comment on the variability of the two data sets.

Table 3.3.7: Summaries of gestational age and birth weight data

Measure	Gestational age	Birth weight
mean	33.53	3,477.75
SD	3.54	521.83
CV	0.11	0.15

Exercises on Session 2:

1. From 140 children whose urinary concentrations of lead were investigated 40 were chosen who were aged at least 1 year but less than 5 years. The following concentrations of copper (in μmol/24hr) were found.

0.70, 0.45, 0.72, 0.30, 1.16, 0.69, 0.83, 0.74, 1.24, 0.77, 0.65, 0.76, 0.42, 0.94, 0.36, 0.98, 0.64, 0.90, 0.63, 0.55, 0.78, 0.10, 0.52, 0.42, 0.58, 0.62, 1.12, 0.86, 0.74, 1.04, 0.65, 0.66, 0.81, 0.48, 0.85, 0.75, 0.73, 0.50, 0.34, 0.88

   Find the median, range and quartiles.

2. In the campaign against smallpox a doctor inquired into the number of times 150 people aged 16 and over in an Ethiopian village had been vaccinated. He obtained the following figures: never, 12 people; once, 24; twice, 42; three times, 38; four times, 30; five times, 4. What is the mean number of times those people had been vaccinated and what is the standard deviation?

3. You examine a group of healthy adults (presenting to your clinic for their annual physical exams) and record their respiratory rates.

Outcome (RR in breaths per minute)	Number of adults
11	10
12	9
13	11
14	14
15	10
16	6
Total	60

   a. Calculate the mean of your sample data (n=60).
   b. Calculate the standard deviation of your sample data (n=60).
   c. What is the median value?
   d. What is the mode value?
   e. What is the interquartile range?

4. Your physical diagnosis teacher tells you that one out of every two Stanford medical students can't hear a grade III/VI systolic heart murmur. As an experiment, you ask 100 Stanford medical students to examine a patient with aortic stenosis and a classic crescendo-decrescendo III/VI systolic murmur (http://www.openheartsurgery.com/sound_files/a_stenos.rm) and document their findings: {0=murmur, 1=no murmur} as follows:

Outcome	Frequency
No	52
Yes	48

Total	100

a. Calculate the mean of your sample data (n=100).
b. Calculate the standard deviation of your sample data (n=100).
c. What is the median value?
d. What is the mode value?
e. What is the interquartile range?

References

1. Centers for Disease Control and Prevention: Principles of Epidemiology, 2nd ed. Atlanta, U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, Epidemiology Program Office, Public Health Practice Program,1992.
2. Jekel JF, Katz DL, Elmore JG: Epidemiology, Biostatistics, and Preventive Medicine, 2nd ed. Philadelphia, W.B. Saunders, 2001.
3. Rothman KJ: Epidemiology: An Introduction. Oxford, Oxford University Press, 2002.
4. Last JM (ed): A Dictionary of Epidemiology, 4th ed. Oxford, Oxford University Press, 2001.
5. Michael J. Panik. Advanced Statistics from an Elementary Point of View. Elsevier Inc. 2005, USA
6. Alvan R. Feinstein. Principles of Medical Statistics. Chapman & Hall/CRCBoca, 2002.

Session 4: Probability and probability distribution

Session overview

Science and Scientists arrive at different conclusions in many different areas. Nature is complex and full of unexplained biological variability. In addition, almost all methods of observation and experiment are imperfect. Observers are subject to human bias and error. Science is a continuing story; participants vary; measurements fluctuate. But most important of all, we always have to deal with incomplete information: it is either impossible, or too costly, or too time consuming, to study the entire population; we often have to rely on information gained from a sample – that is, a subgroup of the population under investigation.

So some uncertainty almost always prevails. Thus, science and scientists cope with uncertainty by using the concept of probability. By calculating probabilities, they are able to describe what has happened and predict what should happen in the future under similar conditions.

Learning objective

Up on completing this section, the trainees are expected to:

- Define and understand probability concepts and definitions
- Calculate probabilities and understand its applications
- Differentiate and apply commonly used probability distributions

What is probability?

Probability is a mathematical construction that determines the likelihood of occurrence of events that are subject to chance. When we say an event is subject to chance, we mean that the outcome is in doubt and there are at least two possible outcomes. Probability is a formal way to measure the chance of these uncertain events. Think of the occurrence of an event as the outcome of an experiment.

Definition of terms and concepts

Random experiment:involves obtaining observations or measurements of some kind.

Examples:counting arrivals at emergency room, toss of a coin; throw a die, polling, inspecting an assembly line, etc.

Population: set of all possible observations. Conceptually, a population could be generated by repeating an experiment indefinitely.

Event: any set of outcomes of interest in an experiment:

- Elementary event (simple event): one possible outcome of an experiment
- Compound event: a collection of possible outcomes (simple events) of a random experiment.

Application of conditional probability in diagnostic/or screening tests

- Diagnostic test characteristics (sensitivity and specificity) are based on experiments in which the test is compared to a "gold standard."
- True positives – the test is positive given the person has the disease ($P(T^+/D^+)$ = Sensitivity)
- False positives – the test is positive although the person does not have the disease
- True negatives – the test is negative given the person does not have the disease ($P(T^-|D^-)$ = Specificity)
- False negatives – the test is negative even though the person has the disease

Table 1. Table of the possible outcomes of a diagnostic/ or screening test

Test result	TRUTH	
	D^+	D^-
+ve (T+)	TP	FP
-Ve (T-)	FN	TN

- Sensitivity = $P(T^+|D^+) = P(T^+\&D^+)/P(D^+)$
- Specificity = $P(T^-|D^-) = P(T^-\&D^-)/P(D^-)$

Example 1: Suppose you have a panel of diagnostic tests and each give false positive results 2% of the time (98% specificity). If you test your patient with one of the tests and they do not have the disease, there is a 2% chance you'll get a false positive result. There is a 98% chance you will get the correct negative result. If you give the patient 2 tests, what is the chance of at least 1 false positive?

Example 2: A cytological test was undertaken to screen women for cervical cancer. Consider a group of 24,103 women consisting of 379 women whose cervices are abnormal (to an extent sufficient to justify concern with respect to possible cancer) and 23,724 women whose cervices are acceptably healthy. A test was applied and results are presented in **Table 1.**

Table 1 Table of a cytological test result among 24103 women

Test Result (X)	**True (Disease Status) (Y)**		**Total**
	+	–	

+	154	362	**516**
–	225	23,362	**23,587**
Total	**379**	**23, 724**	**24,103**

The probability of a positive test result is denoted Pr as (X = +):

Pr (X = +) = 516/24,103 = 0.021 and

The probability of a negative test result is denoted as Pr (X = −)

Pr (X= −) = 23,587/24,103 = 0.979

Similarly, the probabilities of having (Y = +)and not having (Y = −) the disease are given by Pr (Y = +) = 379/24,103 = 0.015 and Pr (Y = −) = 23,724/24,103 = 0.985

Conditional probability

Sensitivity: probability of test result positive given that the person has the disease.

Pr (X = + / Y = +) = Pr (X = +&Y = +) / Pr (Y = +) = 154/379 = 0.406

a. **Random Variables**

Random variable is numerical outcome of a random circumstance or numerical characterization of outcomes of an experiment. That is, the outcome of the experiment is determined by probability of occurrence. It assigns a number to each outcome of a random circumstance, or, equivalently, to each unit in a population.Two different broad classes of random variables:

1. A **continuous random variable**: It can take any value in an interval or collection of intervals.
2. A **discrete random variable:** It can take one of a countable list of distinct values.

Discrete Random Variables (DRV)

Let X = the random variable and k be a number the discrete random variable could assume. Then P(X =k) is the probability that X equals k.

Continuous Random Variable (CRV)

A continuous random variable has infinitely many values, and those values are often associated with measurements on a continuous scale with no gaps or interruptions. Height, time, weight, and money are examples of CRV. We will discuss more on CRV in the subsequent subsection.

Probability Distribution

Probability distribution is a distribution of the possible values of a random variable and their associated probabilities. Probability distribution function (pdf) X is a table or rule that assigns

probabilities to possible values of X. Probability distributions describe the possible values of a random variable and associated probabilities of occurrence. Why do we care about probability distributions? This is because many statistical tests are based on probability distributions which are foundations of statistical inferences.

Types of probability distributions:

1. Discrete Probability Distribution: It is a distribution of the possible values of a discrete random variable and their associated probabilities.

2. Continuous Probability Distribution: It is a distribution of the possible values of a continuous random variable and their associated probabilities.

Binomial Random Variables

It is one of the classes of discrete random variables. A binomial random variable X is defined as the number of "successes" in *n* independent trials where the Pr (success) = p is constant.

Conditions for a binomial experiment:

1. There are *n* "trials" where *n* is determined in advance and is not a random value.
2. Two possible outcomes on each trial, called "success" and "failure" and denoted S and F.
3. Outcomes are independent from one trial to the next.
4. Probability of a "success", denoted by *p,* remains same from one trial to the next. Probability of "failure" is 1 – *p*.

Binomial Probability Distribution

Binomial probability distribution is based on events in which there are only two possible outcomes on each occurrence.

$$P(X = x) = \binom{n}{x} p^x q^{n-x} = \frac{n!}{x!(n-x)!} p^x q^{n-x} \quad , x = 0,1,...,n$$

Binomial distribution

In the definition above notice the following conditions need to be satisfied for a binomial experiment:

Example 3: The proportion of people in the population with the disease is 15%, then P(X=1)=0.15 and P(X=0)=0.85. Here, code 1 stands for presence of disease and code 0 stands for absence of disease. Assume the probability of disease in each person is independent. If we take a random sample of 5 people from this population,

1. What is the probability that ALL of them will have the disease P(X=5)?
2. What is the probability that <u>exactly one person</u> P(X=1) has the disease? Use the binomial distribution to find this probability.
3. What is the probability that <u>exactly five people</u> P(X=5) of 5 have the disease = .00008? Use the binomial distribution to find this probability.

Solutions:

1. by the multiplication rule for independent outcomes: P(X=5) = $P(X_1=1)*P(X_2=1)*P(X_3=1)*P(X_4=1)*P(X_5=1)$
   = 0.15 x 0.15 x 0.15 x 0.15 x 0.15 = 0.00008
2. The probability that <u>exactly one person</u> P(X=1) has the disease

$$P(X=x)=\binom{n}{x}p^x q^{n-x}=\frac{n!}{x!\,(n-x)!}p^x q^{n-x}$$

$$P(X=1)=\binom{5}{1}0.15^1 0.85^{5-1}=\frac{5!}{1!(5-1)!}x0.15^1 x0.85^4$$

$$=5x0.15x0.85^4=0.3920$$

3. The probability that <u>exactly five people</u> P(X=5) of 5 have the disease = .00008

Practice problem 2:

You are performing a cohort study. If the probability of developing disease in the exposed group is .05 for the study duration, then if you (randomly) sample 500 exposed people,

1. How many do you expect to develop the disease? Give a margin of error (+/- 1 standard deviation) for your estimate.
2. What's the probability that **<u>at most</u>** 10 exposed people develop the disease?

Solutions on practice problem 2.1

1. Give a margin of error (+/- 1 standard deviation) for your estimate.
X ~ binomial (500, .05)
E(X) = 500 (.05) = 25
Variance (X) = 500 (.05) (.95) = 23.75
Standard Deviation (X) = square root (23.75) = 4.87, therefore 25 $\pm$ 4.87

2. What's the probability that **<u>at most</u>** 10 exposed subjects develop the disease?
This is asking for a **cumulative probability**: the probability of 0 getting the disease or 1 or 2 or 3 or 4 or up to 10.
P(X≤10) = P(X=0) + P(X=1) + P(X=2) + P(X=3) + P(X=4)+….+ P(X=10)=

$$\binom{500}{0}(.05)^0(.95)^{500}+\binom{500}{1}(.05)^1(.95)^{499}+\binom{500}{2}(.05)^2(.95)^{498}+\ldots+\binom{500}{10}(.05)^{10}(.95)^{490}<.01$$

Continuous Random Variables

A continuous random variable has infinitely many values, and those values are often associated with measurements on a continuous scale with no gaps or interruptions. In continuous random variables, the outcome can be any value in an interval or collection of intervals. For DRV we can find the probability that the variable X exactly equals a specified value. We can't do this for CRV. For CRV we are only able to find the probability that X falls between 2 values. We do this by determining the area between the two values under a curve called the probability density function of the random variable.

Probability density function for a continuous random variable *X* is a curve such that the area under the curve over an interval equals the probability that *X* is in that interval.

$P(a \leq X \leq b)$ = area under density curve over the interval between the values *a* and *b*.

A density curve (or probability density function) is a graph of a continuous probability distribution. It must satisfy the following 2 properties:

1. Total area under the curve = 1.0
2. Every point on the curve must have a vertical height that is 0 or greater (the curve cannot fall below the x-axis)

Because the total area under the density curve is equal to 1.0, there is a correspondence between area and probability.

Normal distribution

Many human anatomic and physiologic characteristics approach the normal distribution. Other terminology used synonymously with "normal distribution" includes Gaussian curve, curve of error, and normal probability curve. An understanding of the characteristics of the normal distribution is fundamental in the development of even a basic knowledge of Biostatistics.

Given the nature of data collected in medical science research, the normal distribution is the one with which the clinician will be most familiar.

Most statistical methods applied to interval or ratio data assume that the data are normally distributed.

If a population of measurements follows a normal curve, and if *X* is the measurement for a randomly selected individual from that population, then *X* is said to be a normal.

Any normal random variable can be completely characterized by its mean, μ, and standard deviation, σ.

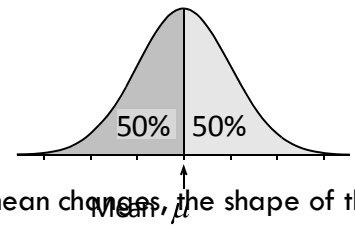
Normal Distribution

The probability density function (pdf) of normal random variables is given by:

$$\mathbf{f(x)} = \frac{\mathbf{1}}{\sqrt{\mathbf{2\pi\sigma}}}\mathbf{e}^{-\frac{1}{2}\left(\frac{\mathbf{x}-\mu}{\sigma}\right)^2}, \mathbf{where} -\infty < \mathbf{x} < +\infty$$

Characteristics of Normal Curve

- The curve is bell-shaped and symmetrical: mean, median, and mode are all equal.
- The highest frequency is in the middle of the curve.
- The frequency gradually tapers off as the scores approach the ends of the curve.
- The curve approaches, but never meets, the abscissa at both high and low ends.
- It is determined by two quantities: its mean (μ) and SD (σ).
- Changing μ alone shifts the entire normal curve to the left or right.
- Changing σ alone changes the degree to which the distribution is spread out.



When the mean changes, the shape of the normal distribution changed as well.

Standard Normal Distribution

The height of the frequency curve, which is called the probability density, cannot be taken as the probability of a particular value. This is because for a continuous variable there are infinitely many possible values so that the probability of any specific value is zero. An observation from a normal distribution can be related to a standard normal distribution (SND) which has a published table through z: $z = \frac{x-\mu}{\sigma}$.

Standard normal distribution (SND) is a normal probability distribution that has a mean of 0 and variance of 1.

Basic method for obtaining probabilities for normal random variables

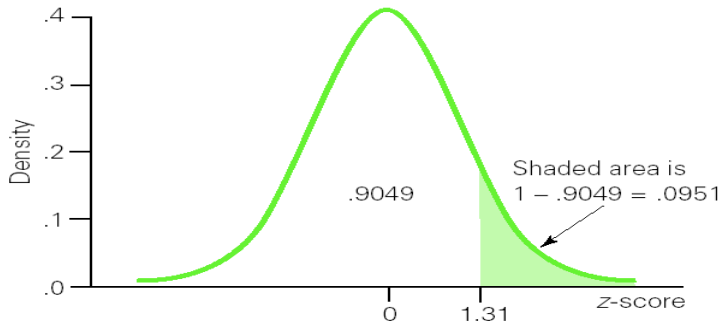
1. Sketch a normal curve, marking on the mean and values of interest.

2. Shade the area under the curve corresponding to the required probability.
3. Convert all values in original scale to their corresponding **z-scores.**
4. Obtain the desired probability from the upper-tail areas provided by a standard normal table.

Example 4: Finding probabilities

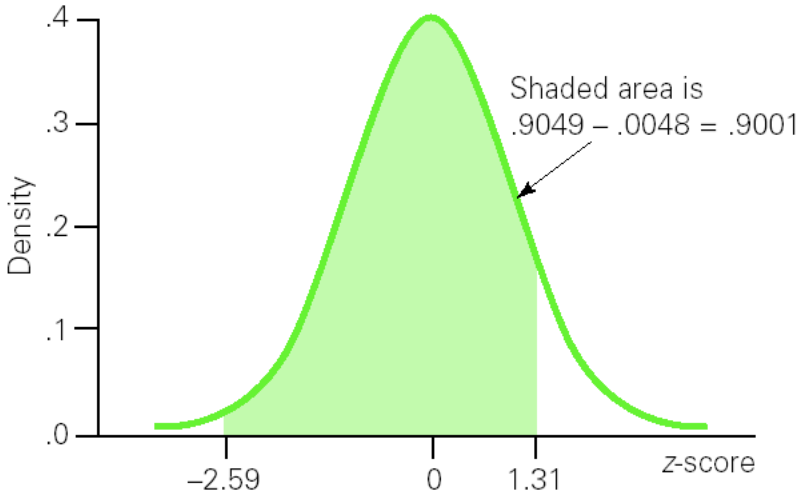
1. What is the area to the left of Z=1.50 in a standard normal curve?
2. Find the probability of obtaining Z > 1.31

   $P(Z > 1.31) = 1 - P(Z \leq 1.31) = 1 - .9049 = .0951$



3. Find the probability if Z is between –2.59 and 1.31

   $P(-2.59 \leq Z \leq 1.31) = P(Z \leq 1.31) - P(Z \leq -2.59) = .9049 - .0048 = .9001$



Exercise

1. Let X be a discrete random variable that represents the number of diagnostic services a child receives during an office visit to a pediatric specialist; these services include procedures such as blood test and urinanalysis. The probability distribution of X appears below.

X	0	1	2	3	4	5+

P(X=x)	0.671	0.229	0.053	0.031	0.01	0.006

a) What is the probability that a child receives exactly three diagnostic services during an office visit to a pediatric specialist?
b) What is the probability that he or she receives at least one service? Four or more service?
c) What is the probability that the child receives exactly three services given that he or she receives at least one service?

2. Consider a group of seven individuals selected from the population of 65-74 year-olds in a country. The number of persons in this sample who suffer from diabetes is a binomial random variable with parameters n=7 and p=0.125.
   a. What is the probability that exactly two of the individuals in the sample suffer from diabetes?
   b. What is the probability that four of them have diabetes?
3. Assume that among diabetics the fasting blood level of glucose is approximately normally distribute with a mean of 105 mg per 100 ml and SD of 9 mg per 100 ml.
   a. What proportions of diabetics have levels between 90 and 125 mg per 100 ml?
   b. What proportions of diabetics have levels below 87.4 mg per 100 ml?
   c. What level cuts of the lower 10% of diabetics?
   d. What levels encompass 95% of diabetics?

References:

7. Michael J. Panik. Advanced Statistics from an Elementary Point of View. Elsevier Inc. 2005, USA
8. Alvan R. Feinstein. Principles of Medical Statistics. Chapman & Hall/CRCBoca, 2002.
9. Daniel, W. W. 1999. Biostatistics: a foundation for analysis in the health sciences. New York: John Wiley and Sons.
10. Morton RF, Hebel JR, McCarter RJ: A Study Guide to Epidemiology and Biostatistics, 4th ed. Gaithersburg, Maryland, Aspen Publications, 1996.
11. Norman GR, Streiner DL: Biostatistics: The Bare Essentials, 2nd ed. Hamilton, Ontario, B.C. Decker, 2000.
12. Pagano M, Gauvreau K: Principles of Biostatistics, 2nd ed. Pacific Grove, CA, Duxbury Press, 2000.
13. BMJ. Statistics at Square One.
14. Kline et al. *Annals of Emergency Medicine* 2002; 39: 144-152.
15. Johnson R. *Just the Essentials of Statistics*. Duxbury Press, 1995.

Session 5: Sampling and sample size determination

Session overview

It is an explicit or implicit objective of most studies in health care which 'count' something or other (quantitative studies), to offer conclusions that are generalizable. This means that the findings of a study apply to situations other than that of the cases in the study. It is the representativeness of a sample which allows the researcher to generalize the findings to the wider population. Representative sample can be obtained by applying random sampling techniques.
However, there is a second issue which must be addressed in relation to sampling, and this is predominantly a question of sample size. The larger a sample size, the more likely it is that a finding of a difference such as this is not due to chance, but really does mean there is a difference. Many quantitative studies undertaken and published in medical journals do not have a sufficient sample size to adequately test the hypothesis which the study was designed to explore. Such studies are, by themselves, of little use, and -- for example in the case of drug trials – could be dangerous if their findings were generalized.

We will consider these issues of sample size, and how to calculate an adequate size for a study sample in the second half of this pack. Before that, let us think in greater detail about what a sample is.In some circumstances it is not necessary to select a sample. If the subjects of your study are very rare, for instance a disease occurring only once in 100,000 children, then you might decide to study every case you can find. More usually, however, you are likely to find yourself in a situation where the potential subjects of your study are much more common and you cannot practically include everybody. So it is necessary to find some way of reducing the number of subjects included in the study without biasing the findings in any way. Random sampling is one way of achieving this, and with appropriate statistics such a study can yield generalizable findings at far lower cost. Samples can also be taken using nonrandom techniques, but in this module we will emphasize on random sampling, which -- if conducted adequately -- will ensure external validity.

Learning objectives:

Having successfully completed this section, you will be able to:

- Define key terms used in sampling
- Distinguish between random and non-random sample,
- Identify the different methods of random sample,
- Explainadvantages and disadvantages of random sampling methods,
- Describethe importance of estimating sample size and influencingfactors
- Compute sample size for different study objectives.

Why not study the whole population?

- The physical impossibility of checking all items in the population,
- The cost of studying all the items in a population,
- The sample results are usually adequate,
- Contacting the whole population would often be time-consuming and
- The destructive nature of certain tests (e.g., study of light bulb life),

Concepts in sampling

Population, Sampled Population, Target Populations and Study Units

There are several key concepts that we need to consider when looking at samples, and these are: elements, population, sampling criteria, andrepresentativeness and precision.

A **population** is what we call the entire group of individuals or elements who meet the sampling criteria. One of the primary aims of statistics is to help draw objective conclusions that pertain to a larger group (called population) than the one for which data are available.

Target populationis defined as the population to be studied; it is the population about which information is desired. This is in contrast to the **study** or **sampled population**— the population from which the sample is actually obtained. Based upon these two population notions, consequently, we can describe a sample (or study for that matter) as being **valid**if the target and sampled populations have similar characteristics. (Note that some items in the target population may not be a member of the frame.).

The **unit of analysis** is the major entity that is being analyzed in a study. It is the 'what' or 'who' that is being studied. Examples include individuals (most common), groups, social organizations and social artifacts.

Example1: Consider the following example which compares two treatments for angina. Obviously, you cannot give the treatments to all patients with angina, but you can study a small group of such patients. You would then try to generalize your conclusions based on the results from that small group to a larger group of patients – perhaps even to most patients with angina.
In this example, the set of all angina patients would be the target population about which we wish to make inferences. The population is made up of study units (the units we study from the population) – which in these examples are angina patients.

Example 2: suppose we want to study people with elevated cholesterol levels (the word 'elevated' being precisely defined). It would not be practical to study all persons with elevated serum cholesterol levels, but we would hope to learn something relevant to all such persons on the basis of an experiment performed on a small group, or sample.

In this second example, the set of all persons with elevated cholesterol levels would be the target population about which we wish to make inferences.

Although it seems obvious in these examples that we are studying people, and that these people make up specific populations, the situation is not always this clear. The population of interest may, for example, be made up of blood samples or tissue specimens, each such sample or specimen being a study unit. We often use animal models in our initial investigations of an area of human research, and so the study unit may be a rat, a hamster, or a dog. In genetic studies, the study unit may be a family.

The important point to remember is that, in statistics, a population is the group of all study units about which a particular investigation may provide information. The study units make up the population, and the population about which we wish to make inferences determines what is meant by a study unit.

We must also carefully distinguish between the target population and the study population. The target population is the whole group of study units to which we are interested in applying our

conclusions. The study population, on the other hand, is the group of study units to which we can legitimately apply our conclusions.

Unfortunately the target population is not always readily accessible, and we can study only that part of it that is available. If, for example, we are conducting a telephone interview to study all adults (our target population) in a particular city, we do not have access to those persons who do not have a telephone. We may wish to study in a particular community the effect of drug A on all persons with cholesterol levels above a specified value; however, short of sampling all persons in the community, only those persons who for some reason visit a doctor's office, clinic, or hospital are available for a blood sample to be taken. Thus, we have a study population of accessible study units and a target population that includes both the study population and the inaccessible study units. Those study units that are not readily accessible may or may not have the same characteristics as those of the target population. Their exclusion from the study population means that inferences made about the study population need not necessarily apply to the target population. As we shall note later, when families are the study units, it can be very difficult to match the study and target populations, or even to define the study population.

There are many ways to collect information about the study population. One way is to conduct a complete census of the population by collecting data for every study unit in it. The amount of money, time, and effort required to conduct a complete census is usually unreasonable. A more practical approach is to study some fraction, or sample, of the population. If the sample is representative of the population, then inferences we make from the sample data about the population will be correct. Because our interest is in estimating parameters and testing hypotheses about parameters of the population, special efforts should be made to obtain a representative sample. Haphazard samples, or samples selected on the basis of being easy to collect, are rarely representative of the population. We will now first describe methods of sampling a population that can be used in the simpler situations and that usually lead to representative samples.

Practice problem 1: A researcher wanted to estimate the proportion of the adult population of a certain community who has consulted doctors in the past one year for the purpose of determining their health seeking behaviors. For the scenario, define

- Target population=
- Element=
- Frame=
- Sampling unit=

2.2 Probability Samples

In order to make the kinds of inferences we discuss in later part of the module, we should ideally select well-defined probability samples, in which every unit in the population has an equal probability of being included in the sample. Although this may often be impossible, a clear understanding of what can be done in the simplest of situations will help you appreciate the problems we face when conducting epidemiological and genetic studies.

Probability sampling is also known as 'random sampling' or 'chance sampling'. To obtain a random (or probability) sample, the first step is to define the target population to which the study is intended to conclude. Then, clearly indicate the accessible population from which the actual sample to be drawn. This population is known as sampled/ or study population. Once the study population is known, the next step is obtaining or preparing the samplingframe, which is thought of as a list of all the people / patients / items relevant to the study.

To be a 'random' sample, every individual in the population must have an equal probability of being selected. In order to carry out random sampling properly, strict procedures need to be adhered to. Random sampling techniques can be split into **simple random sampling**and**systematic sampling**.

Under these sampling designs, every item of the universe has an equal chance of inclusion in the sample. The results obtained from probability or random sampling can be assured in terms of probability i.e., we can measure the errors of estimation or the significance of results obtained from a random sample, and this fact brings out the superiority of random sampling design over the deliberate sampling design. Random sampling ensures the law of Statistical Regularity which states that if on an average the sample chosen is a random one, the sample will have the same composition and characteristics as the universe. This is the reason why random sampling is considered as the best technique of selecting a representative sample.

In brief, the implications of random sampling (or simple random sampling) are:
(a) It gives each element in the population an equal probability of getting into the sample; and all choices are independent of one another.
(b) It gives each possible sample combination an equal probability of being chosen.

Simple Random Sampling (SRS)

SRS is a sampling procedure which ensures equal probabilities to each element in the study population. Keeping this in view we can define a simple random sample (or simply a random sample) from a finite population as a sample which is chosen in such a way that each of the ${}_NC_n$ possible samples has the same probability, $\frac{1}{{}_NC_n}$, of being selected.

Example 3: To make it more clear we take a certain finite population consisting of six elements (say a, b, c, d, e, f) i.e., N = 6. Suppose that we want to take a sample of size n = 3 from it. Then there are ${}_6C_3 = 20$ possible distinct samples of the required size, and they consist of the elements abc, abd, abe, abf, acd, ace, acf, ade, adf, aef, bcd, bce, bcf, bde, bdf, bef, cde, cdf, cef, and def. If we choose one of these samples in such a way that each has the probability 1/20 of being chosen, we will then call this a random sample.

How to select a random sample?

With regard to the question of how to take a random sample in actual practice, we could, in simple cases like the one above, write each of the possible samples on a slip of paper, mix these slips thoroughly in a container and then draw as a lottery either blindfolded or by rotating a drum or by any other similar device. Such a procedure is obviously impractical, if not altogether impossible in complex problems of sampling. In fact, the practical utility of such a method is very much limited.

Fortunately, we can take a random sample in a relatively easier way without taking the trouble of enlisting all possible samples on paper-slips as explained above. Instead we can use computer generated table of random numbers.

One may note that it is easy to draw random samples from finite populations with the aid of random number tables only when lists are available and items are readily numbered. But in some situations it is often impossible to proceed in the way we have narrated above. For example, if we want to estimate the mean height of trees in a forest, it would not be possible to number the trees, and choose random numbers to select a random sample. In such situations what we should do is to select some trees for the sample haphazardly without **aim** or **purpose**, and should treat the sample as a random sample for study purposes.

Simple random sampling is possible when the population is homogeneous and frame is available. However, if frame is not available a simpler and quicker way is to use systematic sampling.

Advantage

- Highly representative if all subjects participate; the ideal

Disadvantage

- Not possible without complete list of population members
- potentially uneconomical to achieve
- can be disruptive to isolate members from a group

- time-scale may be too long, data/sample could change

Systematic Random Sampling (SRS)

A method of probability sampling in which elements on an ordered list of population members are chosen by applying an interval of constant length after a random start. Systematic sampling is a more commonly employed method. After numbers are allocated to everybody in the study population frame, the first individual is picked using a random number table or lottery method and then subsequent subjects are selected using a fixed sampling interval, i.e. every k^{th} person.

Selecting a Systematic Sample

a. The sampling frame consists of a list numbered sequentially from 1 to the number of sampling units in the list.
b. A sampling interval (denoted by the symbol, k) is chosen. If a sample of about n out of N elements is desired, k is usually the ratio, N/n, rounded to the nearest integer.
c. A random number between 1 and k is chosen. This number is called the random start and will be denoted by the symbol, m.
d. Elements selected in the sample are those numbers m and every k-th element for the remainder of the list; i.e., m, m+k, m+2k, etc.

Assume, for example, that we wanted to carry out a survey of patients with asthma attending clinics in one city. There may be too many to interview everyone, so we want to select a representative sample. If there are 3,000 people attending the clinics in total and we only require a sample of 200, we would need to:

- calculate the sampling interval (k) by dividing 3,000 by 200 to give a sampling fraction of 15
- select a random number between one and 15 using a set of random tables
- if this number were 13, we select the individual allocated number 13 and then go on to select every 15th person, i.e. numbers 28, then 43, then 58, and so on.

This will give us a sample size of 200 as required.

Note. Care needs to be taken when using a systematic sampling method in case there is some bias in the way that lists of individuals are compiled. For example, if all the husbands' names precede wives' names and the sampling interval is an even number, then we could end up selecting all women and no men.

Example 4: We wish to select a systematic 1-in-5 sample from a population of 1000 discharges in a hospital. If the random start is 3 then the next unit will be 8, then 13, and so on.

Advantages

- Systematic sampling can be quickly and easily applied.
- With proper ordering of the population list, systematic sampling can be used as a method of selecting a sample which is similar to a proportionate stratified sample.

Disadvantage

- It can interact with a hidden periodic trait within a population

Stratified Random Sampling

What is Stratification?

It isthe process of dividing a population of elements into distinct subpopulations called strata. Strata are formed so that each population element is assigned to only one stratum. Stratified sampling is a way of ensuring that particular strata or categories of individuals are represented in the sampling process.

If, for example, we want to study risky sexual practice among high school adolescents, and we know that approximately four percent of our population frame is made up of a particular grade of high school adolescents, there is a chance that with simple random sampling or systematic sampling we could end up with no adolescents (or a much reduced proportion) in our sample. If we wanted to ensure that our sample was representative of the population frame, then we would employ a stratified sampling method.

- First we would split the population into the different strata, in this case, separating out those individuals with the relevant high school grade.
- We would then apply random sampling techniques to each of the grades of the high school separately, using the same sampling interval in each grade.
- This would ensure that the final sampling frame was representative of the minority grade (in terms of size of class) we wanted to include.

Consider another example, you wish to stratify a list of patients of a large reference hospital by age. Since the age of all employees is available on our sampling frame, we form the following strata:

Table.2 Age stratified list of patients of a large reference hospital.

Stratum	Stratum Composition:
1	Less than 25 years old
2	25 to 34 years old
3	35 to 44 years old
4	45 to 54 years old
5	55 years of age or older

Stratified Sampling Procedures

a. The population is divided into strata so that each population element is a member of only one stratum. We use the letter K to represent the number of strata that are formed and N_k to denote the number of population elements which fall in the k^{th}stratum. The total number of elements in the population is, therefore,

$$N = N_1 + N_2 + ... + N_k = \sum_{k=1}^{K} N_k$$

b. A sample size is chosen for each stratum. We denote the sample size in the k^{th}stratum by the symbol, n_k. The total sample size over all strata is then

$$n = n_1 + n_2 + ... + n_k = \sum_{k=1}^{K} n_k$$

The corresponding sampling fraction for the k^{th} stratum would be $f_k = \frac{n_k}{N_k}$ with the overall sampling fraction being $f = \frac{n}{N}$.

c. A probability sample is separately chosen in each stratum so that the choice of elements in one stratum does not depend upon choices made in the other strata. Selection procedures among strata are often the same although different selection methods can be used, if needed.
d. The population value to be estimated (e.g., mean, proportion, etc.) is estimated separately for each stratum.
e. An estimate for the entire population is produced by appropriately combining the individual stratum estimates.

What is Stratified Simple Random Sampling?

Stratified sampling in which simple random sampling is used in each stratum.

Stratified simple random sampling is a simple form of stratified sampling. There are many other types of stratified sampling, however.

How to Select a Stratified Simple Random Sample

a. Divide the population into strata.
b. Determine sample sizes for each stratum.
c. Select a separate simple random sample in each stratum.

Allocation of the Sample among Strata

There are two commonly applied allocation strategies among strata. One is called Proportionate Stratified Sampling and the other is called Disproportionate. Both strategies

are special types of stratified random sampling designs so we continue to assume that simple random sampling is the selection method in each stratum.

Proportionate Stratified Sampling

Choose the same sampling fraction f_k for all strata. In other words, $f_k = \frac{n_k}{N_k} = \frac{n}{N} = f$

This is the same as saying that $W_k = \frac{N_k}{N} = \frac{n_k}{n} = w_k$

This means that the proportion of the sample chosen from any given stratum will be the same as the proportion of the population in that same stratum.

Example 5: A study of the length of stay of patients at Black Lion Hospital. Consider selecting patients admitted to wards A, B, C and D in the hospital for the study assuming that the four wards will have different lengths of stay.

Stratum (k)	**Stratum size (N_k)**	**Stratum Sample Size (n_k) $n_k = n\ (N_k / N)$**
1 (Ward A)	220	300(220/3078) = 21.4 ≅ 21
2 (Ward B)	1054	300(1054/3078) = 102.7 ≅ 103
3 (Ward B)	1382	300(1382/3078) = 134.7 ≅ 135
4 (Ward B)	422	300(422/3078) = 41.1 ≅ 41
Total	3078	n = 300

Thus, using proportional allocation, the sample sizes for different strata are 21, 103, 135 and 41, respectively, which is in proportion to the sizes of the strata viz., 220: 1054 : 1382: 422.

Proportional allocation is considered most efficient and an optimal design when the cost of selecting an item is equal for each stratum, there is no difference in within-stratum variances, and the purpose of sampling happens to be to estimate the population value of some characteristic.

But in case the purpose happens to be to compare the differences among the strata, then equal sample selection from each stratum would be more efficient even if the strata differ in sizes. In cases where strata differ not only in size but also in variability and it is considered reasonable to take larger samples from the more variable strata and smaller samples from the less variable strata, we can then account for both (differences in stratum size and differences in stratum variability) by using **disproportionate sampling design** by requiring:

$n_1/N_1\sigma_1 = n_2/N_2\sigma_2 = ... = n_k/N_k\sigma_k$ where σ_1, σ_2 , ... and $\sigma_k$denote the standard deviations of the k strata, N_1, N_2,..., $N_k$denotethesizes of the k strata and n_1, n_2,..., $n_k$denote the sample sizes of k strata. This is called 'optimumallocation' in the context of disproportionate sampling. The allocation in such a situation results inthe following formula for determining the sample sizes different strata:

$$n_i = \frac{n.N_i\sigma_i}{N_1\sigma_1 + N_2\sigma_2 + ... + N_k\sigma_k}$$ for*i*= 1, 2, … and *k*.

Advantage

- Can ensure that specific groups are represented, even proportionally, in the sample(s) (e.g., by gender), by selecting individuals from strata list

Disadvantage

- More complex, requires greater effort than simple random; strata must be carefully defined

Cluster Sampling

Cluster sampling is a probability sampling in which sampling units at some point in the selection process are collections, or clusters, of population elements. It is a method frequently employed in national surveys where it is uneconomic to carry out interviews with individuals scattered across the country. Cluster sampling allows individuals to be selected in geographic batches.

For instance, before selecting individual people at random, the researcher may decide to focus on certain 'areas', e.g. towns, electoral wards or general practices - selecting these by a method of random sampling. Once this was done, they could either i) select all the individuals within these areas, or ii) use random sampling to select just a proportion of the individuals within these chosen areas.

Although cluster sampling is a very valuable technique and is widely used, it is worth noting that it does not produce strictly *independent* samples, since the knowledge that one person in a specific cluster has been selected will increase the probability that others in the same cluster will also be selected.

Obviously care must be taken to ensure that the cluster units selected are generally representative of the population and are not strongly biased in any way. If, for example, all the general practices selected for a study were single-handed, this would not be representative of all general practices.

Selecting a Simple **One-Stage** Cluster Sample

a. Specify appropriate clusters.
b. Select a simple random sample of clusters from a complete list of clusters.
c. Collect survey data from all population elements falling in the selected clusters.

Some Implications of Using Cluster Sampling

a. If we collect survey data on all members of each selected cluster (i.e., we have a "one-stage" sample of members), the probability of choosing each element in this cluster is **the same as the probability of choosing the cluster regardless of the number of elements in the cluster**. For example, if we have 100 clusters of unequal size and we randomly choose 10 of them, the probability of selection for each element in the 10 selected clusters is 0.1 regardless of the sizes of the selected clusters.
b. Cluster sampling generally yields estimates with **relatively larger variances** (i.e., lower precision) than samples of the same size which are chosen by element (i.e., non-cluster) sampling. The amount of the increase in variance is directly related to the average sample cluster size.
c. Because members of clusters are often close in geographic proximity, the average **cost per sample element can be reduced** substantially over element sampling if cluster sampling is used. The amount of the reduction in costs is directly related to the average size of the clusters that are used.
d. Since elements in clusters are usually similar (i.e., clusters are internally homogeneous), the amount of information gathered by the survey may not be increased substantially as new measurements are taken within clusters. This tells us that **sample cluster sizes should not be too large**. As a general rule, the number of clusters in the population should be large which means that the average size of clusters should be kept as small as possible.
e. Cluster sampling **eliminates the need for a sampling frame consisting of a list of all elements in the population**. Since clusters are the units being sampled, a listing of all clusters in the population constitutes an appropriate frame.

Multi-Stage Random sampling

Multi-Stage Sampling ---A method of probability sampling in which the sample of elements is chosen in two or more stages. Second stage sampling units are chosen from the sampling units selected in the first stage. Third stage units are chosen from second stage sampling units; and so forth.

Selecting a Two-Stage Sample

a. A list of first stage sampling units is prepared. Sampling units in the first stage of a multi-stage sample are called primary sampling units, or PSUs.
b. A probability sample of first stage units is chosen
c. In each of the selected first stage units a list of population elements is prepared.
d. A **separate** probability sample of elements is selected in each of the selected first stage units.

Probability Proportional to Size Sampling Technique (PPS)

Probability proportional to size (PPS) is a sampling technique for use with surveys or mini-surveys in which the probability of selecting a sampling unit (e.g., village, zone, district, health center) is proportional to the size of its population. It gives a probability (i.e., random, representative) sample. It is most useful when the sampling units vary considerably in size because it assures that those in larger sites have the same probability of getting into the sample as those in smaller sites, and vice versa. This method also facilitates planning for field work because a pre-determined number of respondents are interviewed in each unit selected, and staff can be allocated accordingly.

2.3 Non-Random Samples

They are case selection kinds rather than random selection. Non-random (or non-probability) sampling is not used very often in quantitative medical social research surveys. The techniques most commonly used are convenience, volunteer, purposive, snowball and quota sampling.

Convenience sample

Also known as an accidental sample, convenience sampling is non-probability sampling in which people are included in the research study because they just happen to be in the right place at the right time. To put it most simply, a convenience sample is a group of participants to whom the researcher has access, for example, patients on a ward. In accidental/convenience sampling, potential participants are simply entered into the study until the desired sample size is reached.

Volunteer sample

A volunteer sample is one in which the participants have volunteered to take part in the study. This type of sample is generally regarded as the weakest form of sampling, but it is useful when respondents are difficult to recruit by any other means. A major problem with a volunteer sample is that the participants may well have volunteered because they have their own agenda/ulterior motives which may clash with the researcher's aims.

Purposeful sampling

Purposive sampling is a non-probability technique that involves the conscious selection by the researcher of certain people to include in a study. Participants are selected because they have particular characteristics that are of interest to the researcher. For example, they have had the experience in which the researchers are interested, or there are certain aspects of their lives in which the researchers are interested.

Snowball sample

In a snowball sample, participants who are already part of the sample are asked to identify others who would possibly be suitable for inclusion in the study and who would be agreeable to taking part in it. In other words, the sample gradually increases in size, like a snowball being rolled down a hill. This type of sample is useful when the researcher is studying a sub-group who may not easily be accessible otherwise, for example drug users. Snowball sampling techniques offer an established method for identifying and contacting hidden populations and, potentially, for their enumeration although often this may be a secondary concern.

Quota Sampling

Quota sampling is a technique for sampling whereby the researcher decides in advance on certain key characteristics which s/he will use to stratify the sample. Interviewers are often set sample quotas in terms of age and sex. For example, consider a market research study where interviewers will stop people in the street to ask them a series of questions on consumer

preferences. The interviewer might be asked to sample 200 people, of whom 100 should be male and 100 should be female - and, within each of these groups, there should be 25 people in each of the age-groups: under-20, 20-39, 40-59 and over-60. The difference with a stratified sample is that the respondents in a quota sample are notrandomly selected within the strata. The respondents may be selected just because they are accessible to the interviewer. Because random sampling is not employed, it is not possible to apply inferential statistics and generalize the findings to a wider population.

Non probability samplings are u**seful in some situations:**

- when doing exploratory research
- when interested in small population, extreme cases

Two major weaknesses:

1. don't control for investigator bias in selection of sample; might select most available or certain type of respondent
2. unknown pattern of variability, therefore can't calculate sampling error

Sampling and non-sampling errors

Every study has error; error introduced in every stage – both design and in procedures in implementing design. If we undertake a complete census of some population, then we can readily describe, in varying degrees of detail, many of its salient features or characteristics. However, if we only sample from the population, then it should be intuitively clear that the different possible samples obtained will exhibit different sets of sample values (although some duplication in the sample values can occur). Hence, any conclusion reached about the population from any one sample may differ slightly from that reached on the basis of examining some other sample. Again, this is because different samples typically possess different sample values. Given that none of the samples will look exactly like the population at large, we will most assuredly find a difference between some true population parameter (θ) and the statistic ($\hat{\theta}$) used to estimate it.

Hence the degree of *samplingerror*is $\hat{\theta} - \theta$. It should be obvious the sampling error is inescapable—it reflects the inherent natural variability among a parameter and a statistic used to estimate it. For some samples the amount of sampling error will be large; for others it may be quite small. (If the true $\theta$is known then the difference between $\hat{\theta}$ and θreflects the degree of

accuracy of our estimate of θ. Since $\theta$is usually unknown, the best we can do is talk about a long-term degree of *precision* of our estimate of θ; i.e., we can determine an *error bound* on $\hat{\theta}$as an estimate of θ).

This is in contrast to the notion of *non-sampling error*, which is due essentially to unsound sampling or experimental techniques, and which can be controlled.

Here human or mechanical factors distort the observed values, thus contributing to the difference between $\hat{\theta}$ and θ. Non-sampling error emerges when you have a *biased sample*. For instance, some items in the population may be more likely to be included in the sample than others or errors of observation or measurement result in a systematic accumulation of inaccuracies in a single direction. When this occurs $\hat{\theta}$may be larger on the average (a positive bias) or smaller on the average (a negative bias) than θ. If on the average $\hat{\theta}$ equals θ, then $\hat{\theta}$ is said to be *unbiased*; that is, the long-run average of the sampling error is zero. It is important to identify possible sources of error and attempt to reduce them. Two basic sources of error:

1. **Sampling Error**: The error that arises as a result of taking a sample from a population rather than using the whole population. These errors occur because of variation in the number or representativeness of the sample that responds. Sampling errors can be controlled by (1) careful sample designs, (2) large samples, and (3) multiple contacts to assure representative response.

   Characteristics
   - generally decreases as the sample size increases (but not proportionally)
   - depends on the size of the population under study
   - depends on the variability of the characteristic of interest in the population
   - can be accounted for and reduced by an appropriate sampling plan
   - can be measured and controlled in probability sample surveys.

2. **Selection bias** (bias in selection and don not refers to measurement/ information bias) - respondents are not representative of larger population. Resulted from:
   a. Not selecting from population (sampling frame)
      - sampling frame inaccurate
      - undercoverage—leaves people out
      - overcoverage—includes ineligibles
      - multiplicity—people included more than once
   b. NON-RESPONSE BIAS—Non-response errors occur when respondents are different than those who do not respond. This may occur because either the potential respondent was not

contacted or they refused to respond. The extent of this non-response error can be checked through follow-up surveys using alternate modes.

2.4. Sample size determination

Among the questions that a health worker should ask when planning a surveyor study is "How large a sample do I need?" The answer will depend on the aims, nature and scope of the study and on the expected result, all of which should be carefully considered at the planning stage.
If the sample size ('n') is too small, it may not serve to achieve the objectives and if it is too large, we may incur huge cost and waste resources. As a general rule, one can say that the sample must be of an optimum size i.e., it should neither be excessively large nor too small.
For example, in a study of the curative effect of a drug on a fatal disease such as the acquired immunodeficiency syndrome (AIDS), where a single positive result could be important, sample size might be considered irrelevant. In contrast, if a new malaria vaccine is to be tested, the number of subjects studied will have to be sufficiently large to permit comparison of the vaccine's effects with those of existing preventive measures.

The type of "outcome" under study should also be taken into account. There are three possible categories of outcome. The first is the simple case where two alternatives exist: yes/no, dead/alive, vaccinated/not vaccinated, existence of a health committee/lack of a health committee. The second category covers multiple, mutually exclusive alternatives such as religious beliefs or blood groups. For these two categories of outcome the data are generally expressed as percentages or rates. The third category covers continuous response variables such as weight, height, age and blood pressure, for which numerical measurements are usually made. In this case the data are summarized in the form of means and variances or their derivatives. The statistical methods appropriate for sample size determination will depend on which of these types of outcome the investigator is interested in.

Only once a proposed study and its objectives have been clearly defined can a health worker decide how large a sample to select from the population in question. This module is intended to be a practical guide to making such decisions. It presents a variety of situations in which sample size must be determined, including studies of population proportion, odds ratio, relative risk and incidence rate, mean, and differences in mean and proportions. In each case the information needed is specified and at least one illustrative example is given.

Random sampling (simple or systematic) is assumed for all examples, so that if the sample selection process has some structure (cluster or stage), consideration of design effect could be made. Hence, for samples that are not random or systematic, a design effect other than 1.0 may be used and the calculated sample sizes are multiplied by the design effect. In addition, a finite population correction will be applied if the population size is not large ($N \leq 10{,}100$).

In conclusion, the investigator should have decided on the study design, made a reasonable guess at the likely result, determined what levels of significance, power and precision (where relevant) are required and considered operational constraints such as restrictions on time or resources.

Factors to be considered in determining sample size

Technically, the sample size should be large enough to give a confidence interval of desired width and as such the size of the sample must be chosen by some logical process before sample is taken from the universe. Size of the sample should be determined by a researcher keeping in view the following points:

i. **Nature of population:**Universe may be either homogenous or heterogeneous in nature. If the items of the universe are homogenous, a small sample can serve the purpose. But if the items are heterogeneous, a large sample would be required. Technically, this can be termed as the dispersion factor.

ii. **Population size** – what is the size of the population to be surveyed? The default value is at least 10,000. In general, when sampling from a "large" population, whether there are 100,000 in the population or 100 million, this will not affect the sample size calculation. However, when the population size is small, then this could reduce the sample size.

iii. **Anticipated % frequency (p) or standard deviation** – provide an educated guess of the percent of the population with the outcome of interest or the amount of variability in the population ((to be estimated from past experience or on the basis of a trial sample). Of course, if you knew this with any accuracy, you would not need to perform the survey. If you are unsure of the percentage, use of 50% will result in the largest sample size (holding the other three pieces of information being requested the same). If it is not possible to have guess estimate of the population standard deviation, consider taking one sixth of the range (1/6(Maximum value – minimum value)) of the measurements on the outcome variable.

iv. **Number of classes proposed:** If many class-groups (groups and sub-groups) are to be formed, a large sample would be required because a small sample might not be able to give a reasonable number of items in each class-group.

v. **Nature of study:**If items are to be intensively and continuously studied, the sample should be small. For a general survey the size of the sample should be large, but a small sample is considered appropriate in technical surveys.

vi. **Type of sampling:**Sampling technique plays an important part in determining the size of the sample. A small random sample is apt to be much superior to a larger but badly selected sample.

vii. **Standard of accuracy and acceptable confidence level:** If the standard of accuracy or the level of precision is to be kept high, we shall require relatively larger sample. For doubling the accuracy for a fixed significance level, the sample size has to be increased fourfold. **Confidence limits,**this question is asking exactly how wide (in absolute terms) you would like the confidence interval to be around your point estimate. Using the default values, with an anticipated frequency of 50% and confidence limits as $\pm$5%, for the calculated sample size the confidence interval would be 50% $\pm$5%, i.e., (45%, 55%).

viii. **Availability of resource including finance:**In practice, size of the sample depends upon the amount of money available for the study purposes. This factor should be kept in view while determining the size of sample for large samples result in increasing the cost of sampling estimates.

ix. **Design Effect:** if simple random sampling is to be used to select individuals (or whatever the element of analysis), then the design effect (DEFF) should be left as one. If a cluster-type survey is being used in the sampling methodology, the DEFF is frequently larger than one, perhaps in the range of 2 to 10 depending on the outcome being studied. An estimate of the DEFF can usually be found in the literature.

x. **Other considerations:** Nature of units, non-response, size of questionnaire, availability of trained investigators, the conditions under which the sample is being conducted, the time available for completion of the study are a few other considerations to which a researcher must pay attention while selecting the size of the sample.

It is important to have a sample that is the correct size. It is also important to have a method that will allow prediction of the correct sample size for estimating a population mean or a population proportion. This is important especially in business or commercial situations where money is

involved. Selecting a sample size that is too big wastes money and one that is too small may give inaccurate results.

Steps to determine sample size:

1. Specify tolerable error (i.e., desired precision and confidence level via d and α)
2. Identify appropriate equation relating tolerable error (d, α) to sample size (n)
3. Estimate unknown quantities in equation
4. Solve for n
5. Evaluate (and return to first step) - Can you afford the sample size? What expectations can be altered?

1. Specify tolerable error

Need two parameters

- d : margin of error or half-width of CI
- α : [1-α]x100% is confidence level

2. Equation linking d, α, and n

Link equation is expressed with population parameters. But we'll usually need to insert parameter estimates. Most common link equation is half-width of confidence interval (CI), $d = z_{\alpha/2}\, SE\,[\hat{\theta}]$. The actual link equation depends on (will change with) the estimator and design.

Example: consider estimating the population mean

$$d = z_{\alpha/2}\sqrt{\frac{\sigma^2}{n}\left[1-\frac{n}{N}\right]}$$

Where, $\frac{n}{N}$ is called finite population correction (FPC).

3. Estimate unknowns

For instance, estimate of population variance, σ^2

- Previous study or Pilot study or Estimate of variance under normality with:

$$\sigma = \frac{\text{range for 95\% of values in the data}}{4} \text{ or}$$

$$\sigma = \frac{\text{range of 99\% of values in the data}}{6}$$

As approximately 95% of values are within 2 standard deviation of the mean and 99.7% are within 3 standard deviation.

For proportions

- If have a good guess for true proportion P, use $\sigma^2 = \frac{N}{N-1}P(1-P) \approx P(1-P)$

- If there isn't a good estimate of p , use $P = 0.5,\ \text{or}\ \sigma^2 \approx 0.25$
- P= 0.5 leads to maximum possible variance for estimated proportion under SRS, so this is a good conservative estimate in the absence of estimated proportion.

4. Solve for required sample size (n):

I. SRS and population mean, $n = \frac{z^2\sigma^2}{d^2}(1-\frac{n}{N})$

II. SRS and population proportion, $n = \frac{z^2pq}{d^2}(1-\frac{n}{N})\ \text{where,}\ q = 1-p$

Note: for large population, we can ignore the FPC

Special case for proportions

Confidence level of (1- α)%, use p = 0.5

Link equation is, $d = z_{\alpha/2} \times \sqrt{\frac{0.5 \times 0.5}{n}\left[1-\frac{n}{N}\right]}$

Equation for sample size is: $n = \frac{z^2 0.25}{d^2}(1-\frac{n}{N})\ \text{where,}\ q = 1-p$

5. Evaluate sample size

Can you afford the sample size?

- No
  - Relax parameters for tolerable error, i.e. increase the margin of error
  - Decrease confidence level
- Yes
  - Check level of precision for subpopulations
  - Occasionally, similar level of precision can be obtained for smaller sample size
- Sometimes there is not much gain in precision for a higher sample size

For instance, n = 400 ford≅ 0.05 and n = 500 for d≅ 0.04

Sample size for the difference between proportions:

Sample size in each group (assumes equal sized groups)

$n = 2 \times \frac{(\bar{p})(1-\bar{p})(Z_\beta + Z_{\alpha/2})^2}{(p_1 - p_2)^2}$ where,

- Z_β SND table value for β power represents the **desired power** (typically 0.84 for 80% power).
- $(\bar{p})(1-\bar{p})$ is a measure of **variability** (similar to standard deviation)
- $(p_1 - p_2)$ an e**ffect Size** (the difference in proportions)

$Z_{\alpha/2}$ SND table value for α level of significance represents the desired **level of statistical significance** (typically 1.96).

Sample size for the difference between means:

$$n = 2 \times \frac{\sigma^2 (Z_\beta + Z_{\alpha/2})^2}{(\bar{x}_1 - \bar{x}_2)^2}$$ where,

- Z_β SND table value for β power represents the **desired power** (typically 0.84 for 80% power).
- σ^2 is the pooled variance that measures**variability** with the assumption of equal variance
- $(\bar{x}_1 - \bar{x}_2)$ an e**ffect Size** (the difference in proportions)
- $Z_{\alpha/2}$ SND table value for α level of significance represents the desired **level of statistical significance** (typically 1.96).

Requirements:

- The proportion of the baseline (controls or non-exposed) population
  - EXPOSED (for case-control studies), or
  - DISEASED (for cohort/intervention studies)
  - Often based on previous studies or reports
- Magnitude of the expected effect (RR, OR)
  - Often based on previous studies or reports
  - Minimum effect that investigator considers worth detecting

Example 2.4.1:

A health officer wishes to estimate the mean serum cholesterol in a population of men. From previous similar studies a standard deviation of 40 mg/100ml was reported. If she is willing to tolerate a marginal error of up to 5 mg/100ml in her estimate, how many subjects should be included in her study? (α = 5%, two sided)

Solution 2.4.1:

a) If the population size is assumed to be very large, the required sample size would be:
   $n = (1.96)^2 (40)^2 / (5)^2 = 245.86 \approx 246$ persons
b) If the population size is, say 2000, the required sample size would be 216 persons.
c) If the investigator anticipates that 15% of the subjects will fail to comply with the intended study, the sample size required will be:
   n = 246 + (0.15 x 246) = 283 men

Example 2.4.2:What sample size do I need if?

Cohort study of oral contraceptive (OC) use in relation to risk of MI among women of childbearing age

Previous studies:

- Proportion of non-OC users who had diseases = 0.15
- Proportion of OC-users who had diseases = 0.25

- A relative risk of 1.67
  - Conventional α = 0.05 (two-sided)
  - Conventional β = 0.20 (80% power to detect a difference if one truly exists)
  - Assume equal sample sizes ($n_1 = n_2$)

Solution 2.4.2:251 OC users (and 251 non-OC users)

Example 2.4.3:What sample size do I need if?

Case-control study of oral contraceptive (OC) use in relation to risk of MI among women of childbearing age

Previous studies:

- 15% of women with MI use OCs
- 10% of women without MI use OCs
  - OR of MI associated with current OC use = 1.8
  - Conventional a = 0.05 (two-sided)
  - Conventional b = 0.20 (80% power to detect difference if one truly exists)
  - Assume equal sample sizes ($n_1=n_2$)

Solution 5.4.4: 409 cases and 409 controls

Design Effect:

Sample size formula with design effect:

$$\text{Var SRS} = \frac{p(1-p)}{n} \quad \text{Var Cluster} = \frac{\sum_{k=1}^{K}(p_i - p)^2}{k(k-1)} \quad \text{Design effect (DE)} = \frac{\text{Var Cluster}}{\text{Var SRS}}$$

Example 2.4.5: sample size formula with design effect

Sample size with simple random / systematic sampling:

$$n = \frac{z^2 p(1-p)}{d^2} = \frac{1.96^2 x 0.15 x 0.85}{0.03^2} = 544$$

Sample size with cluster sampling:

$$n = DE\frac{z^2 p(1-p)}{d^2} = 2x\frac{1.96^2 x 0.15 x 0.85}{0.03^2} = 1088$$

What about unequal sample sizes?

- This is easy to do; formula changes slightly
- n_1 is the sample size for the first group
- k * n_1 is the sample size of the second group (where k is pre-specified, e.g., 2x, 3x as many controls as cases)
- Very easy to do in Epi Info

Sampling in Qualitative Research

Since the objective of qualitative research is to understand and give meaning to a social process, rather than quantify and generalise to a wider population, it is inappropriate to use random

sampling or apply statistical tests. Sample sizes used in qualitative research are usually very small and the application of statistical tests would be neither appropriate nor feasible.

Exercises Session 2:

1. Suppose we wanted to compare the views and satisfaction levels of women who gave birth at home compared with the majority of women who have given birth in hospital, a systematic or random sample, although representative of all women giving birth would not produce a sufficient number of women giving birth at home to be able to compare the results, unless the total sample was so big that it would take many years to collate. We would also end up interviewing more women than we needed who have given birth in hospital. In this case it would be necessary to over-sample or over-represent those women giving birth at home to have enough individuals in each group in order to compare them. For this scenario given above, what type of sampling do you propose?

   Answer: use disproportionate stratified random sampling to select the sample in this instance.

2. Let us suppose that we want a sample of size $n = 30$ to be drawn from a population of size $N = 8000$ which is divided into three strata of size $N_1 = 4000$, $N_2 = 2400$ and $N_3 = 1600$. Adopting proportional allocation, Find the sample sizes for the different strata:

   Solutions: For strata with $N_1 = 4000$, we have $P_1 = 4000/8000$ and hence $n_1 = nxP_1 = 30\ (4000/8000) = 15$.

   Similarly, for strata with $N_2 = 2400$, we have $n_2 = nxP_2 = 30\ (2400/8000) = 9$, and for strata with $N_3 = 1600$, we have $n_3 = n.P_3 = 30\ (1600/8000) = 6$.

3. A simple random or systematic sample is to be used to survey a large population concerning satisfaction with particular aspects of health care. The expected result is unknown, but guesstimated to be about 50% positive and 50% negative. If the result is 50%, we want 95% confidence that the true frequency lies between 45 and 55%. How large should the sample be?

   Answer: the sample needed is 384 persons (ignoring non-response and other possibly important factors)

4. Suppose we assume that true systolic blood pressure (SBP) of 35 to 39 year old OC users is normally distributed with mean (132.86 mmHg) and standard deviation (15.34 mmHg). Similarly, for non-OC users, assume the SBP is normally distributed with mean (127.44 mmHg) and standard deviation (18.23 mmHg). If we desire an equal sample size in both groups, what would be the minimal sample size in each group to detect a difference with a power of

80% at 95% confidence level? A hypothetical example on blood pressure study among oral contraceptive (OC) users and non-users described given in a text by Rosner.

5. A phase I clinical trial is to be conducted to determine the frequency of adverse effects from a new medication. Two groups of equal size will be randomly allocated to receive the drug or a placebo. The effect being measured is expected to occur in 2% of the placebo group. How large must the groups be to detect a risk/prevalence ratio of 2.0 for an adverse effect with 95% confidence and 80% power? Answer: 1144 to 1242 in each group, depending on method.
6. Usual expectations for a case control study are 95% confidence (that a difference detected is 'real') and 80% power (to detect a difference if there is one in the underlying population). How many cases and controls, in 1:1 ratio, are needed to detect an odds ratio of 2.0 or greater?

References:

1. Fox N., Hunn A., and Mathers N. Sampling and sample size calculation. The NIHR RDS for the East Midlands / Yorkshire & the Humber 2007.
2. Kish, L., Survey Sampling, Wiley and Sons, New York, 1965, Sections 3.1-3.6 and 4.6.
3. C.R.Cothari. Research Methodology: Methods and Techniques. 2nded. New Age International (P) Ltd, Publishers, New Delhi, 2004.
4. Peduzzi, Peter. And John Concato.A simulation study of the number of study events per variable in logistic regression analysis. J ClinEpidemiol Vol. 49, No 12, pp.1373-1379, 1996.
5. M. Pathmanathan, V, I. Brownlee, Ann. Designing and conducting health systems research projects: vol (1). 2003.
6. Cochran, W. G., Sampling Techniques, Third Edition, Wiley and Sons, New York.
7. Abramson, JH. *Survey methods in community medicine* (3rd Ed.), p. 121. 1984. Churchill Livingstone, Edinburgh.
8. Biemer&Lyberg, 2003, *Introduction to Survey Quality*.
9. S. K. Lwanga and S. Lemeshow. Sample Size Determination in Health Studies: A Practical Manual. World Health Organization, Geneva, 1991.
10. Lemeshow, S. et al., Adequacy of sample size in health studies (Chichester,
11. John Wiley, 1990. Bernard Rosner. Fundamentals of Biostatistics (5th edition)
12. http://biostat.mc.vanderbilt.edu/twiki/bin/view/Main/PowerSampleSize
13. http://calculators.stat.ucla.edu
14. http://hedwig.mgh.harvard.edu/sample_size/size.html

Sample schedule

On Leadership strategic information program

On the first module, Leadership and descriptive epidemiology and biostatics

Week I	**Monday**	**Tuesday**	**Wednesday**	**Thursday**	**Friday**
08:30 – 10:15 am	**Registration** Introduction to the overall course Introduction to STI	Inspiring vision	Strategic leadership – Implementation	SMDP Process improvement Steps II	SMDP Process improvement Steps VI
10:15 – 10:30 am	B r e a k				
10:30 – 12:30 pm	Situational analysis and planning M02	Systems Thinking	Strategic leadership – opportunities and constraints	SMDP Process improvement Steps III	SMDP Process improvement Steps VII
12:30 – 02:00 pm					
02:00 – 03:30 pm	Concepts of Leadership & management	Mental Models	SMDP Process improvement Overview	SMDP Process improvement Steps IV	Survey Protocol development
03:30 – 03:45 am	B r e a k				
03:45 – 05:15 pm	Concepts of Leadership & management	Emotional Intelligence	SMDP Process improvement Steps I	SMDP Process improvement Steps V	Survey Protocol exercise

Week 2	Monday	Tuesday	Wednesday	Thursday	Friday

08:30 – 10:15 am	Introd. to descriptive Epidemiology	Introduction to Biostatistics (Types of variable)	Measure of dispersion	Reference citation and Endnote	Survey Protocol exercise
10:15 – 10:30 am			B r e a k		
10:30 – 12:30 pm	Measures of occurrence (incidence and prevalence)	Introduction to biostatistics(scales of measurement, questioner,data collection)	Probability and probability distribution	Reference citation and Endnote	Protocol Presentation
12:30 – 02:00 pm			L u n c h		
02:00 – 03:30 pm	Descriptive epidemiologic studies	Data presentation (Tables, Graphs, Maps, and Charts, Frequency distribution)	Sample size determination	Reference citation Exercise	Protocol Presentation
03:30 – 03:45 am			B r e a k		
03:45 – 05:15 pm	Hypothesis generation	Descriptive data analysis (Data summarization Measure of central tendency)	Sampling Methods	Survey protocol exercise	Protocol Presentation