

# DRUG UTILIZATION

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# Definition

- ✓ Drug Utilization according to WHO (1977), is the "marketing, distribution, prescription, and use of drugs in a society, with special emphasis on the resulting medical, social and economic consequences"
- ✓ Drug utilization studies may be divided as descriptive and analytical.
- ✓ The descriptive part emphasis describing the patterns of drug utilization and identifying problems deserving more detailed studies.
- ✓ Analytical part focuses in linking drug utilization data to figures on morbidity, outcome of treatment and quality of care with the ultimate goal being to assess whether drug therapy is rational or not.

## Cont'd

- ✓ Drug utilization research and Pharmacoepidemiology may provide insights into the following aspects of drug use and drug prescribing:
  - ❖ Pattern of use: extent and profiles of drug use and trends in drug use and costs over time.
  - ❖ Quality of use: audits comparing actual use to national and regional prescription guidelines or local drug formularies.
  - ❖ Determinants of use: user characteristics (e.g. socio-demographic parameters, attitude towards drug), prescriber characteristics (e.g. specialty, education and factors influencing therapeutic decisions) and drug characteristics (e.g. therapeutic properties affordability).
  - ❖ Outcome of use: health outcome (benefits and adverse effects) and economic consequences.

# Objectives

1. Describing current treatment practices
2. Comparing the performance of individual facilities or prescribers
3. Periodic monitoring and supervision of specific drug use behaviors
4. Assessing the impact of an intervention

# Types

- ✓ There are 4 types of drug use studies:
  - ❖ Descriptive: Cross-sectional (basic)
  - ❖ Comparative: Stratified cross-sectional
  - ❖ Monitoring: To assess change over time
  - ❖ Evaluation: To evaluate intervention impact

## Cont'd

- The principal aim of drug utilization research is to facilitate rational use of drugs in populations.
- DUSs facilitate rational use of drugs in populations in three important ways:
  - a. Description of drug use patterns
  - b. Early signals of irrational use of drugs
  - c. Interventions to improve drug use

# Description of drug use patterns

- a. By making estimates of the numbers of patients exposed to drugs within a given time period.
- b. By describing the extent of use at a certain moment and/or in a certain area (e.g. country, region, community, hospital).
- c. By Estimating to what extent drugs are properly used, overused, or underused.
- d. Describing the pattern or profile of drug use - assessing which alternative drugs are being used for particular conditions and to what extent.
- e. Comparing observed patterns of drug use with current recommendations or guidelines for the treatment of a certain disease.
- f. Feedback drug utilization data to prescribers.

# Early signals of irrational use of drugs

- a. By comparing drug utilization patterns and costs between different regions or time periods.
  - ✓ Hypotheses can be generated to form the basis for investigations of the reasons for, and health implications of, the differences found.
- b. Comparing observed patterns of drug use with current recommendations/guidelines for treatment of a certain disease.
  - ✓ Hypotheses can then be generated about whether discrepancies represent less than optimal practice, whether pedagogic interventions (education) are required, or whether the guidelines need to be reviewed in the light of actual practice.



## To assess the interventions made to improve drug use

➤ Intervention to improve drug use follow - up: DUR may enable us to assess whether interventions undertaken to improve drug use have had the desired impact by:

- Monitoring and evaluating the effects of measures taken to improve undesirable patterns of drug use (regional/local formularies, information campaigns, regulatory policies etc.)
- Following the impacts of regulatory changes.
- Assessing to which extent promotional activities of the pharmaceutical industry impact on the patterns of drug use.

# Descriptive tools for DUR

If drug utilization studies are to be reliable,

- Follow the use of common drug classification system and
- International unit of measurements.
  - serve as tools for performing comparative studies of both supply and consumption of drugs.

# Drug classification systems

- ✓ Drugs can be classified in various ways according to
  - ❖ their mode of action,
  - ❖ the pharmacological/therapeutic groups to which they belong,
  - ❖ their indications, or
  - ❖ their structure.
- ✓ Of the various systems proposed and used experimentally, only two have been universally acceptable in drug utilization research.
  - ❖ The anatomical-therapeutic (AT)
  - ❖ The anatomic therapeutic-chemical classification (ATC).

## Cont'd

- ✓ According to AT system, drugs are divided into 14 main categories based on the system or organ on which they act.
- ❖ Examples: alimentary system and metabolism, the blood and blood-forming organs, the heart and vascular system or the central nervous system.
- ❖ The first letter in the code allocated to a drug refers to the system in which the drug acts.
- ❖ Four more digits follow, corresponding to second and third levels of classification. For example, the N group (central nervous system) is split into therapeutic subgroups (second level) and each of these into more pharmacological subgroups (third level)

# Cont'd

- ✓ Diazepam is for example classified as follows
  - ❖ N; central nervous system (first level anatomical group)
  - ❖ N05: psycholeptics (second level, main therapeutic group)
  - ❖ N05A2; tranquilizers (third level, therapeutic subgroup)
- ✓ Two problems arise with the use of such a classification are
  - ❖ It does not allow the identification of a particular drug (all tranquilizers such as benzodiazepines, diphenylmethane derivatives, glycol derivatives, etc.) are classified in the same group, N05A2
  - ❖ Classification of fixed dose combinations - as theses are classified according to their main indications, they may contain one or more components that remained unclassified.

## Cont'd

- ✓ ATC (anatomical-therapeutic-chemical classification system)
  - ❖ Developed based on the concept of AT
  - ❖ The system allows for complete chemical and therapeutic identification of each compound by involving the addition of two further levels of classification.
  - ❖ Initially extensively used in Nordic countries but later on adopted by the WHO Drug Utilization Research Group (DURG)

# Cont'd

## ✓ Example of how glibenclamide is classified in this system

- A; Alimentary tract and metabolism (first level, anatomical group)
- A10; Drug used in diabetics (second level, therapeutic main group);
- A10B; oral blood glucose lowering drug (third level, therapeutic/pharmacological subgroup)
- A10B B; Sulfonamides, urea derivatives (fourth level, chemical/therapeutic/pharmacological subgroup).
- A10B B01; Glibenclamide (fifth level, subgroup for chemical substance)

# UNITS FOR THE QUANTIFICATION OF DRUG USE (DRUG UTILIZATION METRICS)



# Defined daily dose (DDD)

- DDD is the assumed average maintenance dose per day for a drug used for its main indication in adults.
- DDD is a unit of measurement and does not necessarily agree with the recommended or prescribed daily dose (PDD)
- Doses for individual patients and patient groups will often differ from DDD because they have to be based on individual characteristics (e.g. age, weight) as well as pharmacokinetic and pharmacogenetic considerations.
- DDD may even be a dose that is rarely prescribed, because it is an average of two or more commonly used dose sizes.

## Cont'd

- ✓ Drug utilization figures should preferably be presented as numbers of DDDs/1000 inhabitants/day or when in-hospital drug use is considered, as DDDs per 100 bed days.
- ✓ DDD/1000 inhabitants/day can be calculated as

$$\frac{\text{DDD}}{1000 \text{ inhabitants} \times \text{day}} = \frac{\text{Amount of drug sold in one year (mg)}}{\text{DDD (mg)} \times 365 \text{ days} \times \# \text{ of inhabitants}} \times 1000 \text{ inhabitants}$$

## Cont'd

### Prescribed daily dose/consumed daily dose

- The average dose prescribed according to representative sample prescriptions.
- The PDD can be determined from prescription studies and medical-pharmacy records.
- It is important to relate the PDD to the diagnosis for which the dosage is based.
- PDD does not necessarily reflect actual drug utilization

# Cont'd

## Other units used for quantification of drug use

- ✓ Cost is consumption parameter used widely in drug utilization studies (for example: the overall cost or unit cost of a drug, or consumption expressed in terms of economic expenditure by a particular institution)
- Common physical units (e.g. grams, kilos, liters), numbers of packages or tablets and numbers of prescription are also used for quantifying drug utilization.
- This can be applied only when the use of one drug or of well-defined products is evaluated.

# How to investigate drug use in health facilities?

- ✓ Drug use indicators: Facility based measures meant to describe practices in a representative sample of health facilities.
- ✓ There are two type of indicators:

## A). Core Drug use indicators

- i. Prescribing indicators
- ii. Patient care Indicators
- iii. Facility indicators

## B). Complementary drug use indicators

# WHO indicators

- ✓ Core indicators:
  - ✓ are highly standardized and that should be included in any drug use study - using indicators.
  - ✓ They provide a simple tool for quickly and reliably assessing a few critical aspects of drug use.
- ✓ Complementary indicators:
  - ✓ used to measure performance in addition to core drug use indicators,
  - ✓ are less standardized and needs adaptation to local circumstances (e.g. average drug cost per encounter)

## A). Core drug use indicators

### I) Prescribing Indicators

#### □ WHO/INRUD health facility prescribing indicators

- Average number of medicines per encounter
- % of medicines prescribed by generic name
- % of encounters with an antibiotic prescribed
- % of encounters with an injection prescribed
- % of medicines prescribed which are from the **essential medicines list** or **formulary list**

## **1      Average number of drugs per encounter**

*Purpose*                      To measure the degree of polypharmacy.

*Prerequisites*            Combination drugs are counted as one. Guidelines are needed on how to count certain ambiguous prescribing practices (e.g. some standardized sequential therapies).

*Calculation*              Average, calculated by dividing the total number of different drug products prescribed, by the number of encounters surveyed. It is not relevant whether the patient actually received the drugs.

*Example*                    In health centers in Indonesia patients are prescribed an average of 3.3 drugs per consultation.



## 2 Percentage of drugs prescribed by generic name

*Purpose* To measure the tendency to prescribe by generic name.

*Prerequisites* Investigators must be able to observe the actual names used in the prescription rather than only having access to the names of the products dispensed, since these may be different; a list must be available of specific product names to be counted as generic drugs.

*Calculation* Percentage, calculated by dividing the number of drugs prescribed by generic name by the total number of drugs prescribed, multiplied by 100.

*Example* In health units in Nepal an average of 44% of drugs are prescribed by generic name.

**3 Percentage of encounters with an antibiotic prescribed**

**4 Percentage of encounters with an injection prescribed**

*Purpose* To measure the overall level of use of two important, but commonly overused and costly forms of drug therapy.

*Prerequisites* A list must be available of all the drug products which are to be counted as antibiotics; investigators must be instructed about which immunizations are not to be counted as injections.

*Calculation* Percentages, calculated by dividing the number of patient encounters during which an antibiotic or an injection are prescribed, by the total number of encounters surveyed, multiplied by 100.

*Example* In dispensaries in Nigeria 48% of all outpatient encounters were prescribed one or more antibiotics, while an injection was prescribed during 37% of all consultations.

## **5 Percentage of drugs prescribed from essential drugs list or formulary**

<i>Purpose</i>	To measure the degree to which practices conform to a national drug policy, as indicated by prescribing from the national essential drugs list or formulary for the type of facility surveyed.
<i>Prerequisites</i>	Copies of a published national essential drugs list or local institutional formulary to which data on prescribed drugs can be compared; procedures are needed for determining whether or not brand name products are equivalent to ones appearing in generic form on the drug list or formulary.
<i>Calculation</i>	Percentage, calculated by dividing the number of products prescribed which are listed on the essential drugs list or local formulary (or which are equivalent to drugs on the list) by the total number of products prescribed, multiplied by 100.
<i>Example</i>	In dispensaries in Tanzania on average 88% of drugs prescribed appeared on the national essential drugs list.

# Prescribing indicator form

Ser. No.	Date of Rx	Age (yrs)	No. of drugs	No. of Generics	Antibiotic (0/1)*	Injection (0/1)*	No. on EDL
1							
2							
3							
4							
5							
6							
7							
8							
9							
10 ...							
Total							
Average							
Percentage							

## II) patient care indicators

- ❑ WHO/INRUD health facility patient care indicators
  - Average consultation time
  - Average dispensing times
  - % of medicines actually dispensed
  - % of medicines that are adequately labeled
  - % of patients who know how to take their medicines

## **6      Average consultation time**

<i>Purpose</i>	To measure the time that medical personnel spend with patients in the process of consultation and prescribing.
<i>Prerequisites</i>	Procedures for accurately recording the time spent during the consultation, that is, the time between entering and leaving the consultation room. Waiting time is not included.
<i>Calculation</i>	Average, calculated by dividing the total time for a series of consultations, by the number of consultations.
<i>Example</i>	In Malawi patients spend an average of 2.3 minutes with health workers in the consultation room.

## 7      **Average dispensing time**

<i>Purpose</i>	To measure the average time that personnel dispensing drugs spend with patients.
<i>Prerequisites</i>	Procedures for accurately recording the average time patients spent with pharmacists or drug dispensers, that is, the time between arriving at the dispensary counter and leaving. Waiting time is not included.
<i>Calculation</i>	Average, calculated by dividing the total time for dispensing drugs to a series of patients, by the number of encounters.
<i>Example</i>	In health centres in Tanzania patients spend an average of 78 seconds receiving their drugs.

## 8      **Percentage of drugs actually dispensed**

<i>Purpose</i>	To measure the degree to which health facilities are able to provide the drugs which were prescribed.
<i>Prerequisites</i>	Information on which drugs were prescribed, and whether these drugs were actually dispensed at the health facility.
<i>Calculation</i>	Percentage, calculated by dividing the number of drugs actually dispensed at the health facility by the total number of drugs prescribed, multiplied by 100.
<i>Example</i>	In health facilities in Nepal, 73% of prescribed drugs were actually dispensed at the health facility.



## 9      **Percentage of drugs adequately labelled**

<i>Purpose</i>	To measure the degree to which dispensers record essential information on the drug packages they dispense.
<i>Prerequisites</i>	Investigators must be able to examine the drug packages as they are actually dispensed at the health facility.
<i>Calculation</i>	Percentage, calculated by dividing the number of drug packages containing at least patient name, drug name and when the drug should be taken, by the total number of drug packages dispensed, multiplied by 100.
<i>Example</i>	In Region A only 10.2% of drugs dispensed were adequately labelled.

## 10 Patients' knowledge of correct dosage

<i>Purpose</i>	To measure the effectiveness of the information given to patients on the dosage schedule of the drugs they receive.
<i>Prerequisites</i>	Access to a written prescription or to a patient card against which patients' knowledge on the dosage schedule can be checked, or access to standards for how each common drug is supposed to be used; investigators must be trained to evaluate patient knowledge during the interview, or to record patient responses for later evaluation.
<i>Calculation</i>	Percentage, calculated by dividing the number of patients who can adequately report the dosage schedule for all drugs, by the total number of patients interviewed, multiplied by 100.
<i>Example</i>	In 23 health facilities in Bangladesh 63% of patients were able to repeat the correct dosage schedule of the drugs they had received.

## Patient care indicator form

Patient identifier (code) \_\_\_\_\_ No of drugs prescribed \_\_\_\_ no of drugs dispensed \_\_\_\_\_

Age \_\_\_\_\_ sex \_\_\_\_\_ Educational status \_\_\_\_\_

Dispensing time \_\_\_\_\_ Dispensing counseling time \_\_\_\_\_

Dispensers in the pharmacy \_\_\_\_\_

<b>Adequate labeling</b> Indicate response as ✓(yes) or x (No)								<b>Patient knowledge</b> Indicate response as ✓(yes) x (No)			
S/N	Name of dispensed drug	Patient name	Strength	dose	freq	Amount of drug	Duration	Dose	Freq.	duration	Reason for prescription
1											
2											
3 ...											

## III). Health facility indicators

### □ WHO/INRUD health facility indicators

- Availability of essential medicine list or formulary
- Availability of key set of indicator medicines
- Availability of standard treatment guideline (STG)

## **11 Availability of copy of essential drugs list or formulary**

<i>Purpose</i>	To indicate the extent to which copies of the national essential drugs list or local formulary are available at health facilities.
<i>Prerequisites</i>	A national essential drugs list or a local formulary must exist for that level of care; if not, the indicator would always be scored "no".
<i>Calculation</i>	Yes or no, per facility.
<i>Example</i>	In Country A only 28% of health facilities had a copy of the national list of essential drugs.

## 12 Availability of key drugs

<i>Purpose</i>	To measure the availability at health facilities of key drugs recommended for the treatment of some common health problems.
<i>Prerequisites</i>	A short list of 10-15 essential drugs must be compiled that should always be available.
<i>Calculation</i>	Percentage, calculated by dividing the number of specified products actually in stock by the total number of drugs on the checklist, multiplied by 100.
<i>Example</i>	In health centers in Nigeria, on average 62% of 14 key essential drugs were actually in stock.

## B). Complementary indicators

□ WHO/INRUD medicine use indicators with less standardization and less experience in actual use:

- % of patients treated without medicines
- Average medicine costs per encounter
- % of medicine cost spent on antibiotics
- % of medicine cost spent on injections
- % of prescriptions in accordance with STG
- % of patients satisfied with care provided
- % of facilities with access to impartial information

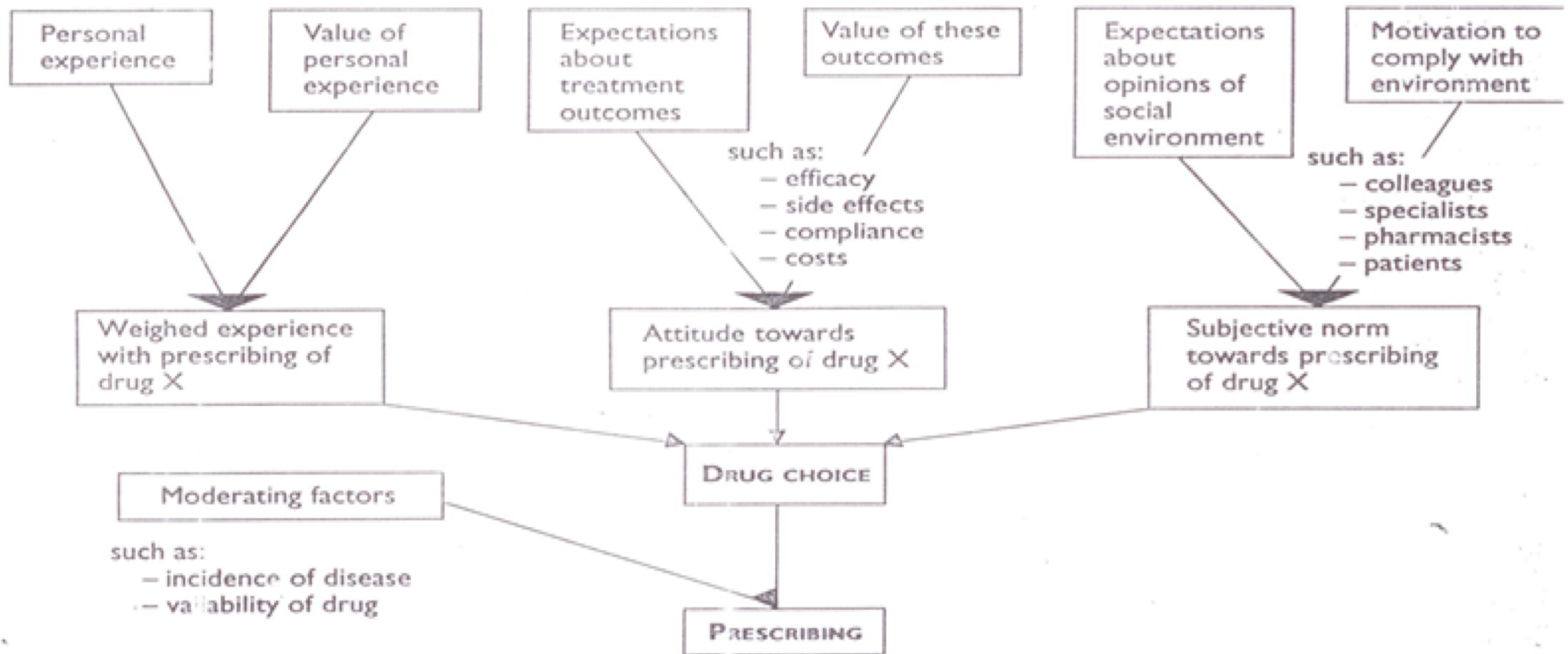
# THE SOCIAL ASPECTS OF DRUG USE



# Definition

- ✓ Drug use, as part of the process of medical care, requires that the people who give and take drugs to make various types of decisions.
- ✓ At all points, they are affected by their varied cultural values, by their social networks and by psychological factors.
- ✓ The process takes place in a specific organizational setting provided by health care system, which has its own influence on events by determining the availability of medical care services as well as drugs. (The influence of the health care system on drug use)
- ✓ Drug use as part of the medical care process involves different steps.

Fig. 4. A drug choice model



Source: Denig et al. (16).

## Cont'd

- ✓ The first step in the drug use process is the decision of what to do in the event of perceived illness.
- ✓ Most symptoms will simply be tolerated as minor inconveniences and some will pass almost unnoticed.
- ✓ Where there is a response, it usually takes the form of self-medication as a means of normalizing the situation.
- ✓ Self-medication is the solution most likely to be adopted when relief is wanted but the perceived severity of the symptom and its anticipated duration give the patient no cause of concern.
- ✓ It is thus employed most commonly for self limiting diseases that involve only minor discomfort or are perceived as non-serious.

## Cont'd

- ✓ Of the very many symptoms an individual experiences, only 10-30% brought to the attention of medical care personnel.
- ✓ Professional care is sought when the results do not meet the user's expectations.
- ✓ Self-medication can also be the alternative when professional care is not available or affordable.
- ✓ Illness behavior is affected by the social network; notably friends and family.
- ✓ The social network shapes one's attitude to health; it provides knowledge and skills related to health and provide social support and coping ability.

# Cont'd

- ✓ The use of prescribed drug is influenced by the prescribing behavior of physicians:
- ✓ Prescribing behavior of physicians is affected by factors that influence prescribing at the macro-level (so called conditioning factors) and factors that influence individual physicians
- ✓ The main conditioning factors are:
  - The tradition and education of the population, which may mould both the expectation of the patients and the views of the physicians;
  - Medical teaching and professional thinking, which define the concepts of health and illness and thus determine the use of physicians services;
  - The level and distribution of wealth in a country and the ideology and power of the state- these can affect the organization, regulation and availability of both professional care and drug supply;
- ✓ The power and vitality of the pharmaceutical industry

## Cont'd

- ✓ **Micro-level factors that influence individual physicians are:**
  - The demands and expectations of pressure groups and the society;
  - The influence of pharmaceutical industry and research results;
  - The control measures and regulation imposed by the health authorities.

# Patient compliance

- ✓ The term compliance has been defined as the extent to which the patient's behavior in terms of taking medications, following diets or executing other life style changes, coincides with clinical prescription.
- ✓ Compliance in taking medication includes two different aspects: dose taking and dose timing reflected by taking compliance and timing compliance.
- ✓ There are different methods to measure compliance: direct and indirect methods
- ✓ Direct methods include: observation, biological assays and the use of markers.

## Cont'd

- ✓ Some of the indirect methods are: interview, pill counts, clinical response and the use of medication monitors.
- ✓ Some reasons of non-compliance are associated with the drug therapy itself; it becomes more pronounced where the treatment is complex, where treatment is prolonged, or where there are troublesome side effects



## Cont'd

- ✓ Three theories have emerged to deepen the understanding of the behavioral determinants of compliance and non-compliance:
- The first theory places the source of non-compliance in the physician-patient interaction/communication.
  - Compliance will be better where the instruction given to the patient are explicit and understandable;
  - Patient satisfaction is relevant (a patient who is satisfied will be more compliant)
  - Relevance of physician's communication style stressing the importance of motivating the patients besides providing him/her with information.

# Cont'd

## ✓ Expectancy - value theory (health belief model)

- The role of patient beliefs in compliance
- A patient who has received a drug goes through a rational decision process, based on his/her knowledge and expectations.
- The patient's beliefs about his/her own illness and its severity, the expected benefits of the drugs and the costs of treatment are important predictor of compliance

## ✓ The third theory viewed drug as an indicator of the degree of the disorder, the change in medication implying for the patient a change in the severity of the disorder

- A large part of non-compliance is a form of self-regulation by the patient.

## Cont'd

- ✓ Studies for example found out four major reasons for self-regulation by epileptic patients (in the sense of reducing/stopping the medication):
  - A way of evaluating the current state of the disease;
  - A desire to avoid drug dependence;
  - An attempt to overcome the stigma of chronic invalidity that chronic treatment is felt to confer; or
  - An attempt to prevent the disease interfering with daily life.

## Definitions of compliance

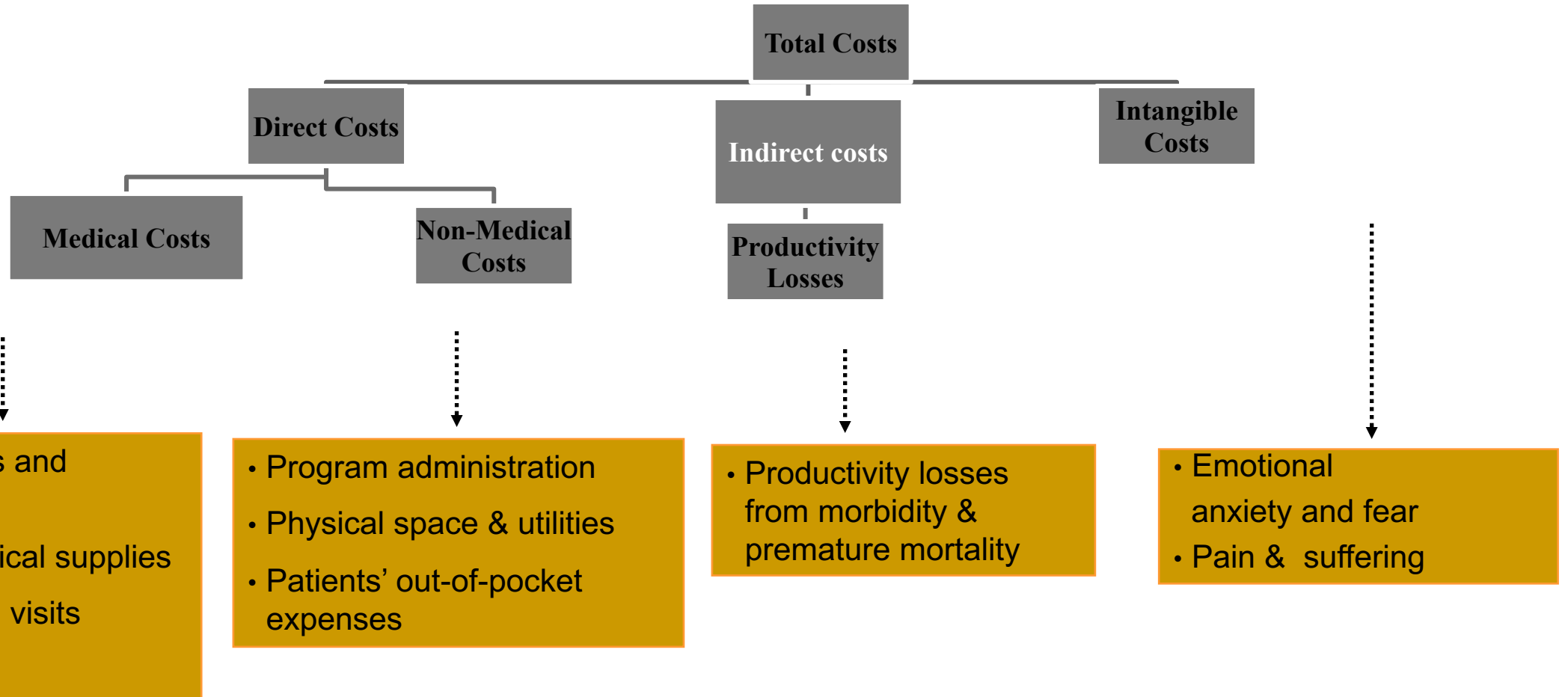
- ✓ Taking compliance: % of days in which the prescribed dose is taken.
- ✓ Timing compliance: % of doses taken within a 25% of the prescribed interval.
- ✓ Tablets compliance: % of tablets consumed.
- ✓ Refill compliance: % of patients returning at the right time for their refills.

# The Economic Aspects of Drug Use

## The economic aspects of drug use

- ✓ Alongside the medical and social determinants of drug use, economic factors play an important role.
- ✓ The price of a drug product is not the same as the cost of drug therapy.
- ✓ An illness consumes resources and thus has a cost.
- ✓ The cost of an illness is the sum of three components: the medical resources used to treat the illnesses, the nonmedical resources associated with it, and lost productivity due to illness or disability (indirect cost).

# Cost components of COI-analysis



## Cost Components

## Operationalizing

### Direct costs

- Ingredients of care delivery
  - ✓ Nursing time
  - ✓ Medical time
  - ✓ Drugs
  - ✓ Equipment
  - ✓ Space
  - ✓ Facilities
- Costs falling on other agencies/parts of health system
- Costs falling on patients and families
- Time off work for the patient
- Time off work for family and friends (care giver)

### Productivity costs (Indirect costs)

- Estimate resource quantity
- Find value or cost of each unit
- *Quantity X value=cost*
- Report hours/days lost
- Use average wage rates (or actual wage rates)
- Adjust for labour participation rates



## Cont'd

- ✓ The acceptability of any measure to contain cost must be measured in terms of its possible effect on public health.
- ✓ The basic rule is that expenditure on drugs should be related to what it buys in terms of public health.
- ✓ Cost will need to be set against direct and indirect benefits and any proposed economy measure will have to be evaluated for its possible disadvantages or risks as compared with alternatives.

# PE evaluation techniques/methods

- ✓ Are analytical tools to identify which of several alternatives offers the greatest benefit compared with its cost.
- ✓ The commonly used are
  - *Cost minimization analysis (CMA)*
  - Cost-effectiveness analysis
  - Cost-utility analysis
  - Cost-benefit analysis
- ✓ and described here in increasing order of methodological and practical difficulty.

# 1. Cost minimization analysis (CMA)

- ✓ calculates the cost of two or more alternatives that have the same outcome to identify the lowest-cost option.
- ✓ *focus entirely on the cost*
- ✓ *easily applied and understood by doctors*
- ✓ Eg., A decision to introduce generic prescribing rather than by brand name which would achieve the same level of benefit at a reduced cost.

## 2. Cost-effectiveness analysis(CEA)

- ✓ Measures both costs and benefits of alternatives to find the strategy with the best ratio of benefits per money unit.
- ✓ health benefits are in natural units (e.g. years of life saved or ulcers healed etc) and
- ✓ the costs are measured in monetary terms.

## Cont'd

### CEA:

- ✓ compares therapies which can be measured on a **common scale of outcome** but perhaps exhibit different success rates.
- ✓ the most commonly applied form of economic analysis
- ✓ However, it does not allow comparisons to be made b/n two totally different areas of medicine with different outcomes.
  - ❖ Eg., Relief from ulcer due to use of PPI and H<sub>2</sub>-receptor blocker

### 3. Cost-utility analysis(CUA)

- ✓ Measures the effect of interventions in both quantitative and qualitative terms, using utility-based units such as QALYs.
- ✓ Cost is measured in monetary units.
- ✓ Outcome is not measured on a **common natural scale** rather in terms of changes in patient wellbeing (utility).  
and,
- ✓ Since such an outcome measure is not disease specific, CUA can in theory compare the 'value' of health interventions in more than one area of medicines.

## 4. Cost-benefit analysis (CBA)

- ✓ CBA compares the costs and benefits of an intervention by translating the health benefits into a money value.
- ✓ Both costs and benefits are measured in the same units i.e monetary units

# Types of pharmacoeconomic analysis

Methodology	Cost measurement unit	Outcome unit
Cost minimization	Dollars	Various- but equivalent in comparative groups
Cost effectiveness	Dollars	Natural units (life years, mg/dl blood sugar, LDL cholesterol)
Cost utility	Dollars	Quality adjusted life years(QALY)
Cost benefit	Dollars	Dollars



**Thank you!**