

Costs and Time Preference

Chapter 3



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Objectives

Upon completing this chapter, you will be able to:

- compare and contrast direct, indirect, and intangible costs
- describe the 4 steps while measuring the cost of therapy or service
- list the 4 perspectives of cost analysis and describe how they differ
- explain why timing adjustments for costs is necessary
- perform calculations on timing adjustments for costs

- costs are
 - the values of all the **resources** used to produce a good or to provide a service
 - the resources can be labor, buildings, equipments, supplies, etc.
 - the amount of money that the consumer must pay in order to receive that product or service
- costing process involves the systematic **collection**, **categorization**, and **estimation** of costs of the disease or its treatment

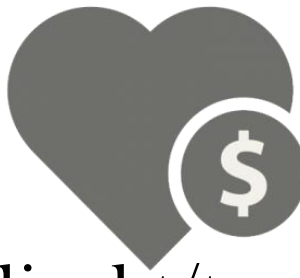
Difference between cost and price?

- cost is what we pay **to produce** goods or to provide services
 - it is value of resources consumed to produce goods and services
 - it is an expenditure **from the producers/providers** perspective
- price/charge is what we pay **to purchase goods or services**
 - the amount of money that the consumer must pay in order to receive that product or service
 - it is an expense from the **from buyers** perspective

Cost categorization

- there are **four types** of pharmacoeconomic- related costs:
 - direct medical costs
 - direct nonmedical costs
 - indirect costs and
 - intangible costs





Direct medical costs

- costs associated with those resources used **specifically** for medical t/t
- the amount of money spent directly on medical services
- direct medical costs are the **most obvious** costs to measure
- Examples of direct medical costs include costs of:
 - pharmaceuticals
 - diagnostic tests
 - medication administration
 - medication monitoring
 - patient counseling and consultations (physician and pharmacists visits)
 - nursing services and lab tests and hospitalizations, etc.

Direct non medical costs

- are costs to patients and their families that are **directly associated** with t/t but are **not medical in nature**
- are any out of pocket expenses for nonmedical services
- Examples of direct nonmedical costs include the costs of:
 - traveling to and from clinic or hospital
 - food and hotel stays for patient or family during out-of-town t/t
 - special diets, etc.
- direct costs - are costs that are directly attributable to patient care

Direct costs = direct medical costs + direct non medical costs

- Following are costs incurred due to ESRD. Categorize them as direct medical or direct non medical cost.
 - cost of t/ting ESRD
 - cost of t/ting ESRD co-morbidities
 - costs for transportation to clinics and home
 - modifications for in-house dialysis machines
 - cost of physician visits
 - cost of t/ting side effects



Indirect costs

- refer to **loss of productivity** because of illness or death or as results of time spent receiving t/t
- costs resulting from a patient being unable to perform normal activities due to illness and therefore borne by either the patient, the patient's family, or an employer
- indirect costs are non-medical costs

- indirect costs are measured by lost wages, willingness to pay, or human capital theory

Indirect costs = morbidity costs + mortality costs

- morbidity costs can be:
 - absenteeism (when people miss work)
 - presenteeism (when people are less productive while at work)
- mortality costs represent the incomes lost as a result of premature death

- Examples of indirect costs:
 - reduced levels of output/decreased productivity
 - lost earnings
 - because of illness, side effects, or time spent receiving t/t, caring for a sick family member
 - future wages lost because of a premature death

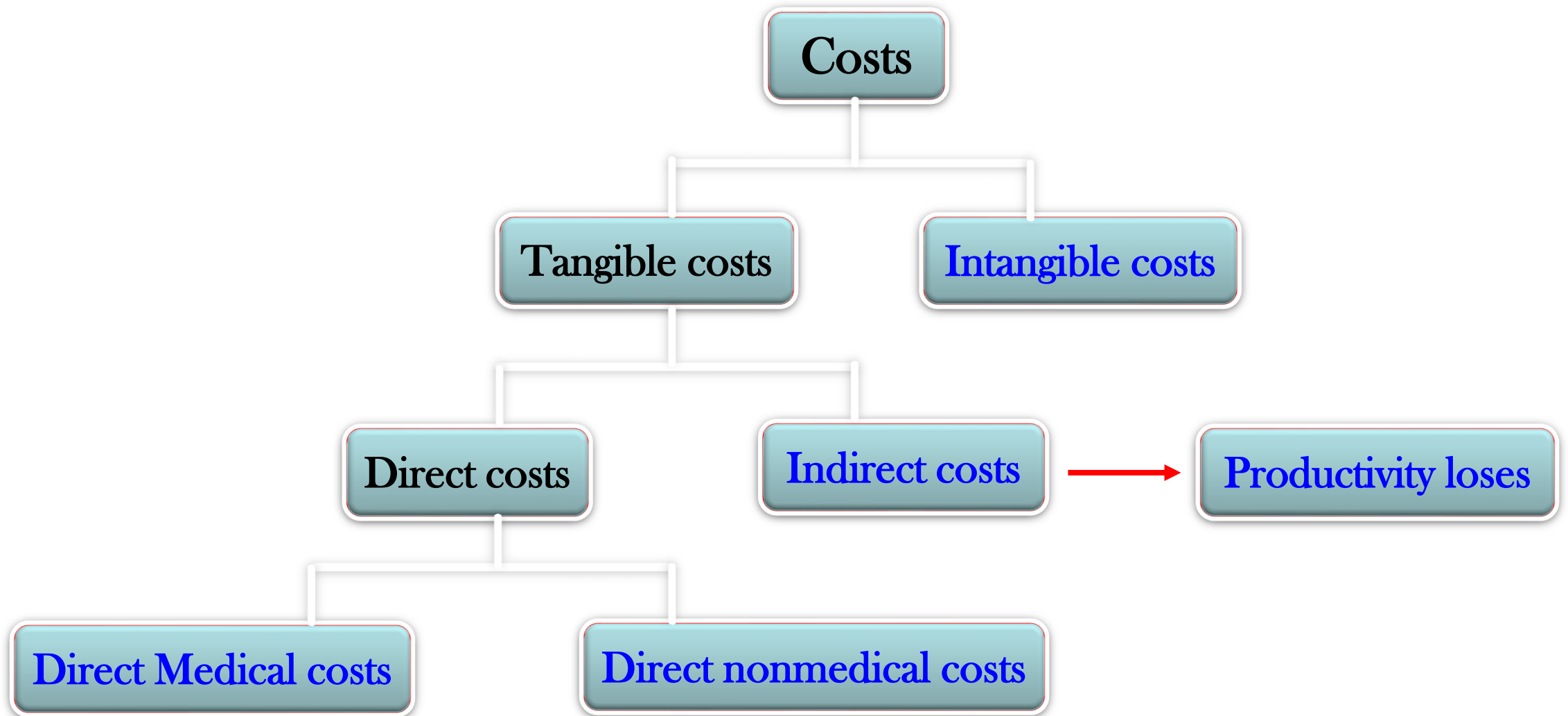


Intangible costs

- are those **emotional** costs such as costs of pain, suffering, anxiety and fatigue which a patient or their family might suffer because of an illness or the treatment of an illness
- are the nonmaterial costs
- intangible costs are often not included in cost analyses, because
 - it is **difficult to measure** or place a monetary value on these types of costs

- Examples of intangible costs:
 - disfigurement (e.g. breast cancer with surgery)
 - functional limitations (e.g. paralysis from polio)
 - pain and suffering (e.g. rheumatoid arthritis or bone metastasis)
 - fear (HIV, rabies)

- A pharmacist running a private community pharmacy has suffered from renal failure. He visits a hospital 3 times a week for dialysis. Cost of one dialysis is 1,500 Eth birr. He uses his own automobile to travel to the hospital. His productivity has decreased because of repeated absenteeism for dialysis, fatigue and headache. His average monthly income has fallen from 40,000 birr to 30,000 birr.
- a. What are the direct medical, direct nonmedical, indirect and intangible costs incurred by the pharmacist?
- b. If he dies, what type of costs will be incurred by his family? and how much?



Total costs = direct medical costs + direct nonmedical costs + indirect costs + **intangible costs**

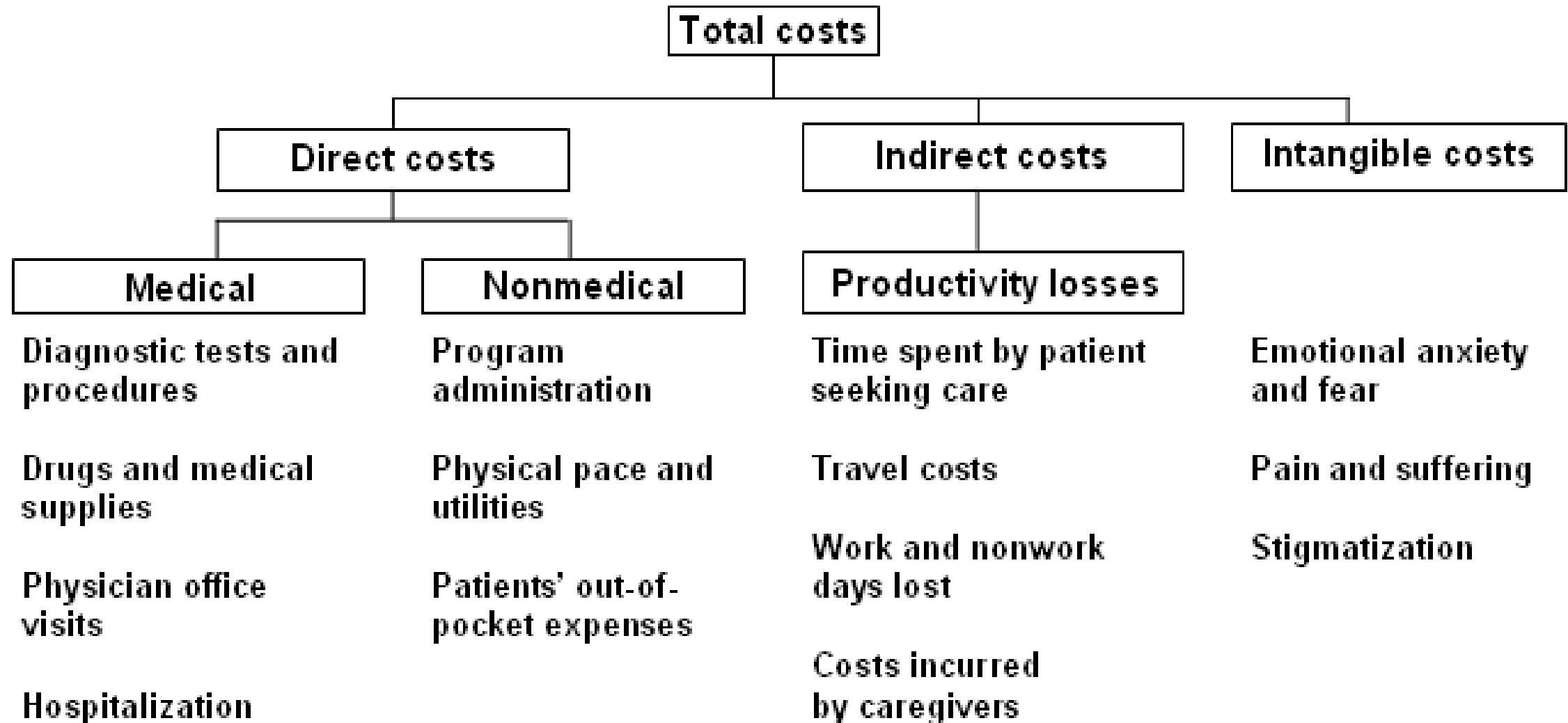
Quantification of Costs

- costing process involves four steps:
 - Specifying the inputs --- identify resources used
 - Measuring resources used
 - Value the resources used ---- assigning monetary values
 - Adjusting for time preferences

1. Specifying the inputs

- develop comprehensive list of all relevant inputs (i.e. resources consumed) to produce a given output and present them in a classification system that is most suitable for our analysis
 - with unit price of each resource
- what resource use is induced by the intervention?
- the list will be determined by the perspective of the analysis

Example: List of resources



Perspectives of cost analysis

- perspective is the **viewpoint** from which the cost analysis is conducted



- there are four types of perspectives in cost analysis:
 - patient, healthcare provider, payer/funding entity and society
- perspectives determine which costs are relevant and should be **included** in the analysis

Patient perspective

- if the perspective of the analysis is the **patient**, only costs **incurred by patients/family** are included
- all costs that only the patient would pay, not costs that third party would cover
 - Examples: out-of-pocket expenses, lost wages, and transportation costs, would be used when estimating costs

- Imagine a pharmacist run asthma management service. Can you think of direct and indirect costs that a patient would incur related to a asthma service?



Asthma management service

- **Direct**

- ❖ Co-pays
- ❖ education
- ❖ transportation
- ❖ prescriptions
- ❖ sitters

- **Indirect**

- ❖ missed work
- ❖ sitters

Healthcare provider perspective

- if the perspective is the healthcare provider (such as hospital, clinic, physician's office, pharmacy), costs related to providing the health services are considered
 - if you are conducting a cost analysis merely to set a budget or plan strategically for the future, you would typically conduct a cost analysis that extended organization-wide
- the monetary value of resources consumed directly to produce a certain health outcome will be included
- Examples: administrative cost, personnel costs, building maintenance costs, facilities and equipment costs, drugs costs, etc.

- Can you think of direct and indirect costs that a provider might incur related to a pharmacist run asthma clinic?



Community pharmacy providing asthma management services

- **Direct**
 - ❖ Equipment
 - ❖ Personnel costs - provider time fees, administrative and support staff
 - ❖ Education
 - ❖ Marketing
- **Indirect (overhead / accounting costs)**
 - ❖ Maintenance
 - ❖ Utilities
 - ❖ Rent
 - ❖ Business licenses
 - ❖ Office supplies
 - ❖ laundry, haz. waste disposal, etc.

Payer/funding entity perspective

- if the perspective is the payer/funding entity, only costs incurred by entities responsible for financial costs of health services are considered (e.g., insurance companies and employers), the amount that is covered by the insurance or employer should be used when estimating costs
- costs a third party payer might cover
- these are almost always direct medical costs

- Can you think of direct and indirect costs that a third party payer might pay for related to a pharmacist run asthma clinic?



Asthma management service

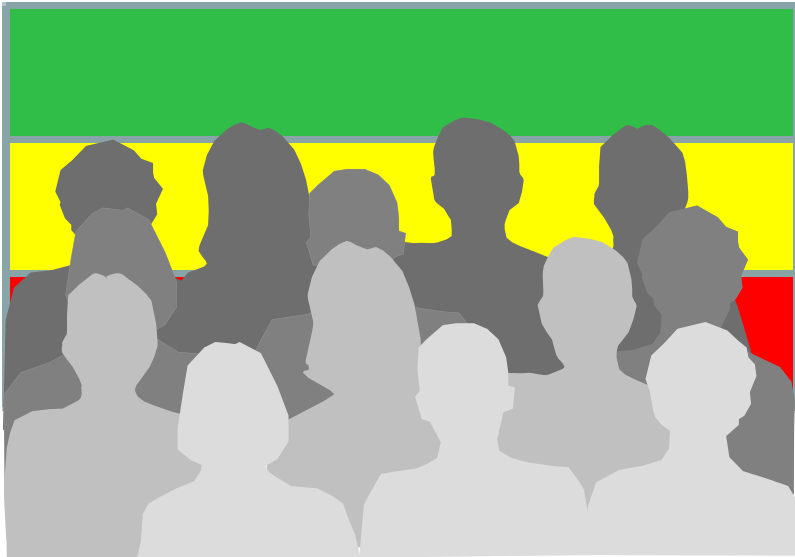
- **Direct**
 - ❖ Hospitalizations
 - ❖ Laboratory costs
 - ❖ Medications
 - ❖ Medical devices
 - ❖ Physician / pharmacist fees
- **Indirect**
 - ❖ ?

Societal or governmental perspective

- if the perspective of the analysis is societal, **all costs**, regardless of who incurs them, are included
 - all direct and indirect costs such as costs to the insurance company, costs to the patient, costs to the healthcare provider, other sector costs would be used to estimate costs
- the societal perspective the most comprehensive perspective
- most studies will include only **direct medical costs**

- societal perspective is common in countries where the government is the largest payer of health care benefits
- the choice of a perspective depends on **who will be using** the results of the cost analysis
- as a general rule:
 - CEA and CUA require only **health care costs** to be collected
 - CBA requires **all costs** and benefits to be collected, no matter on whom they fall

Imagine again the pharmacists run asthma management service. Can you think of direct and indirect costs that society or the government might incur related to a pharmacist run asthma service?



Asthma cost of illness

- **Direct**

- ❖ healthcare costs
- ❖ Medication R & D
- ❖ Healthcare workforce etc

- **Indirect**

- ❖ lost productivity
- ❖ lost wages

2. Measuring the quantity of resources used

- having developed the list of resources, we can **measure the quantity** of each resource used in the delivery of the intervention
- what quantity of each resource is needed?
- determine how many units is consumed over the study period
 - count the number of units that are consumed over time
 - determine hours or days lost

3. Valuing the resources used — assigning monetary value

- how much does each resource cost in monetary terms?
- direct costs such as costs of drugs, equipments, supplies, counseling and consultation times can be valued as follows:

$$\text{Direct cost} = \text{Quantity of resources consumed} \times \text{unit cost}$$

- this is relatively simple for consumable items

- Indirect costs (productivity costs) such as, time off work for the patient and time off work for family and friends can be valued as follows:
 - determine hours or days lost
 - then multiply this with average wage rates (or actual wage rates)

Indirect cost = *hours or days lost* x *hourly or daily wage rate*

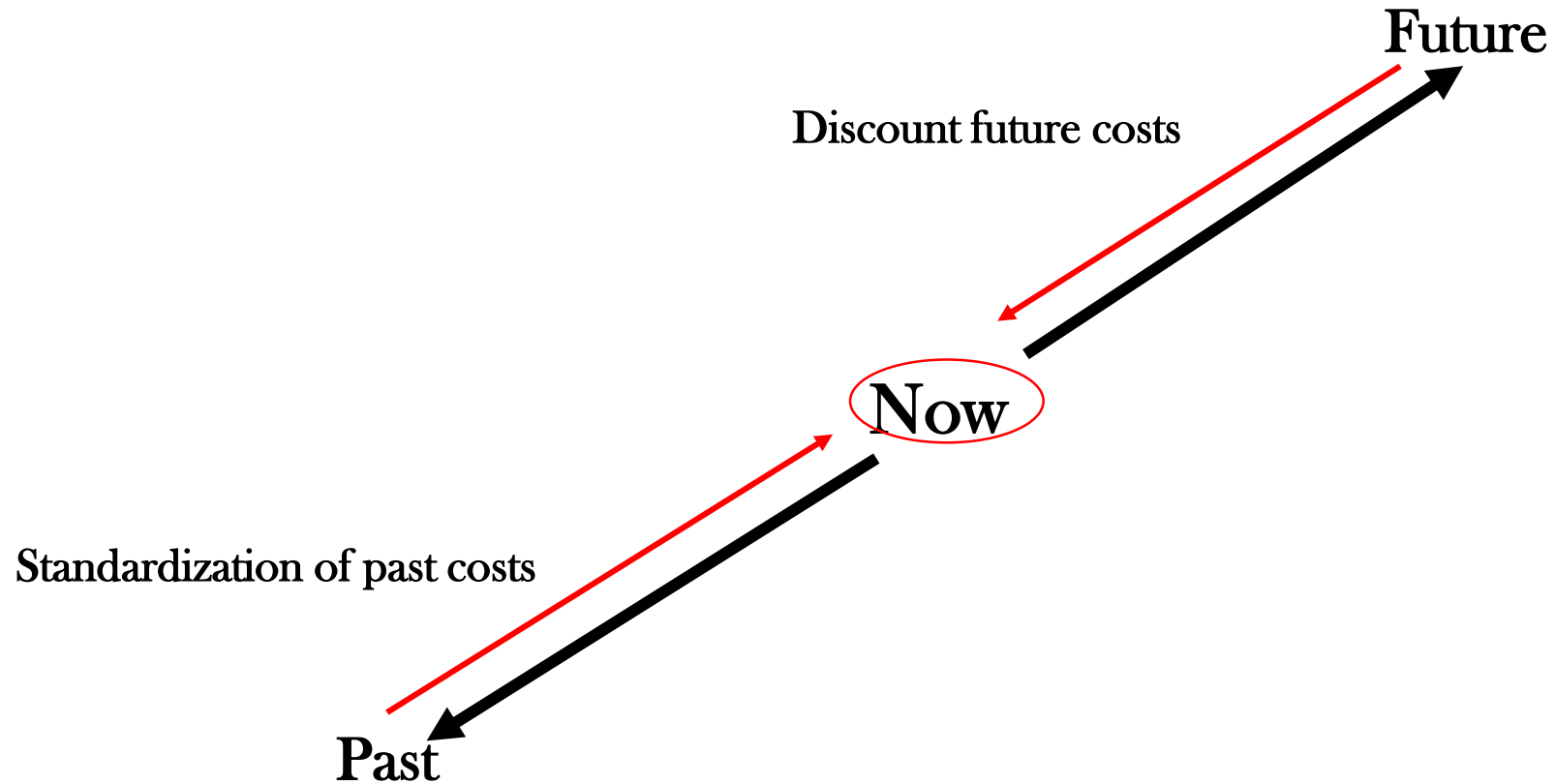
Common sources of cost data

- Reading assignment
- Common sources of cost data include:
 - primary data collection
 - secondary data sources:
 - medical or computerized records
 - average medical personnel wages

4. Timing adjustments for costs

- a cost or outcome today is **not equivalent** in value to the same cost or outcome in the future or past
- direct comparison of unadjusted cost and outcome data which are collected from **different years** is inaccurate
- to make costs and outcomes collected in different years comparable, they should be standardized to the **same base year**
 - timing adjustments for costs

- when costs are estimated from different years for more than **one year** before or after the analysis, the costs should be adjusted, or valued at one point in time



There are three types of timing adjustment for costs:

- discounting future costs
- standardization of past costs
- annuitizing capital expenditures

Bringing Future Costs (outcomes) to the Present: Discounting

- discounting is the process of converting future costs to their present value
- money payable in the future has lower value than money payable today
 - adjustments for this time value are estimated using a discount rate

Discounting formula

- There are two approaches for discounting future costs depending on whether all the costs occur at the end of each year or at the beginning of each year

- when all **costs occur at the end** of each year, future costs can be discounted using the following equation

$$PV = F_1 \times df_1 + F_2 \times df_2 + \dots F_t \times df_t$$

Where, PV = present value of future costs

F = future costs at year t and

df = discount factor

t = the number of years in the future at which the cost occurs

- When all costs occur at the beginning of each year, year 1 costs will not be discounted, Year 2 costs should be discounted by year 1, year 3 by year 2...
- Then, when all costs occur at the beginning of each year, future costs can be discounted using the following equation

$$PV = F_1 + F_2 \times df_1 + F_3 \times df_2 + \dots F_t \times df_{t-1}$$

- If the present value will be calculated based on the same time that the first year costs accrue, then the costs for Year 1 cannot be considered future costs and should not be discounted
- And if costs occurring in Year t occur at the beginning of Year t , we should discount those costs only for Years $(t - 1)$

- The discount factor (df) = $1/(1+r)^t$
where r = discount rate
 t = the number of years in the future at which costs occur
- discount factor can be obtained for a given t and r from a [table](#)

Example 1: The costs of cancer t/t for the next 3 years are \$5,000 for year 1, \$3,000 for year 2, and \$4,000 for year 3. Determine total costs in PV terms using 5% discount rate.

- a. assuming that all the costs occur at the end of each year.
- b. assuming that all the costs occur at the beginning of each year.

a. assuming that all the costs occur at the end of each year.

$$\begin{aligned} PV &= F_1 \times df_1 + F_2 \times df_2 + F_3 \times df_3 \\ &= \$5,000(0.9524) + \$3,000(0.9070) + \$4,000(0.8638) \\ &= \$4,762 + \$2,721 + \$3,455 = \underline{\underline{\$10,938}} \end{aligned}$$

Year Costs Are Incurred	Future Costs (\$)	Present value (\$)
Year 1	5,000	4,762
Year 2	3,000	2,721
Year 3	4,000	3,455
Total	12,000	10,938

b. assuming that all the costs occur at the beginning of each year

$$\begin{aligned} PV &= F_1 + F_2 \times df_1 + F_3 \times df_2 \\ &= \$5,000 + \$3,000(0.9524) + \$4,000(0.9070) \\ &= \$5,000 + \$2,857 + \$3,628 = \underline{\$11,485} \end{aligned}$$

Year Costs Are Incurred	Future Costs (\$)	Present value (\$)
Year 1	5,000	5,000
Year 2	3,000	2,857
Year 3	4,000	\$3,628
Total	12,000	<u>\$11,485</u>

- Future health is often considered to be less valuable than immediate health
- This has important implications because the utility of an outcome often depends on when it occurs. For example, a stroke that occurs immediately may have a different impact on the patient than one that occurs ten years later
- For economic analyses, both costs and outcomes are discounted at the same discount rate

- Example 2: A decision maker has funds of approximately \$146,000 to implement a preventive programme. Suppose a 5 year program has been proposed with the following expected costs and health outcomes.

Year	Cost	outcomes
1	\$20,000	2 LY
2	\$30,000	4 LY
3	\$50,000	10 LY
4	\$35,000	15 LY
5	\$30,000	20 LY

- If all the costs occur at the end of each year, is the budget at hand enough to cover the proposed programme under a discount rate of 5%?

- Example 3: Project A costs \$300,000 in year 1 to implement. Project B costs \$350,000 in year 20. Which of the two projects is less costly? Given a discount rate of 3%.

- Discounting future costs makes it possible to:
 - evaluate future costs from the perspective of the moment in time in which the decision to allocate funds must be made, and
 - compare programs and interventions with costs that occur at different times

Bringing Past Costs to the Present: Adjusting for Inflation

- Inflation is a persistent and appreciable **increase** in the general price level that occurs over time
- Inflation **decreases the purchasing power** of each unit of money
 - therefore, to make costs from different past years comparable, we have to standardize all costs to the **same base year**
- If retrospective data are used to assess resources used over a number of years back, these costs should be adjusted, or valued at one point in time

- inflation is usually measured by the **consumer price index** (CPI), which describes the prices in a given period as a percentage of prices in a base period

$$\text{Adjusted cost} = C_t * CPI_t$$

where, C_t = nominal cost for selected year, CPI_t = consumer price index of selected year

$$CPI_t = (1 + \%Inflation)$$

$$\text{Adjusted cost} = C_t * (\text{inflation rate} + 1)$$

- Example 4: Which of the following two projects is less costly, if the consumer price index (CPI) inflation rate for 2019 was 22.5%?

Project	Cost Estimate (\$)	Year of Cost Estimate
A	150,000	2018
B	152,000	2019

- for uniform comparison of costs of the two projects, 2018 costs should be adjusted to their 2019 value.

$$\text{Adjusted cost} = C_t * (\text{inflation rate} + 1)$$

$$= 150,000(0.225 + 1) = \underline{183,750}$$

2019 value of \$15,000 is \$183,750 which is higher than \$152,000.

Therefore, project A is more costly

- Example 5: Based on the following costs from a *retrospective* analysis, what is the 2019 value of the total cost of the intervention? use medical consumer price index inflation rate for 2018 = 3.5% and for 2019 = 4%?

Year of cost estimate	2017	2018	2019
Intervention costs	10,000	20,000	30,000

Since the costs are collected at different years, they should be adjusted, or valued at one point in time before adding together.

Adjusted 2017 cost = $10,000 \times 1.035 \times 1.04 = 10,764$

Adjusted 2018 cost = $20,000 \times 1.04 = 20,800$

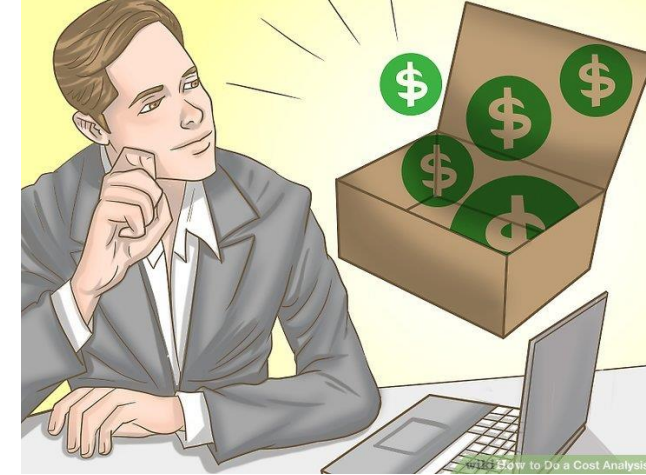
Then total cost = $10,764 + 20,800 + 30,000 = \underline{61,564}$

- Example 6: Based on the following costs from a *retrospective* analysis, what is the 2019 value for the three alternatives using a medical consumer price index (MCPI) inflation rate of 3.5% per year?

Year	2017	2018	2019
Intervention costs	10,000	20,000	30,000
Alternative 2 costs	15,000	25,000	35,000
Alternative 3 costs	20,000	40,000	45,000

Annuitying Capital Costs

- capital costs are expenditures on resources such as equipment, and buildings, which are usually purchased once at the beginning of the program and have useful lives **greater than 1 year**
- annuitying is the allocation, on a constant annual basis, of the cost of a capital item over its lifetime
 - to calculate depreciation of assets
- if your organization's capital assets, such as furniture, equipment, must be used to implement the program or provide the service you're evaluating, depreciation of those assets should be included in your **total costs** for the program or service



- assigning the entire purchase cost to only the purchase year would overestimate that year's costs and underestimate future periods' costs
- annuitizing spreads the capital costs over the useful life of resources and provides more accurate estimates of true resource use
 - used to match the services provided by capital resources with their costs

- For situations where the capital item has a resale value at the end of the project the equivalent annual cost is calculated as follows:
 - estimate the scrap value (resale value at the end of the project)
 - subtract scrap value from the original purchase cost
 - divide the result by the annuity factor

$$EAC = (P_c - S_v) / af$$

Where, EAC = the capital item's equivalent annual cost

P_c = the original purchasing cost

S_v = Scrap value (after t years of service) of the item = resale value

af = annuity factor

- the annuity factor (af) = $(1 / r) - (1 / (r (1 + r)^t))$

Where, r = discount rate and t = years of the items useful life

- For a given r and t , af can be determined from a [table](#)

- Example 7: a car is purchased for \$20,000 in year 1 of a project for outreach program on drug procurement and supply chain management in Ethiopia. The project phase outs after 10 years. The car can be sold after 10 years for \$5,000 (scrap value). Calculate the average annual cost of the car using a discount rate of 5%.

1: calculate the Present Value of the Scrap Value (PS_v)

Here We are apply discounting formula

$$\begin{aligned} PS_v &= S_v \times df \\ &= \$5,000 \times 0.6139 = \underline{\underline{\$3,069.5}} \end{aligned}$$

2: determine af for $r = 5\%$ and $t = 10$ years,

$$af = \underline{\underline{7.2717}}$$

$$\begin{aligned} 3: \text{equivalent annual cost (EAC) of the car} &= (P_c - PS_v) / af \\ &= (\$20,000 - \$3,069.5) / 7.2717 \\ &= \underline{\underline{\$2,328.273}} \end{aligned}$$