Costs and Health Services

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HSM 4230

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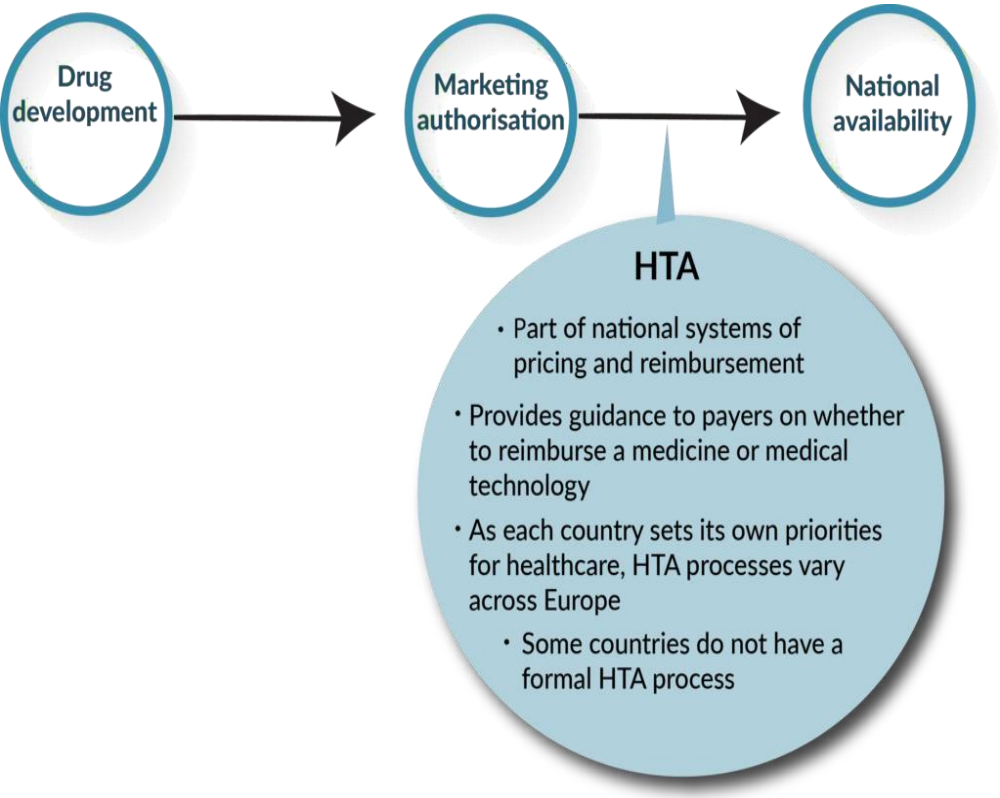
Outline

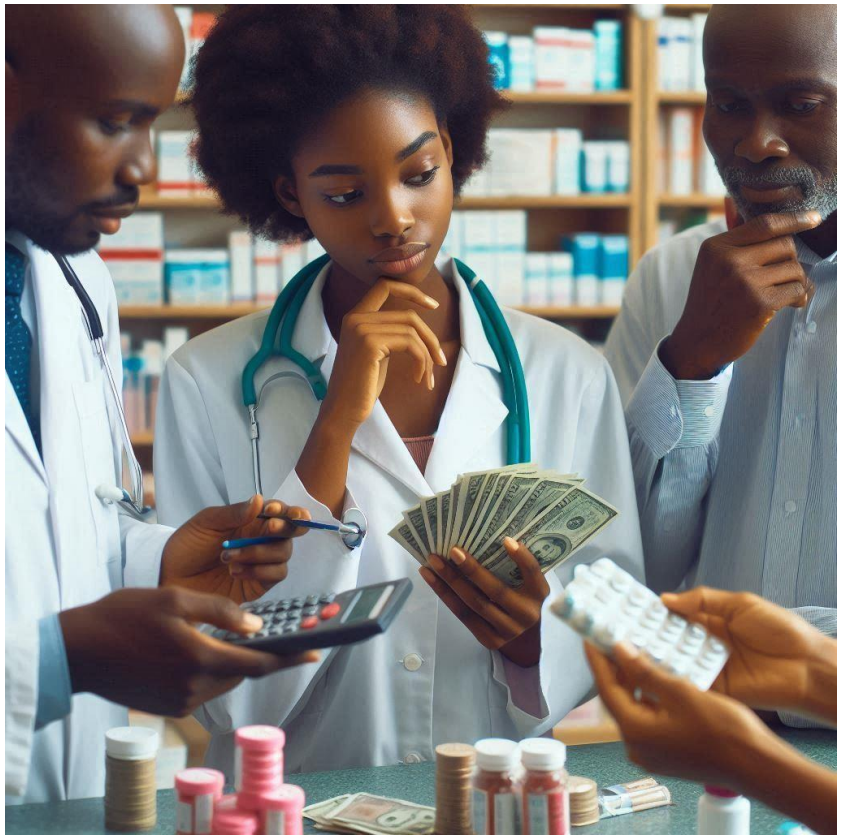
- Introduction
- Cost Effectiveness Analysis
- Evaluating Multiple Treatments
- Measuring Costs
- Measuring Effectiveness
- Cost Benefit analysis
- Conclusions

Introduction

- This practice of **evaluating new medical advances is called health technology assessment (HTA)** and it can generate enormous controversy;
    - In fact, health technology assessment is so controversial that **it is illegal for US Medicare to use HTA in its decision-making**.
- That HTA is a source of contention is no surprise, because **lives hang in the balance whenever cost-effectiveness decisions are made**.
    - If either private or public insurers decide not to cover an expensive cancer medication, then it becomes unaffordable for **a large group of people whose lives may have been saved by it**.

Introduction





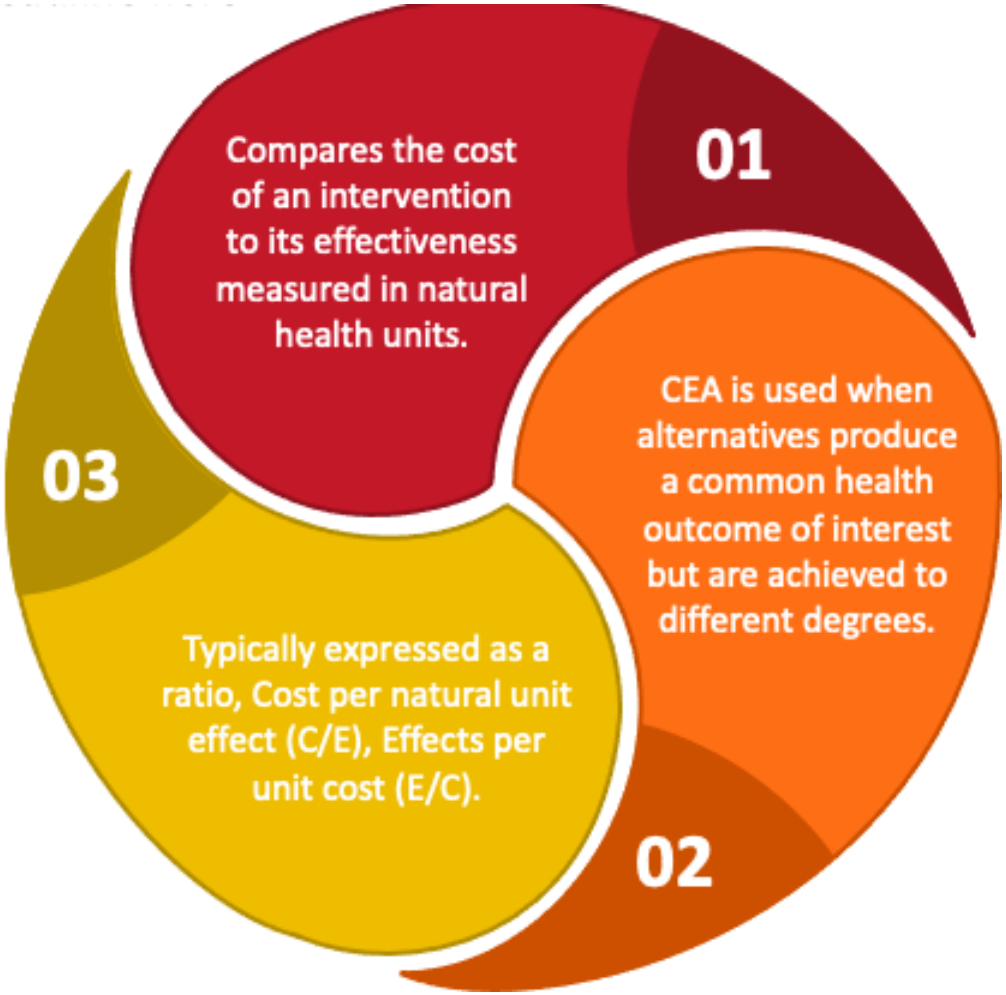
Introduction

- Making these decisions involves **implicitly or explicitly placing a monetary value on human life.**
  - Such valuations of life are **philosophically contentious and politically explosive.**
- The first step in health technology assessment is to measure the **costs and benefits of a health technology**.
- The term "technology" should be interpreted broadly – technologies studied as part of HTA include;
  - new pharmaceutical products
  - new methods for doing a particular surgery
  - machine that helps doctors screen for a disease

Cost Effectiveness Analysis

- HTA encompasses **two different types of analysis**.
  - **Cost effectiveness analysis**, which is the science of comparing the costs and benefits of different medical treatments.
  - **Cost–benefit analysis**, which is used to choose optimally from among different treatments by creating an explicit tradeoff between money and health.
- **Cost-effectiveness analysis (CEA)** is defined as the process of measuring the costs and health benefits of various medical treatments, procedures, or therapies.

Cost Effectiveness Analysis



Cost Effectiveness Analysis

- The primary goal of cost-effectiveness studies is to **compare different therapeutic approaches or strategies for addressing the same medical condition**.
- These studies encompass diverse scenarios.
  - Sometimes, multiple treatments are similar, both in terms of their effects and costs, such as two pills treating the same psychiatric disorder.
  - Other times, treatment options can be vastly dissimilar, like comparing palliative care in a hospice with experimental surgery conducted inside an MRI scanner.
- **Challenge:** When treatments vary significantly in cost and benefit, it becomes **challenging to make meaningful comparisons.**

Cost Effectiveness Analysis

- In some cases, one treatment clearly outperforms another.
- If a treatment is both more cost-effective and more effective in delivering health benefits than another, the latter is said to be **"dominated"** by the former.
- When a treatment is dominated by another, it is always advisable to choose the dominating treatment because it offers better health outcomes at a lower cost.
- Cost-effectiveness studies help healthcare decision-makers identify the **most efficient and cost-effective treatment options,** ensuring that patients receive the best care possible while **optimizing resource allocation**.

Example – ART for HIV treatment

Treatment	Cost per Patient per Year	Quality-Adjusted Life Years (QALYs)	Outcome
Regimen A (newer fixed-dose combination)	$500	0.85	Dominant
Regimen B (older multi-pill regimen)	$700	0.75	Dominated

- **Regimen A dominates Regimen B** because: It **costs less** ($500 vs. $700)
- It **provides better health outcomes** (0.85 QALYs vs. 0.75 QALYs)
- In this case, Regimen B would be considered **inefficient** and likely excluded from further consideration unless there are specific contextual factors (e.g., drug resistance, availability) that justify its use.

ICER: The Incremental Cost-effectiveness Ratio

- The heart of cost-effectiveness analysis is the incremental cost-effectiveness ratio (ICER), which provides a **comparison between any two treatment options that are not dominated**.
- If neither treatment is dominant, one treatment must be both more expensive and more effective.
- **Incremental cost-effectiveness ratio (ICER)**: the ratio of the incremental costs of pursuing one treatment over another to the incremental benefits of that treatment.
- The formula for an ICER is given by equation

$$\text{ICER}_{A,B} = \frac{C_A - C_B}{E_A - E_B} > 0$$

ICER: The Incremental Cost-effectiveness Ratio

- where:
    - CA and CB are the **respective costs of treatments A and B,** and
    - EA and EB are the **respective health outcomes of treatments A and B.**
- Costs in ICER calculations are typically **expressed in currency and encompass financial expenses related to treatment.**
- However, additional factors like time and travel costs may also be considered.
- **Health outcomes** are defined based on **the specific context, often quantified as additional years of life or other relevant measures**.
- The health benefits of medical treatments can range from extending life (open heart surgery) to relieving pain (morphine) to avoiding complications from a disease (insulin therapy for diabetics).

ICER: The Incremental Cost-effectiveness Ratio

$$\frac{(Cost_{new} - Cost_{old})}{(Effectiveness_{new} - Effectiveness_{old})} = \textbf{ICER}$$

$$\textbf{ICER} = \Delta C / \Delta E$$

Incremental resources **required** by the intervention

Incremental health effects gained by using the intervention

ICER – Practical Applications

- **Practical Applications**
- How much money and time should doctors spend screening patients for unusual diseases?
- **Objective:** Understand the importance of balancing the cost and benefits of disease screening.
- **Key Point**: Early detection of diseases like cancer, diabetes, and HIV saves lives, but indiscriminate screening can be expensive and potentially harmful to wrongly diagnosed patients.
- **Role of Cost-Effectiveness Analysis:** Introduce the concept of cost-effectiveness analysis as a tool to help make informed decisions about disease screening.

ICER – Practical Application

- **Example:** Suppose we have two health technologies to compare; **Targeted vs. Universal Screening for HIV**
- **Scenario**: Two health clinics in a city, each with a different screening strategy for HIV.
- Which strategy is superior?
- **Sanders et al. (2005)** examine both strategies using real-world HIV survival data and a simulation model.

Clinic 1	Clinic 2
Targeted Screening: Tests only symptomatic patients or high-risk individuals to save on unnecessary costs. Some HIV cases may be missed.	**Universal Screening:** Tests every patient regardless of symptoms, potentially costly but can lead to early HIV detection and treatment

ICER – Practical Application

Table 14.1. *Comparison of strategies for HIV screening.*

Treatment strategy	Cost per patient	Average life expectancy
Targeted screening	$51,517	21.063 years
Universal screening	$51,850	21.073 years

Source: Data from Table 3 in Sanders et al. (2005).

- **They find that neither strategy is dominated**: universal screening is more expensive, and it leads to a higher average life expectancy for patients
- Present the Incremental Cost-Effectiveness Ratio (ICER) as a measure to determine the price of generating extra days of life with universal screening.

ICER: The Incremental Cost-effectiveness Ratio

$$\text{ICER}_{u,t} = \frac{\$51{,}850 - \$51{,}517}{21.073 \text{ years} - 21.063 \text{ years}} = \frac{\$333}{3.92 \text{ days}} = \$84.95/\text{day of life}$$

- This ICER essentially provides a price for generating extra days of life for patients with universal screening.
- **If the clinic that uses targeted screening switches to universal screening, it could "buy" extra days of life expectancy for about $85 each**.
- If this tradeoff is worthwhile, then universal screening is optimal.
- Note that the **ICER by itself does not make a determination about which treatment is optimal**; it simply indicates exactly how expensive a health improvement is in monetary terms.
- **An ICER is a positive fact about costs and benefits of two different treatments, not a normative judgment about which treatment is better**.

Evaluating Multiple Treatments

- In disease treatment, cost-effectiveness analysis plays a vital role in evaluating the value of different treatment options.
- Initially, it seems straightforward when only one drug is available.
- The Incremental Cost-Effectiveness Ratio (ICER) can be calculated by **comparing the costs and benefits of using the drug with the costs and benefits of doing nothing**.
- However, this simplistic model assumes that doing nothing is costless and results in instant death, which is rarely the case in real-world scenarios.

Evaluating Multiple Treatments

- Imagine a new, deadly disease called bhtitis.
- If only one drug were available to treat this disease, cost-effectiveness analysis is easy.
- Suppose the costs of the drug are ***Cdrug*** and the benefits (measured in terms of life expectancy) are ***Edrug***.
- We could find an ICER by comparing the costs and benefits of using the drug with the costs and benefits of doing nothing:

$$\text{ICER}_{drug,nothing} = \frac{C_{drug} - 0}{E_{drug} - 0} = \frac{C_{drug}}{E_{drug}}$$

Evaluating Multiple Treatments

- In reality, diseases often don't lead to immediate death, and the "do nothing" option may involve some costs, such as pain management or hospice care.
- Moreover, **there can be multiple drugs available** for treatment, each with its own set of costs and benefits.
- This complexity is further exacerbated when considering that **some drugs may have deadly side effects when combined**.
- When comparing multiple drugs and their associated ICERs, the decision-making process becomes intricate.
- For instance, determining which drug is preferable when faced with three drugs (A, C, G) with different ICERs ($40,000, $60,000, $107,692) is far from straightforward.

Evaluating Multiple Treatments

Table 14.3. *Various drug therapies for bhtitis.*

Treatment regimen	Total cost (TC)	Life expectancy (LE)	Cost per extra year of life (TC/LE)
No treatment	$0	0.0	-
Drug *A*	$40,000	1.0	$40,000
Drug *B*	$80,000	0.2	$400,000
Drug *C*	$160,000	3.0	$53,333
Drug *D*	$220,000	2.0	$110,000
Drug *E*	$260,000	1.0	$260,000
Drug *F*	$280,000	0.2	$1,400,000
Drug *G*	$320,000	2.8	$114,286
Drug *H*	$360,000	3.4	$105,882
Drug *I*	$400,000	3.4	$117,647

- Additionally, when dealing with ten total treatment strategies (including no treatment), there are a total of 45 pairwise comparisons to consider.
- It seems more intuitive to compare these drugs by simply dividing the costs of each drug by their health effects,
- This appears to tell us how expensive it is to extend life with each drug, and dramatically simplifies the ten-way comparison.

Evaluating Multiple Treatments

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- The decision rule would be simple: always **pick the drug with the lowest cost per year of life.**
- In the case of bhtitis, **drug A appears to be the most cost-effective, because it produces life years most cheaply**
- Each year costs only $40,000. But as we will see, **this method for comparing drugs is incorrect.**

The Trouble With Average Cost-effectiveness Ratios

- When we compare a treatment with a hypothetical alternative with no costs and instant death, we are actually calculating an **average cost-effectiveness ratio (ACER), not an ICER**.
- The average cost-effectiveness ratio is the **ratio of the costs of pursuing a treatment to the health effect of that treatment**.
- For a treatment T, the ACER is

$$\text{ACER}_T = \frac{C_T}{E_T}$$

The Trouble With Average Cost-effectiveness Ratios

- where
  - CT is the cost of T, and ET is the health effect of T.
- The last column in Table 14.3 lists the ACER for each drug.
- Comparing the ACERs of different treatment options, intuitive though it may be, **will not typically reveal all the cost-effective drugs**.
- Consider, for example, a comparison between drug A and drug C.
- Drug A has the lower ACER, so it seems like it must be more cost-effective than drug C.
- But now consider the ICER between the two:

The Trouble With Average Cost-effectiveness Ratios

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$$\text{ICER}_{C,A} = \frac{C_C - C_A}{E_C - E_A} = \frac{\$160{,}000 - \$40{,}000}{3.0 - 1.0} = \$60{,}000/\text{year}$$

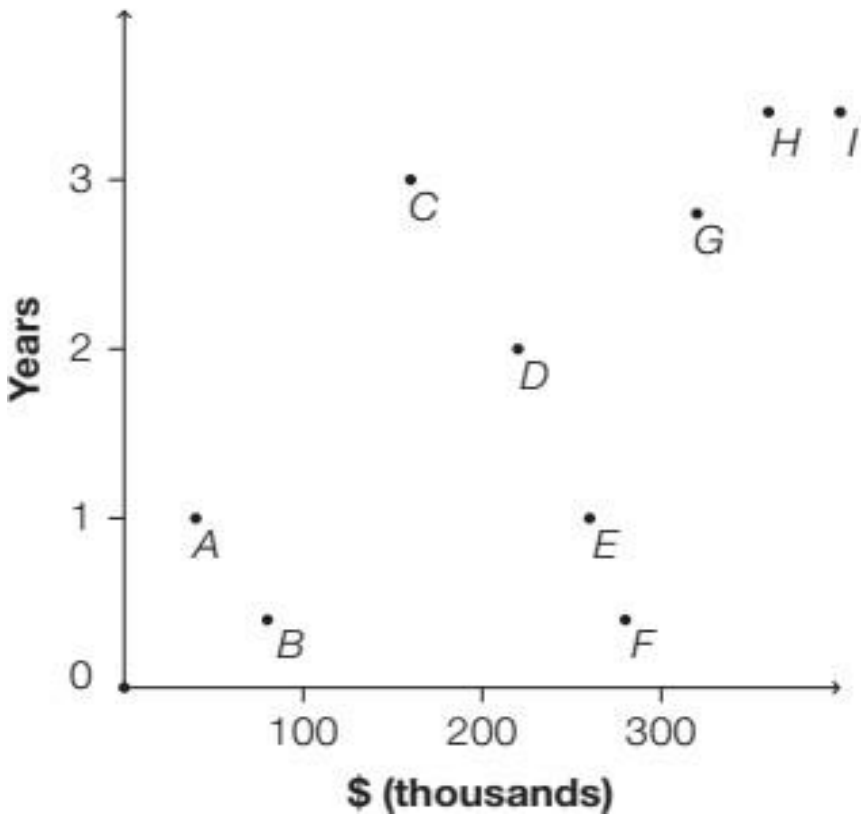
The Trouble With Average Cost-effectiveness Ratios

- This ICER is high, but not so high that A is definitely preferable to C.
- If someone values life at more than $60,000 per year, then drug C is better than drug A, because it produces more years of life at a relatively low price.
- The misleading comparison of ACERs showed that drug A was always more cost-effective than drug C, but a calculation of the ICER shows that drug C may sometimes be more cost-effective.

The Cost-effectiveness Frontier

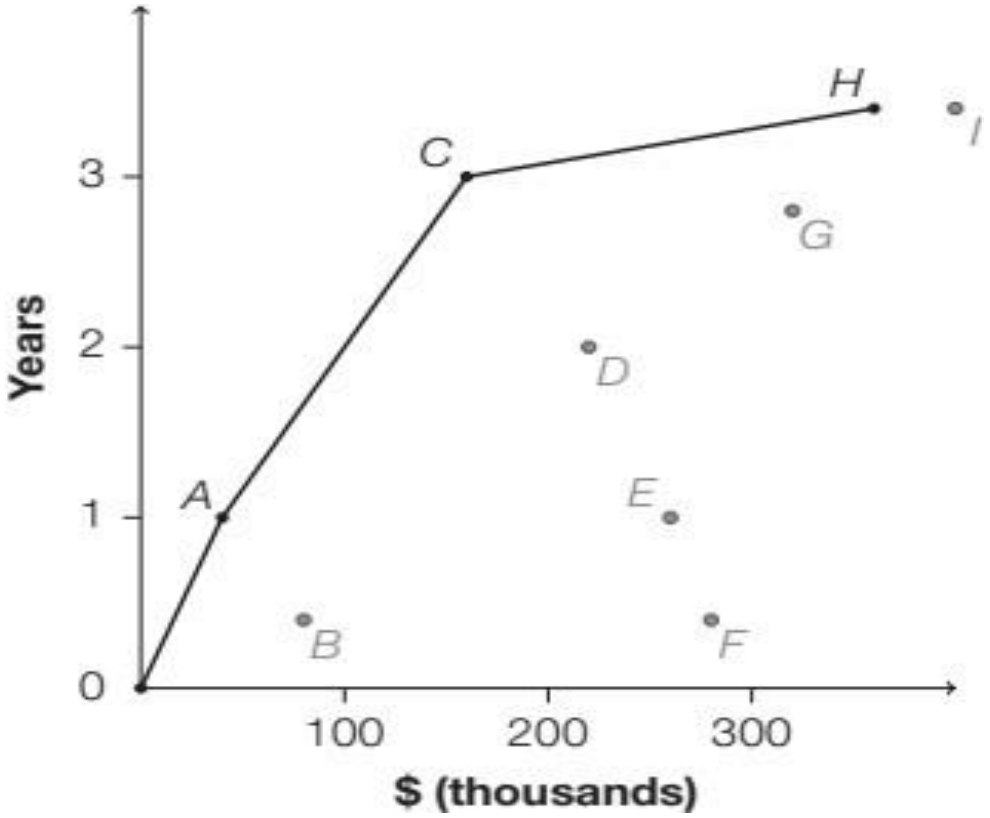
- In order to find all of the potentially cost-effective treatments, **we must compare every drug to every other drug to figure out which treatments are dominated**.
- This task is made easier with a **graphical approach that allows us to construct a curve called a cost effectiveness frontier (CEF)**.
- This frontier shows the **subset of treatment strategies which are not dominated by any other treatment**
- Our first step is to graph the costs and health effects of the various possible treatments for bhtitis.
- We label the option of doing nothing as treatment 0. Figure 14.1 plots the nine drugs from Table 14.3, along with treatment 0.

The Cost-effectiveness Frontier



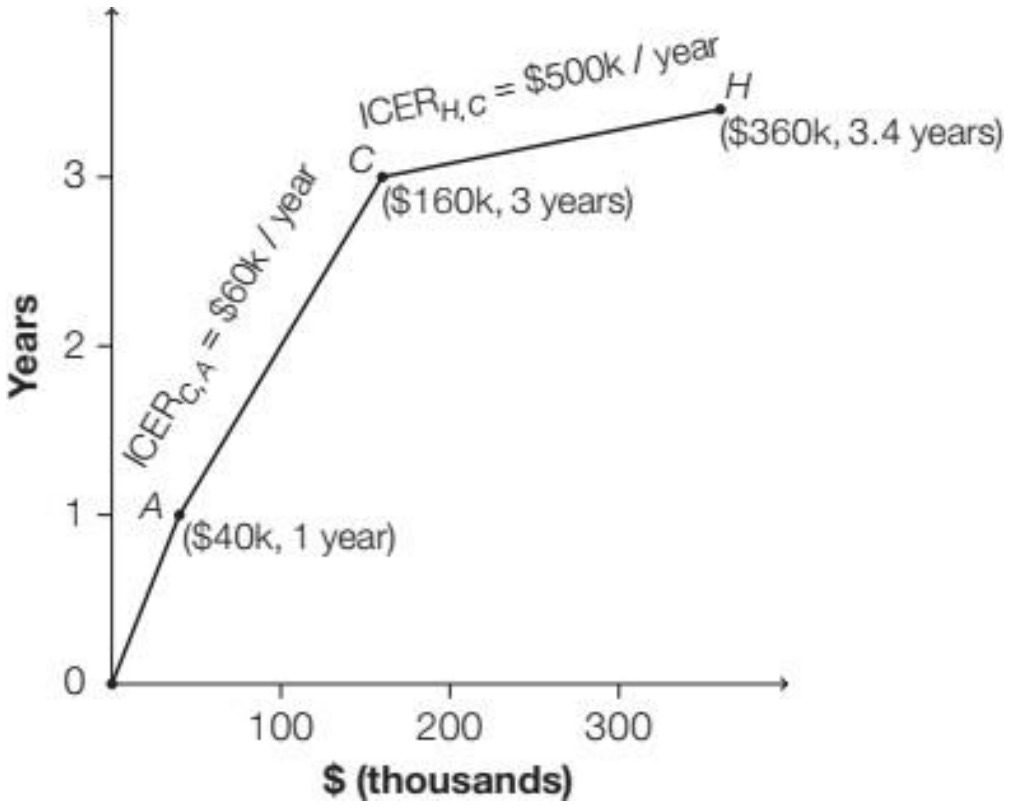
- Recall that a treatment is **dominated if another treatment is both cheaper and more effective.**
- Graphically, a treatment is **dominated if any treatment lies to its northwest**.
- In Figure 14.1, many treatments are dominated: drug B is dominated by drug A, drug D is dominated by drug C, and drug F is dominated by drug E, among others.

The Cost-effectiveness Frontier



- We connect the **points that are not dominated** and ignore the points that are dominated.
- The result is the curve in Figure 14.2, which connects treatments 0, A, C, and H.
- It is clear why most points are not on the CEF; drug F, for example, is dominated by several other drugs.
- But it is less clear why we discard drug I as well.
- A close inspection of drug I reveals that it is dominated by drug H, because it provides exactly the same health effect but costs more money.
- Even though H does not lie to the northwest of I, I is still dominated.

The Cost-effectiveness Frontier



- The CEF simplifies the comparison between treatments by identifying which drugs are dominated.
- Cost-effectiveness analysts **can then rule out the dominated drugs (which should never be used anyway) and focus only on treatment options that are non-dominated**.
- The slope of the line segment between any two points also has a ready interpretation:
- it is equal to the inverse of the ICER of those two treatments (see Figure 14.3).
- **This link between the ICER and the slope of the CEF will be helpful when we decide which of the potentially cost-effective treatments is best to use.**

Measuring Costs

- **Cost-effectiveness analysis (CEA) is a crucial tool for healthcare decision-making.**
- It helps determine the most efficient allocation of resources in healthcare and ICERs help identify cost-effective treatments.
- The practical challenge in CEA is determining accurate values for C (Costs) and E (Health Effects)
- Accurate C and E values are crucial for meaningful CEA results. Wheras Inaccurate inputs can lead to flawed resource allocation decisions
- **Key Questions:**
- Should **long-term costs for future medical problems be included in cost calculations?**
- What's the **best measure of a medicine's effectiveness**: years of survival, disability avoidance, or another metric?

Whose Costs Should Count in CEA?

- The first question in Cost-Effectiveness Analysis (CEA) is determining the perspective it should take - patient, insurer, or another party.
- Perspective impacts the evaluation of cost-effectiveness, as different parties bear different costs and benefits.
- Common Perspectives:
  - Two common perspectives in CEA studies: "Social Planner" and "Patient."
  - Public insurers **often use the social planner perspective to make coverage decisions.**

Social Planner Perspective in CEA

- **Key Elements:**
  - In the social planner perspective, **all costs associated with a treatment strategy are considered, regardless of who pays them**.
  - Costs include **direct payments by insurers and patients, as well as indirect costs like lost work time and family involvement**.
- **Examples of Inclusions:**
  - Lost work time due to treatment should be quantified as part of the costs.
  - Family members' lost leisure time while caring for the patient should also be counted as a cost.
- **Implications:**
  - Adopting the social planner perspective provides a **holistic view of the societal impact of a treatment strategy**.
  - It allows for a **comprehensive evaluation of cost-effectiveness**, ensuring that all relevant costs are considered.

Special Considerations in Cost-Effectiveness Analysis

- In Cost-Effectiveness Analysis (CEA), most costs should be counted, but there's one important exception.
- Exception: **Monopoly-Priced Prescription Drugs**:
  - When a treatment includes monopoly-priced prescription drugs and other such inputs, **only the marginal costs of the drug should be counted.**
  - The extra money paid above marginal cost goes to **drug companies as monopoly profits.**

Perspectives and Divergence in CEA

- **Social Planner Perspective:**
  - From a social planner's perspective, only marginal production costs of monopoly-priced drugs should be included.
  - Monopoly profits are seen as a gain for drug company shareholders.
- **Patient Perspective:**
  - From a patient perspective, only costs directly borne by the patient are included.
  - Key costs include out-of-pocket expenses for the treatment, which may vary depending on insurance coverage.

Perspectives and Divergence in CEA

- Divergence in CEA:
  - Treatments deemed cost-effective from the **social planner perspective may not be so from the patient's perspective due to differing cost considerations**.
  - Divergence can occur due to **moral hazard induced by insurance or the presence of positive/negative externalities.**
- Perspective matters in CEA, and understanding these nuances is crucial for making informed healthcare decisions.

Which Costs Should Count? - Example

- Cost-effectiveness analysis (CEA) involves choices about which costs to consider in evaluations.
- A simple example illustrates the complexities of cost accounting in healthcare decisions.
- **Scenario: The Incredible Lung Cancer Treatment:**
  - Imagine a national insurance system deciding whether to cover a remarkable new lung cancer treatment.
  - The treatment is highly effective and affordable, costing only $1,000 for a complete course.

The Complexities of Cost Analysis

- **The Dilemma:**
  - The new lung cancer treatment is **highly effective, with low direct costs compared to other treatments**.
  - Benefits outweigh costs significantly, making it seem like an obvious choice for coverage.
- **Ambiguities in Cost Analysis:**
  - Decision-makers must grapple with what costs to consider:
    - Direct treatment costs.
    - Indirect costs (e.g., lost productivity).
    - Long-term healthcare expenses.
    - Potential side effects and complications.

Incorporating Nonpecuniary Costs in Cost-Effectiveness Analysis

- Nonpecuniary costs (costs that can't be quantified in monetary terms), though challenging to quantify, play a crucial role in CEA perspectives.
- **Scenario: Remote Gobi Desert Hospital Treatment:**
  - Imagine a treatment only available in a remote Gobi Desert hospital, highly uncomfortable and time-consuming.
  - Patients incur significant nonpecuniary costs for travel discomfort.
  - Yet this is difficult to account for during costing

Non-Medical Costs in CEA Perspectives

- Non-medical costs should be counted when analyzing from the social planner or patient's perspective.
- These costs consume real resources and wouldn't have occurred with an alternative treatment.
- For instance - Travel and discomfort-related costs for patients seeking the Gobi Desert treatment are tangible non-medical expenses that should be factored into CEA.

Dealing with Future Costs in CEA

- **Future Costs Dilemma:**
  - How should future costs be considered in CEA when a miraculous treatment leads to extended patient survival?
- **Example:**
  - If the new lung cancer treatment is covered by insurance, patients **might survive longer and potentially face heart attack costs in the future**.
- **Controversy:**
  - Debate exists on whether and how to count future costs against the new cancer treatment.

Estimating Future Costs in CEA

- **Estimation Challenges:**
  - Estimating future costs requires forecasting potential health contingencies, which is complex.
  - Comprehensive accounting of all contingencies is impossible.
- **Simplifications:**
  - Practical CEAs often **simplify future cost calculations, including only a subset of possibilities.**
  - These simplifications are necessary due to **limited information and aim to strike a reasonable compromise**.
- **Non monetary costs and future costs** are intricate aspects of CEA.
- Their inclusion and estimation involve **nuanced decisions** that impact healthcare resource allocation.

Measuring Health Benefits in Cost-Effectiveness Analysis

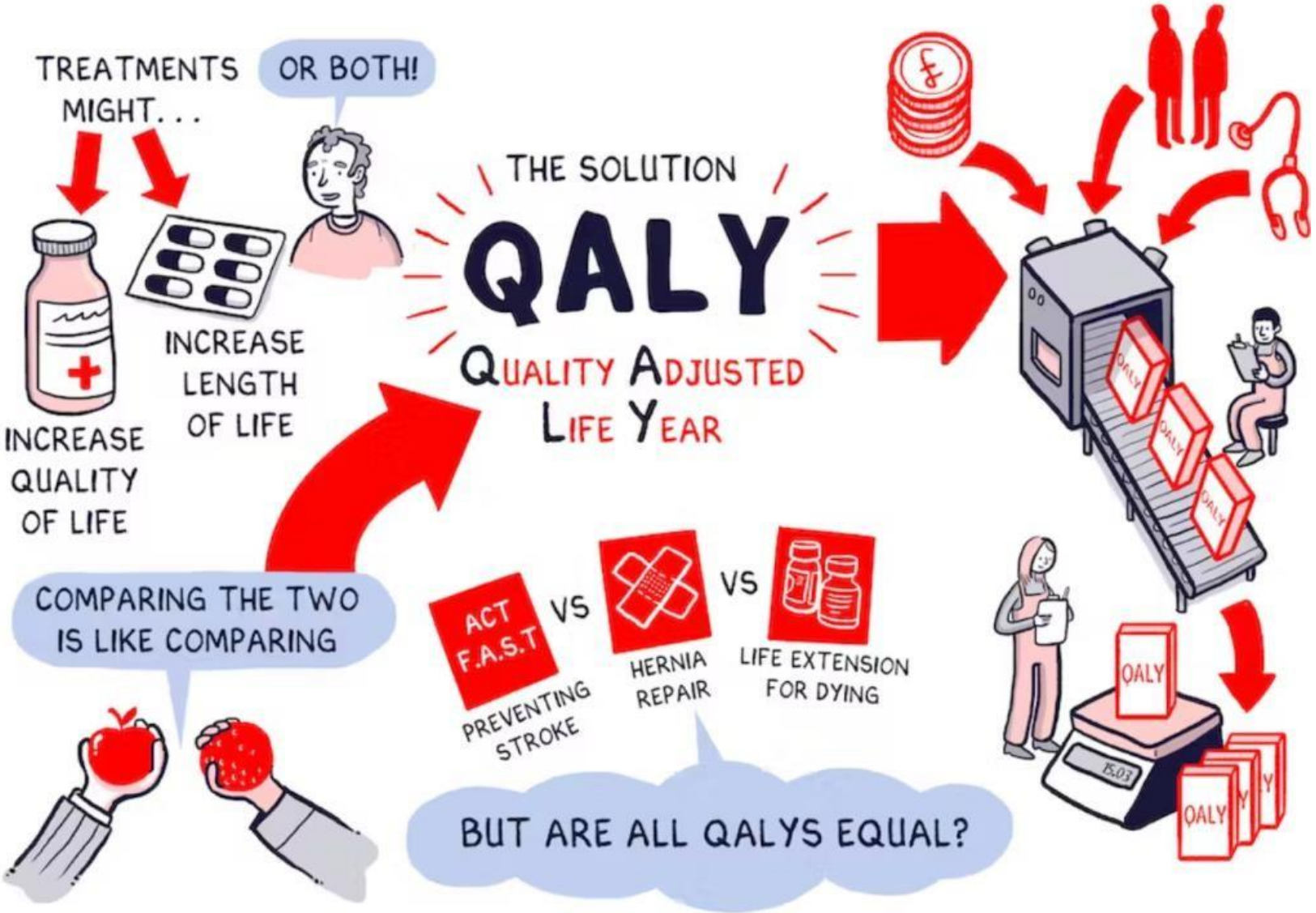
- Determining if a drug is cost-effective involves assessing both its costs and health benefits.
- Selecting the appropriate health outcome and measuring the effects of treatments are critical steps.
- **Health Outcomes Measurement:**
  - Health effects can be measured in various ways, including
    - survival,
    - happiness,
    - pain relief,
    - sick days, and more.
  - Previously, examples used **life expectancy as health outcomes** .

Evaluating Health Benefits: A Complex Challenge

- **Example Scenario:**
  - In a CEA study where "effectiveness" is defined as increased life expectancy, only treatments extending life are valued.
- **Examples**:
  - How does this approach value **palliative drugs** like morphine that **improve quality of life but don't extend it**?
  - Can a **surgery doubling life expectancy** but **causing paralysis** be considered more effective than a side-effect-free drug adding only one year of life?
- Measuring health benefits in CEA demands **thoughtful consideration of diverse health outcomes**, recognizing that effectiveness encompasses more than just survival.

Measuring Health-Related Quality of Life in Cost-Effectiveness Analysis (CEA)

- CEA evaluates **not just years of life** but also the **quality of those years**, recognizing that health condition matters to individuals.
- **Quality-Adjusted Life Years (QALYs):**
  - QALYs **combine life expectancy and health-related quality of life into a single index**.
  - Each year of life is assigned a quality weight (q) between 0 (equivalent to death) and 1 (full health).
  - QALYs represent the weighted sum of years lived with their respective quality weights.


TREATMENTS MIGHT...
OR BOTH!
INCREASE LENGTH OF LIFE
INCREASE QUALITY OF LIFE
THE SOLUTION
QALY
QUALITY ADJUSTED LIFE YEAR
COMPARING THE TWO IS LIKE COMPARING
ACT F.A.S.T
PREVENTING STROKE
VS
HERNIA REPAIR
VS
LIFE EXTENSION FOR DYING
BUT ARE ALL QALYS EQUAL?
QALY

Quantifying Quality-Adjusted Life YEARS (QALY)

- QALY Calculation:
  - The QALYs are computed by summing the **product of quality weights (q between 0 and 1) and the likelihood of survival for each year.**
  - Years with a weight of 0 are equivalent to death, whereas years spent in full health are assigned a weight of 1.
  - The number of QALYs derived over a certain time span is **the weighted sum of the quality weights and duration lived at that weight**.

Quantifying Quality-Adjusted Life YEARS (QALY)

$$\mathrm{QALY} = \sum_{t=1}^{t=\max} \frac{F_i \, q_i}{(1+d)^t}$$

- where *F* i is the probability that the person is still alive at age *i*;
- *d* is the time discount factor; and the value
- *qi* is the quality weight, between 0 and 1, assigned to each year of the person's remaining life until a maximum value, *max*

Quantifying Quality-Adjusted Life YEARS (QALY)

- For example, a patient receives the same number of QALYs from living two years at q=0.5 (with chronic cough and insomnia, say), from four years at q = 0.25 (confined to a wheelchair, perhaps), and from one year with full health q = 1.
- Formally, the calculation of QALYs is the **discounted sum of the product quality weights q of each year times the likelihood of survival to each year**

Quality-Adjusted Life Expectancy

- **Quality-Adjusted Life Expectancy (QALE):**
  - QALE measures the expected years a person will live, weighted by the discounted quality of life for each of those years.
  - QALE reflects how individuals expect to live in terms of QALYs.
  - For someone with current age t0 and the potential of living at most to age Z, the quality-adjusted life expectancy (QALE) is the number of years people expect to live weighted by the discounted quality of life in each of those years.
  - In other words, the QALE is the number of QALYs a person expects to live:

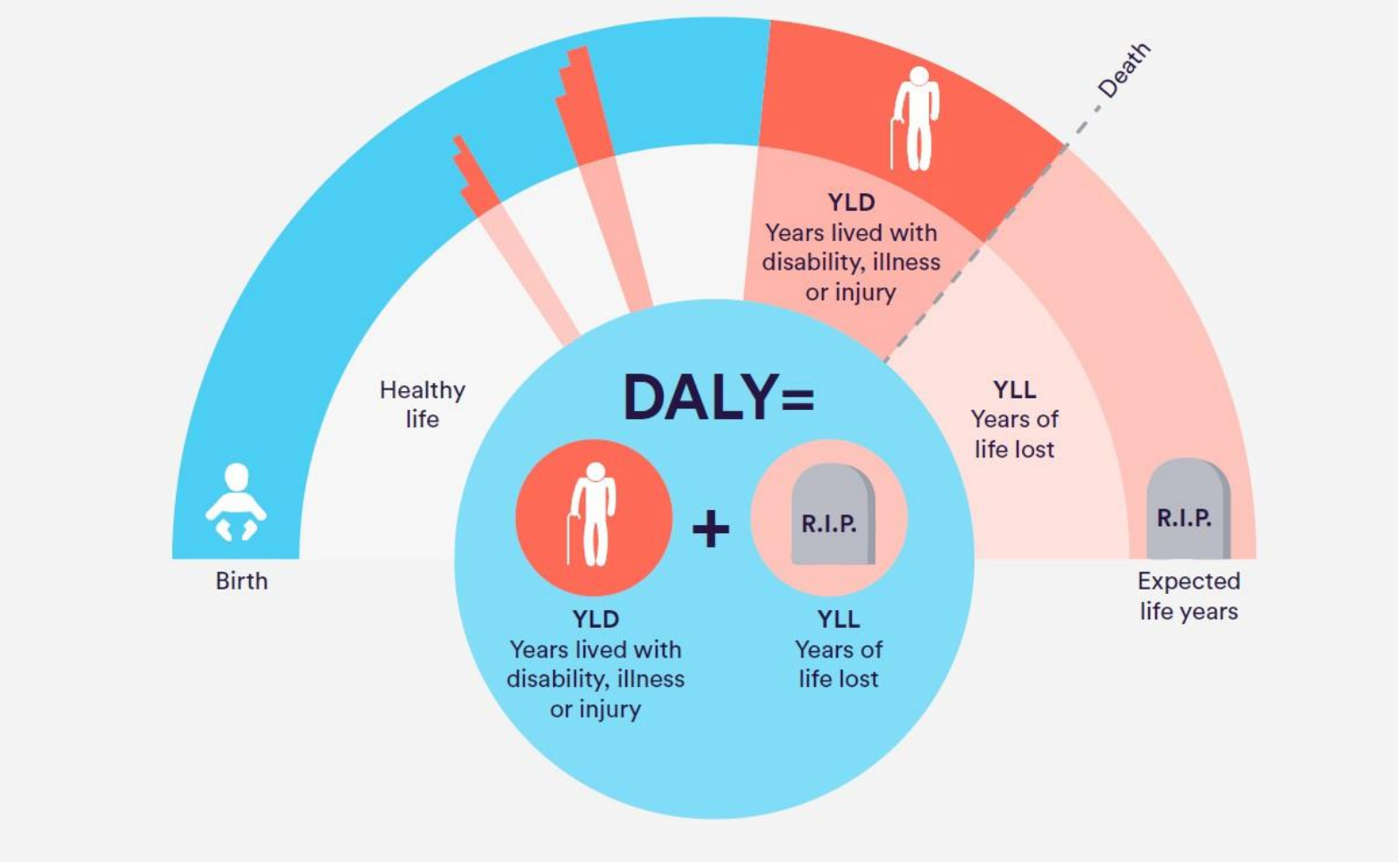
Quality-Adjusted Life Expectancy

$$\mathrm{QALE} = \sum_{t=t_0}^{Z} \delta^{t-t_0} q_t P_t$$

- where Pt is the probability of surviving to each year t,
- qt is the quality weight,
- δ is the time-discounting factor.
- If there is no time discounting (δ = 1) and if each year of life is lived in full health (q = 1), then the formula for QALE is identical to the formula for life expectancy

Measuring Health Loss with Disability-Adjusted Life Years (DALY)

- Alongside QALYs**, Disability-Adjusted Life Years (DALYs**) are another vital measure in Cost-Effectiveness Analysis (CEA).
- Unlike QALYs, which measure health gained, **DALYs quantify health lost in comparison to a benchmark.**
- Why Use DALYs:
  - DALYs are commonly used to evaluate the **impact of epidemics or health crises.**
  - They provide **insights into the burden of diseases and health crises on a population**.
- Example:
  - The 2006 **chikungunya epidemic** in India resulted in a total loss of **25,588 DALYs across approximately 1.39 million cases** (Krishnamoorthy et al., 2009).



Example; According to Fan et al.(2021), the 2020–2021 **global health burden of COVID-19 (31,930,000 DALYs)** is larger than the annual DALYs of other infectious diseases (Malaria (42, 280), Tuberculosis (36), Lymphatic filariasis (5, 644), Leishmaniasis (2357), Schistosomiasis (1760), Trypanosomiasis (1598), Rabies (1160), Onchocerciasis (987), Chagas (649), Dengue (653), and Leprosy (177)).

Cost–benefit Analysis: Picking The Optimal Treatment

- Cost-effectiveness analysis makes **no judgment about whether more expensive treatments on the frontier are worth it** (thought does identify treatment strategies inside the frontier as not worthwhile).
- **Cost–benefit analysis (CBA) takes the additional step of assigning a value to health benefits in monetary terms.**
- CBA allows us **to pick an optimal treatment from the list of potentially cost-effective treatments**.
- In other words, **cost–benefit analysis allows us to determine which single treatment is most cost-effective**.
- This is where the dispassionate mathematics of cost-effectiveness ends and the **contentious practice of life valuation begins.**

Cost Benefit Analysis (CBA)

- When we place a monetary value on each life year or quality-adjusted life year, **we implicitly create a set of indifference curves that can be plotted in the same space as the Cost effectiveness frontier**
- Let us assume that a person values each QALY at $100,000.
- As a result, **the indifference curves are sloped as to indicate indifference between one additional quality-adjusted life year and $100,00**0
- we plot this set of indifference curves and find a tangency point with the CEF for bhtitis (Figure 14.6).
- Under this assumption, the cost-effective treatment for a patient stricken with bhtitis is drug C

Cost–benefit Analysis (CBA)

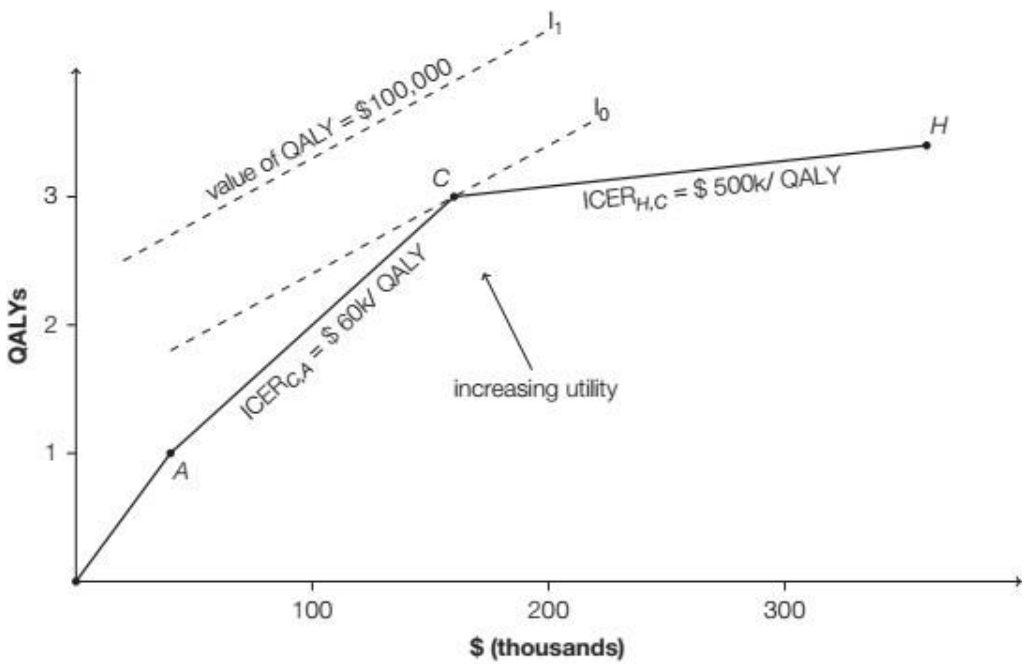


Figure 14.6. *Tangency between indifference curves and the CEF at point C.*

- Consider a bhtitis victim without insurance who also values each QALY at $100,000.
- Because he is uninsured and pays the full cost of treatment, he optimizes by picking drug C.
- He takes the three additional QALYs that drug C provides for only $160,000.
- He forgoes the extra 0.4 QALYs he could get with drug H, which would cost $200,000 more than drug C.
- **Drug H would only be worth it if he values extra QALYs at $200,000 ÷ 0.4 = $500,000.**

Cost–benefit Analysis (CBA)

- Another way to say this is that the ICER between drug C and drug H is $500,000, which exceeds the value he places on a QALY.
- Instead of buying those extra 0.4 years, he would rather save his money and bequeath it to his children (or maybe spend it on a year-long cruise of the seven seas).
- Based on his valuation of a life year, this is a good decision for him.
- This cost-effectiveness analysis was done from the perspective of the uninsured patient; we discuss next how the analysis changes with insurance coverage.

Influence of Insurance on Treatment Decisions

- Consider a patient with a certain valuation of a Quality-Adjusted Life Year (QALY) and a generous insurance package covering 90% of medical expenses.
- The insurer provides comprehensive coverage, including treatments that may not be cost-effective.

- **Effect on Cost per QALY:**
  - With insurance, the patient's out-of-pocket cost per QALY for certain treatments is significantly reduced.
  - For instance, drug C now costs the patient only 10% × $160,000 = $16,000 for three QALYs, and drug H costs only 10% × $360,000 = $36,000 for 3.4 QALYs.

Moral Hazard in Treatment Decisions

- **Impact of Insurance:**
  - The insured individual's perspective shifts due to the insurance coverage, leading to different treatment choices.
- **Moral Hazard Example:**
  - The patient initially considered drug H not worth the extra costs without insurance.
  - The Incremental Cost-Effectiveness Ratio (ICER) of drug H with respect to drug C was $500,000/QALY, while the patient valued life at $100,000 per QALY.

Moral Hazard in Treatment Decisions

- **Insurance Influence:**
  - With insurance, the patient opts for drug H, incurring only $20,000 in additional costs.
  - The extra costs of drug H are shared by all members in the patient's insurance pool, promoting technology overuse and potentially inefficient innovations.
- **Generous insurance can lead to moral hazard**, where patients make different choices due to reduced personal cost, potentially impacting cost-effectiveness and healthcare resource allocation.

Rationing

- Insurance companies and national insurance programs are cognizant of the problem of **technology overuse**
- A major technique that is relevant to cost-effectiveness analysis is rationing
- **Rationing**: any method for allocating a scarce resource other than prices
- Rationing is a practice often used by governments during wartime when the military consumes a significant portion of available resources.
- To prevent these necessities from becoming prohibitively expensive and to **ensure equitable distribution**, governments implement rationing measures

Rationing in Healthcare Markets

- In typical markets, prices play a vital role in efficiently allocating scarce resources.
- Everyday goods like gasoline and breakfast cereal are "rationed" by price, as people must pay for what they consume within budget constraints.
- **Unique Nature of Healthcare Markets**:
  - Unlike most markets, healthcare markets operate differently.
  - Medical care **prices are intentionally kept artificially low** and often fail to efficiently manage the use of limited medical resources like hospital beds and surgeon's time.

Rationing Strategies in Healthcare Markets

- **Rationing Methods:**
  - Insurers and governments employ rationing strategies to address **issues like moral hazard without relying solely on price adjustments.**
  - Private insurance companies and national programs like the UK's National Health Service (NHS) **may decline coverage for treatments considered not cost-effective.**
- **Example: Case of bhitis**
  - In the case of bhtitis, an insurance company covering 90% of expenses might decline coverage for drug H.
  - Patients can still purchase drug H themselves, but the insurance covers only 90% for drugs A and C.
  - Patients often opt for drug C, aligning with their choice even without insurance, resulting in a **compromise solution with a substantial cost reduction.**

Rationing in Healthcare Decision-Making

- **Government Regulatory Measures:**
  - Governments may implement regulatory commissions to oversee costly medical treatments and procedures.
  - For instance, the Czech Republic established a commission in the 1990s to regulate expensive technologies and drugs, considering patient factors and indications for treatment.
  - Zambia's NHIS (NHIMA) has some services subject to rationing; "Spectacles - The NHIS also pays for visual corrective spectacles to the member once every three years."

Rationing in Healthcare Decision-Making

- **Decision-Making Factors:**
  - Evaluate factors like a patient's health, social situation, and psychological conditions to approve or withhold treatments.
  - Decisions may involve assessing a patient's educational prospects and family commitment for certain procedures.
  - The age of the patient often influences treatment choices, with younger patients receiving more expensive procedures with longer potential benefits.

Rationing in Healthcare Decision-Making

- Valuation of life years and quality weights for disabilities is necessary for governments and companies to make life-and-death decisions on behalf of patients.
- Rationing becomes essential in healthcare markets due to unique characteristics, whereas other markets allow individuals to make decisions based on personal preferences and budgets.

EXERCISE

Indicate whether each statement is true or false, and justify your answer. Be sure to state any additional assumptions you may need.

1. A dominated treatment is one that is less cost-effective than another treatment (even though it may produce better medical outcomes).
2. Both ICERs and ACERs compare two drugs on the basis of both cost and medical efficacy.
3. If a medical screening technique is perfect at detecting a disease before it develops and is able to prevent the disease from occurring, it must be cost-effective.
4. An ICER value indicates which of two treatment options is better.
5. The cost-effectiveness frontier (CEF) shows the subset of treatment strategies which are not dominated by any other treatment.
6. Cost–benefit analysis (CBA) allows us to pick an optimal treatment from the list of potentially cost-effective treatments

EXERCISE

- Suppose Jay has been experiencing back pain, and has four options for treatment (TABLE 14.6)

1. Plot these four treatments on cost–pain reduction axes. Create a cost-effectiveness frontier by connecting potentially cost-effective treatments.

2. Calculate the ICER between cortisone injections and a chair cushion, and between acupuncture and cortisone injections.

Table 14.6. *Potential therapies for back pain.*

Treatment regimen	Total cost	Pain reduction
Do nothing	$0	0 units
Chair cushion	$100	20 units
Cortisone injections	$700	25 units
Acupuncture	$1,000	50 units

EXERCISE

Suppose that a patient has the opportunity for a treatment that will extend life by one year with a probability of 0.9 ($F1 = 0.9$) and by two years with a probability of 0.5 ($F2 = 0.5$). The patient will die with certainty after two years. Quality weight $q1$ is 0.8 in Year 1 and $q2$ is 0.6 in Year 2. The discount rate is 0.05 per year

What is the overall QALY calculation for this individual?

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