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Hello, everyone good afternoon, first of all thank you everyone for joining the discussion. I am very happy to be a part of economic modelling team at Novartis. This is first presentation of economic modelling assignment. I wanted to thank you everyone for your support during my onboarding training and assignment.

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In this slide I will talk about how Health leads to happiness and wealth and how Effective health intervention increase happiness & wealth. When we are physically and mentally well, we feel happy. Effective health interventions, like access to healthcare increase happiness. Good health also improves our economic situation by allowing us to work and earn more. By investing in health, we can lead happier and wealthier lives.

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Here I will talk about why we need economic evaluation. As I mentioned in previous slide effective health intervention increases happiness & wealth.So, The problem is that how we decide the which health intervention is more effective because we have multiple option available in market and we have limited money to spend for intervention.

We need to choose best option that provide the most benefits for available resource.
Here is the tough decision we have to take because,
Before we choose to use a new drug at the populational level.
we are interested to know that.

1. Whether the treatment is effective or not.
2. If it is effective, we also interested to know that weather is good value for money or not.

we can't choose all the available option because we have a limited budget when we know that a treatment is effective, we need to know whether it is also cost effective or not.
In this type of situation economic evaluation helps us to compare the two or more interventions in terms of both costs and health consequences.
So, this is the background of why we need economic evaluation.
This is the formal definition of Economic evaluation: An economic evaluation is defined as a comparison of two or more interventions in terms of both costs and health consequences.

Type of economic evaluation

This is list of types of economic evaluation that I will discuss in subsequent slides.

Cost-consequence analysis

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Cost-Consequence Analysis (CCA) is a method used in health economics and healthcare decision-making to assess and compare the costs and consequences of different healthcare interventions or treatments.
This analysis considers a comprehensive list of costs and consequences associated with healthcare interventions.
These may include assessing the impact of interventions on patient health, such as improvements in quality of life, reduction in mortality rates.
It also gives the financial implications of interventions, including costs.

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This is the example of cost-consequence analysis where we have two different option available in each treatment choice associated with the various consequence also.
Here we list both cost and consequence for both option and allow decision maker two choose best option according to their context.

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Cost-minimization analysis

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Cost Minimization Analysis (CMA) is a type of economic evaluation that compares the costs of two or more interventions that have the same or similar outcomes.
It helps to choose the most efficient option among alternatives that are equally effective.
It allows to identify the least expensive option with the same effectiveness.

Here we compare the cost for between intervention and standard of care if both are same effective and choose the option has less expensive.

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Here is the example of cost minimization.
We wanted to compare the ICU cost difference between two medications dexmedetomidine vs midazolam.
Assumes both have effectiveness. Total ICU costs include ICU stay, mechanical ventilation, treating adverse drug reaction, and study medication cost.
Dexmedetomidine showed cost savings of $9,679 compared to midazolam.

Costs for ICU stay, and mechanical ventilation were main contributors (98.5%) to cost difference.
Results that Dexmedetomidine is preferred over midazolam due to overall cost savings and identical effectiveness.

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Cost-Benefit Analysis

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Cost benefit analysis (CBA) is one type of economic evaluation that compares the costs and benefit of healthcare intervention.
Here benefits are measured in monetary value. It compare that which intervention provide the most benefit.
Primary aim of cost benefit analysis is to verify whether that the investment for benefit is more than its cost or not.
We need to choose which option provides the best value of investment.
In cost benefit analysis we convert the health outcome in terms of monetary value gained. Here cost and outcome are measured in same units.
We take the decision based on the benefit cost ratio.

If BCR>1 we can consider investment is worth it.
If BCR<1 we can consider investment is not worth it.
If BCR=1 Investment is benefit both same.

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Here is the example of cost benefit analysis in this study whether a continuous Internet-based education program (IEP) as an add-on to a standardized patient management program (SPMP) improves health outcomes of asthma patients at a favorable benefit-cost ratio. They convert the benefit in terms of monetary value and calculate the Benefit cost ratio.
Benefit-cost ratio for SPMP group is 1.07 and SPMP+IEP group is 1.42.
So that decision took based on the benefit cost ratio SPMP+IEP intervention was superior to SPMP due to higher benefit-cost ratio.

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Cost-effectiveness Analysis

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Cost effectiveness analysis is one type of economic evaluation that compares the costs and effects of alternative health interventions.
It is primarily used when we have a different health Intervention with a common health outcome.
We have to choose which option is best in terms of cost and its effectiveness.
In cost effectiveness analysis we measure the health outcome in natural units like cancer case avoided, life year gain.
We calculate the ICER value and take decision based on the ICER value. I will about this in next slide.

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An incremental cost-effectiveness ratio is a summary measure representing the economic value of an intervention, compared with an alternative (comparator).
This is the formula for calculating ICER it is the ratio of difference in cost and difference in intervention.
Here is the example of calculation of ICER.
In first scenario we got the ICER value is $164 means payer has to pay $164 per QALY in order to adopt intervention 2.
Similarly in second scenario ICER value is $250 means payer has to pay $250 per QALY in order to adopt intervention 3.

We can say both are cost effective if the ICER value fall under willingness to pay threshold value.

In ICER plane we can see in X-axis effectiveness and Y-axis cost and diagonal line is called willingness to pay threshold.
ICER plane divide into four quadrant A,B,C,D . If the ICER value fall under this threshold we, can it is cost effective.

Net monetary benefit

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Here is the example of cost-effectiveness analysis we will compare the triptorelin, goserelin, and Leuprolide in the Treatment of Patients with Metastatic Prostate Cancer.
Aim of this study is to analyze the cost-effectiveness of triptorelin, goserelin, and leuprolide in the treatment of the patients with metastatic prostate cancer.
Here is the cost, QALY and ICER value for three treatment option.
ICER for leuprolide is $15618.95 and triptorelin is $25396.73 compared with Goserelin.
Due to a higher cost per QALY for leuprolide and triptorelin. Goserelin was considered as a superior treatment option.

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Cost-utility analysis

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Let's talk about cost utility analysis it is special case of cost-effectiveness analysis.
Some time we have different health intervention and have different health outcome.
In this type of situation, we require a common measurement outcome which is called QALY.
As we can see in this picture, we have the different health intervention and also different health outcome. In next slide I will talk more about QALY.This is the calculation of QALY. It is calculated by multiplying of length of life and quality of life. In this example we can easily see that how we can calculate the QALY.This is the combination of length of life and quality of life how intervention can change our length of life.

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This is the flow of cost-utility analysis here we measure the outcome in terms of QALY and compare.

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This is the similar slide as cost-effectiveness that I already explain the basic difference here is that instead to effectiveness we take the QALY.
That's the reason it is called a special case of cost-effective analysis.

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This is the example of cost-utility analysis aim of this study is to determine the cost-utility of ocrelizumab versus rituximab in patients with RRMS, from the perspective of the Colombian healthcare system.
cost-effectiveness threshold of $5180 defined for Colombian health system.
Ocrelizumab becomes a cost-effective therapy if there is a high willingness to pay.

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Comparison types of economic model

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This is the comparison of type of economic evaluation in terms of cost and health outcomes.

Budget Impact Model

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Budget impact analysis (BIA) is one type of economic evaluation that estimate the financial consequence of adopting a new intervention.
It also helps us understand the financial impact of introducing new healthcare interventions or technologies into existing budgets.
By assessing costs and budgetary consequences, budget impact analysis provides valuable information to determine whether the new interventions are affordable or not.

Hurdle of the market

1st Hurdle: Phase I (Safety) : Is the treatment safe.
2nd Hurdle: Phase II (Efficacy): Is the treatment effective.
3rd Hurdle: Phase III (Quality): Is treatment better than intervention or SoC.

4th Hurdle: (Efficiency)
The 'fourth hurdle' is commonly described as what has to be done to gain market access and reimbursement for a pharmaceutical product.
Demonstrating to regulatory agencies just a product's safety, efficacy, and quality (the first three hurdles) is no longer sufficient.
Manufacturers must often now demonstrate both *clinical effectiveness* (Is the new product better than currently available alternatives, including no treatment?) as well as *cost-effectiveness* (Is the product good value for money?) in order to assure success in the marketplace.

5th Hurdle:
The 'fifth hurdle' is commonly described the affordability.

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BIM vs EM

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1. ICER can't handle uncertainties very well.?

Problem with ICER.

The main reason ICER struggles with uncertainty is because it aims to produce a single "best" answer. But when there's uncertainty, there's a range of possible outcomes, not just one. So, it's not always clear-cut which treatment is best. To manage this, usually, a range of likely ICER values is presented, rather than a single number. That way, we capture the whole range of what might happen, not just one possibility.

Solution:

Probabilistic Sensitivity Analysis: This approach uses probability distributions for uncertain parameters rather than single-point estimates. The model is run many times with different combinations of parameters drawn from these distributions to produce a range of ICERs.

2. ICER and WTP ?

ICER is the ratio of the difference in cost to the difference in effectiveness of two interventions. Basically, it tells you how much extra cost is needed to gain an additional unit of health benefit (like one more year of healthy life) with a new treatment compared to the current standard of care.

Willingness-to-Pay, on the other hand, is the maximum amount an individual, or society, is prepared to pay to gain that additional unit of health benefit.

The relationship between ICER and WTP is used to judge whether an intervention is considered cost-effective. If the ICER of an intervention is less than or equal to the WTP threshold, the intervention is deemed to be cost-effective, because we're getting enough health benefit for the extra cost. But if the ICER is more than the WTP, the intervention might not be considered cost-effective, because it's too expensive for the extra health benefit it provides.

So essentially, the ICER gives us a measure of cost-effectiveness, and the WTP gives us a threshold to judge whether that cost-effectiveness is acceptable or not.

3.Net monetary benefits

Incremental NMB measures the difference in NMB between alternative interventions, a positive incremental NMB indicating that the intervention is cost-effective compared with the alternative at the given willingness-to-pay threshold.

$$\text{ICER} = \frac{\Delta C}{\Delta B} \overset{?}{<} \lambda$$

$$\Delta C \overset{?}{<} \lambda \cdot \Delta B$$

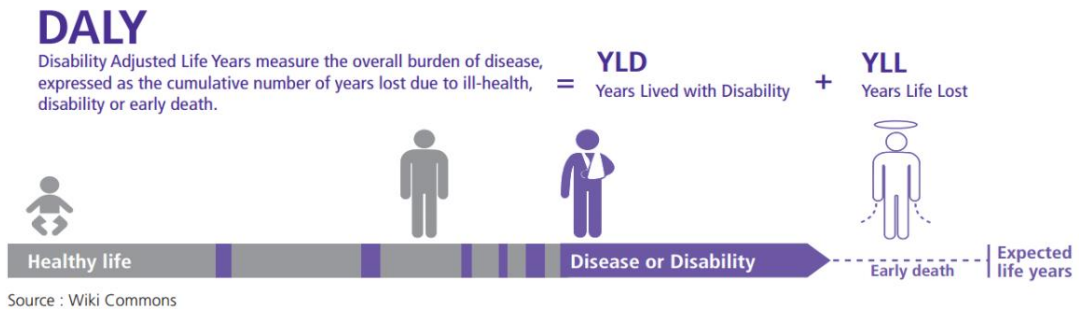
$$0 \overset{?}{<} \lambda \cdot \Delta B - \Delta C = \text{INMB}$$

$$\begin{aligned}\text{INMB} &= \lambda \cdot \Delta B - \Delta C \\ &= \lambda \cdot (B_1 - B_0) - (C_1 - C_0) \\ &= (\lambda \cdot B_1 - C_1) - (\lambda \cdot B_0 - C_0) \\ &= \text{NMB}_1 - \text{NMB}_0\end{aligned}$$

3. Net health benefits

   NHB is usually measured using QALYs and is calculated by: *incremental gain in QALYs – (incremental cost / opportunity cost threshold)*. A positive NHB implies that overall population health would be increased as a result of the new intervention, whilst a negative NHB implies that the health benefits of the new intervention are not sufficient.

4. Disability adjusted life year (DALY)



DALYs = Years of life lost due to premature mortality (YLL) + Years lived with disability (YLD)

DALY = DA + LY
= (Disability Rate * Year lived with disability) + (Life Expectancy – Age at Death)
= (0.5 * 4) + (75 – 60)
= 2 + 10
= 12 DALY