Advanced Certificate in Economic Evaluation in Public Health Interventions

Cost-Effectiveness Analysis in Public Health

Average Cost-Effectiveness Ratio (ACER) – Related terms: cost-effectiveness, incremental cost-effectiveness ratio (ICER).
The ACER is the ratio of total costs to total health outcomes for a single intervention, calculated as Total Cost ÷ Total Effectiveness. It provides a baseline measure of efficiency but does not compare alternatives directly.
Example: In a vaccination program, the ACER might be $150 per disability-adjusted life year (DALY) averted.
Practical application: Useful for preliminary screening of interventions when resources are limited.
Challenges: ACER can be misleading if multiple interventions are compared because it ignores the incremental nature of decision-making and may overstate the value of a less efficient option.

Budget Impact Analysis (BIA) – Related terms: cost-effectiveness analysis (CEA), financial feasibility, health economics.
A BIA estimates the financial consequences of adopting a new health intervention within a specific budget context over a defined time horizon. It focuses on affordability rather than value for money.
Example: A health department evaluates the 5-year budget impact of introducing a new hepatitis B vaccine, projecting incremental expenses and potential savings from avoided treatments.
Practical application: Helps policymakers decide whether an intervention can be funded given fiscal constraints.
Challenges: Requires detailed cost data, assumptions about uptake rates, and may be sensitive to changes in population demographics or policy environment.

Cost-Effectiveness Threshold (CET) – Related terms: willingness-to-pay (WTP), ICER, health opportunity cost.
The CET represents the maximum amount a decision-maker is prepared to pay for a unit of health gain (e.g., per QALY or DALY). It serves as a benchmark to judge whether an ICER is acceptable.
Example: In many low- and middle-income countries, the CET is set at one to three times the gross domestic product per capita.
Practical application: Enables consistent ranking of interventions across disease areas.
Challenges: Determining an appropriate CET is contentious; thresholds may not reflect true opportunity costs and can be politically driven.

Cost-Effectiveness Analysis (CEA) – Related terms: economic evaluation, incremental analysis, health outcomes.
CEA compares the relative costs and outcomes (often expressed in natural units like cases averted or life-years saved) of two or more interventions. The result is usually expressed as an ICER.
Example: Comparing a school-based nutrition program to a community-wide health education campaign,

CEA quantifies the additional cost per child gaining one healthy weight year.
Practical application: Guides resource allocation decisions by identifying interventions that provide the greatest health benefit per dollar spent.
Challenges: Requires robust data on both costs and effects; results can be sensitive to methodological choices such as discount rates and perspective.

Cost-Utility Analysis (CUA) – Related terms: quality-adjusted life year (QALY), cost-effectiveness analysis, utility measurement.
CUA is a form of CEA that incorporates patient preferences for different health states by using utility weights, typically expressed as QALYs. It allows comparison across diverse health programs.
Example: A CUA of a new antiretroviral regimen may report an ICER of $800 per QALY gained compared with standard therapy.
Practical application: Facilitates cross-program priority setting when health benefits differ in nature (e.g., mental health vs. infectious disease).
Challenges: Utility elicitation can be methodologically complex; cultural differences may affect preference measurement.

Discount Rate – Related terms: present value, time preference, economic evaluation.
The discount rate adjusts future costs and health outcomes to their present value, reflecting the principle that resources today are valued more than resources in the future. Standard rates range from 3 % to 5 % per annum.
Example: A cost incurred in year 5 is multiplied by (1 + discount rate)^-5 to obtain its present value.
Practical application: Ensures comparability of interventions with different time horizons, such as preventive vaccines versus acute treatments.
Challenges: Choice of discount rate can substantially alter conclusions; different rates for costs and outcomes add complexity.

Dominance (Strict and Extended) – Related terms: incremental cost-effectiveness ratio, efficiency frontier, decision rule.
An intervention is strictly dominated if it is both more costly and less effective than an alternative. Extended (or weak) dominance occurs when an intervention's ICER is higher than that of a more effective option, making it inefficient.
Example: A screening test that costs $200 more and prevents 0.5 fewer cases than another test is strictly dominated.
Practical application: Dominated options are excluded from further analysis, simplifying the decision set.
Challenges: Accurate identification of dominance requires precise estimates; measurement error may misclassify interventions.

Health-Adjusted Life Year (HALY) – Related terms: QALY, DALY, outcome measure.
HALY is a generic metric that combines mortality and morbidity into a single figure, representing the number of years of healthy life gained from an intervention. QALYs and DALYs are specific types of HALY.

Example: A program that reduces malaria incidence may produce 10,000 HALYs over a decade.
Practical application: Provides a common language for comparing disparate health programs.
Challenges: Selection of the appropriate HALY type influences results; data on disability weights may be scarce.

Incremental Cost-Effectiveness Ratio (ICER) – Related terms: ACER, dominance, cost-effectiveness threshold.
The ICER is the ratio of the difference in costs to the difference in effectiveness between two interventions: (Cost A – Cost B) ÷ (Effect A – Effect B). It quantifies the additional cost required to gain one extra unit of health outcome.
Example: An ICER of $1,200 per QALY indicates that each additional QALY achieved by a new drug costs $1,200 compared with the comparator.
Practical application: Central decision-making metric in CEA; interventions with ICERs below the CET are considered cost-effective.
Challenges: Sensitive to small differences in effectiveness; uncertainty around the ICER often requires probabilistic analysis.

Incremental Net Benefit (INB) – Related terms: willingness-to-pay, ICER, decision rule.
INB translates cost-effectiveness into monetary terms: $INB = (\lambda \times \Delta Effect) - \Delta Cost$, where λ is the willingness-to-pay threshold. A positive INB indicates that an intervention is cost-effective at the given λ.
Example: With $\lambda = \$5,000$ per DALY, $\Delta Effect = 0.8$ DALYs, and $\Delta Cost = \$3,200$, INB = $1,800, suggesting cost-effectiveness.
Practical application: Facilitates statistical testing and regression analysis in CEA.
Challenges: Requires specification of λ, which may be uncertain; interpretation depends on the chosen threshold.

Markov Model – Related terms: state-transition, cohort simulation, time horizon.
A Markov model is a mathematical framework that simulates the progression of a cohort through a series of health states over discrete time cycles, allowing for recurring events and long-term outcomes.
Example: A chronic disease model with states “healthy,” “diseased,” “complication,” and “death” can estimate lifetime costs and QALYs of a therapeutic regimen.
Practical application: Captures disease dynamics where events can recur, such as infection cycles or treatment failures.
Challenges: Requires assumptions about transition probabilities; model complexity can increase computational burden.

Net Monetary Benefit (NMB) – Related terms: incremental net benefit, willingness-to-pay, cost-effectiveness.
NMB is calculated as $(\lambda \times Effect) - Cost$. It expresses the value of an intervention in monetary terms, facilitating comparison across alternatives. The intervention with the highest NMB is deemed optimal.
Example: For $\lambda = \$3,000$ per QALY, an intervention achieving 0.5 QALYs at $1,200 yields an NMB of $300.
Practical application: Simplifies decision analysis and allows for probabilistic sensitivity analysis using standard statistical software.

Challenges: Dependent on the chosen λ; if λ is mis-specified, NMB may mislead decision makers.

Opportunity Cost – Related terms: health-system budget, resource allocation, cost-effectiveness threshold.
Opportunity cost represents the health benefits forgone when resources are allocated to one intervention rather than the next best alternative. In CEA, it is often expressed as the health gain that could have been achieved elsewhere with the same spending.
Example: Funding a new screening program may prevent 1,000 DALYs but simultaneously displace a vaccination program that could have averted 1,500 DALYs; the latter loss is the opportunity cost.
Practical application: Provides an economic rationale for setting realistic CETs based on actual health system constraints.
Challenges: Quantifying opportunity costs requires comprehensive data on all competing interventions, which is rarely available.

Probabilistic Sensitivity Analysis (PSA) – Related terms: Monte Carlo simulation, uncertainty, cost-effectiveness acceptability curve.
PSA incorporates parameter uncertainty by assigning probability distributions to model inputs and repeatedly sampling from them to generate a distribution of outcomes (e.g., ICERs).
Example: Assigning a beta distribution to utility weights and a gamma distribution to cost parameters, then running 10,000 simulations to produce a cloud of ICER points.
Practical application: Provides decision makers with the probability that an intervention is cost-effective at various thresholds.
Challenges: Requires computational resources and expertise in statistical modeling; results can be sensitive to the choice of distributions.

Quality-Adjusted Life Year (QALY) – Related terms: utility, health state valuation, CUA.
A QALY combines length of life with quality of life, where each year of perfect health equals 1 QALY and less-than-perfect health is weighted by a utility value between 0 and 1.
Example: A patient living 5 years with a utility of 0.8 accrues 4 QALYs (5 × 0.8).
Practical application: Enables comparison of interventions across disease areas by standardizing health outcomes.
Challenges: Utility measurement can be culturally sensitive; some argue QALYs undervalue certain health states or populations.

Reference Case – Related terms: standardization, methodological guidelines, health technology assessment.
A reference case defines a set of methodological assumptions (e.g., perspective, discount rate, time horizon) that should be consistently applied in CEAs to enhance comparability and credibility.
Example: The WHO reference case recommends a societal perspective, 3 % discount rate, and lifetime horizon for chronic disease evaluations.
Practical application: Researchers align their analyses with the reference case to facilitate policy uptake.
Challenges: Strict adherence may limit flexibility needed for context-specific analyses; updating reference cases can be slow.

Sensitivity Analysis – Related terms: deterministic analysis, PSA, tornado diagram.
Sensitivity analysis explores how changes in key parameters affect the results of a CEA, identifying which variables drive uncertainty.
Example: Varying vaccine efficacy from 70 % to 95 % and observing the impact on the ICER.
Practical application: Helps prioritize data collection and informs robustness of conclusions.
Challenges: One-way sensitivity may oversimplify interactions; comprehensive multi-parameter analysis can be resource-intensive.

Societal Perspective – Related terms: payer perspective, cost components, economic evaluation.
The societal perspective includes all costs and benefits regardless of who incurs them, encompassing direct medical costs, non-medical costs (e.g., transportation), and indirect costs such as productivity losses.
Example: In evaluating a smoking cessation program, costs include counseling fees, participant travel, and lost workdays due to quitting attempts.
Practical application: Provides the most comprehensive estimate of an intervention's economic impact, supporting broader policy decisions.
Challenges: Data on indirect costs may be scarce; assigning monetary values to intangible outcomes can be controversial.

Time Horizon – Related terms: discounting, long-term outcomes, model horizon.
The time horizon defines the period over which costs and effects are measured in a CEA. It should be long enough to capture all relevant differences between interventions.
Example: A lifetime horizon is appropriate for chronic disease interventions, while a 5-year horizon may suffice for short-term treatments.
Practical application: Determines the extent of future benefits included, influencing the ICER.
Challenges: Longer horizons increase uncertainty; projecting costs and outcomes far into the future may require strong assumptions.

Willingness-to-Pay (WTP) – Related terms: cost-effectiveness threshold, λ, monetary valuation.
WTP represents the maximum amount a society or individual is prepared to spend for a unit of health gain (e.g., per QALY). It is often used interchangeably with the cost-effectiveness threshold.
Example: A WTP of $50,000 per QALY is frequently cited in high-income country analyses.
Practical application: Guides interpretation of ICERs and informs reimbursement decisions.
Challenges: Estimating WTP empirically is difficult; values may vary across populations and over time.

Yield (Health Impact) – Related terms: effectiveness, coverage, impact assessment.
Yield refers to the amount of health benefit generated per unit of resource invested, often expressed as cases averted, DALYs saved, or QALYs gained per dollar spent.
Example: A malaria net distribution program may yield 0.02 DALYs averted per $1 invested.
Practical application: Helps compare efficiency of interventions with different scales and modalities.
Challenges: Accurate measurement requires reliable epidemiological data; yield can be context-dependent.

Zero-Cost Intervention – Related terms: cost-saving, free program, budget neutral.
A zero-cost intervention is one that incurs no additional financial outlay for the implementing agency, often because costs are borne by another party or are already embedded in existing services.
Example: A health promotion campaign that uses existing community radio channels without extra fees.
Practical application: Attractive in resource-constrained settings where any additional spending is scrutinized.
Challenges: Hidden costs (e.g., staff time) may be overlooked, leading to underestimation of true resource use.

Adverse Event Cost – Related terms: toxicity, incremental cost, health economics.
Costs associated with negative side effects of an intervention, including medical treatment, hospitalisation, and productivity losses. Incorporating adverse event costs ensures a more accurate net cost estimate.
Example: Adding the cost of managing chemotherapy-induced neutropenia to the total cost of a cancer regimen.
Practical application: Helps decide whether the benefits of a high-risk intervention outweigh its additional costs.
Challenges: Data on frequency and severity of adverse events may be limited; valuation of patient discomfort is complex.

Benefit-Cost Ratio (BCR) – Related terms: cost-benefit analysis, net benefit, economic efficiency.
The BCR is the ratio of total benefits (expressed in monetary terms) to total costs. A BCR > 1 indicates that benefits exceed costs.
Example: A BCR of 1.8 means $1.80 of benefit for every $1 spent.
Practical application: Provides a straightforward metric for policymakers assessing the overall economic return of a program.
Challenges: Translating health outcomes into monetary values can be ethically contentious; BCR does not convey the distribution of benefits.

Cost-Benefit Analysis (CBA) – Related terms: benefit-cost ratio, willingness-to-pay, monetary valuation.
CBA compares the monetary value of all benefits of an intervention with its total costs, yielding a net monetary gain or loss. Unlike CEA, CBA expresses health outcomes in monetary terms.
Example: Valuing a reduction in disease burden using a VSL (value of statistical life) and subtracting program costs to calculate net benefit.
Practical application: Allows direct comparison of health programs with non-health projects (e.g., infrastructure).
Challenges: Requires robust methods to assign monetary values to health outcomes; may undervalue intangible benefits.

Discounted Net Present Value (NPV) – Related terms: discounting, cash flow, economic appraisal.
NPV aggregates all discounted future costs and benefits into a single present-value figure, indicating whether an intervention yields a net gain (> 0) or loss (< 0).

Example: An intervention with discounted benefits of $5 million and discounted costs of $3 million has an NPV of $2 million.
Practical application: Used in investment decisions and long-term health program planning.
Challenges: Sensitive to discount rate selection; future benefits that are highly uncertain can dominate NPV calculations.

External Validity – Related terms: generalizability, transferability, study context.
External validity refers to the extent to which CEA results can be applied to settings or populations beyond the original study environment.
Example: A CEA conducted in urban hospitals may have limited external validity for rural clinics due to differing cost structures.
Practical application: Encourages analysts to report context-specific parameters to aid adaptation.
Challenges: Differences in healthcare systems, price levels, and disease epidemiology can hinder transferability.

Fixed Costs – Related terms: variable costs, overhead, capital expenditure.
Fixed costs are expenses that do not change with the volume of services delivered, such as building rent or equipment depreciation. In CEA, they are allocated across the expected number of units treated.
Example: A laboratory's $200,000 annual rent is a fixed cost that must be spread over all tests performed.
Practical application: Accurate allocation of fixed costs prevents underestimation of per-unit costs.
Challenges: Determining appropriate allocation bases (e.g., number of patients, time) can be arbitrary.

Health Impact Assessment (HIA) – Related terms: impact evaluation, policy analysis, health outcomes.
HIA is a systematic process that predicts the health effects of a policy, program, or project before it is implemented, often incorporating economic evaluation elements like CEA.
Example: An HIA of a new public transport system may estimate reductions in traffic-related injuries and associated cost-effectiveness.
Practical application: Informs policymakers about potential health consequences, supporting evidence-based decisions.
Challenges: Requires interdisciplinary expertise; predictions may be uncertain.

Incremental Cost per Case Averted – Related terms: effectiveness measure, ACER, disease burden.
This metric expresses the additional cost required to prevent one additional case of a disease when comparing two interventions. It is calculated as ΔCost ÷ ΔCases Averted.
Example: An incremental cost of $10,000 to avert 100 extra cases yields $100 per case averted.
Practical application: Useful when the primary outcome is disease incidence rather than QALYs or DALYs.
Challenges: Does not capture severity differences between cases; may overlook broader societal benefits.

Joint Probability Distribution – Related terms: PSA, stochastic modeling, correlation.
In probabilistic analysis, the joint probability distribution defines the simultaneous behavior of multiple correlated parameters, ensuring realistic simulation of combined uncertainty.

Example: Correlating drug price and adherence rates to reflect that higher prices may reduce adherence.
Practical application: Improves the credibility of PSA results by preserving relationships between variables.
Challenges: Requires data on parameter correlations, which are often unavailable.

Long-Term Follow-Up – Related terms: time horizon, durability, outcome measurement.
Long-term follow-up refers to the extended observation period after an intervention to capture delayed effects, cost offsets, or sustainability of benefits.
Example: Monitoring cardiovascular outcomes for ten years after a lifestyle intervention.
Practical application: Provides evidence on durability of health gains, influencing the choice of time horizon.
Challenges: Attrition, changing standards of care, and data collection costs can limit feasibility.

Markov Cohort Model – Related terms: state transition, cycle length, health states.
A Markov cohort model tracks a hypothetical group of individuals as they transition between defined health states over successive cycles, assuming that all members in a state are identical.
Example: A cohort of patients with chronic kidney disease moving between “stage 3,” “stage 4,” “dialysis,” and “death.”
Practical application: Enables estimation of lifetime costs and outcomes for chronic conditions.
Challenges: The “memoryless” property may oversimplify diseases where history influences future risk.

Net Health Benefit (NHB) – Related terms: NMB, utility, QALY.
NHB expresses the health gain of an intervention after accounting for its costs, calculated as Effect − (Cost ÷ λ). It allows direct comparison of health outcomes without monetary conversion.
Example: With λ = $20,000 per QALY, an intervention costing $4,000 and delivering 0.3 QALYs yields an NHB of 0.1 QALYs.
Practical application: Facilitates decision making when monetary thresholds are controversial.
Challenges: Requires a chosen λ; interpretation may be less intuitive for non-economic audiences.

Opportunity Cost of Capital – Related terms: discount rate, cost of financing, economic evaluation.
The opportunity cost of capital reflects the return that could be earned on the funds if they were invested elsewhere, influencing the choice of discount rate for financial costs.
Example: Using a 5 % discount rate to reflect the average return on government bonds.
Practical application: Aligns health economic analyses with broader fiscal policy considerations.
Challenges: Capital markets fluctuate; selecting a single rate may not capture sector-specific financing conditions.

Partial Economic Evaluation – Related terms: cost analysis, cost-effectiveness, scope.
A partial economic evaluation focuses on a subset of cost components (e.g., only direct medical costs) or outcomes, without conducting a full CEA.
Example: Estimating only the program’s implementation costs without measuring health outcomes.
Practical application: Useful for early-stage assessments or when data on outcomes are unavailable.
Challenges: May mislead decision makers if omitted costs or benefits are substantial.

Quality-Adjusted Life Year (QALY) Weighting – Related terms: utility, preference elicitation, health state valuation.
Weighting involves assigning a utility value to each health state based on population preferences, typically derived from instruments like EQ-5D or standard gamble methods.
Example: A health state “moderate arthritis” receives a utility weight of 0.6.
Practical application: Enables conversion of survival time into QALYs for CUA.
Challenges: Preference heterogeneity across cultures; methodological differences can produce varying weights.

Resource Allocation – Related terms: budgeting, priority setting, health economics.
Resource allocation is the process of distributing limited health resources among competing interventions to achieve the greatest possible health gain. CEA provides evidence to inform this process.
Example: Allocating a fixed budget to fund a mix of vaccination, screening, and health education programs based on their cost-effectiveness.
Practical application: Supports transparent and evidence-based decision making at national or institutional levels.
Challenges: Political pressures, equity considerations, and stakeholder interests may conflict with pure efficiency criteria.

Sensitivity Coefficient – Related terms: deterministic sensitivity, tornado diagram, parameter influence.
A sensitivity coefficient quantifies the degree to which changes in a specific parameter affect the ICER or NMB, often expressed as the slope of the relationship.
Example: A 10 % increase in drug price leading to a 5 % rise in the ICER yields a sensitivity coefficient of 0.5.
Practical application: Identifies high-impact parameters for targeted data collection or further research.
Challenges: Linear approximations may not capture non-linear effects; interactions among parameters can complicate interpretation.

Time-Dependent Transition Probabilities – Related terms: Markov model, hazard rate, cycle-specific.
In some models, the probability of moving between health states varies over time, reflecting disease progression or aging effects.
Example: The probability of developing hypertension increases with each successive year in a cohort model.
Practical application: Improves realism of long-term simulations for chronic diseases.
Challenges: Requires detailed longitudinal data; increases model complexity.

Utility Scale – Related terms: QALY, health state valuation, preference measurement.
The utility scale ranges from 0 (equivalent to death) to 1 (perfect health), though negative values are allowed for health states considered worse than death.
Example: A utility of 0.85 indicates a health state 85 % as desirable as perfect health.
Practical application: Standardizes the measurement of health-related quality of life across studies.
Challenges: Different elicitation methods (e.g., time trade-off vs. visual analogue scale) may produce divergent utilities.

Variable Costs – Related terms: fixed costs, marginal cost, scale-up.
Variable costs change proportionally with the volume of services delivered, such as consumables, labor per patient, or medication.
Example: The cost of syringes increases with each additional vaccination administered.
Practical application: Critical for estimating incremental costs when scaling up an intervention.
Challenges: Distinguishing between truly variable and semi-fixed costs can be ambiguous.

Willingness-to-Pay Threshold Adjustment – Related terms: CET revision, inflation, economic growth.
Threshold adjustment updates the CET over time to reflect changes in macro-economic conditions, health system capacity, or societal preferences.
Example: Raising the CET from $30,000 to $35,000 per QALY following a 5 % increase in GDP per capita.
Practical application: Keeps cost-effectiveness decisions aligned with current fiscal realities.
Challenges: Frequent adjustments may create instability; political influences can distort the process.