Health economics in nursing research: what you need to know to include economic evaluation methodology in your research

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Due to limited resources and constant, ever-changing healthcare challenges, health economics is essential to support healthcare decisions while improving health outcomes. Economic evaluation methodology facilitates informed decision-making related to the efficient allocation of resources while positively impacting clinical practice. In this paper, we provide an overview of economic evaluation methods and a real-world example applying one method of economic evaluation (cost-utility analysis) in nursing research.

Keywords
Cost-benefit analysis • Cost-consequence analysis • Cost-effectiveness analysis • Cost-minimization analysis • Cost-utility analysis • Economic evaluation • Economics • Healthcare quality • Nursing research • Quality-adjusted life years

Learning objectives
• To understand the different types of health economic evaluation and when they should be applied.
• Understand the basic steps in undertaking a cost-utility analysis and the type of economic evaluation preferred by many decision-making bodies internationally.
• To interpret the results of a cost-utility analysis.

Introduction

Health Economics is a field of research applying economic theories and methods to understand and explain how society makes decisions regarding their health behaviours, healthcare use, and health resource allocation. Economic evaluation methodology is a tool to guide decision-making around the efficient allocation and equitable distribution of healthcare resources and manage the demand for healthcare services, health promotion, and prevention.

Economic evaluation is defined as 'the comparative analysis of alternative courses of action in terms of both their costs and consequences'. The costs and consequences are synonymous with the inputs and outputs or outcomes of a given intervention. The inputs or resources required to deliver the programmes/intervention are valued by assigning a cost based on the market price. Similarly, the outputs are the resources saved or value created because of the programme/intervention and are valued using different techniques depending on the type of economic evaluation.

Why economic evaluation is essential for research

Policymaking bodies such as the UK National Institute for Health and Care Excellence require the submission of economic evidence to support funding allocation decisions for pharmaceuticals and medical technologies. And increasingly, economic evidence is required at all levels of healthcare policy to support decision-making around interventions in healthcare. There is a paucity of nursing research applying economic evaluation methodology, but this trend is indeed changing positively with an increase in evaluations in nurse-led models of care. Taylor et al. assessed the cost-effectiveness of REACH-HF and home-based cardiac rehabilitation compared with the usual medical care for heart

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failure in the UK, while Driscoll et al. assessed the cost-effectiveness of a heart failure nurse practitioner inpatient service from a health system perspective in Australia.

However, a significant portion of clinical and nursing research lacks a comprehensive view of economic implications with the economic analysis often performed post hoc.7

Overview of economic evaluation methodology

There are different types of economic evaluation depending on how the outputs are expressed, namely, cost-minimization analysis, cost-effectiveness analysis (CEA), cost-utility analysis (CUA), cost-consequence analysis, and cost-benefit analysis.8 The choice of evaluation depends on the questions asked and the specific policy to be informed by the results. These different types of economic evaluations are summarized in Table 1.

In the healthcare setting, CUA and CEA are recommended by regulatory bodies worldwide.9,10 However, CUA has the attraction of providing a comprehensive and standardized framework for comparing costs and outcomes across disparate programmes or interventions and patient populations.4

Cost-effectiveness analysis

Outcomes in CEA are expressed in natural units or physical units of effect that are usually clinically or bio-medically focused, such as the number of infections averted, units of blood pressure reduced, or, more commonly, the number of life years gained.12 The result in CEA is presented as the cost per unit of outcome or outcome per unit of cost. As such, CEA is used when comparing interventions with common or similar outcomes, e.g. within a particular healthcare specialty or programme, to maximize technical efficiency.12,13 Technical efficiency is required when operating within a fixed budget, and there is need to choose between a set of alternatives, so the decision-maker has to maximize the outcome level within the budget constraint.

Cost-utility analysis

Cost-utility analysis is sometimes referred to as a form of CEA. However, unlike CEA where the outcome is programme specific, the unit of outcome in CUA is generic therefore allowing for the comparison of health consequences across disparate conditions and programmes, such as a programme preventing stroke, surgery for the knee, or where a combination of outputs is accrued, and a single unit of outcome is required.

When undertaking a CUA, the outputs reflect society’s utility or value for the given outcome.14 The outcome is assessed as the quality of life or HRQoL resulting from each alternative while the value that society places on that quality of life. These are referred to as multi-attribute utility instruments or preference-based PROMs.15

To demonstrate the steps in Central Illustration, we will consider a hypothetical example of a cost-utility study alongside a randomized control trial to assess the cost-utility of telehealth services compared with usual care of face-to-face services for outpatient care of hypertension in adults.

Step-by-step approach: how to conduct a cost-utility analysis

As previously highlighted, the methods to identify, measure, and value the inputs for CEA and CUA are identical; however, the assessment of outputs or outcomes differs. Often, programmes or interventions have multiple outcomes; however, these are aggregated into a single generic outcome in CUA, the QALY.

Central Illustration summarizes the steps involved in undertaking a CUA.

Step 1: defining the question

In defining the question, the alternatives or programmes being compared, also referred to as comparators, must be stated as should the study’s perspective and time horizon. The other elements to be explicitly stated are the population in which the services are provided and the output of interest, as this informs the type of evaluation to be undertaken. The comparators should always include usual care, the most used alternative, or the existing approach, which is compared against the new intervention(s) or treatment(s). Comparators in the example above are the new intervention, telehealth services vs. face-to-face services (usual care).

The study perspective is determined by the decision-maker and, therefore, dictates whose costs and consequences are assessed. The healthcare payer perspective includes only costs to the healthcare payer such as the cost of treatment and other services provided in the delivery of the care.20 Conversely, the healthcare sector perspective ‘accounts for all monetary costs of healthcare, regardless of who bears the cost’ and therefore includes patient out-of-pocket costs as direct medical costs such as payments for tests, procedures, and medications that are not covered by the healthcare system. The societal perspective, as the name suggests, includes all costs to society.20 This perspective includes costs to other sectors beyond healthcare, such as education and social services, and costs to patients and their families as out-of-pocket medical and non-medical expenditures. Examples of non-medical expenditures include parking fees and, most significantly, the cost of lost productivity due to reduced capacity to work or early retirement for patients and/or carers such as following a stroke. Last is the limited societal perspective, which includes costs to the healthcare sector and to patients and their families; however, it stops short of...
The societal perspective is critical in the analysis of home care models of care where the carer costs are pertinent. Such programmes may be cost-effective from a health system perspective but not a societal perspective once informal carer costs are considered.

The time horizon is the duration over which costs and outcomes are assessed and must be appropriately determined to consider all the benefits accrued from an intervention. If the analysis is alongside a clinical trial, the time horizon is equivalent to the duration of the trial but can be extrapolated to an extended period.

Any perspective could be taken in this case; however, because the management of hypertension involves significant out-of-hospital care and informal carer support, a societal or limited societal perspective is preferable. Because the study is being conducted alongside a randomized control trial, the time horizon will coincide with the duration of the trial.

Research question: what is the cost-utility of telehealth services compared with face-to-face services in managing adult hypertension from a limited societal perspective in Australia?
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CBA, cost-benefit analysis; CCA, cost-consequence analysis; CEA, cost-effectiveness analysis; CMA, cost-minimization analysis; CUA, cost-utility analysis; DALYs, disability-adjusted life years; ICER, incremental cost-effectiveness ratio; PROMs, patient-reported outcome measures; QALYs, quality-adjusted life years.
**Step 2: identification, measurement, and valuation of costs**

This involves identifying the resources required to deliver each alternative, measuring how much and assigning cost values. Examples of resource inputs include capital costs, labour, consumables, and patient costs such as travel and lost productivity. Measurement is implemented using (i) a bottom-up approach or micro-costing, where individual items are quantified, or (ii) a top-down approach or macro-costing, where aggregate quantities are attributed to each alternative. Valuation involves attaching market prices/costs to each item. For example, in Australia, out-of-hospital care is valued based on the medical benefit schedule (MBS), pharmaceuticals are based on the pharmaceutical benefit scheme, while hospitalizations are valued based on diagnosis-related group (DRG) codes. Non-market items such as volunteer time are valued based on market prices of personnel undertaking similar roles as the volunteers.

Because this is a prospective study, a bottom-up or micro-costing approach with real-time recording of cost data will be used. To quantify out-of-pocket costs, patients will fill out a cost diary including costs incurred weekly, time off work to travel and attend face-to-face appointments, gap payment for clinician or allied health visits or prescriptions, over-the-counter medications, transport and parking costs, and informal care costs. The number of visits and matching MBS or DRG codes will be applied to quantify health system costs (see Table 3).

**Step 3: identification, measurement, and valuation of outcomes**

This is determined by the type of analysis being conducted.

This is a CUA alongside a clinical trial. The trial will establish the effectiveness of telehealth services compared with face-to-face services in controlling the clinical outcome, in this case, blood pressure. Because it is a CUA, we will prospectively assess HRQoL using the EQ-5D-5L at baseline and follow-up. To facilitate the calculation of QALYs, patient survival over the study period or stated time horizon will be established using survival analysis calculations. To obtain QALYs, the utility score is multiplied by survival. This is summarized in Table 3.

**Step 4: quantifying costs and outcomes**

Following Steps 1–3, the costs and outcomes of each alternative are quantified and presented.

We will now compute the total costs and total outcomes accrued for each alternative for the entire study period. Because the societal perspective was chosen, both hospital and patient out-of-pocket costs incurred with telehealth and usual care will be quantified. Quality-adjusted life years are estimated by combining the duration of survival with the utility score estimated from the EQ-5D-5L responses. The change in QALYs between baseline and follow-up is then calculated for each alternative. See Table 3 for a hypothetical quantification.
NICE has a threshold of between £20 000 and £30 000 per QALY.

Following the calculation of the ICER, an inference to the cost-effectiveness decision is straightforward; usual care is preferred to because telehealth is more effective but also more costly than usual face-to-face care for hypertension. Secondly, this ICER is below the Australian government threshold of $50 000 per QALY and is, therefore, considered a cost-effective intervention in the Australian setting.

Uncertainty in cost-effectiveness results
Like all statistical calculations, there may be uncertainty in the estimation of inputs and outputs or in the methodology and, therefore, the need to account for uncertainty in the ICER. This uses CEPs and cost-effectiveness acceptability curves (CEACs). The CEPs incorporate bootstrapped pairs of ICERs, visually representing the uncertainty inherent in both cost and outcome estimates; see Figure 1. In Quadrants B and C, the decision is straightforward; usual care is preferred to because telehealth is less effective regardless of cost. In Quadrant D, telehealth is said to have dominated usual care because it costs less yet is more effective. In Quadrant A, the cost-effectiveness decision is not straightforward; the decision-maker must determine if they can afford the intervention based on the cost-effectiveness threshold. The likelihood of an intervention being cost-effective across a range of cost-effectiveness thresholds can be presented in a CEAC where bootstrapped pairs of costs and outcomes are presented, depicting the uncertainty in estimates of the ICER.

Uncertainty is also shown using one-way or two-way sensitivity analysis that is where one or two input parameters are varied over a plausible range to test if the ICER or cost-effectiveness decision is consistent with
Challenges and limitations of conducting economic evaluation in the clinical setting

Most economic evaluations are conducted alongside clinical trials, usually with generous budgets for data collection and patient follow-up. Several factors must be considered for economic evaluations to become a mainstay in quality improvement and routine clinical care including (i) understanding the value of this methodology in routine health decision-making, (ii) availability of resource use data that reflects the real cost of interventions or models of care beyond activity-based funding, (iii) availability of PROMs data as part of routine healthcare, (iv) decommercialization or subsidizing of subscription-based PROMs for use in routine care databases, and (v) availability of health economic expertise to clinicians/health services.

Conclusion

Demonstrating that a new therapy is effective is no longer sufficient to guarantee the best healthcare practice. Nurses and allied health professionals must have a perspective combining healthcare expertise with economic proficiency to address the complex nature of modern healthcare problems. Health economic evaluation must be considered fundamental to nurses and allied health professional research if we are to find solutions to tackle healthcare challenges in the modern world.

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Software

Economic analysis can be undertaken through software such as Microsoft Excel, TreeAge Pro exist,26 Stata, R, Python, and MATLAB.27,28

Reporting and dissemination

Standard reporting of economic analysis must follow recommended guidelines or checklists for research. The most commonly used checklist is the Consolidated Health Economic Evaluation Reporting Standards developed by the International Society for Pharmacoeconomics and Outcomes Research.29 For dissemination to decision-makers on the other hand, different decision-making bodies provide specific guidelines on how economic evaluation results should be presented. These guidelines are publicly available.11,30

Conflict of interest: No conflict of interest to declare.
## Definition of Key Terms

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<th>Definition</th>
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<tr>
<td>Cost-effectiveness plane</td>
<td>Represents differences in costs and health outcomes on a graph, with effectiveness on the x axis and cost on the y axis.</td>
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<td>Economic evaluation</td>
<td>The comparative analysis of alternative courses of action in terms of both their costs and outcomes.</td>
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<td>Healthcare payer perspective</td>
<td>This perspective includes only those monetary costs (e.g. treatment costs and other health service resource use associated with disease management) incurred by a (typically third party) healthcare payer (e.g. Medicare/Medicaid, British national health service, a health maintenance organization, etc).</td>
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<tr>
<td>Healthcare sector perspective</td>
<td>This perspective is similar to the healthcare payer perspective but accounts for all monetary costs of healthcare, regardless of who bears the cost. A key distinction between the healthcare sector and healthcare payer perspectives is that the healthcare sector perspective includes patients' out-of-pocket costs.</td>
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<tr>
<td>Incremental cost-effectiveness ratio</td>
<td>Difference in the change in mean costs in the population of interest divided by the difference in the change in mean outcomes in the population of interest.</td>
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<td>Limited societal perspective</td>
<td>This perspective accounts for cost components beyond those captured by the healthcare sector perspective, including patient time, patient transportation, unpaid caregiver time, and productivity loss. It excludes spillover impacts affecting sectors other than healthcare, such as education.</td>
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<td>Quality-adjusted life years</td>
<td>A measure of the state of health of a person or group in which the benefits, in terms of length of life, are adjusted to reflect the quality of life.</td>
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<td>Sensitivity analyses</td>
<td>A means of exploring uncertainty in the results of economic evaluations.</td>
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<td>Societal perspective</td>
<td>A societal perspective is broader than the limited societal perspective. It represents the overall public interest by including all resources that could be used for other purposes.</td>
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<td>Time horizon</td>
<td>This is the time over which costs and outcomes are measured.</td>
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## References