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REFLECTION

A REFLECTION ON A COST-EFFECTIVENESS ANALYSIS OF THE NURSING PROCESS

UMA REFLEXÃO SOBRE A ANÁLISE DE CUSTO-EFETIVIDADE DO PROCESSO DE ENFERMAGEM

UNA REFLEXIÓN SOBRE EL ANÁLISIS COSTO-EFECTIVIDAD DEL PROCESO DE ENFERMERÍA

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ABSTRACT

Objective: this theoretical reflective study aimed to discuss the principles of cost-effectiveness analysis and its application to the nursing process in the context of healthcare system sustainability. **Method**: the analysis explored the current state of healthcare systems worldwide, noting the underfunding that poses a significant threat to achieving the Sustainable Development Goals. **Results**: the study highlights that currently, the employment of the nursing process can reduce morbidity and mortality, significantly impacting individuals, families, health systems, and society. **Conclusion**: it is crucial for nurses to conduct cost-effectiveness studies across various care contexts. Active participation in generating economic evidence can clarify the cost-effectiveness of interventions, aid in optimizing resource allocation, support health system sustainability, and contribute to the achievement of the Sustainable Development Goals.

Keywords: Nursing Process; Cost-Benefit Analysis; Health Care Costs; Clinical Nursing Research; Health Services Administration; Nursing.

RESUMO

***Objetivo**: este estudo teórico reflexivo teve como objetivo discutir os princípios da análise de custo-efetividade e sua aplicação no processo de Enfermagem no contexto da sustentabilidade do sistema de saúde. **Método**: a análise explorou o estado atual dos sistemas de saúde em todo o mundo, observando que o subfinanciamento representa uma ameaça significativa para alcançar os Objetivos de Desenvolvimento Sustentável. **Resultados**: o estudo destaca que, atualmente, a aplicação do processo de Enfermagem pode reduzir a morbidade e a mortalidade, impactando significativamente indivíduos, famílias, sistemas de saúde e a sociedade. **Conclusão**: é crucial que os enfermeiros realizem estudos de custo-efetividade em vários contextos de cuidado. A participação ativa na geração de evidências econômicas pode esclarecer a custo-efetividade das intervenções, ajudar na otimização da alocação de recursos, apoiar a sustentabilidade do sistema de saúde e contribuir para o alcance dos Objetivos de Desenvolvimento Sustentável.*

***Palavras-chave**: Processo de Enfermagem; Análise Custo-Benefício; Custos de Cuidados de Saúde; Pesquisa em Enfermagem Clínica; Administração de Serviços de Saúde; Enfermagem.*

RESUMEN

***Objetivo**: este estudio teórico reflexivo tuvo como objetivo discutir los principios del análisis costo-efectividad y su aplicación en el proceso de Enfermería en el contexto de la sostenibilidad del sistema de salud. **Método**: el análisis exploró el estado actual de los sistemas de salud en todo el mundo, observando que la falta de financiación representa una amenaza importante para el logro de los Objetivos de Desarrollo Sostenible. **Resultados**: el estudio destaca que, actualmente, la aplicación del proceso de Enfermería puede reducir la morbilidad y la mortalidad, impactando significativamente a los individuos, las familias, los sistemas de salud y la sociedad. **Conclusión**: es fundamental que las enfermeras realicen estudios de costo-efectividad en diversos entornos de atención. La participación activa en la generación de evidencia económica puede aclarar la relación costo-efectividad de las intervenciones, ayudar a optimizar la asignación de recursos, apoyar la sostenibilidad del sistema de salud y contribuir al logro de los Objetivos de Desarrollo Sostenible.*

***Palabras clave:** Proceso de Enfermería; Análisis Costo-Beneficio; Costos de la Atención en Salud; Investigación en Enfermería Clínica; Administración de los Servicios de Salud; Enfermería.*

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INTRODUCTION

Health systems worldwide have faced challenges that jeopardize the goal of universal access to health care by 2030, as established by the United Nations (UN) in the Sustainable Development Goals[1,2]. This is associated with several causes, such as the increase in the prevalence rate of chronic diseases with the concomitance of infectious diseases, as well as the demands for health care resulting from external causes, which overloads health systems, especially in low- and middle-income countries. Therefore, the use of resources in the health sector must be optimized to ensure access and universality[3]. One of the recommended ways to optimize the allocation of health resources is through cost-effectiveness analysis (CEA). According to the United States Centers for Disease Control and Prevention, a CEA consists of a procedure to assess the costs and health outcomes of at least one intervention[4]. Also, the use of CEA is crucial for the health sector sustainability as it evaluates the true value of health interventions. CEAs compare the costs and clinical outcomes of various interventions and are not only justified by cost increases but also by the need for assessment. Nurses play a vital role in integrating CEAs into daily practice, especially for evaluating widely used health technologies (HT) that are undervalued in economic evaluations[5].

HTs cover all scientific and applied knowledge for promoting health, mitigating health problems, and improving rehabilitation[5]. They include medicines, equipment, procedures, organizational and educational systems, assistance programs, and protocols. This concept allows economic assessments of care processes, including the nursing process (NP)[6,7].

The NP is a vital component of nursing science widely used in care settings. It involves several stages, including data collection, nursing diagnosis, nursing planning, nursing intervention, and nursing assessment[8]. The NP is a scientific method based on critical thinking, scientific reasoning, and problem-solving. It is a mild HT that relies on relationships, communication, autonomy, and embracement to achieve care effectiveness and obtain desired results[9].

Therefore, this study aimed to discuss the principles of cost-effectiveness analysis and its application to the nursing process in the context of the health system sustainability.

Moreover, this is a theoretical study, the foundation of which is based on the discursive formulation about CEAs, supported by national and international scientific literature and critical analysis by the authors about the application of CEA in the NP[10].

THE CEA PROCESS

CEA is a process that compares the costs and effectiveness of alternative HTs with the same clinical purpose. The results are expressed as a cost-effectiveness ratio, with cost as the numerator and effectiveness as the denominator. This approach can be used to measure clinical outcomes such as adherence to therapy or absence of complications. CEA is particularly useful when comparing new technology to traditional or standard technology in clinical practice[11].

The term effectiveness means identifying which interventions work, in what type of patients, and under what circumstances, based on data effectively generated in the daily clinical practice. Outcomes, which are response variables previously established by professionals or researchers, are often used interchangeably with effectiveness. Outcomes can be expressed through physiological, biochemical, or behavioral measures, such as pain control, blood glucose reduction, and improved adherence to therapy, among others, in the context of nursing care[11].

In CEA, it is crucial to adopt an appropriate perspective to determine relevant costs based on study objectives. The societal perspective is often ideal as it includes costs for the health system, individuals, and lost productivity. However, for many HTs, this perspective may be impractical. Thus, more limited perspectives, such as those of health services, users, and professionals, help clarify which direct and indirect costs to consider, including categories, such as material resources, human resources, and infrastructure. The selection of costs and effectiveness indicators can vary based on the perspective used[11].

Costs in CEAs encompass resources used in producing goods or services and delivering interventions, including savings from health interventions. Direct medical costs involve materials, tests, fees, medications, devices, and care, while direct non-medical costs cover food, and support services. Indirect costs are related to productivity loss due to treatment, disease, or premature death. Accurate cost estimates should account for category, use frequency, and cost variations, avoiding simplistic models that might not reflect reality. Models such as Decision Models, Markov Modeling, or Partitioned Survival Analysis are valuable. The chosen time horizon should suit the effectiveness or outcome, and monetary value sources must align with the study perspective for transferability. Currency and data year must be stated for inflation adjustments and international comparisons. The CEA of nursing interventions should encompass clinical practice context, patient particularities, outcome-cost relationships, and the incremental cost-effectiveness ratio

(ICER). The ICER evaluates whether an intervention's additional cost is justified by its extra effectiveness[11]. Interpreting CEA results requires understanding that a cost-effective technology is not necessarily the cheapest or most effective option. Instead, it means that its additional benefits justify the extra cost compared to alternatives[12].

Data sources

The concepts discussed within this manuscript are rooted in the interdisciplinary domains of NP, HTA, CEA. Accordingly, the authors systematically gathered pertinent literature from these fields to explore and delineate the intricate relationships existing among them[11,13].

Overview of the concept: Stages of CEA application model

The CEA application model must follow the reporting recommendations of economic studies indicated in the Consolidated Health Economic Evaluation Reporting Standards (CHEERS)[14]. This model recommends a description of the items to be known: context and characteristics of the target population, analysis perspective, comparators, time horizon, effectiveness measures, cost estimation, discount rate, currency, model chosen, sensitivity analysis, and premises[15].

Context and Characteristics of the target population

The research question is essential to guide CEA, focusing on the target population based on clinical conditions, age, gender, or geographical location, covering groups exposed to the intervention and associated outcomes. The target population is critical as outcomes vary across groups, and CEAs are required for each subgroup[11, 15]. This theoretical CEA's model was guided by the question: "What is the most cost-effective therapeutic intervention to improve adherence in older adults with hypertension?". Moreover, this theoretical model targeted older adults with hypertension at a Brazilian Primary Health Unit (PHU) with a team of nurses, physicians, a nutritionist, and a social worker. Older adults, especially those with chronic diseases such as hypertension, are major medication consumers, where adherence to treatment is vital for disease control and prevention of complications[16]. Adherence involves following health professionals' recommendations on medicines, diets, or lifestyle changes and it is influenced by sociodemographic, clinical factors, and the health professional/patient relationship[16]. Therapeutic non-adherence in older adults with hypertension is a significant risk factor for complications[17] that can raise healthcare costs[18]. Therefore, an assessment of the NP, as a key HT employed by nurses, is required.

Analysis perspective and comparators

In this theoretical model, four hypothetical interventions (A, B, C, and D) were designed to address the nursing diagnosis in older adults with hypertension, within the scope of a PHU of the Brazilian Public Health System (SUS). Each intervention includes the specific Nursing Interventions Classification (NIC), as follows:

- *Intervention A*: Combines counseling, assistance in self-care, and building of a complex relationship.

- *Intervention B*: Combines education and control on medicines use, guidance on the health system, and creation of care networks.

- *Intervention C*: Combines self-esteem enhancement, education on physical activity, and education on the health-disease process.

- *Intervention D*: Combines all elements of the above interventions: counseling, assistance in self-care, building of a complex relationship, education and control on medicines, guidance on the health system, creation of care networks, self-care enhancement, education on physical activity, and education on the health process.

Time horizon

The time horizon is the period for data collection and analysis based on disease progression, the potential impact of interventions, and differences in costs and outcomes between interventions. This period can range from the treatment duration to the patient's lifetime(11).

Treatment time and time horizon are often used interchangeably, but they are distinct measures. Treatment time refers to the duration of the intervention administration, while the time horizon can encompass the treatment period and longer durations, depending on the need to assess outcomes and potentially cover the patient's lifetime[11,15].

In this theoretical CEA of NP for older adults, a one-year time horizon was considered, defined as the period

during which a hypothetical adverse event could occur on individuals who do not adhere to the treatment.

Effectiveness measures

The effectiveness measures consisted of adherence to treatment, absence of hypertensive crisis, and need for hospitalization. An effectiveness level equal to one (E=1) was considered for patients with treatment adherence and without hypertensive crisis or need for hospitalization. For non-adherent patients with hypertensive crisis and need for hospitalization, effectiveness was considered equal to zero (E=0).

Based on this calculation, Interventions A, B, C, and D showed hypothetical effectiveness levels of 20%, 60%, 40%, and 80%, respectively. The mean effectiveness measures, along with their respective minimum and maximum values, can be seen in Table 1.

Cost estimation and currency

The CEA's model, the direct costs associated with the intervention production process and the treatment of adverse events (hypertensive crisis and hospitalization) were considered. The cost of the intervention represents its annual value. The currency adopted was the Brazilian Real (BRL), with January 2025 as the reference month for the monetary values of the different cost categories.

Discount rate

CEA model's require the calculation of current values for future costs and health effects through discounting[15]. The discount rate should be appropriate to the CEA's perspective and location, with a recommended annual rate of 5% in Brazil and 3% internationally. Thus, no discount rate was applied in the analyzed model.

Model used

Models are mathematical structures used in CEA to represent health interventions and their potential effects. The model choice depends on the research question, considering factors such as time horizon, unit of analysis, and presence of infectious diseases. Common models include Decision Model, State Transition Model, Microsimulation Model, Dynamic Transmission Model, Dynamic Simulation Model, and Partitioned Survival Model[15].

The Decision Tree (DT) was adopted as the data analysis model and this choice is justified by the study clinical scenario as well as the time horizon. The DT represents a crucial tool for synthesizing information on effectiveness, outcomes, and costs in CEA. In this model, which aims to compare competing assistance interventions, values of outcome probability and costs are used. It is highly practical, as it allows summarizing a real-world situation quantitatively, even when based on uncertain parameters (outcome and cost), to capture the essence of the clinical problem[15].

The DT structure consists of three types of nodes: decision, chance, and end nodes, which indicate different points. The decision node, an square, indicates a decision point between alternative interventions and is located at the beginning of the DT; the chance node, a circle, indicates the point at which two or more alternative outcomes are possible; and the end node, a triangle, indicates the point at which the DT is completed. DTs have numbers in parentheses on each branch of the chance nodes, representing the probabilities of outcomes occurring, yes or no. In a single chance node, the sum of the probabilities expressed in the branches, regardless of the number, must total one, a hundred percent[15].

The main advantage of DTs over other types of models is their logical format, which is easy to follow. The main disadvantage is that DTs are only applicable to situations in which there are no, or a very limited number of, recurring events and where the time horizon is relatively short and fixed[15]. The main advantage of DTs over other types of models is that the presentation is in a logical format and easy to follow.

Cost-Effectiveness Analysis

After identifying the costs and effectiveness of each intervention, their relationship was established. The CEA results were expressed as a quotient with cost as the numerator and effectiveness as the denominator for

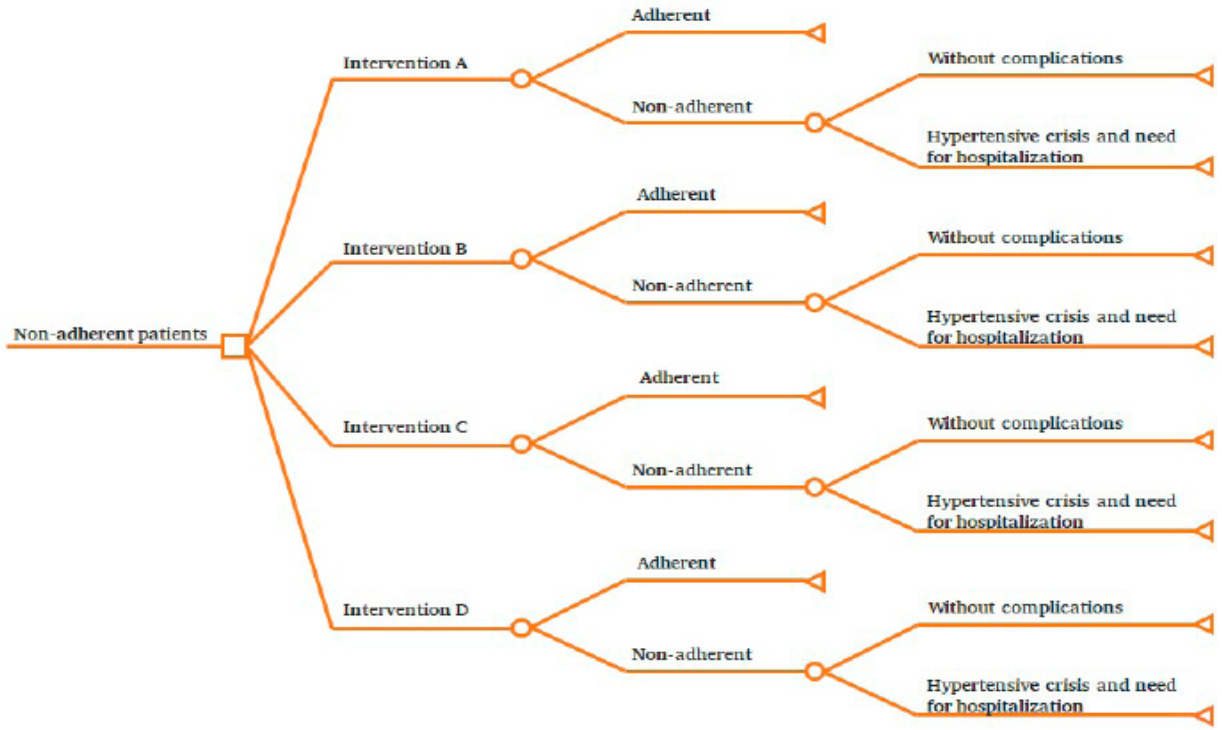
Table 1 — Effectiveness measures (Hypothetical data)

Variable	Mean	Min	Max
Probability of patient adhering to treatment	0.39	0.31	0.42
Relative risk for increase in adherence			
Intervention A	1.20	1.10	1.30
Intervention B	1.60	1.40	1.70
Intervention C	1.40	1.20	1.60
Intervention D	1.80	1.70	2.00
Absence of hypertensive crisis and need for hospitalization	70%	49%	100%

Table 2 — Direct costs of the Nursing interventions (Hypothetical data)

Cost item	Mean cost (BRL)	Minimum cost (BRL)	Maximum cost (BLR)
Intervention A	7,547.52	3,773.76	8,262.96
Nursing consultation	3,781.44	1,890.72	3,781.44
Nursing prescription	467.04	233.52	467.04
Nursing evolution	1,868.16	934.08	1,868.16
Surveillance and monitoring	1,430.88	715.44	2,146.32
Intervention B	3,649.56	2,530.98	4,768.14
Nursing consultation	1,890.72	1,418.04	2,363.4
Nursing prescription	467.04	233.52	700.56
Nursing evolution	934.08	700.56	1,167.6
Surveillance and monitoring	357.72	178.86	536.58
Intervention C	6,135.12	5,071.2	10,500.12
Nursing consultation	2,836.08	2,363.4	4,726.8
Nursing prescription	467.04	467.04	934.08
Nursing evolution	1,401.12	1,167.6	2,335.2
Surveillance and monitoring	1,430.88	1,073.16	2,504.04
Intervention D	17,332.2	11,375.94	23,531.22
Nursing consultation	8,508.24	5,672.16	10,871.64
Nursing prescription	1,401.12	934.08	2,101.68
Nursing evolution	4,203.36	2,802.24	5,370.96
Surveillance and monitoring	3,219.48	1,967.46	5,186.94
Hypertensive crisis and need for hospitalization	36,523.63	20,040.77	41,021.12

Figure 1 — Conceptual model



each intervention. The analysis revealed that intervention A had a lower cost-effectiveness ratio. Interventions B and C presented negative incremental cost-effectiveness ratio (ICER) values, while intervention D had an ICER of BRL 18,733[15], due to hypertensive crisis and hospitalization avoidance. It is important to note that ICER can be misleading: both less expensive, more effective interventions and more expensive, less effective interventions generate negative ICERs. Table 3 illustrates the CEA and ICERs of Interventions A, B, C, and D, showing that negative ICER values indicate higher effectiveness and lower cost.

The incremental cost, incremental effectiveness, and ICER values must use the same comparator, which can alter these values if the comparator changes. In table 3, Intervention A is the comparator, so it does not have values for incremental cost, incremental effectiveness, and ICER.

The CEA showed that interventions B and D are not dominated strategies, while interventions A and C are dominated options. Not dominated should be understood as an intervention clinically superior and less costly, compared to others. A dominated intervention is clinically inferior and more costly. In Figure 2, intervention D demonstrated an additional cost of BRL 9,033.52 and 5% higher effectiveness compared to Intervention A.

Sensitivity analysis

Sensitivity analysis in CEA examines the consistency of results amidst uncertainties in costs or effectiveness. It involves varying parameters to assess their impact on outcomes, ensuring robustness in findings. Univariate sensitivity analysis isolates each parameter to determine its minimum and maximum values, illustrating their impact on cost-effectiveness, often depicted in tornado diagrams. These diagrams highlight parameters with the greatest influence on study outcomes[15]. Figure 3 demonstrates how variables affect cost changes.

Multivariate probabilistic sensitivity analysis, unlike univariate methods, simultaneously evaluates how multiple variables impact cost-effectiveness outcomes. It employs Monte Carlo analysis to assess model uncertainty and result robustness. In a study involving older adults, Monte Carlo simulations were conducted 10,000 times to estimate mean costs and effectiveness, with distributions adjusted informally for subsequent formal Bayesian analysis[15].

Results indicated that intervention A was optimal below a willingness-to-pay threshold of BRL 100,000; above this threshold, intervention D became the preferred option. This threshold serves as a benchmark to determine cost acceptability relative to treatment benefits; for instance, if the threshold is BRL 30,000.00 the most effective treatment below this cost should be chosen

The CEA showed that two interventions are cost-effective for improving adherence in aged patients to hypertension treatment. Thus, it is up to the health team together with the manager to define which strategies will be implemented due to the costs of the interventions. The cost for the total population served in the PHU should be increased, since the costs presented are related to the treatment of a single patient.

Table 3 — Cost-effectiveness analysis and ICER

Treatment	Cost (BRL)	IC (BRL)	Ef.	iEf.	ICER	CE	Conclusion
Intervention A	18,338		0.63			29,219	Dominated
Intervention B	12,302	-6,036	0.74	0.11	-54,874	16,696	Not dominated
Intervention C	15,792	-2,545	0.68	0.05	-50,912	23,149	Dominated
Intervention D	21,335	2,997	0.79	0.16	18,733	26,959	Not dominated

IC: Incremental Cost; Ef.: Effectiveness; iEf.: Incremental Effectiveness; ICER: Incremental Cost-Effectiveness Ratio; CE: Cost-Effectiveness

FINAL CONSIDERATIONS

The active participation of nurses in the generation of economic evidence that shows the cost-effectiveness ratio of the interventions adopted in different care contexts is of foremost importance. The applicability of the CEA in the assessment of interventions at the bedside requires, on the part of the professional, appropriation of specific knowledge and, above all, clear goals in relation to the care proposed in the NP. These aspects will support decision-making at different management levels and may assist health systems in achieving the Sustainable Development Goals as set by the UN. e poderão auxiliar os sistemas de saúde a atingirem os Objetivos de Desenvolvimento Sustentável estabelecidos pela Organização das Nações Unidas.

Figure 2 — Cost-effectiveness ratios used to improve adherence to therapy

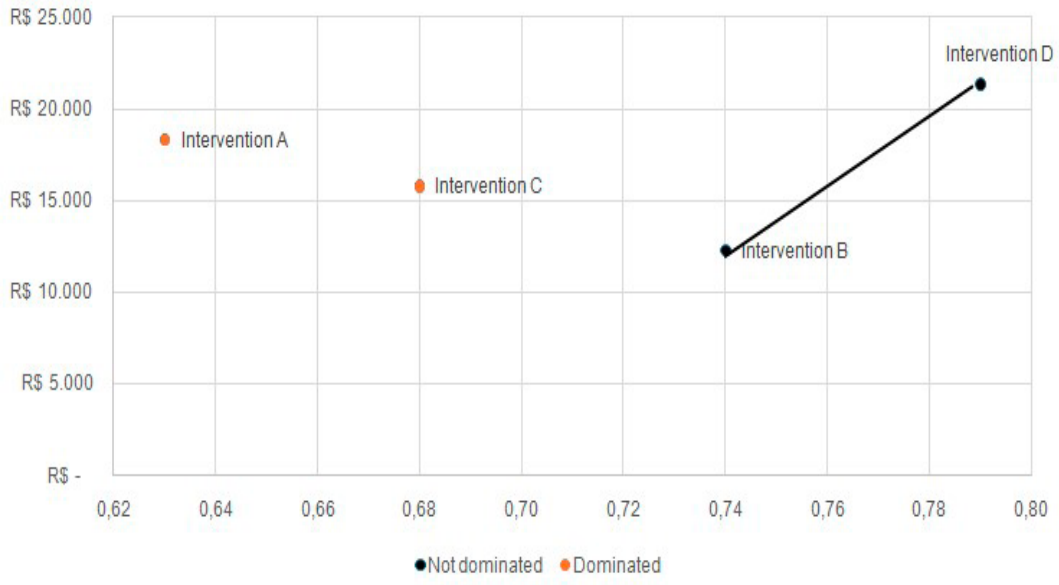


Figure 3 — Tornado diagram for cost

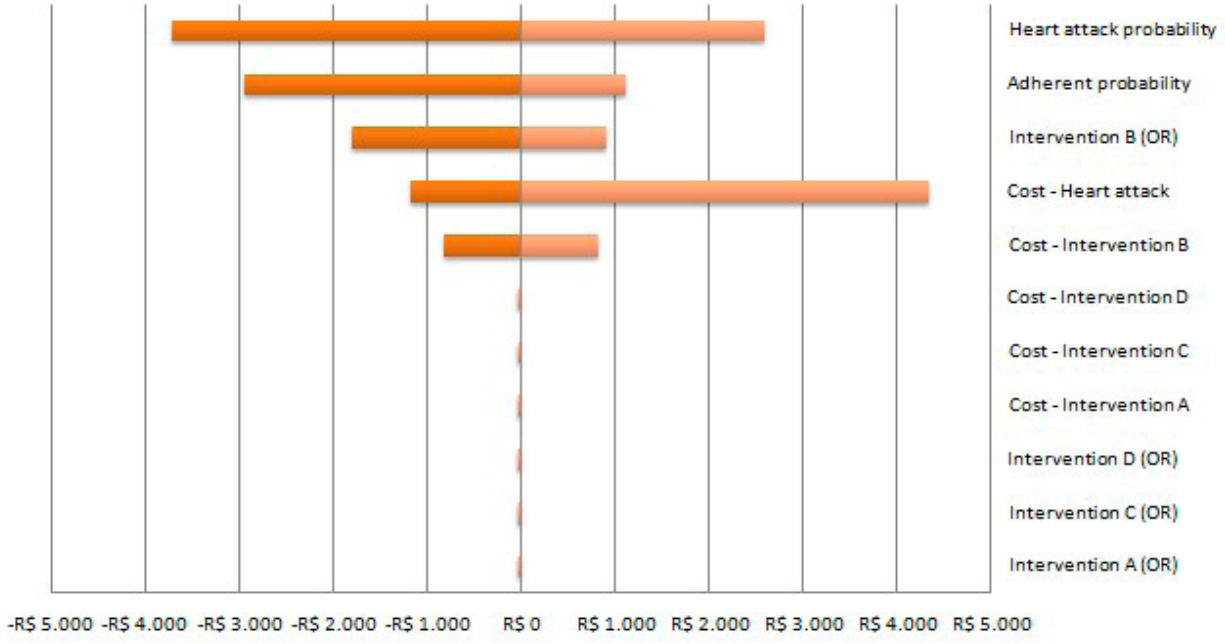
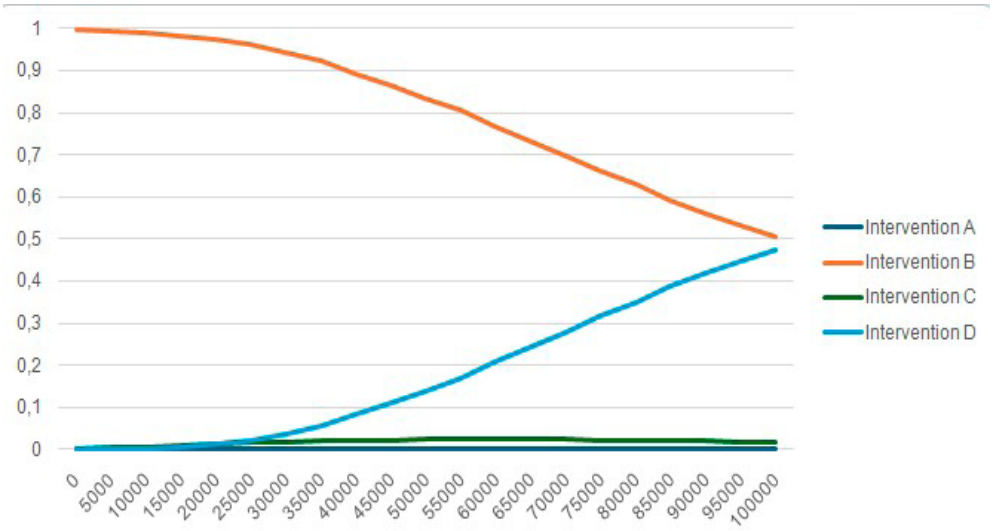


Figure 4 — Cost-effectiveness acceptability curve



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