Special Section

TEXTO & CONTEXTO ENFERMAGEM
TEXT & CONTEXT NURSING TEXTO & CONTEXTO ENFERMERÍA

COST-EFFECTIVENESS OF TWO DRESSINGS IN PREVENTING PRESSURE INJURIES IN INTENSIVE CARE PATIENTS

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ABSTRACT

Objective: to analyze the cost-effectiveness of using silicone adhesive multilayer foam and transparent polyurethane film in preventing pressure injuries in patients admitted to an Intensive Care Unit.
Method: this is an economic cost-effectiveness study, developed with public domain data and a rapid literature review, which included three studies developed in Canada, the United Kingdom, Italy and the United States. The searches were carried out in the PubMed, Cochrane and Scopus databases. The population was patients admitted to the Intensive Care Unit. The perspective was from the Brazilian Health System, with a time horizon of less than one year. Data was collected and analyzed between March and June 2022. A decision tree model was developed using TreeAge Pro® 2017 software to project economic outcomes of incremental cost and effectiveness, incremental cost per effectiveness, and cost per percentage increase in preventing the development of pressure injuries. Sensitivity analysis was also performed. The Consolidated Health Economic Evaluation Reporting Standards and the Methodological Guideline for Economic Evaluation of the Brazilian Ministry of Health recommendations were adopted.
Results: multilayer foam reduces the occurrence of pressure injuries at a lower cost when compared to film, promoting an average saving of R$ 278.78 (US$ 1,393.90) for each patient.
Conclusion: multilayer foam was the most cost-effective technology in preventing pressure injuries in Intensive Care Unit patients in the Brazilian Health System.

DESCRIPTORS: Pressure Ulcer. Cost-Effectiveness Analysis. Health Evaluation. Health Care Costs. Nursing.

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CUSTO-EFETIVIDADE DE DUAS COBERTURAS NA PREVENÇÃO DE LESÃO POR PRESSÃO EM PACIENTES DE TERAPIA INTENSIVA

RESUMO

Objetivo: analisar o custo-efetividade do uso da espuma multicamadas de poliuretano com silicone e do filme transparente de poliuretano na prevenção de lesões por pressão, em pacientes internados em Unidade de Terapia Intensiva.
Método: estudo econômico de custo-efetividade, desenvolvido com dados de domínio público e de uma revisão rápida da literatura, que incluiu três produções desenvolvidas no Canadá, Reino Unido, Itália e Estados Unidos. As buscas foram realizadas nas bases PubMed, Cochrane e Scopus. A população foi de pacientes internados em Unidade de Terapia Intensiva. A perspectiva foi do Sistema Único de Saúde, com horizonte temporal inferior a um ano. Os dados foram coletados e analisados entre março e junho de 2022. Um modelo de árvore de decisão foi desenvolvido por meio do *Software TreeAge Pro*® 2017 para projetar resultados econômicos de custos e eficácia incremental, custo incremental por eficácia, e custo por aumento percentual na prevenção do desenvolvimento de lesões por pressão; também foi feita análise de sensibilidade. Adotou-se as recomendações do *Consolidated Health Economic Evaluation Reporting Standarts* e da Diretriz Metodológica de Avaliação Econômica do Ministério da Saúde do Brasil.
Resultados: a espuma multicamadas reduz a ocorrência de lesão por pressão a um custo inferior quando comparado ao filme, promovendo em média, uma economia de R$ 278,78 (US$ 1.393,90) para cada paciente.
Conclusão: a espuma multicamadas apresentou-se como a tecnologia mais custo-efetiva na prevenção de lesão por pressão em pacientes de Unidade de Terapia Intensiva, no contexto do Sistema Único de Saúde.

DESCRITORES: Lesão por pressão. Análise de custo-efetividade. Avaliação em saúde. Custos de cuidados de saúde. Enfermagem.

RENTABILIDAD DE DOS APÓSITOS EN LA PREVENCIÓN DE LESIONES POR PRESIÓN EN PACIENTES DE CUIDADOS INTENSIVOS

RESUMEN

Objetivo: analizar la costo-efectividad del uso de espuma de poliuretano multicapa con silicona y película de poliuretano transparente en la prevención de lesiones por presión en pacientes ingresados en una Unidad de Cuidados Intensivos.
Método: estudio de costo-efectividad económica, desarrollado con datos de dominio público y una revisión rápida de la literatura, que incluyó tres producciones desarrolladas en Canadá, Reino Unido, Italia y Estados Unidos. Las búsquedas se realizaron en las bases de datos PubMed, Cochrane y Scopus. La población fueron pacientes ingresados en la Unidad de Cuidados Intensivos. La perspectiva fue desde el Sistema Único de Salud, con un horizonte temporal inferior a un año. Los datos se recopilaron y analizaron entre marzo y junio de 2022. Se desarrolló un modelo de árbol de decisiones utilizando el software TreeAge Pro® 2017 para proyectar resultados económicos de costo y efectividad incrementales, costo incremental por efectividad y costo por aumento porcentual en la prevención del desarrollo de lesiones por presión. También se realizó un análisis de sensibilidad. Se adoptaron las recomendaciones de los Consolidated Health Economic Evaluation Reporting Standarts y la Guía Metodológica para la Evaluación Económica del Ministerio de Salud de Brasil.
Resultados: la espuma multicapa reduce la aparición de lesiones por presión a un costo menor en comparación con la película, promoviendo un ahorro promedio de R$ 278,78 (US$ 1.393,90) por cada paciente.
Conclusión: la espuma multicapa fue la tecnología más costo-efectiva en la prevención de lesiones por presión en pacientes de la Unidad de Cuidados Intensivos del Sistema Único de Salud.

DESCRIPTORES: Úlcera por Presión. Análisis de Costo-Efectividad. Evaluación en Salud. Costos de la Atención en Salud. Enfermería.

INTRODUCTION

Pressure injury (PI), previously conceptualized as pressure ulcer, is defined as an injury located in the skin and/or underlying tissue, normally over a bony prominence, as a result of pressure and torsional/shear force[1]. PI continues to be an important health problem in patients who need to remain hospitalized for long periods[2]. There are several places affected by these injuries, but mainly those that suffer greater pressure, such as the gluteal, sacral and heel regions[2–3].

The most frequent predictors of PI development generally include advanced age, prolonged stay in the Intensive Care Unit (ICU), diabetes, altered systemic blood pressure, longer time on mechanical ventilation, performing intermittent hemodialysis or continuous venous hemofiltration therapy, need for vasopressor support, sedation and long periods in the same position in bed[4]. Therefore, ICU patients are more predisposed to PI occurrence[4–6].

It is noteworthy that professional nurses are permanently involved in PI prevention and treatment actions, which constitutes a challenge[5]. PI prevention reduces length of stay, risk of infections and readmissions, promotes patient quality of life and reduces the cost of treatment[7–8]. In Brazil, when considering only the year 2020 and hospitalizations due to PI, an additional R$19 million, or US$104.5 million (1% of total health expenditure), was spent in the Brazilian Health System (*Sistema Único de Saúde* – SUS), and could reach up to 5% in other health systems[7–9]. Therefore, it is necessary to invest in actions and technologies aimed at preventing PI and assessing its benefits and costs.

Among the technologies available for PI prevention, there are silicone adhesive multilayer foam (SMF) and transparent polyurethane film (TPF)[10]. Multilayer polyurethane foam dressings are increasingly being used to prevent PI. They can be applied to areas of the body that are vulnerable to pressure, friction, shear and moisture, such as the sacrum and heels. It is believed that by redistributing pressure, reducing friction and shear force on the skin, and controlling moisture, these dressings may help prevent PI[11]. TPF is a synthetic, adhesive and hypoallergenic material. It is inactive in the presence of humidity, having a gas exchange system similar to that of healthy skin, which allows the diffusion of gases, such as oxygen and vapors. It has an elastic quality that allows it to be applied to different parts of the body and resists friction and shear forces[12].

Studies show that both technologies are effective in preventing PI[11–13]. However, no studies were identified that investigated the cost-effectiveness of these technologies in the SUS in patients admitted to the ICU. Hence, there is an urgency to develop cost-effectiveness studies, because it is important to know whether such technologies, in addition to being effective, are also economically viable, since the most effective option available does not always justify the cost of its use, and this information needs to be clear and proven among decision makers.

Therefore, the question arises: is there a difference between the cost-effectiveness of SMF and TPF in preventing PI in patients admitted to ICU?

Thus, this study aimed to carry out a cost-effectiveness analysis of SMF and TPF in PI prevention in patients admitted to an ICU.

METHOD

This is a cost-effectiveness economic study, developed based on data from scientific literature (three studies) and public domain data.

The literature review stage was carried out with the aim of finding the best cost and effectiveness estimates of both dressings that could be used as a parameter in the cost-effectiveness simulation in the economic model. The PICO strategy ((P) Population, (I) Intervention, (C) Comparison, (O) Outcome) was used. In this perspective, population (P)= patients admitted to the ICU, intervention

(I)= SMF, comparison (C)= TPF, outcome (O)= PI prevention. So, the following question was structured: is there a difference between the cost-effectiveness of SMF and TPF in preventing PI in ICU patients?

The searches were carried out in PubMed, Cochrane and Scopus, in March 2022, using terms in accordance with PICO. Search strategies were constructed for each database searched. After carrying out the searches, retrieved studies were selected and subsequently read in full, choosing, in the end, three studies. The selection phase adopted the following inclusion criteria: preferably being a systematic review, cost-effectiveness economic analysis study, and/or answering the research question. The studies included were developed in Canada, the United Kingdom, Italy and the United States of America, therefore, all international publications. The population had patients who were hospitalized, specifically in the ICU, in which these technologies (foam or film) were used to prevent PI. Furthermore, the studies analyzed SMF regarding its effectiveness, as well as comparing it with other dressings, including TPF.

To carry out the cost-effectiveness analysis, the Economic Assessment Methodological Guideline of the Brazilian Ministry of Health[14] and the Consolidated Health Economic Evaluation Reporting Standards (CHEERS) recommendations were adopted, published in 2022, which has a checklist of 28 items regarding title, abstract, introduction, method, results and discussion. Its purpose is to guide researchers in conducting and publishing an economic analysis, for better quality and transparency of the research carried out[15].

The population of this analysis was made up of adult patients admitted to the ICU, regardless of the reason, even if they did not have PI at the time of admission and who used technologies (foam or film) to prevent the emergence of PI during their stay in the ICU. The population analyzed came from the literature review carried out.

The choice of this population for the present cost-effectiveness study is justified, as the literature demonstrates that PI incidence of PI during the period of ICU hospitalization presents great variability, reaching 6 to 50% per patient, depending on the prevention measures adopted during this period[16–17].

The intervention and comparator treatments were based on preventive therapies for PI occurrence, these being SMF and TPF.

The patients' hospitalization period was considered as the time horizon; therefore, the period was considered to be less than one year. This period was considered sufficient for the development of PI, as the literature indicates that patients admitted to the ICU develop PI on the second or third day of hospitalization[18].

No discount rate was used due to the model's time horizon being less than one year[19]. SUS' perspective was considered. No willingness-to-pay threshold was used, as there is no official definition by the Brazilian Ministry of Health[20].

The inputs for constructing the economic model were obtained from an estimate of data from the literature and conducted in accordance with the guidelines established in the calculation of costs at the person level, i.e., treatment was considered individually for each patient.

Based on the research question and objective of this study, the final outcome assessed was PI prevention. The outcomes PI incidence were also considered according to the type of intervention, mean length of stay in the ICU and effectiveness of interventions (film and foam) in reducing PI incidence.

Estimates of mean length of stay in the ICU and PI treatment cost were based on data from DATASUS, referring to 2020 to 2021, which were subsequently processed using the public domain Tabwin software. The costs of the interventions were based on mean values of government

purchases available in the Brazilian Health Prices Bank from October 2020 to April 2022. The values used were all updated for Brazil, and presented in the form of the monetary unit of the country: *real* (R$). The values of the results found were also presented in the text in dollars, based on the exchange rate at the time, in which US$ 1 was equivalent to R$ 5, according to the Central Bank of Brazil. The data was collected and analyzed between March and June 2022. Analysis parameters are shown in Chart 1.

Chart 1 – Cost-effectiveness analysis parameters. Florianópolis, SC, Brazil, 2022.

Parameter	Mean	Distribution measures	Distribution	Reference
PI incidence*	15.4%	Alpha = 28 Beta = 154	Beta	Forni 2020[21]
Mean length of ICU stay†	7.2	4.23	Gamma	Tabwin 2020[9]
Intervention effectiveness – incidence reduction				
TPF§ (comparator)	1.00	–	–	Shi 2021[10]
Silicone adhesive multilayer foam (RR)¶	0.70	0.32 – 1.54	Uniform	Shi 2021[10]
Frequency of use				
TPF§	10 days	–	–	Poitras 2017[22]
Silicone adhesive multilayer foam	5 days	–	–	Otawa 2017[22]
Costs				
TPF§	4.24	10% / +10%	Triangle	Health Price Bank[23]
Silicone adhesive multilayer foam	27.00	-10% / +10%	Triangle	Health Price Bank[23]
PI treatment*	6,100.49	510.71	Gamma	Tabwin 2020[9]

Caption: *PI: Pressure Injury; †ICU: Intensive Care Unit; §TPF: Transparent Polyurethane Film; ¶RR: Relative Risk.
|Note: the costs analyzed were in *reais* (R$), or Brazilian currency.

The decision tree model was developed by TreeAge Pro 2017® software. A decision tree is a model that provides a logical structure for a decision and possible events as it unfolds over time. Thus, it presents itself as an appropriate model to evaluate scenarios with a short follow-up period[19].

Projected economic outcomes included incremental costs, incremental effectiveness, incremental cost per effectiveness, cost per percentage increase in preventing the development of PI was reported.

Univariate deterministic sensitivity analysis was presented using the Tornado Diagram, which demonstrates the impact that the variation in each parameter has on the result of the study. Probabilistic sensitivity analysis using the Monte Carlo Method was used to assess the uncertainty in the model and the robustness of results. The model was run 1,000 times to estimate mean costs and effectiveness. In this way, distributions are assigned to each of the model parameters reflecting the evidence available to inform the estimates.

RESULTS

In the deterministic analysis for the period of ICU stay, SMF showed greater effectiveness (0.89) and lower cost (R$ 663.73=US$ 3,318.65) when compared to TPF (Figure 1). Pragmatically, patients undergoing SMF have a lower risk of developing PI. Furthermore, using foam promoted, on average, savings of R$ 278.78, equivalent to US$ 1,393.90, for each patient exposed to the technology when compared to TPF use, as described in Table 1.

Table 1 – Results of cost-effectiveness analysis (baseline case). Florianópolis, SC, Brazil, 2022.

Treatment	Cost	Incremental cost	Effectiveness	Incremental effectiveness	Incremental cost-effectiveness	Cost-effectiveness	Conclusion
SMF‡	663.73		0.89			743.93	Not dominated
TPF*	942.52	278.78	0.84	-0.05	-6,034.41	1,114.10	Absolutely dominated

Caption: ‡SMF: silicone adhesive multilayer foam; *TPF: transparent polyurethane film.
|Note: the costs analyzed were in *reais* (R$), or Brazilian currency.

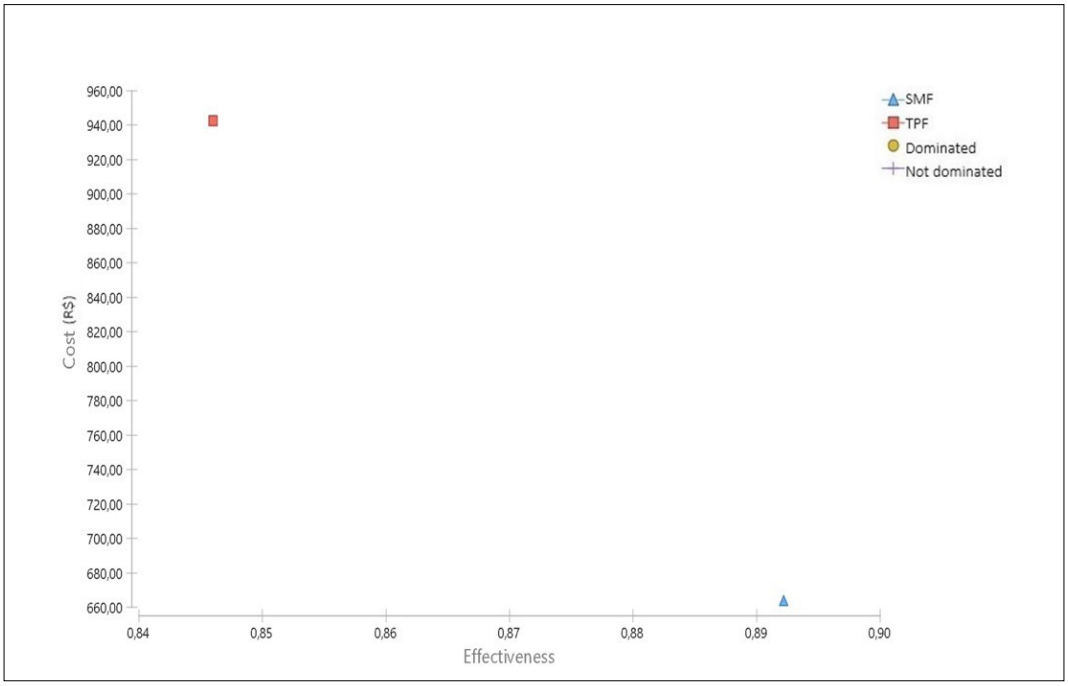

Figure 1 – Cost-effectiveness analysis. Florianópolis, SC, Brazil, 2022.
Caption: SMF: silicone adhesive multilayer foam; TPF: Transparent Polyurethane Film

Univariate sensitivity analysis, carried out using the tornado diagram, demonstrated that the parameter that most impacts the model result is the cost of treating PI (Figure 2).

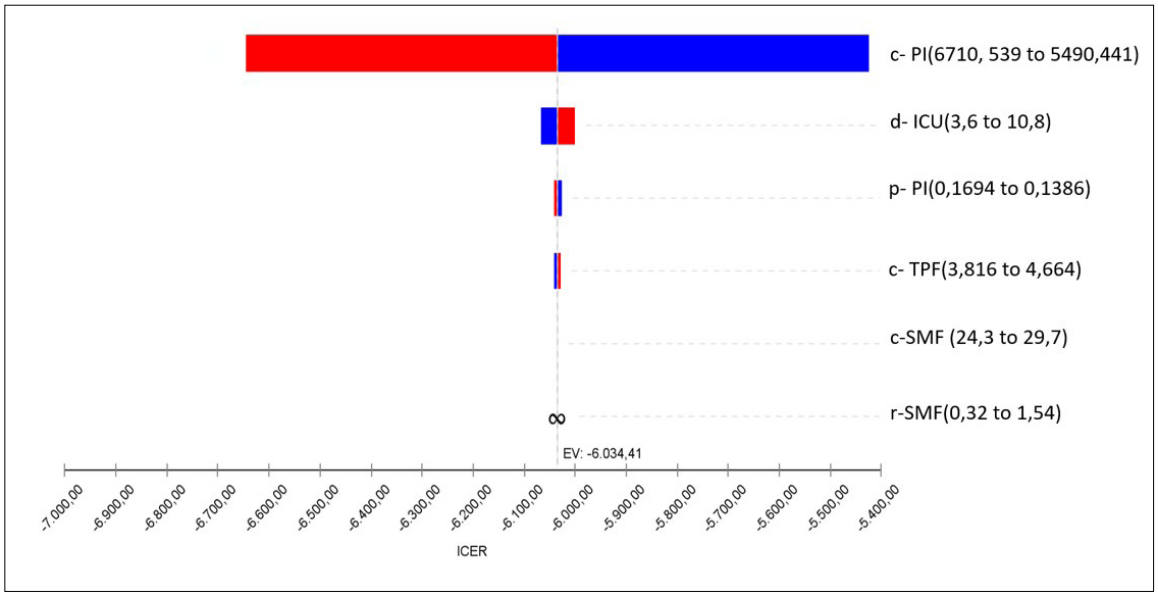

Figure 2 – Tornado diagram of the incremental cost-effectiveness ratio (ICER) of TPF versus SMF. Florianópolis, SC, Brazil, 2022.
Caption: ICER: incremental cost-effectiveness ratio; c-PI: cost of pressure injury; d-ICU: days spent in the Intensive Care Unit; p-PI: probability of pressure injury; c-TPF: cost of transparent polyurethane film; c-SMF: cost of silicone adhesive multilayer foam; r-SMF: relative risk of silicone adhesive multilayer foam; EV: expected value.
Note: Costs analyzed were in *real* (R$), or Brazilian currency.

Multivariate probabilistic sensitivity analysis demonstrated that, after 1,000 changes to the variables, and considering all willingness-to-pay thresholds, the treatment carried out using SMF should be considered as the first alternative to PI prevention treatment (Figure 3). Figure 4 shows that it is possible to verify the dispersion of interactions between cost and effectiveness.

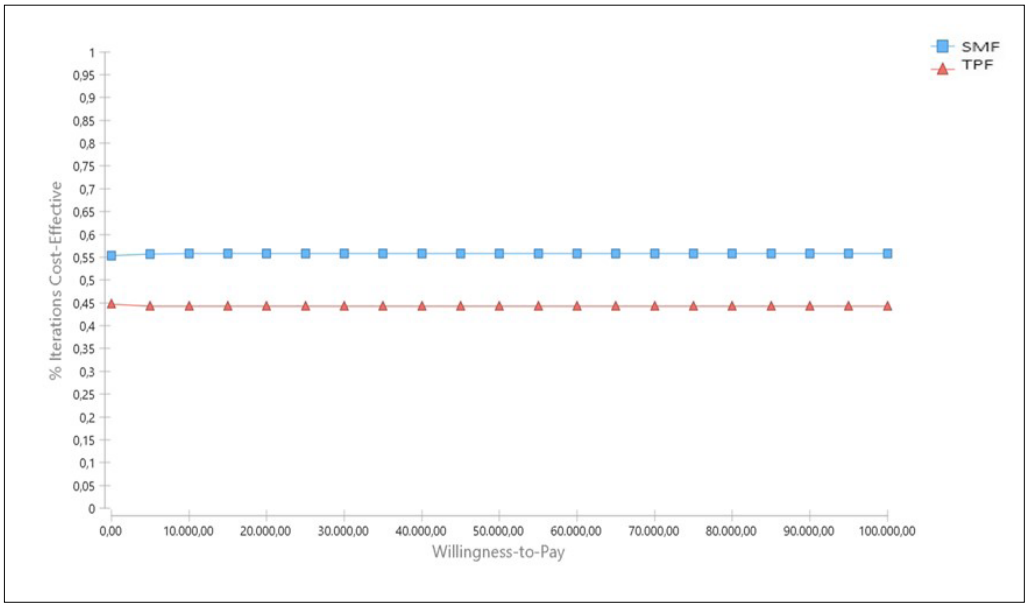

Figura 3 – Cost-effectiveness acceptability curve. Florianópolis, SC, Brazil, 2022.
Caption: SMF: silicone adhesive multilayer foam; TPF: transparent polyurethane film.

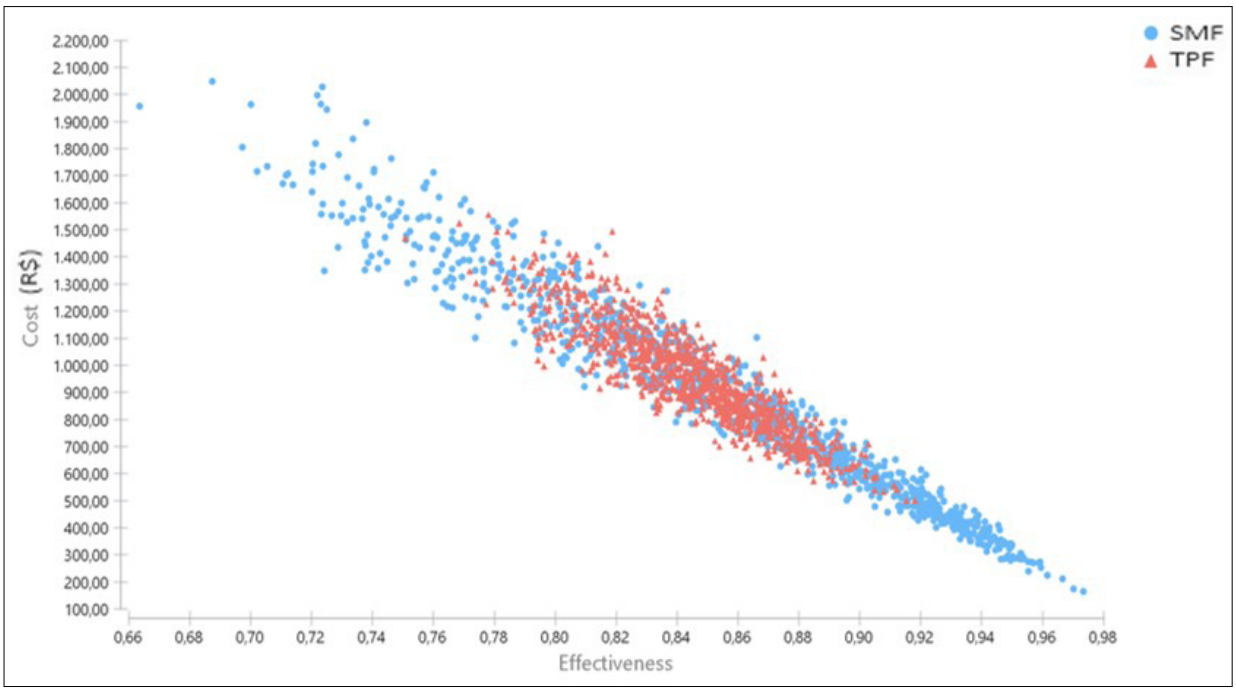

Figure 4 – Scatterplot of cost-effectiveness sensitivity analysis. Florianópolis, SC, Brazil, 2022.
Caption: CE: cost-effectiveness; SMF – silicone adhesive multilayer foam; TPF – transparent polyurethane film.

DISCUSSION

This study aimed to analyze the cost-effectiveness of two PI prevention technologies in ICU patients in the Brazilian SUS. In this case, the model demonstrated that SMF was superior in terms of effectiveness and lower in terms of cost when compared to TPF. Thus, SMF was the cost-effective treatment and remained the first therapy of choice in sensitivity analysis.

This finding supports other studies, which recommend uding multilayer foam with a silicone edge as it is the most effective in preventing PI in the heel region in ICU patients[24–26], in the sacral region[27] and in older adults[21]. Thus, this work presents a consolidation in the knowledge of scientific production, providing an advancement in its use in the Brazilian context. Additionally, it contributes to adopting practices based on scientific evidence to reduce PI in hospitalized patients, which are cost-effective, and at the same time provide an improvement in quality of life and a reduction in hospitalization time. This, in turn, results in substantial savings for both the hospital and the healthcare system, given the considerably high cost associated with PI treatment[27–29]. It is noteworthy that the use of technologies to prevent PI is an important recommendation[1] to reduce the risk of these injuries. In Australian long-term care facilities, the use of multilayer silicone foam was compared with clinical guidelines in preventing PI in 228 older adults, showing a relative risk reduction of 80% in those who used the foam[30].

The results presented in this study should be interpreted with caution, given the several limitations associated with the analysis. Firstly, there has been no direct comparison between SMF and TPF; the data came from a network meta-analysis[10]. Secondly, follow-up was limited to the period of hospitalization in the hospital, i.e., costs arising from PI treatment were not considered if patients were discharged and/or treated on an outpatient basis.

Despite the limitations, the results present strengths. Other cost-effectiveness studies carried out in different contexts and with dressings present similar limitations. The effectiveness results demonstrate that the assessed dressings are cost-effective in relation to the absence of PI prevention measures. Therefore, it is recommended to use different prevention measures in care practice.

Future studies are advisable in order to expand the assessment. In this regard, it may be relevant to assess the quality of life of patients admitted to the ICU and how PI affects their lives. Carrying out these studies will allow a comparison of how PI affects patient health, complementing aspects of clinical outcomes, and enabling assessments of quality-adjusted life years (QALY). It is also necessary to analyze cost-effectiveness from the perspective of supplementary and hospital health to understand whether the amounts paid by the SUS and supplementary health can cover the expenses of hospital institutions that provide services to these institutions.

CONCLUSION

It was possible to conclude that SMF provides greater effectiveness and savings when compared to TPF. Therefore, it is a cost-effective technology for preventing PI in patients admitted to the ICU. Therefore, the adoption of SMF may be a viable alternative for PI prevention in the SUS.

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NOTES

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APPROVAL OF ETHICS COMMITTEE IN RESEARCH

This study was developed based on publicly accessible data; therefore, it is exempt from approval by the Research Ethics Committee.

CONFLICT OF INTEREST

There is no conflict of interest.

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