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Original Article

ANÁLISE DE CUSTOS DO TRATAMENTO DE LESÃO POR PRESSÃO EM PACIENTES INTERNADOS

COST ANALYSIS OF THE TREATMENT OF PRESSURE INJURY IN HOSPITALIZED PATIENTS

ANÁLISIS DE COSTOS DEL TRATAMIENTO DE LESIÓN POR PRESIÓN EN PACIENTES INTERNADOS

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RESUMO

Objetivo: Avaliar o custo do tratamento de lesões por pressão em pacientes internados, relacionado a materiais de curativos e mão de obra do profissional de enfermagem. **Método:** estudo transversal, descritivo, com dados secundários de análise de custos diretos com materiais de curativos no tratamento de lesões por pressão, realizado em hospital de médio porte, de ensino, no estado de Minas Gerais**.** A amostra foi não probabilística, totalizando 60 participantes. **Resultados:** em relação aos custos com tratamento de lesão por pressão, observou-se média de custo semestral de R$ 1.886,00 por paciente e, custo total de R$ 113.186,00. Quanto ao custo com profissionais da enfermagem, a maioria dos pacientes teve custo máximo de R$ 1.000. Conclusões: a avaliação da população e dos custos indicou que o tratamento de lesão por pressão acarreta custos elevados e onera as instituições de saúde. Medidas preventivas, quando possível, devem ser otimizadas, resultando em economia para a instituição.
Descritores: Úlcera por Pressão; Economia da enfermagem; Enfermagem.

ABSTRACT

Objective: To evaluate the cost of treatment of pressure injuries in hospitalized patients, related to the dressing materials and nursing workforce**. Method:** cross-sectional, descriptive study with secondary data of direct cost analysis with dressing materials in the treatment of pressure lesions, conducted at a medium sized teaching hospital in the state of Minas Gerais. The sample was not probabilistic, totaling 60 participants. **Results:** in relation to costs with treatment of pressure injury, we observed a half-yearly cost average of R $ 1,886.00 per patient, and a total cost of R $ 113,186.00. As for the cost of nursing professionals, the majority of patients had a maximum cost of R $ 1,000. **Conclusions:** the evaluation of population and costs indicated that the treatment of pressure injury entails high costs and burden health institutions. Preventive measures, when possible, should be optimized, resulting in savings for the institution.
Descriptors: Pressure Ulcer; Economics Nursing; Nursing.

RESUMEN

Objetivo: Evaluar el costo del tratamiento de lesiones por presión en pacientes hospitalizados, relacionado a materiales de curativos y mano de obra del profesional de enfermería. **Método:** Estudio transversal, descriptivo, con datos secundarios de análisis de costos directos con materiales de curativos en el tratamiento de lesiones por presión, realizado en un hospital docente de tamaño mediano en el estado de Minas Gerais. La muestra fue no probabilística, totalizando 60 participantes. **Resultados:** en relación a los costos con tratamiento de lesión por presión, se observó promedio de costo semestral de R $ 1.886,00 por paciente y, costo total de R $ 113.186,00. En cuanto al costo con profesionales de la enfermería, la mayoría de los pacientes tuvo un costo máximo de R $ 1.000. **Conclusiones:** la evaluación de la población y de los costos indicó que el tratamiento de lesión por presión conlleva costos elevados y las instituciones de salud. Las medidas preventivas, cuando sea posible, deben ser optimizadas, resultando en economía para la institución.
Descriptores: Úlcera por Presión; Economía de la Enfermería; Enfermería.

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INTRODUCTION

Pressure injuries (PI) are common events that persist over the years, affecting hospitalized and home care patients. They involve a category of injuries and are most often preventable, the occurrence of which implies an impact on the quality of life of individuals and their families, as well as the high costs to the health system [(1)].

The etiology of pressure injury (PI) is multifactorial, including intrinsic and extrinsic factors. Intrinsic factors are those belonging to the individual, such as age, any physiological factor such as the presence of chronic diseases and morbidities. These may be Systemic Arterial Hypertension (SAH), Diabetes Mellitus (DM) or circulatory diseases, unconsciousness, immobility, loss of sensation or motor function, urinary or fecal incontinence, malnutrition and very high or very low body mass index. Extrinsic factors are those to which the individual is exposed, such as: contact pressure over bone prominence, shear forces, friction and humidity[(2)].

Pressure injuries can develop within 24 hours or take up to five days to manifest. Since pressure is the main agent for the formation of PI in individuals who are unable to move, or exposed to excessive compression areas involving soft tissues against bony prominences. This occurs due to a pressure exerted on the skin higher than the normal capillary pressure (32 mmHg), causing the collapse of these capillaries, i.e., there is a decrease in blood supply, which leads to tissue hypoxia and nutrient reduction in that part. Eventually, the area becomes inflamed, possibly leading to cell death and local cell necrosis, triggering the formation of PI. The most frequent locations for the development of lesions are in areas where the body pressure in the bony prominences is higher, such as the sacral, trochanteric, sciatic and calcaneal region[(3)].

As established by NPUAP (2016), pressure injuries are staged to indicate the extent of tissue damage involved. Thus, lesions have the following definitions: Stage 1 (intact skin with unbleachable erythema); Stage 2 (loss of skin thickness with dermis exposure); Stage 3 (total loss of skin thickness); Stage 4 (loss of skin thickness and tissue loss); Pressure injury nonstable pressure; Pressure injury related to medical devices; Mucous Membrane Pressure Injury.

The ideal thing to do when there is a risk of developing pressure injury is prevention. To this purpose, the Ministry of Health (MS), in partnership with the Health Surveillance Agency (ANVISA), established, in April 2013, with Ordinance No. 529, the National Patient Safety Program (PNSP). Its objective is to contribute to the qualification of health care in all health facilities in the national territory, motivating improvements related to patient safety, in order to prevent and reduce the incidence of adverse events in care and hospitalization, and the PI is one of the events considered. One of the main actions of the PNSP is the obligation of hospitals and health services to have a Patient Safety Center (NSP) implemented[(3)].

The development of behaviors aimed at the prevention of PI should be the goal of any health service. Health professionals need to be aware, including spending issues, as a patient affected by the complication implies increased costs for the facility.

According to the literature[(4)], there is a proportional relationship between the costs and the stages of pressure injuries, so that the more severe the injury, the greater the treatment expense.

Different coverage costs vary depending on the area and severity of the PI. A study on this topic[(5)] presented costs involved in the treatment of PI. Such work can provide support for decision makers, as well as for conducting cost-effectiveness investigations, a crucial factor in care management. However, more studies are needed.

Despite the awareness of nursing professionals about the physical and emotional consequences for patients, most of them are unaware of the economic consequences for the institution when a patient develops this adverse event: PI. This was considered the problem of this research. In addition, to perform the systematization of nursing care (SAE), the socioeconomic and epidemiological characterization of the patient who develops this condition becomes an ally for its prevention. Thus, this study aims to evaluate the cost of treating PI, related to dressing materials and nursing workforce, as well as to characterize the population affected by PI during hospitalization.

This knowledge will contribute to the proper planning of care, enabling the direction of rational and efficient use of resources, often scarce, collaborating mainly to avoid adverse events to the patient.

METHOD

This is a descriptive cross-sectional study, with secondary data from direct cost analysis of dressing materials in the treatment of pressure injuries (PI). It was performed at a medium-sized teaching hospital in the state of Minas Gerais. Participants were all patients who developed pressure injury at the time of admission to the hospital, scenario of this research, during the first semester of 2018. The inclusion criterion was that the patient was 18 years old or older and had been undergoing PI treatment. The sample was non-probabilistic, totaling 60 participants.

Data were collected via the form, in the records of patients who developed PI, with retrospective filling, covering sociodemographic, clinical and cost-related variables. A data collection instrument was developed for the research.

Sociodemographic variables were: age, gender, color, employment status and marital status. Clinical variables were underlying disease (affected system), length of stay and outcome (discharge, transfer or death). The variables related to the cost were materials used, expenses with the material used and cost-hours of the nursing professional (nurse or nursing technician), by dressing change and established by the Regional Nursing Council of Minas Gerais - COREn MG (R$ 37.91 per hour).

The collected data were transferred to Microsoft® Excel spreadsheets and, at first, evaluated using descriptive statistics techniques, whose purpose was to summarize the information. Patient characterization was performed by calculating the absolute and relative frequencies of categorical variables and calculating the mean, median, minimum, maximum, standard deviation and coefficient of variation for quantitative variables. The coefficient of variation (CV), the relationship between the standard deviation and the mean, assesses the degree of heterogeneity of each quantitative variable, measures the level of data variability: if CV> 30%, then the variable has great variability. Variable with CV> 100%, when the standard deviation is greater than the average, has extremely high variability. For each item consumed/required for pressure injury treatment, the reference value for its cost was calculated. The reference value or "normality standard" was defined as the 90^{th} percentile (p_{90}) of the cost with each component of pressure ulcer treatment: only 10% of patients have expenditures above the 90^{th} percentile. In addition, dispersion diagrams were constructed by crossing quantitative variables with total and material costs.

Then, after descriptive analysis of the data, univariate analyzes were performed to identify the factors, the total cost and the cost of materials used in the treatment for pressure injury treatment. Bilateral statistical hypothesis tests were performed, considering a significance level of 5% (α=0.05). Univariate analysis was conducted to assess the crude association of independent variables of interest with cost outcomes. Categorical variables were evaluated using Pearson's chi-square test and exact tests (when necessary); Quantitative variables were evaluated by nonparametric Mann-Whitney or Kruskal-Wallis test.

In the last step, multivariate analysis was performed using multiple linear regression for the total cost outcome. The variables that made up the model at this stage of multivariate analysis were selected by univariate analysis (p-value ≤ 0.25). For the selection of independent factors associated with total cost, multiple linear regression methods with automatic variable selection or Foward Stepwise were applied. Three Foward Stepwise methodologies were used: Foward Stepwise Wald, Conditional Foward Stepwise, and Foward Stepwise. The applicability of the multiple linear regression model was evaluated by the coefficient of determination (r2). All analyzes were performed using the Statistical Package for Social Sciences® (SPSS), version 18.0 and Microsoft® Excel itself.

The project was submitted to the Research Ethics Committee (COEP) of the Federal University of Minas Gerais (UFMG), and was approved under number 2930479. An informed consent waiver was requested, as the data were retrospective and collected from medical records and costs released by the hospital pharmacy. The anonymity of the patients and the institution was preserved. The risks were minimal since only researchers had access to data from both the medical records and the costs released by the Pharmacy.

RESULTS AND DISCUSSION

The results and discussion are presented in three steps, called Part 1, Part 2 and Part 3. Part 1 refers to the "Profile of the patients analyzed". Part 2 concerns the "Dressing materials usage profile and costs". Part 3 is entitled "Cost Factors Associated with the Treatment of Pressure Injuries". Data are presented in graphs, tables and diagrams.

Part 1 – Profile of the patients

Most patients (63%) were female. This data was also found in a study of PI in critically ill patients [6], in which 51% were women. However, in a research about the incidence of PI [7], this problem affected men more (52.9%). Although these two studies were directed to patients admitted to intensive care, this difference between them may be related to the comorbidities of each patient.

As for color, 62% of the patients were white, while brown and black together constituted 38% of the sample. The literature is not unanimous in this regard, since a study on the incidence of PI in hospitalized patients had the majority (51%) of brown or black patients. However, scholars postulate that black skin is more resistant to external aggression caused by moisture and friction[9].

Regarding the employment situation, 47% were retired, while 41% worked outside. It is noteworthy that the average age in this study was 78 years-old, i.e., age compatible with retirement. However, in research on PI[6], 55% of participants were still active at work. It was not characteristic of this study the non-consideration of household chores as work, since 13% of patients identified themselves as homemakers.

Regarding marital status, 45% were married. The others were widowed (37%), single (15%) or separated (3%). Different data was found in the literature[10] on the profile of patients with pressure injury, where 52% were single and 27% were married. This data may vary according to the age of the sample. The authors point out that the spouses become the caregivers of their husbands and wives, expressing concern about providing good health care for their partners.

The most common underlying diseases were: affected system, neurological system (60%), cardiovascular system (47%), locomotor system (47%), endocrine system (43%), genitourinary system (27%), respiratory system (18%) and digestive system (15%). The remaining (others) constituted 18%. The literature varies in this respect, since authors observed in a study on PI that 63% of the associated diseases were infectious, parasitic diseases and neoplasms [11]. It is recalled that infections and neoplasms may have other risk factors PI.

The mean age of the patients in this study was 78 years-old, with a standard deviation of 14.3. With regard to the elderly people, it is considered that the PIs are complications that may occur in people in fragile situation, especially those with mobility restriction and advanced age [12]. The absolute majority of patients evaluated (72%) were between 70 and 95 years old. The age ranged from 35 to 100 years-old.

The weight of the patients at the time of hospitalization was 64 kg on average, with a standard deviation of 12.5 kg. No data were recorded in the medical records regarding height of patients, making it impossible to calculate Body Mass Index (BMI). Individuals weighing less than 30 kg or weighing between 30 and 40 kg together constituted 5% of the sample. In contrast, the weight between 80 and 90 kg affected 2% of the sample. Referring to the literature[13], there is an association between nutritional deficit and development of PI and healing delay. However, an integrative literature review showed that there is a high rate of PI in critically ill and/or overweight critically ill patients[14]. In this study, the absolute majority (30%) of the patients had weight between 50 and 60 kg.

As for treatment time, the hospitalization rate in weeks ranged from one to more than 20 weeks. Most subjects evaluated (62%) had treatment performed within three weeks. However, a great heterogeneity in the results was observed. Some patients (12%) were hospitalized for more than 15 weeks.

This time variation may be related to a number of factors, such as underlying disease and age, among others. In an integrative review on nursing care in the prevention of PI, specifically for ICU patients[15], the authors selected 18 articles that cited risk factors for the development of this condition. However, only one article indicated length of stay as a risk factor for PI. Nevertheless, it is known that hospitalization may be linked to a number of

factors, such as decreased mobility, vasoactive drugs, delayed bladder catheter, mechanical ventilation, friction and shear, humidity, cardiovascular or nervous system diseases and others[15]. Patient clinical data and length of stay and treatment are shown in Table 1.

Table 1 - Clinical profile of the evaluated patients - quantitative variables.

Variables	Average	Median	Standard deviation	Coefficient of variation
Age (years)	78	81	14,3	18%
Weight on admission (Kg)	64	65	12,5	20%
Total treatment time (weeks)	4	2	4,9	125%
Total length of stay (weeks)	6	3	8,9	142%

Source:

The coefficient of variation, the relationship between the standard deviation and the average show a very large variation in the data when assuming values above 30%. If the mean value is very different from the median, then aberrant data is present and the median should be chosen to represent the data.

Regarding the outcome of hospitalization, we were struck by the death rate: 50% of the remaining 38% were discharged and 12% were transferred to other institutions. It is recalled that 60% of patients had neurological disorders, which may have given them a more reserved prognosis.

Part 2 – Profile of the dressing materials usage and costs

In the data on the cost of dressing materials and labor, it is important to highlight that the covers and topical drugs used in this service are products indicated by the current literature[10]. Hydrocolloid plate, hydrogel, calcium or sodium alginate, petrolatum impregnated mesh, activated carbon, silver sulfadiazine, collagenase, transparent film, vacuum dressing reservoir and negative pressure dressing kit, as well as basic materials such as bandages, gauze pads and saline are used. Great heterogeneity was observed in all items used in the treatment of pressure injuries (Table 2).

Table 2 – Cost profile with dressing materials and labor.

Cost item for pressure injury treatment	Sum	Minimum	Maximum	Average	Median	Standard deviation	Coefficient of variation
Hydrocolide 20x20 cm total value	R$535	R$0	R$170	R$9	R$0	R$30	333%
Needle desc 25x8 total value	R$195	R$0	R$27	R$3	R$1	R$5	152%
Age total value	R$1.242	R$0	R$347	R$21	R$4	R$60	289%
Hydrogel total value	R$8.315	R$0	R$1.237	R$139	R$25	R$258	186%
Alginate calcium / sodium alginate 10x10cm total value	R$4.363	R$0	R$1.814	R$73	R$0	R$280	385%
Petrolatum impregned screen 7.5x20 cm total value	R$18	R$0	R$14	R$0	R$0	R$2	609%
Alginate tape / cord total value	R$372	R$0	R$169	R$6	R$0	R$27	429%
Bandage 15cmx1,8m total value	R$2.276	R$0	R$442	R$38	R$7	R$79	208%
Bandage 10cmx1,8m total value	R$1.036	R$0	R$277	R$17	R$5	R$41	240%
Gaze compress 7,5x7,5 cm total value	R$13.997	R$2	R$4.143	R$233	R$54	R$568	244%
Physiological saline 100 ml total value	R$5.263	R$4	R$436	R$88	R$42	R$112	127%

Physiological saline 250 ml total value	R$1.121	R$0	R$265	R$19	R$0	R$47	250%
Activated coal total value	R$634	R$0	R$516	R$11	R$0	R$67	634%
Silver sulphadiazine total value	R$732	R$0	R$704	R$12	R$0	R$91	746%
Colagenase total value	R$4.370	R$0	R$1.102	R$73	R$0	R$190	260%
Transparent film 10cmx12cm total	R$1.340	R$0	R$523	R$22	R$0	R$71	317%
Curative pressure kit neg. Total value	R$3.245	R$0	R$2.445	R$54	R$0	R$330	611%
Vacuum curative reservoir total value	R$1.959	R$0	R$1.123	R$33	R$0	R$179	549%
Total spending with materials	R$51.014	R$9	R$8.388	R$850	R$227	R$1.667	196%
Time cost of professional (nurse/nursing technician)	R$62.172	R$76	R$6.141	R$1.036	R$455	R$1.293	125%
TOTAL COST	R$113.186	R$123	R$13.998	R$1.886	R$700	R$2.665	141%

Source:

Table 2 shows great heterogeneity in all items used in the treatment of PI, indicating the sum of each product used during the first semester of 2018.

Taking hydrogel as an example, expenditures on semester with this product were R $ 8,315.00. On the other hand, expenses with petrolatum-impregnated canvas were R$ 18.00 in total. Importantly, essentially basic products can have a reasonable single price, however, they are used on a large scale, such as 100 ml saline, whose minimum in this work was R$ 4.00 and maximum of R$ 436.00, in an average of R$ 88.00 per patient, with a standard deviation of R$ 112.00. It is considered that the treatment of any skin lesion, using cutting edge materials and covers is justified, taking into account the benefits of faster and less painful healing for the patient and the systematic work of professionals.

In an observational study[10] conducted at the palliative care unit of a hospital in Minas Gerais, whose sample consisted of 40 patients, the authors observed that the expenses with the materials for the treatment of PI exceeded R$ 1,220.00 per day, surpassing R$ 36,629.95 per month, totaling an annual expense of R$ 445,664.38. These values are unique to the materials used for the treatment of PI, since the authors do not mention labor costs of professionals. Thus, it is inferred that PI treatment is very costly to the institution. PI prevention measures need to be intensified, including reducing spending.

With this work, we sought the value of direct costs with dressing materials (average and median, 95% confidence interval) and indirect costs, which refer to the dressing performed by a nursing technician or nurse. COREn/MG establishes the amount of R$ 37.91 for each hour dedicated to dressing, for both the nursing technician and the nurse. In this study, the average value of this service was R$ 1,036.00. Most patients evaluated (68%) had a maximum cost of R$ 1,000.00. There is great disparity in results, with a few patients (10%) with labor costs over R$ 2,500.

In the literature[5], we present labor calculations based on the payroll of all employees involved via the Worker Point Calculation System. For the authors, there was a variation of 5.75 to 33.73 minutes in the application of all coatings. The authors compare the sacral PI dressings with the others, taking into account that the time taken to position the person treated, as well as to perform the cleaning of the sacral PI, were longer.

The following are maximum reference costs, based on the 90th percentile of dressing materials and labor costs for pressure injury treatment (Table 3).

Table 3 – Maximum reference costs for the treatment of pressure injuries.

Cost item for pressure injury treatment	Maximum reference cost (90th percentile)
Hydrocolide 20x20 cm total value	R$4
Needle desc 25x8 total value	R$7
Age total value	R$35
Hydrogel total value	R$433
Alginate alginate of calcium/ sodium 10x10cm total value	R$54
Petrolatum impregned screen 7.5x20 cm total value	R$0
Alginate tape / cord total value	R$0
Bandage 15cmx1,8m total value	R$81
Bandage 10cmx1,8m total value	R$36
GAZE COMPRESS 7,5x7,5 CM TOTAL VALUE	R$517
Physiological serum 100 ml total value	R$292
Physiological serum 250 ml total value	R$78
Activated coal total value	R$0
Silver sulphadiazine total value	R$0
Colagenase total value	R$158
Transparent film 10cmx12cm total value	R$48
Pressure curative kit neg. Amount	R$0
Vacuum curative reservoir total value	R$0
Total spending with materials	R$2.128
Time cost of professional (nurse/nursing technician)	R$2.438
Total cost	R$4.403

Source:

Only 10% of patients have a cost above the 90th percentile, defined as the maximum referral cost.

Investigating the costs of treating PI[16] mapped the activities of 26 dressings performed by nurses in a public hospital in Minas Gerais. About these dressings, four corresponded to PI category 2; one to category 3; 13 to category 4; six to PI that cannot be classified and two others did not have the mentioned category. The authors stratify the prices of mulches and adjuvants, namely: hydrocolloid; alginate; hydrofiber and silver; collagen and alginate; hydrogel; nanocrystalline silver. Considering the costs of coverage, medical supplies and human resources, the costs ranged from R$ 16.41 to R$ 260.18, depending on the type of coverage and extent of PI.

In regard to the patients evaluated in this study, 38% had a maximum cost of R$ 300. There was great heterogeneity in the results, with a few patients (11%) with material costs above R$ 2,500.

Part 3 - Factors Associated with Costs for Treating Pressure Injuries

The "Neurological System" comorbidity was significantly lower when present (p = 0.001). These indices differ from those found in a study on the costs of PI with neurosurgical patients[16].

Although no association calculation was performed, the authors observed four patients, and one of the patients with stage 2 PI needed to perform hydrogel debridement with calcium alginate, which increased the cost of treatment. In the same study, one of the patients, considered to be the most critical patient in the series, was admitted with stage 1 PI, but rapidly evolved to stage 3 and required surgical debridement, hydrogel dressing, activated charcoal and antimicrobial use.

All reported patients[16] were from the neurosurgery clinic. However, patients who received some kind of prevention had the lowest costs compared to others. The average daily cost of participant named patient 4 exceeded the average daily cost of patient 1 by 45%. In comorbidities involving the other systems there was no association.

Patients discharged from hospital also had a significantly lower cost compared to patients who died or transferred to another hospital (p = 0.005).

Table 4 - Univariate analysis of possible factors associated with the cost of dressing materials for the treatment of pressure injuries.

Variable	Categories	n	Average cost with materials	Standard deviation	P-value
Sex	Female	38	R$788	R$1.853	0,104
	Male	22	R$958	R$1.317	
Color	White	37	R$575	R$997	0,869
	Black	9	R$879	R$1.050	
	Pardo	14	R$1.560	R$2.901	
Marital status	Married	27	R$1.062	R$1.810	0,062
	Widower	22	R$329	R$618	
	Single	9	R$1.539	R$2.717	
	Divorced/separated	2	R$634	R$224	
Comorbidity: Cardiovascular System	No	32	R$791	R$1.961	0,524
	Yes	28	R$918	R$1.283	
Comorbidity: Digestive System	No	51	R$905	R$1.751	0,379
	Yes	9	R$539	R$1.095	
Comorbidity: Endocrine System	No	34	R$908	R$1.937	0,858
	Yes	26	R$774	R$1.262	
Comorbidity: Genitourinary System	No	44	R$809	R$1.741	0,960
	Yes	16	R$964	R$1.488	
Comorbidity: Locomotor System	No	32	R$1.009	R$1.738	0,328
	Yes	28	R$668	R$1.592	
Comorbidity: Neurological System	No	24	R$1.375	R$1.900	0,001
	Yes	36	R$500	R$1.412	
Comorbidity: Respiratory System	No	49	R$748	R$1.486	0,510
	Yes	11	R$1.306	R$2.347	
Comorbidity: Others	No	49	R$756	R$1.458	0,364
	Yes	11	R$1.270	R$2.438	
Outcome of hospitalization	Death	30	R$954	R$1.808	0,005
	Discharge	23	R$549	R$1.639	
	Transfer to another hospital	7	R$1.396	R$952	

Note: p-value calculated by the nonparametric Mann-Whitney or Kruskal-Wallis test.

Discussing costs for the treatment of pressure injuries by univariate analysis of the possible factors associated with the cost of dressing materials for the treatment of pressure injuries, it was found that the variables gender, color, work status and marital status did not present p <0.005, that is, there was no significance.

In the univariate analysis of the possible factors associated with the total cost of treating pressure injuries, it was observed that the marital status “Widower” was significantly lower (p = 0.042). In addition, patients with “Neurological System” comorbidity had a significantly lower cost when present (p = 0.011). As with material cost analysis, patients discharged from hospital also had significantly lower total costs (p = 0.010). These data are shown in Table 5.

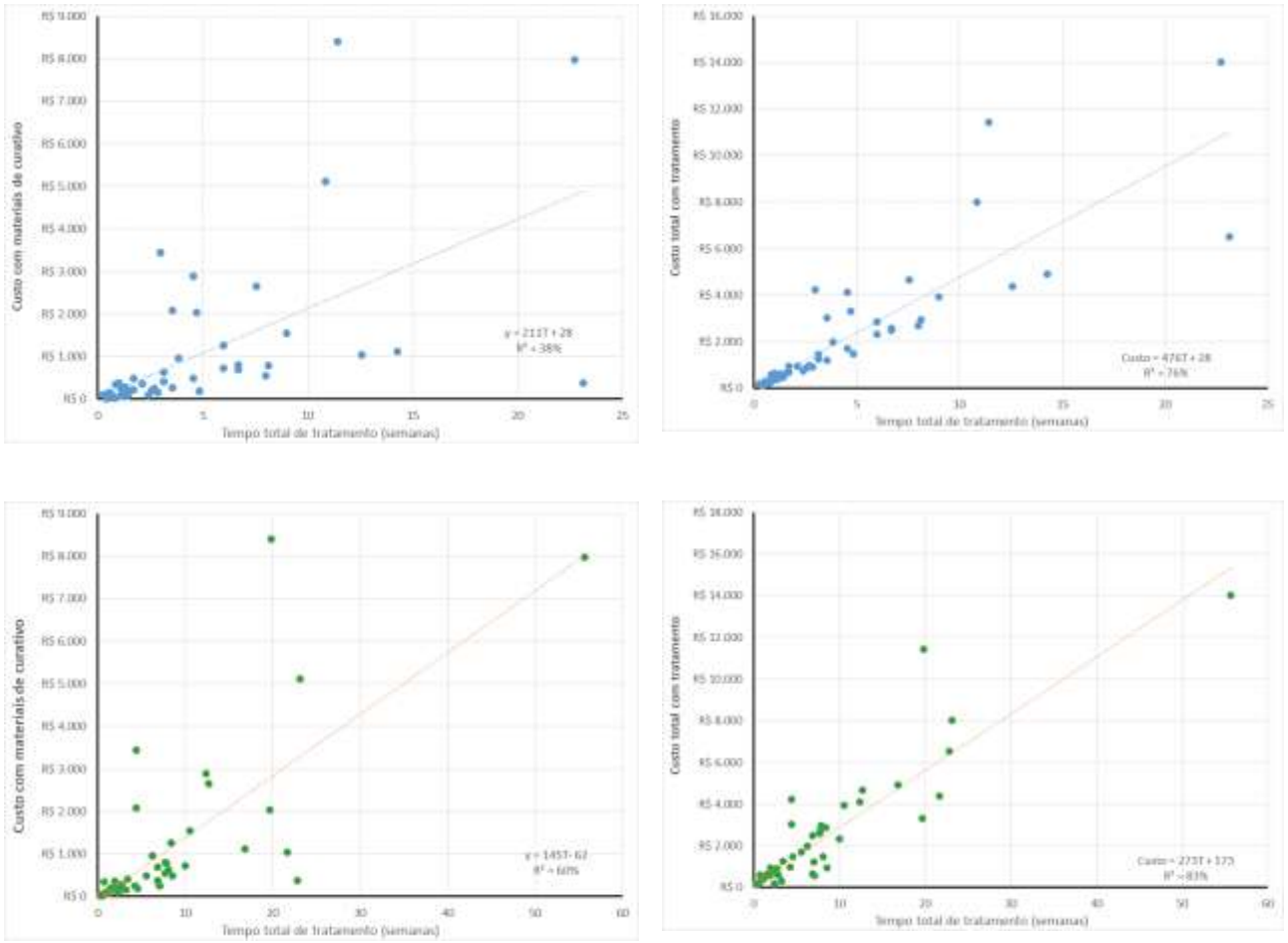
Table 5 - Univariate analysis of possible factors associated with the total cost of treating pressure injury.

Variable	Categories	n	Average cost with materials	Standard deviation	P-value
Sex	Female	38	R$1.691	R$2.909	0,092
	Male	22	R$2.224	R$2.204	
Color	White	37	R$1.617	R$1.921	0,996
	Black	9	R$1.548	R$1.656	
	Pardo	14	R$2.816	R$4.372	
Work situation	Retired	28	R$1.937	R$2.363	0,528
	Housewife	1	R$4.223	-	
	Shopkeeper	8	R$2.189	R$4.791	
	Locksmith	1	R$1.699	-	
	Seller	1	R$1.199	-	
	Others	21	R$1.634	R$2.232	
Marital status	Married	27	R$2.511	R$3.085	0,042
	Widower	22	R$898	R$1.254	
	Single	9	R$2.461	R$3.576	
	Divorced/separated	2	R$1.752	R$1.162	
Comorbidity: Cardiovascular System	No	32	R$2.018	R$3.203	0,917
	Yes	28	R$1.736	R$1.923	
Comorbidity: Digestive System	No	51	R$2.041	R$2.820	0,315
	Yes	9	R$1.010	R$1.298	
Comorbidity: Endocrine System	No	34	R$1.998	R$3.045	0,687
	Yes	26	R$1.741	R$2.119	
Comorbidity: Genitourinary System	No	44	R$1.833	R$2.810	0,726
	Yes	16	R$2.035	R$2.296	
Comorbidity: Locomotor System	No	32	R$2.045	R$2.848	0,635
	Yes	28	R$1.705	R$2.479	
Comorbidity: Neurological System	No	24	R$2.710	R$3.104	0,011
	Yes	36	R$1.338	R$2.206	
Comorbidity: Respiratory System	No	49	R$1.551	R$2.116	0,316
	Yes	11	R$3.381	R$4.172	
Comorbidity: Other	No	49	R$1.741	R$2.520	0,316
	Yes	11	R$2.535	R$3.296	
Outcome of hospitalization	Death	30	R$1.806	R$2.532	0,010
	Discharge	23	R$1.620	R$3.128	
	Transfer to another hospital	7	R$3.107	R$970	

Note: p-value calculated by the nonparametric Mann-Whitney or Kruskal-Wallis test.

Scatter diagrams assessing the relationship between treatment time and length of stay versus cost of materials and total cost suggest a strong correlation between both times and costs for treating pressure injuries (Figure 1).

Figure 1 - Diagrams of dispersion treatment time and material cost.



Source: Research data.

There is logic to this relation: longer hospitalization implies greater exposure to risk factors. According to researchers[17], bed restriction, mobility difficulty and clinical condition favor the onset of PI. Thus, efforts should be made to minimize the effects of hospitalization with regard to the risks of developing PI.

Regarding the multivariate analysis of the possible factors associated with the total cost for the treatment of pressure injuries, considering a set of variables, it was observed that only the hospitalization time and the treatment time were significantly associated with total cost, with p value 0.000 and 0.032, respectively.

Table 6 - Multivariate analysis to identify factors associated with the total cost for treating pressure injury.

Variable	Coefficient	Standard error	P-value
Total treatment time (weeks)	166,1	58,4	0,006
Total length of stay (weeks)	192,8	32,0	0,000
Constant	25,8		

The evaluation by multiple linear regressions was obtained by the Stepwise Forward method. The three Foward Stepwise methodologies used (Foward Stepwise Wald, Conditional Foward Stepwise, and Foward Stepwise) resulted at the same model. Of all the variables evaluated, only two were independently and significantly associated with the total cost: total treatment time (weeks) and total hospitalization time (weeks).

The multivariate model can be used to predict the total cost of treating PI. This model uses treatment time and length of stay, and they have a determination coefficient (r2) of 85%, i.e., the model explains 85% of the variability in the total cost of each patient.

This study had as limiting factor the absence in the medical records of more information about patients, such as height, which would allow the calculation of BMI. However, the objectives were achieved, allowing estimating the cost of treating a pressure injury in relation to its prevention.

FINAL THOUGHTS

The results presented by this study showed, among other aspects, that the population most at risk for the development of pressure injuries was the elderly people, with a mean age of 78 years-old, due to the changes generated by the aging process, making the skin more healthy, tenderness, muscle loss, and reduction of subcutaneous tissue fat. It was also observed that most patients are female (63%), with predominantly white skin color, 45% are married, 47% are retired, and 60% have underlying diseases related to the neurological system. The nutritional status of the patient also contributes to the process of pressure injury, given that malnourished or obese patients are more vulnerable to their involvement. However, in this study, the majority (30%) of the analyzed subjects weighed between 50 and 60 kg.

Regarding the costs of treating PI, the average cost per year of PI treatment per patient was R$ 1,886.00 and total semiannual cost of R$ 113,186.00. Regarding the distribution of labor costs involving nursing professionals (nurses and nursing technicians) for the treatment of PI, most patients evaluated (68%) had a maximum cost of R$ 1,000.00, with a few patients, (10%) with labor costs over R$ 2,500.00. Direct costs were appropriated focusing on materials and covers/adjuvants used and nursing time invested in performing these procedures.

This study will contribute to the improvement of health care management, as it will provide reflections on the cost and benefits of PI prevention in terms of cost reduction, thus optimizing nursing practice. It is also noteworthy that patient well-being and comfort are sovereign factors in health care quality management.

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