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Association of blood pressure documentation with adverse outcomes in an emergency department in Brazil

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ABSTRACT

Objective: To associate blood pressure (BP) documentation with adverse outcomes in an emergency department (ED).

Methods: This is a retrospective observational study, and 642 records of patients admitted to the ED of a tertiary hospital in Brazil were used. We included medical records of patients of both sexes aged over 18 years, who were allocated in general wards in the period December 2015-June 2016. Association between BP measurements with length of stay (LOS), worsening of clinical presentation, unplanned patient transfer, readmission, stroke or transient ischemic attack, cardiorespiratory arrest, and death were investigated.

Results: Association was observed between worsening of clinical presentation and systolic ($p = 0.003$) or diastolic ($p = 0.001$) BP values. The association between LOS and worsening of clinical presentation with the number of BP measurements or mean time between BP measurements was statistically significant ($p < 0.001$). Unplanned patient transfer was associated with an increase in the number of BP measurements ($p < 0.001$). The mean time between BP measurements was higher among patients who returned to the ED within 48–72 h ($p = 0.030$).

Conclusions: The results of this study showed association between BP documentation with adverse outcomes in the ED, reinforcing the need to develop educational strategies regarding nursing records and monitoring of vital signs.

1. Introduction

Blood pressure (BP) documentation, which represents the patient's condition and allows an early recognition of clinical deterioration, is one of the most common tasks accomplished by a nursing professional in the emergency department (ED). The BP documentation includes the number of measurements and the frequency of systolic and diastolic BP values recorded for a certain time. These records are usually shared among the multiprofessional team and systematically interpreted to contribute to clinical judgment, develop decision making skills, and prevent potential adverse events [1].

Although BP documentation for critical nursing care is important, studies have shown that monitoring of vital signs in medical records is still unsatisfactory and does not reflect the care provided to patients [2–5]. Failures to identify physiological parameter changes have been associated with unfavorable clinical outcomes, such as unscheduled return visits to the emergency department, greater length of stay in care units, unplanned transfers to higher-intensity settings, and increased mortality rates [6–9].

Previous studies have found that about 8.3–15.0% of patients admitted in emergency departments experienced predictable and preventable adverse events due to suboptimal management issues and inappropriate monitoring of vital signs [10,11].

Although abnormal BP values have been associated with acute events in adult patients [12], there is a lack of knowledge about how BP documentation can point out the early recognition of clinical deterioration and affect the quality of care in the emergency department.

Other physiological parameters, such as heart rate, respiratory rate, and arterial oxygen saturation, are also recorded in the routine practice and considered common predictors of deterioration. However, isolated

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low blood pressure is associated with a significant increase in cardiac arrest and mortality rates [9]. Systolic blood pressure (SBP) lower than 100 mmHg may indicate circulatory impairment in severely ill patients, including those with heart failure, sepsis, or progressive hemorrhages [12]. Similarly, increase in SBP values greater than 200 mmHg can lead to acute organ damage and adverse cardiac or cerebrovascular events, such as myocardial infarction, hypertensive crises, and stroke [13]. Previous studies have shown that diastolic blood pressure (DBP) lower than 60 mmHg is an important mortality predictor in younger adults and elderly patients and should also be monitored by health providers [14,15].

Documentation of BP values is an essential element of clinical surveillance in high-risk patients and may enhance the prediction of unfavorable clinical outcomes and care quality. Therefore, the objective of this study was to associate BP documentation with adverse outcomes in an emergency department.

2. Methods

This study is a retrospective, cross-sectional, and observational study conducted in the emergency department of a tertiary hospital located in the city of São Paulo, Brazil. We analyzed a convenient sample of charts, which included patients of both sexes, aged over 18 years, and admitted to the observation unit in the period December 2015 - June 2016. We sought to determine a period of six months for the data collection to provide a varied distribution of patient demand and clinical outcomes, since a single medical center was analyzed.

Although the sample was of convenience, its size was checked for power to detect medium-size effects in the comparison between groups for non-normal numerical measurements using the Mann-Whitney test. Initially, calculations were made considering *t*-tests and then added 15%, based on data in the literature [16]. The minimum N value required in each group was calculated to achieve a power of 80%, significance of 5%, and effect size of 0.5 (medium effect) [17]. Thus, if one group had a minimum N of 50 individuals, the other would need to have at least 140 observations, which we achieved in three of the five outcomes analyzed [18].

We excluded charts of patients with emotional disorders and psychomotor agitation, which could interfere with BP measurement, and charts of patients in palliative care or “do not resuscitate orders”, which could change the study results. These criteria were established to avoid impacts on internal validity, such as inaccurate BP measurements, low number of BP measurements, and inappropriate adverse outcomes.

Data were collected by the Quality of Blood Pressure Documentation Questionnaire (QBPDQ; supplementary material 1), which was validated regarding appearance and content by experts in BP measurement, critical care, patient safety, and related topics using the Delphi technique [19]. Such questionnaire has not yet been externally validated. The QBPDQ was composed of three items: (1) patient identification (age, gender, and diagnostic hypothesis), (2) BP documentation (time of BP measurement; SBD and DBP values in mmHg; and number of BP records), and (3) patient outcomes (length of stay greater than six hours in the emergency department; worsening of clinical presentation; unplanned patient transfer to the ward, semi-intensive unit, or intensive care unit; readmission within 48–72 h with the same complaint; cardiorespiratory arrest, stroke, and transient ischemic attack or death within 48 h). The length of stay was measured from the documented triage time to discharge time and worsening of clinical presentation was described by SBP ≤ 90 mmHg, SBP ≥ 180 mmHg or clinical deterioration reported in patient charts (physiological decompensation accompanied by objective findings, such as fever, tachycardia, tachypnea and delirium). Unplanned patient transfers were considered when the patienťs clinical condition required an exchange of accommodation for the ward, semi-intensive or intensive care units.

The patient outcomes were determined by means of an extensive literature review on incidents and adverse events in emergency departments. Such outcomes were associated with BP values, number of BP measurements per patient, and mean time interval between each measurement.

The mean time interval between BP measurements was documented according to an institutional protocol [20], which defines that (1) patients with SBP ≤ 90 or ≥ 180 mmHg should have their blood pressures recorded at least every 15 min; (2) patients with SBP > 90 or < 180 mmHg should have their blood pressures recorded according to the Emergency Severity Index (ESI) triage algorithm [21].

The institutional protocol recommends that patients should have their blood pressures recorded according to their ESI level classification as follows: Level 1 at least every 2 h; Level 2 at least every 4 h; Level 3 at least every 6 h; and Levels 4 or 5 according to registered nurse request [20].

The BP measurements were performed by nursing professionals during the first clinical assessment in the triage room or observation unit. All measurements were performed on patients’ upper arm using Dräger Infinity Delta (Dräger Medical Systems, Inc.; Danvers, MA, USA) routine monitoring devices. All nursing professionals in the emergency department documented BP values in the charts after an institutional educational program was implemented for training and validation regarding the oscillometric technique and BP recording. The professionals received information about the aim and content of the study, and they signed the informed consent before the study was initiated.

This study followed the national and international standards of ethics in research involving human subjects as well as the requirements of the Brazilian Resolution N° 466/2012. The study project was approved by the Research Ethics Committee of the participating hospital (protocol number 1.105.180/2015).

The data were entered into a database, processed using the SPSS v.20.0 (SPSS Inc.; Armonk, NY, USA) software, and the analyses were conducted using the R 3.2.2. (R Foundation; Vienna, 2015) software. Descriptive analyzes were performed for all variables and the results were presented as median values, interquartile ranges (for non-normal variables), and absolute numbers and percentages (for categorical variables). Mann-Whitney tests were used to compare groups with basis on their numerical measurements. The significance level $\alpha = 0.05$ was adopted.

3. Results

A total of 665 patients presented to the emergency department during the study period, but 23 were excluded due to emotional disorders (2), psychomotor agitation (8), and palliative care or “do not resuscitate orders” (13). At the end, 642 records were included, comprising charts of men (310; 48.3%) and women (332; 51.7%) with a mean age of 60.6 years. Half of the medical records (50.2%) belonged to patients diagnosed with digestive, respiratory, and circulatory diseases (Table 1). Regarding BP documentation, 1830 records were analyzed; they were performed in the morning (494; 27.1%), afternoon (597; 32.7%), and evening (732; 40.2%). The patient’s profile distribution of the first systolic and diastolic BP assessment (at admission) is shown in Fig. 1 and all measurements obtained after admission are shown in Fig. 2.

Regarding patient outcomes, 251 (39.1%) charts were from patients with extended length of stay in the emergency department, 65 (10.1%) presented worsening of clinical condition, 51 (7.9%) were transferred to hospital sectors without prior planning, 35 (5.5%) returned to the emergency department within 48–72 h with similar complaints, and 4 (0.6%) had cardiorespiratory arrest after 48 h of admission. One case of death (0.2%) and no case of stroke or transient ischemic attack were reported, which prevented the use of comparison tests.

The results showed no association between SBP and DBP with length of stay, readmissions, or cardiorespiratory arrests. Patient charts that reported worsening of clinical presentation indicated a decrease in the SBP ($p = 0.003$) and DBP ($p = 0.001$) values, and charts that

Table 1
Sample characterization ac cording to age, gender, and diagnosis (n = 642). São Paulo, SP, Brazil, 2016.

Sample characterization	N (%)	Median [IQR]
Age (years)		62.50 [43.25; 78.00]
Genders		
Male	310 (48.3)	
Female	332 (51.7)	
Diagnoses		
Diseases of the digestive system	129 (20.1)	
Diseases of the respiratory system	116 (18.1)	
Diseases of the circulatory system	77 (12.0)	
Diseases of the genitourinary system	68 (10.6)	
Diseases of the nervous system	60 (9.3)	
Diseases of the musculoskeletal system	46 (7.2)	
Injuries, poisonings and consequences of external causes	28 (4.4)	
Others	118 (18.3)	

IQR: interquartile range.

reported unplanned patient transfer to the ward, semi-intensive or intensive care units presented a decrease in DBP ($p = 0.012$) values.

Association between worsening of clinical presentation and the number of BP measurements or mean time interval between these records showed statistically significant ($p < 0.001$) results (Fig. 3). The number of BP measurements and mean time interval between BP measurements were higher ($p < 0.001$) among patients who remained in the emergency department for an extended time (Fig. 4).

Unplanned transfers were associated with increase in the BP measurements ($p < 0.001$) and decrease in the mean time interval between records ($p = 0.030$). Regarding type of patient accommodation, patients who were transferred to wards had the number of BP measurement ($p = 0.011$) increased as well as those who were transferred to the semi-intensive or intensive care units ($p < 0.001$).

In the cases of readmission within 48–72 h, the mean time interval between BP measurements was higher ($p = 0.030$) among patients who returned to the emergency department for medical evaluation.

Only four cases of cardiorespiratory arrest were reported, and they did not show significant differences when associated with number and frequency of BP measurements. The median values for the associations between the study variables are shown in Table 2.

4. Discussion

The BP documentation is an essential tool for early recognition of clinical deterioration and potential adverse events in critically ill patients [6]. Many studies have been published in the last years showing high prevalence of abnormal vital signs preceding cardiac arrest and in-hospital mortality [9–11]. However, little evidence is available on how BP documentation can affect care quality in the emergency department [2].

The results of our study showed that patient charts reporting worsening of clinical presentation and unplanned transfer were associated with decrease in BP values. Previous studies have stated that changes in BP values are directly related to poor prognosis and increased mortality in the emergency department, especially among the elderly population, trauma victims, and patients with infectious, cardiovascular, and gastrointestinal conditions [22–24].

Despite the large evidence on the influence of SBP on patient mortality [25–27], our results pointed out that DBP are also associated with worsening of clinical presentation and unplanned patient transfer. Such findings indicated that the relationship between these variables should be better investigated, because individualized analysis of SBP changes is not sufficient to stratify the risk of unfavorable in-hospital outcomes [28].

Some studies suggested that there is an association between DBP changes and increased risk of cardiovascular events. In addition, DBP is more difficult to control than SBP, especially in older patients who present a significant DBP decrease, history of ischemic heart disease, and cerebrovascular disease [29,30]. Such findings reinforce the need for care strategies in BP surveillance and medical record documentation in ED settings.

The number and the mean time interval between BP measurements were higher in patients who stayed more than six hours in the emergency department. The increase in monitoring may be explained by an excessive waiting time in the observation unit, where a greater number of BP measurements are made at regular intervals, according to established institutional guidelines and nursing care focused on patients' individual needs. Similar evidence was found in a retrospective study conducted in an urban teaching hospital regarding factors that influence the time between records of vital signs in the emergency department. That study showed that increased length of stay had a significant association with increased time between monitoring of vital signs, stating that emergency nurses can follow a floor protocol and obtain vital signs less frequently in stabilized patients who are waiting inpatient beds [31].

Increases in length of stay in the emergency department have been associated with low care quality and adverse outcomes, including diagnosis or treatment delays, communication failures, errors in technical procedures, subsequent hospital admission, and increased mortality rates [32,33]. Furthermore, a longer stay increases nurses' workload and the time of monitoring vital signs. This reinforces the need to implement an educational program regarding abnormal BP values, as well as appropriate clinical documentation and team communication [34].

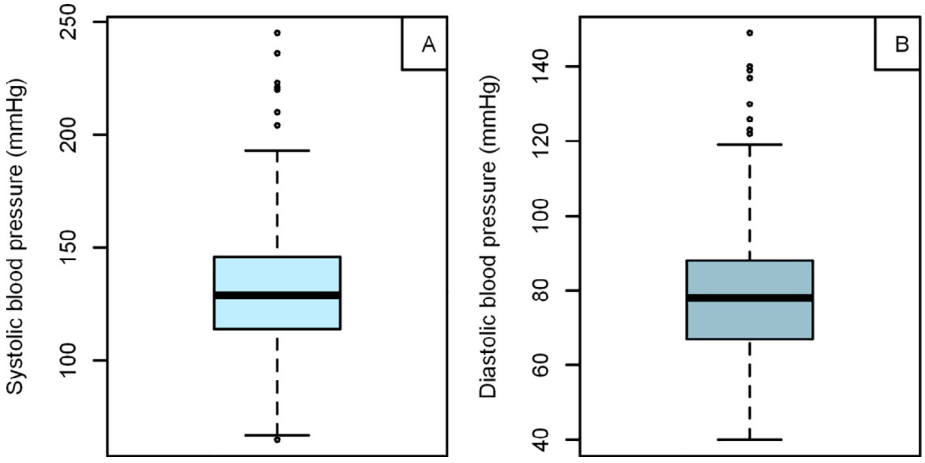

Fig. 1. Box plot of Systolic (A) and Diastolic (B) Blood Pressure values in the first assessment.

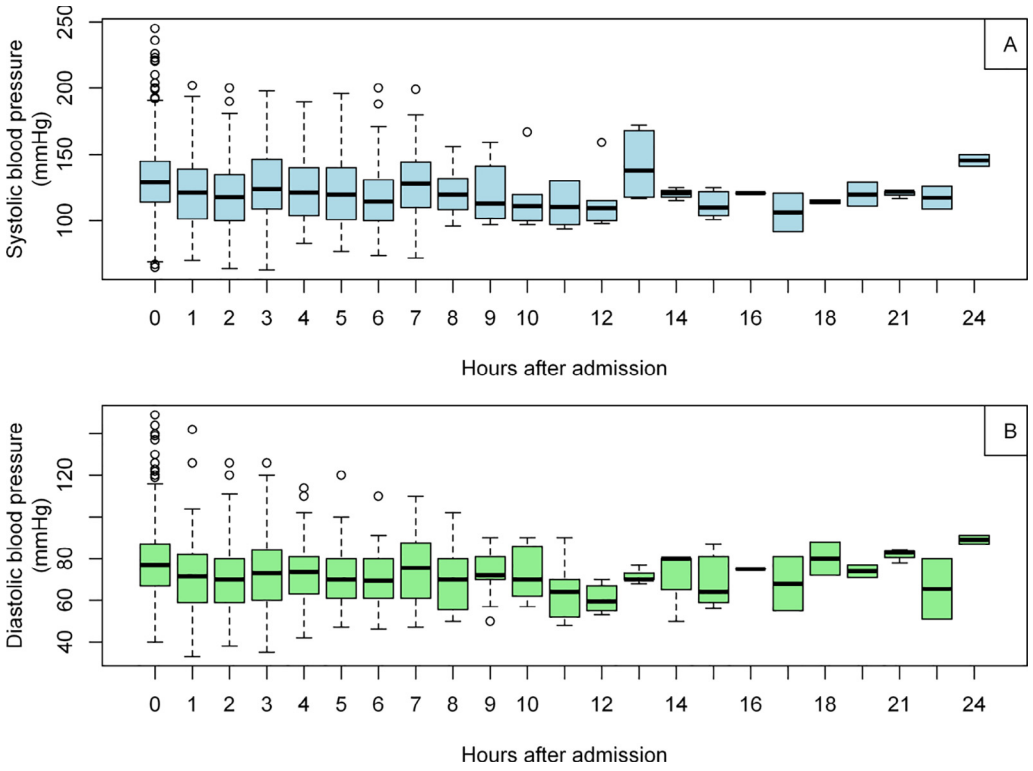

Fig. 2. Box Plot of Systolic (A) and Diastolic (B) Blood Pressure values as a function of time after admission.

Worsening of clinical presentation showed a significant association with increased BP documentation. As expected, patient charts that presented abnormal values and worsening of health condition reported an increase from 2 to 5 in the number of BP measurements and a decrease from 2.72 to 1.97 h in the mean time between BP measurements. Although these data have shown an improvement in clinical surveillance, the frequency of BP measurements did not follow the protocol recommendations and caused a delay in acutely ill patients with important changes in vital signs [12,20].

Possible explanations for the delay in nursing procedures involving critically ill patients are related to increased workload, ED crowding, and hospital admission process with focus on rapid screening and emergency care, not on ongoing critical care [35]. Other findings showed that 6% of patients evaluated in the emergency department had their BP values recorded in charts but omitted during the intershift report, suggesting gaps in emergency training in handover standardization and failures in care quality [36].

Patient charts presenting unplanned transfer due to any physiological change reported rigorous BP monitoring. Unplanned transfer to higher-intensity care settings is associated with changes in clinical condition, failure of diagnostic and therapeutic approaches, need for expert evaluation or hospital technologies, and ineffective communication between health professionals [37].

Delayed recognition of patient deterioration in general wards may lead to unplanned admissions to the intensive care unit, thus affecting interventions and patient status or prognosis [38]. However, poor clinical monitoring has been shown in emergency departments where the frequency of vital signs was evaluated for appropriate and accurate measurements and continuous report of a multiprofessional team [2]. Although the results of the present study have shown a significant increase in the number of BP measurements in patients submitted to unplanned transfer, the mean time between BP records was sub-optimal because a monitoring increase is expected when serious changes in BP values are found.

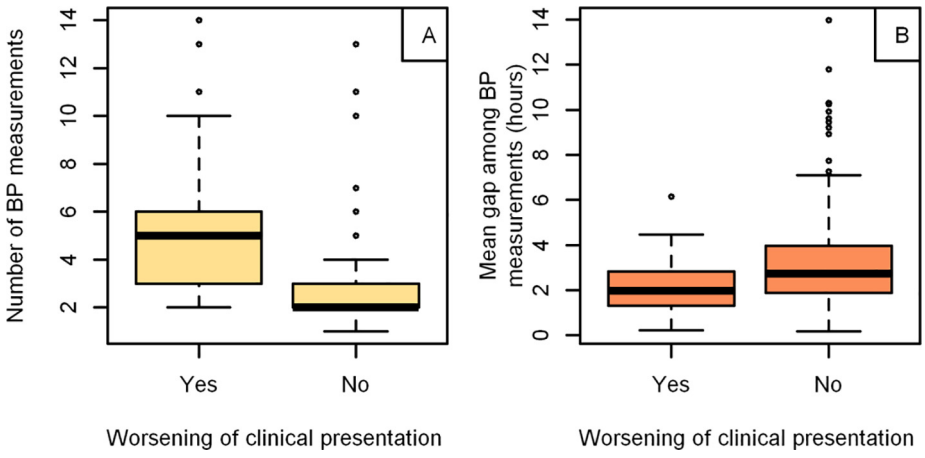

Fig. 3. Association between worsening of clinical presentation with number of BP measurements (A) and mean time interval between BP measurements (B).

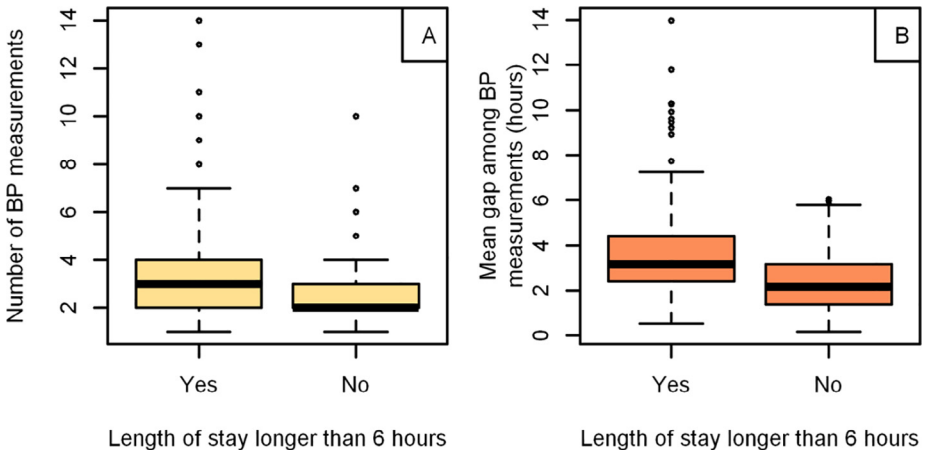

Fig. 4. Association between length of stay greater than 6 h with number of BP measurements (A) and mean time interval between BP measurements (B).

Educational programs have been developed to enhance monitoring of vital signs and improve the quality of nursing handover [39,40]. Recent evidence showed the potential to increase clinical performance and patient safety when appropriate staff education is implemented in early warning score systems and communication tools [40,41]. However, the long-term effectiveness of interventions in the increasing nursing knowledge remains unknown regarding patient physiological deterioration and handover process of critically ill patients, reinforcing the need to implement valid and reliable educational training in emergency departments [41].

The National Early Warning Score 2 (NEWS2) is a scoring system that was developed to standardize the processes of recording and responding to changes in routinely measured physiological parameters of acutely ill patients [12]. Such scoring system is a support for nurses who need to decide whether an increase in the frequency of BP monitoring is necessary. Patients with SBP in the range 91–110 mmHg are classified as low clinical risk and require BP monitoring every 4–6 h; differently, patients with SBP ≤ 90 mmHg or SBP ≥ 200 mmHg are classified as medium clinical risk and require at least one BP measurement per hour [12].

The establishment of a BP monitoring standard must be accompanied by the recording of other important physiological parameters, such as respiratory rate, oxygen saturation, pulse rate, temperature, and consciousness level, because the joint evaluation of these parameters can support the nursing assessment and discrimination risk of serious clinical deterioration [42]. Furthermore, BP measurement as a single parameter can be used in track-and-trigger systems to detect acute illness, review the clinical risk, and decide the frequency of subsequent monitoring [12].

Barriers to implementing early warning scoring systems in our setting required the use of an institutional protocol to determine the frequency of BP monitoring according to the BP values and the ESI triage algorithm score [20,21]. However, standardizing the use of scoring systems will be useful to recognize signs of patient deterioration, direct the frequency of BP monitoring, and promote the clinical nursing judgment in emergency care settings.

The mean time interval between BP measurements was higher in readmitted patients within 48–72 h after ED discharge. This fact may be related to disease evaluation, missed diagnosis, and insufficient treatment [43]. Studies have shown that the mean blood pressure is

Table 2
Association between systolic blood pressure (SBP), diastolic blood pressure (DBP), number (N) and mean time interval (MTI) between blood pressure (BP) measurements with adverse outcomes (n = 642). São Paulo, SP, Brazil, 2016.

	SBP (mmHg)	DBP (mmHg)	BP measurements	
			N	MTI (h)
Length of stay >6 h				
Yes (n = 251)	124.00 [112.50; 137.25]	74.57 [68.37; 81.50]	3.00 [2.00; 4.00]	3.16 [2.40; 4.42]
No (n = 391)	126.00 [113.88; 141.83]	75.50 [67.00; 84.50]	2.00 [2.00; 3.00]	2.17 [1.39; 3.17]
p values	0.169	0.540	< 0.001	< 0.001
Worsening of clinical presentation				
Yes (n = 65)	117.00 [101.00; 137.00]	70.00 [60.43; 78.60]	5.00 [3.00; 6.00]	1.97 [1.32; 2.83]
No (n = 577)	126.00 [114.50; 140.80]	75.50 [68.00; 83.33]	2.00 [2.00; 3.00]	2.72 [1.88; 3.97]
p values	0.003	0.001	< 0.001	< 0.001
Unplanned Transfer				
Yes (n = 51)	119.43 [105.62; 136.00]	71.33 [60.24; 78.50]	4.00 [3.00; 6.00]	2.20 [1.54; 3.14] (n = 49)
No (n = 591)	125.33 [113.88; 140.00]	75.50 [67.67; 83.24]	2.00 [2.00; 3.00]	2.71 [1.83; 3.93] (n = 505)
p values	0.062	0.012	< 0.001	0.030
Readmission within 48–72 h				
Yes (n = 35)	122.00 [113.12; 136.62]	76.50 [68.62; 82.38]	2.00 [1.00; 3.00]	3.51 [2.16; 4.56]
No (n = 607)	125.50 [113.45; 140.00]	75.00 [67.50; 83.00]	2.00 [2.00; 3.00]	2.64 [1.75; 3.79]
p values	0.649	0.529	0.095	0.030
Cardiorespiratory arrest within 48 h				
Yes (n = 4)	112.15 [106.97; 124.75]	73.50 [70.50; 79.88]	2.00 [2.00; 2.75]	2.43 [1.41; 3.41]
No (n = 638)	125.17 [113.35; 140.00]	75.12 [67.50; 83.00]	2.00 [2.00; 3.00]	2.67 [1.79; 3.86]
p values	0.320	0.945	0.890	0.595

mmHg: millimeter of mercury; *p* value: Mann-Whitney test; IQR: interquartile range.

significantly lower in patients readmitted to the emergency department, and the reasons for the unscheduled return visits and poor outcomes are related to a failure to recognize physiological changes and patient discharge without a proper monitoring of vital signs [44].

Strokes, transient ischemic attacks, and deaths were not reported in patient charts or only covered a small number of cases, which did not allow comparison tests. Cardiorespiratory arrests within 48 h after ED discharge had no association with BP documentation variables. However, previous studies, with more representative samples, have shown the importance of these outcomes in the evaluation of care processes and patient safety in emergency departments [10,33,45].

Our study shows association between BP measurement and length of stay greater than six hours, worsening in clinical presentation, unplanned patient transfer, and readmissions in the emergency department. These findings indicate that abnormal BP values need to be early detected to ensure an effective response to clinical deterioration, increase the frequency of BP measurements, and improve care quality to reduce the incidence of adverse outcomes in the emergency department.

This study has some limitations. The results were obtained from a convenience sample in a single medical center and may not apply to other settings. The adoption of the cross-sectional design directed the data collection to a specific time point and did not allow identifying seasonal changes. Retrospective analysis impaired data collection of information regarding patient outcomes due to underreporting of cases and lack of nurse documentation in medical records. Analysis of complications and worsening of clinical presentation after patient discharge was also not possible.

5. Conclusions

Blood pressure documentation is an essential nursing care to identify physiological changes, prevent early clinical deterioration, and occurrence of adverse outcomes. In this retrospective study we observed the association between longer length of stay and higher number of BP readings, worsening of clinical presentation and lower mean time interval between BP measurements, readmissions and higher mean time interval between BP measurements, unplanned patient transfer and lower BP values. Such findings reinforce the need to promote educational strategies regarding monitoring of vital signs, implementation of nursing record protocols, and handover standardization to support clinical practices and development of future interventions in factors related to nursing documentation.

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Ethical statement

This study followed the national and international standards of ethics in research involving human subjects and the requirements of Resolution N°. 466/2012

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None.

Declaration of Competing Interest

The authors declared that there is no conflict of interest.

Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ienj.2019.100787.

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