Revista Médica IATREIA Universidad de Antioquia

ORIGINAL ARTICLE

Factors Associated with Occupancy Level in a High-Complexity Emergency Department in Medellín

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ARTICLE INFORMATION

Keywords
Bed Occupancy;
Emergencies;
Emergency Service, Hospital

Received: January 25, 2023
Accepted: June 18, 2024

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How to cite: Estrada-Atehortúa AF, Arroyave-Peña T, Quiróz-Álvarez JE, Giraldo-Hoyos JA, Bareño-Silva J. Factors Associated with Occupancy Level in a High-Complexity Emergency Department in Medellín. Iatreia [Internet]. 2025 Apr-Jun;38(2):266-278. https://doi.org/10.17533/udea.iatreia.307

ABSTRACT

Introduction: Emergency department (ED) occupancy is influenced by multiple factors, with overcrowding becoming increasingly prevalent. This complex phenomenon is challenging to be measured and negatively impacts patient care delivery.

Objectives: To determine the ED occupancy level at Hospital Pablo Tobón Uribe, Medellin, using the National Emergency Department Overcrowding Study (NEDOCS), analyzing hospital service factors, processes, physical capacity, and human resources.

Methods: An analytical cross-sectional study was conducted. ED occupancy levels were measured continuously over two weeks. Statistical analysis included univariate, bivariate (Chi-square and Spearman correlation), and multivariate (multiple linear regression) analyses.

Results: NEDOCS indicated dangerously overcrowded conditions 98.2% of the time. Correlation between the emergency physician's perception and NEDOCS scores showed p=0.526. Multivariate model revealed associations with total ED patients (p=0.427), total patients in resuscitation area (p=0.436), and total ED-admitted patients (p<0.01), with an adjusted R^2 of 23%.

Conclusions: ED occupancy levels remained *dangerously overcrowded* during most of the study period. Development of an explanatory model for factors associated with ED occupancy levels was precluded by the constant nature of the outcome variable.

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ARTÍCULO ORIGINAL

Factores asociados al nivel de ocupación en un servicio de urgencias de alta complejidad en Medellín

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INFORMACIÓN ARTÍCULO
Palabras clave
Ocupación de Camas;
Urgencias Médicas;
Servicio de Urgencias en Hospital

Recibido: enero 25 de 2023
Aceptado: junio 18 de 2024

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Cómo citar: Estrada-Atehortúa AF, Arroyave-Peña T, Quiróz-Álvarez JE, Giraldo-Hoyos JA, Bareño-Silva J. Factores asociados al nivel de ocupación en un servicio de urgencias de alta complejidad en Medellín. Iatreia [Internet]. 2025 Abr-Jun;38(2):266-278. https://doi.org/10.17533/udea.iatreia.307

RESUMEN

Introducción: la ocupación de urgencias depende de múltiples factores y cada vez es más frecuente la sobreocupación, un problema difícil de medir y que impacta de forma negativa en el proceso de atención de los pacientes.

Objetivos: determinar el nivel de ocupación del servicio de urgencias del Hospital Pablo Tobón Uribe, Medellín, mediante la aplicación de la escala NEDOCS *(National Emergency Department Overcrowding Study)* según los factores hospitalarios de servicio, procesos, capacidad física y recursos humanos.

Métodos: se realizó un estudio transversal analítico que midió el nivel de ocupación de urgencias durante dos semanas continuas mediante análisis univariado, bivariado (χ^2 y correlación de Spearman) y multivariado (regresión lineal múltiple).

Resultados: se reportó un nivel *peligrosamente congestionado* según NEDOCS el 98,2 % del tiempo. Asociando el nivel de ocupación según la percepción del urgenciólogo con NEDOCS, se obtuvo $p = 0{,}526$, y para el modelo multivariado, el total de pacientes en urgencias ($p = 0{,}427$), el total de pacientes en el área de reanimación ($p = 0{,}436$), el total de pacientes hospitalizados en urgencias ($p = 0{,}01$) y R^2 ajustado de 23 %.

Conclusiones: el nivel de ocupación estuvo en peligrosamente congestionado la mayor parte del tiempo. No fue posible determinar los factores asociados al nivel de ocupación de urgencias mediante un modelo explicativo por el comportamiento constante de la variable desenlace.

INTRODUCTION

'Overcrowding' is a term used to indicate that the capacity of a hospital's emergency department (ED) to provide care to patients is outstripped by demand in a given period of time (1). This is explained by an increase in the number of patients presenting to EDs and because patients admitted to the hospital while in the ED remain there for a long time before being transferred to the relevant medical ward. The problem then centers on the fact that these findings are associated in world literature with increased morbidity and mortality in patients who remain in the ED (2,3).

In a review carried out by O'Connor *et al.* (4) in two hospitals in the city of Ottawa, Canada, it was found that the overcrowding of high complexity EDs by 1.5 times their installed capacity had a negative influence on triage classification, resulting in patients being under- or over-triaged by triage personnel, thus affecting patient destination to the different areas of the ED and lengthening the times for initiating care and defining behavior. ED overcrowding has also been associated with increased presence of adverse cardiovascular outcomes (5), delayed identification of critical situations such as cardiac arrest and increased mortality (5); it also delays antibiotic administration in septic patients (6) and results in decreased user satisfaction and increased work dissatisfaction with low quality of life for healthcare personnel (4,5,7,8). Among the factors that have been associated with overcrowding are the characteristics of the ED service such as its processes, physical and human resources available, particularities of the community and of the health service provider institution and, in some special situations of community interest, the context generated by the pandemic also plays an important role (2). It is therefore necessary to define strategies and tools allowing to objectively measure the level of ED occupancy, to detect when there is overcrowding or a tendency to overcrowding, and to generate interventions to avoid reaching that level with all the adverse outcomes mentioned (9).

There are several tools to measure the occupancy level of an ED, among which the following stand out: READI (Real Time Emergency Analysis of Demand Indicators), EDWIN (Emergency Department Work Index), EDCS (Emergency Department Crowding Scale) and NEDOCS (National Emergency Department Overcrowding Study) (10–13). Of these, the NEDOCS score uses variables that are easy to measure in the service, which facilitates its application in real time and in a dynamic manner. In Colombia specifically, there is little evidence of studies evaluating the application of NEDOCS. In one review study, García-Romero *et al.* (14) compared the usefulness of NEDOCS to evaluate ED occupancy versus the subjective perception of overcrowding in the ED of a high-complexity health institution in Cali, while another study validated the NEDOCS score in a high-complexity ED in the city of Bogotá (15). It is therefore necessary to document more information on its usefulness in our context and thus be able to offer recommendations for dealing with periods of high ED occupancy.

In view of the above, the objective of this study was to determine the ED occupancy level at Hospital Pablo Tobón Uribe, Medellin, according to the hospital-level factors of service, processes, physical capacity, and human resources.

METHODS

An analytical cross-sectional study was carried out by analyzing primary and secondary sources at the Pablo Tobón Uribe Hospital (Medellín, Colombia), which is a high-complexity institution with a high volume of emergency admissions that has become a reference center in the local and national context.

The level of occupancy of the ED was assessed according to the hospital-level factors of service, processes, physical capacity and human resources, without modifying data at the time of

measurement. Subsequently, the NEDOCS scale calculator was used, which requires the following variables: total number of patients in the ED occupying a bed, total number of hospital beds, total number of beds in the ED, hospitalized patients in the ED waiting for a bed in a hospital ward, number of ventilators in use in the ED, longest waiting time per inpatient bed of hospitalized patients in the ED, and waiting room time of the last patient called to a bed in the ED. The measurements were carried out over a period of 2 continuous weeks, between April 19 and May 3, 2022, day and night, measuring each of the variables in real time. The decision was made based on records from the institution's ED, since, in previous years, the period between April and May, excluding Easter Week, shows a stable behavior, similar to the average number of admissions for the year.

The data obtained were recorded in a tool called RedCap (licensed to Hospital Pablo Tobón Uribe) and then exported to Microsoft Excel. Data were analyzed using the open-source statistical package JAMOVI version 2.3.2.0. The freely accessible, web-based NEDOCS calculator was used to determine occupancy levels objectively. The *outcome* variable was defined as the level of ED occupancy and the covariates used were grouped by factors as follows:

i) **Hospital factors of service:** perception of occupancy level according to medical staff, perception of occupancy level according to nursing and triage classification staff.

ii) **Hospital factors of physical capacity:** patients occupying an ED bed, patients in initial care, patients in observation, patients in isolation, patients in resuscitation, patients in fast track, patients in the hospitalization area, patients in the waiting room, patients with admission order in the ED, and patients with observation order in the ED.

iii) **Hospital factors of processes:** longest wait time for a hospital bed of patients hospitalized in the ED, number of ventilators in use in the ED, waiting room time of the last patient called to a bed in the ED, activation of expansion zones, activation of contingency plan, longer wait time for X rays, longer wait time for CT scans and longer wait time for MRI.

(iv) **Hospital factors of human resources:** general practitioners per day shift, general practitioners per night shift, emergency physicians per day shift, emergency physicians per night shift, nursing staff per day shift, nursing staff per night shift, triage nurses per day shift, triage nurses per night shift, nursing assistants per day shift, nursing assistants per night shift.

RESULTS

A total of 56 measurements were taken, one every six hours, beginning on April 19, 2022, at 6 a.m., with the last measurement taken on May 3 at midnight. No data were missing. Table 1 presents the general characteristics of the measurements. Overall, 98.2% of the time the ED was at a *dangerously overcrowded* level as determined by the NEDOCS scale, with an average of 112 patients (SD = 18.9) occupying a bed in the ED. The longest waiting time per inpatient bed for patients hospitalized in the ED was a median of 170 hours (IQR 48, minimum 3, maximum 278) and the average waiting room time for the last patient called to a bed was 4.77 hours (SD 4.46).

Table 1. Description of hospital factors associated with the level of ED occupancy

VARIABLE		n (%)	Mean (SD)	Median (IQR)	Range (minimum:maximum)
HOSPITAL SERVICE FACTORS					
ED occupancy level		**N = 56**	199 (5.02)	200 (0)	164:200
ED occupancy level	Not busy	0 (0)			
	Busy	0 (0)			
	Busy but not overcrowded	0 (0)			
	Overcrowded	0 (0)			
	Severely overcrowded	1 (1.8)			
	Dangerously overcrowded	55 (98.2)			
Medical staff's perceptions of occupancy level	Not busy	1 (1.8)			
	Busy	11 (19.6)			
	Busy but not overcrowded	2 (3.6)			
	Overcrowded	16 (28.6)			
	Severely overcrowded	14 (25)			
	Dangerously overcrowded	12 (21.4)			
Nursing staff's perception of occupancy level	Not busy	0 (0)			
	Busy	0 (0)			
	Busy but not overcrowded	6 (10.7)			
	Overcrowded	1 (1.8)			
	Severely overcrowded	18 (32.1)			
	Dangerously overcrowded	13 (23.2)			
Triage classification	-		3.28 (0.07)	3 (0.1)	3.17:3.44
HOSPITAL PHYSICAL CAPACITY FACTORS					
Patients in the ED occupying a bed			112 (18.9)	114 (27.8)	71:148
Patients in initial care			9 (1.31)	9 (1.25)	5:10
Patients in observation			6.64 (0.74)	7 (0)	4:7
Patients in resuscitation			5.88 (3.21)	6 (5)	0:12
Patients in fast track			22.8 (6.6)	23 (4.25)	5:38
Patients in isolation			5.41 (2.94)	5 (4.25)	1:11
Patients hospitalized in ED hospitalization unit			48 (4.3)	49 (4)	31:68
Patients in waiting room			7.79 (8.18)	5.5 (7)	0:40
Patients with inpatient bed order in the ED			83.3 (14.6)	87 (16.5)	36:111
Patients with observation order in the ED			25.9 (11.3)	25 (11.5)	5:56

Table 1. Description of hospital factors associated with the level of ED occupancy (Continuation)

VARIABLE		n (%)	Mean (SD)	Median (IQR)	Range (minimum:maximum)
HOSPITAL SERVICE FACTORS					
The longest wait time for inpatient bed of patients hospitalized in the ED			169 (52.4)	170 (48)	3:278
Number of ventilators in use in the ED			0.14 (0.35)	0 (0)	0:1
Waiting room wait time for the last patient called to an ED bed			4.77 (4.46)	3.5 (5.63)	0:23
Activation of expansion zones	Yes	56 (100)			
	No	0 (0)			
Activation of contingency plan	Yes	56 (100)			
	No	0 (0)			
Longer wait times for X-rays			0.13 (0.43)	0 (0)	0:2
Longer wait times for CT scans			2.53 (2.91)	1.1 (3.85)	00:11.5
Longer wait times for MRI			0.33 (1.75)	0 (0)	0:11
HOSPITAL HUMAN RESOURCE FACTORS					
General practitioners per day shift			11.1 (0.89)	11 (2)	10:12
General practitioners per night shift			9.52 (0.53)	10 (1)	8:10
Emergency physicians per day shift			4.61 (1.12)	5 (2)	3:6
Emergency physicians per night shift			2 (0)	2 (0)	2:2
Nursing staff per day shift			11.8 (0.4)	12 (0)	11:12
Nursing staff per night shift			10 (0)	10 (0)	10:10
Triage nurses per day shift			3 (0)	3 (0)	3:3
Triage nurses per night shift			1.02 (0.13)	1 (0)	1:2
Nursing assistants per day shift			22.8 (0.38)	23 (0)	22:23
Nursing assistants per night shift			22.8 (0.38)	23 (0)	22:23

*SD: standard deviation, †IQR: interquartile range
Source: own elaboration

When associating the level of occupancy shown by the perception of the emergency physicians with the results of the NEDOCS scale, a χ^2 value of 4.17 (p = 0.526) was obtained. According to the perception of the nursing staff versus the results obtained from the NEDOCS scale, a χ^2 value of 8.48 (p = 0.075) was found (Table 2; Figure 1; Figure 2). When the correlation between the measurements expressing the hospital factors of service, processes, physical capacity and human resources was performed, no significant results were found between the independent variables included and

the ED occupancy level (Spearman's ρ greater than 0.5); therefore, the variables included in the multivariate model were selected by clinical criteria (Table 3). The multivariate model was composed of the dependent variable Y = occupancy level, and the independent variables. In the model used, the occupancy level variable was predicted by the variables patients in the ED (p = 0.427), total patients in the resuscitation area (p 0.436) and total hospitalized patients in the ED (p 0.01), with adjusted R^2 of 0.238 and a BIC of 340 (Table 4).

Table 2. Comparison of the perceptions of occupancy level of emergency physicians and nursing staff on duty with ED occupancy level

Variables	Perception level	NEDOCS occupancy level		Test χ^2	p value
		Severely overcrowded	Dangerously overcrowded		
Emergency physician's occupancy perception	Not busy	0 (0)	1 (2)	4.17	0.526
	Busy	1 (2)	10 (18)		
	Busy but not overcrowded	0 (0)	2 (3.5)		
	Overcrowded	0 (0)	16 (28.5)		
	Severely overcrowded	0 (0)	14 (25)		
	Dangerously overcrowded	0 (0)	12 (21)		
Total observations		1 (2)	55 (98)		
Nursing staff's perception of occupancy level	Not busy	0 (0)	0 (0)	8.48	0.075
	Busy	1 (2)	5 (9)		
	Busy but not overcrowded	0 (0)	1 (2)		
	Overcrowded	0 (0)	18 (32)		
	Severely overcrowded	0 (0)	18 (32)		
	Dangerously overcrowded	0 (0)	13 (23)		
Total observations		1 (2)	55 (98)		

Source: own elaboration

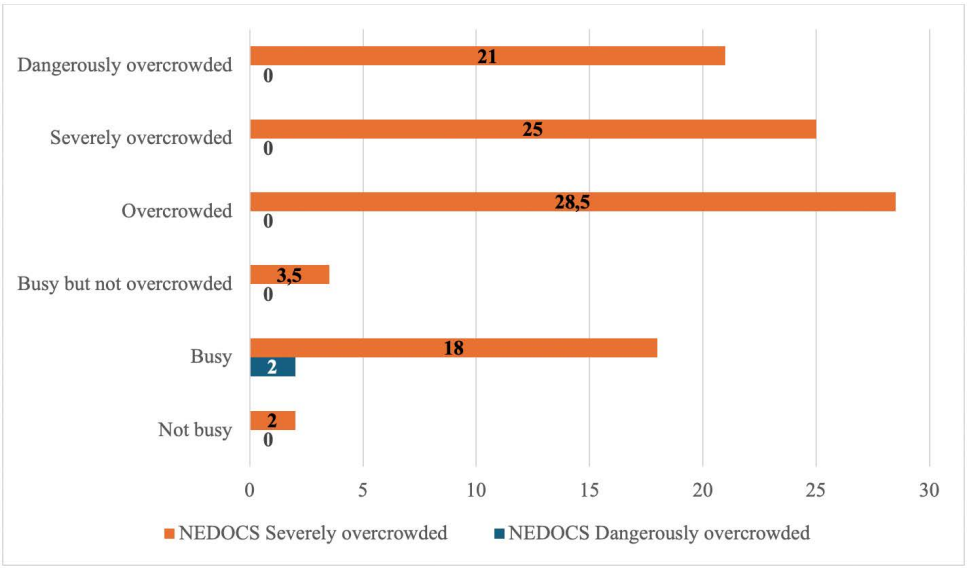

Figure 1. Occupancy level of the ED according to the subjective perception of emergency physicians versus NEDOCS results

Source: own elaboration

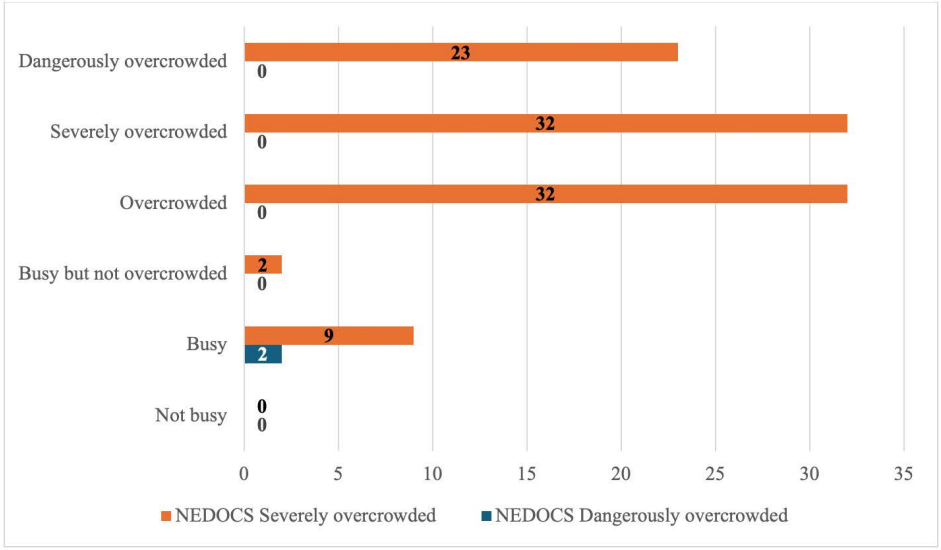

Figure 2. Occupancy level of the ED according to the subjective perception of the nursing staff versus NEDOCS results

Source: own elaboration

Table 3. Correlation matrix between the hospital-related factors of service, processes, physical capacity, human resources and ED occupancy level

CORRELATION MATRIX*	Waiting room time for the last patient called to a bed	Patients in waiting room	Patients in resuscitation	Patients in the ED	Patients hospitalized in the ED
ED occupancy level	0.355	0.251	0.268	0.337	0.420

*Spearman's ρ (rho) was used
Source: own elaboration

Table 4. Coefficients of the ED occupancy level predictive model

Predictor	Estimator	EE	Confidence interval		t	p
			Lower	Upper		
Constant	184.8557	4.2404	176.347	193.3647	43.594	0.001
Patients in the ED	-0.0404	0.0504	-0.142	0.0608	-0.801	0.427
Patients in resuscitation	0.2001	0.2547	0.711	0.3111	0.786	0.436
Patients hospitalized in the ED	0.2388	0.0628	0.113	0.3648	3.806	0.001

Source: own elaboration

DISCUSSION

When determining the occupancy level of the ED of the Pablo Tobón Uribe Hospital by applying the NEDOCS scale, already validated in a high-complexity ED in the city of Bogotá (15), it was found that most of the time (98.2%) during the study it remained in a *dangerously overcrowded* state.

It is essential to recognize this, since it is known that overcrowded levels have a negative impact on the entire patient care process (16). There are several factors that predict this, with the fact that the number of hospitalized patients who remain in the ED is high standing out; in turn, this may be secondary to an increased number of patients admitted through this service, including patients in unregulated transfers from other institutions; increased non-emergent consultations, increased complexity of patients admitted in the institution and a low bed flow in general wards should also be considered, as documented by Hoyos JAG *et al.* (17) in a study in the same institution during 2017.

As a result, another factor appears: long hospital stay times in the ED. This causes the service to be overcrowded and, as a reflection, the high volume of patients there changes the dynamics of the service and overcrowds other important areas such as resuscitation. These findings are consistent with those found by Guiunta *et al.* (18) in an ED of a high-complexity institution with high consultation volumes in Argentina.

As a result of all the above, the subjective perception of nurses and emergency physicians as regards the level of ED occupancy is one of overcrowding at all times. Although no conclusive results were obtained in this study, the findings indicate that the perceptions of emergency physicians tend to be more accurate. This is a striking finding, considering that it is contrary to the

findings reported in the international literature and, specifically, to what was found by García-Romero *et al.* (14) in 2014 and by Canoa *et al.* (15) in 2017 in high-complexity institutions in the cities of Bogotá and Cali, Colombia. These results can be explained in this study by the greater contact that emergency physicians have in areas affected by overcrowding such as resuscitation, by their constant presence in areas with patients hospitalized for long periods of time in the ED and because the nursing professionals surveyed were those who performed triage and were in contact with patients only in pre-triage and the waiting room, which means that they were not present all the time in the areas where the greatest volume of patients was concentrated (7,14,19,21).

However, results such as those reported by Kamini *et al.* (22), who found no correlation between NEDOCS and the actual occupancy status of an urban hospital in Australia in 2006, based on the subjective perception of staff, should also be kept in mind. Wang *et al.* (3) also found that NEDOCS did not accurately reflect the actual ED occupancy status of a hospital in Texas, USA, with more than 100,000 admissions per year (high volume of admissions). Their explanation was based on the fact that NEDOCS did not include parameters of subjective perception of the care staff and did not take into account the level of complexity of the patients; besides, the original studies were conducted in hospitals with average annual ED admissions of 57,000 people, which is lower than that of the hospital where the present study was conducted.

The volume of patients classified as triage III is the largest proportion of those hospitalized in the ED. This means that triage I and II are not directly responsible for the problem of overcrowding: since they are more critical and unstable, they find a place outside the ED (usually surgery or critical care units) much faster than those with a less serious condition but still requiring hospital management, such as triage III. Measures that could be analyzed in future studies stand out, such as the role played by the Integrated Health Access Management Center (CIGA, for its acronym in Spanish) strategy implemented in the city of Medellin in decongesting the ED; this strategy allows rapid management of medical care for patients who arrive at the ED without being in critical condition and who can be referred to priority or less complex care (23).

It is also important to keep in mind the effect of the COVID-19 pandemic. Although at the beginning of it most healthcare institutions worldwide reported a significant drop in the number of ED consultations (24,25), since 2021 there was a change in this pattern, which caused concern about the overcrowding of these services and critical care units, that exceeded outrageous levels by more than 60% in USA hospitals (26).

This is consistent with the records kept at the Pablo Tobón Uribe Hospital, since for the year 2022 emergency consultation volumes were so high (average service occupancy of 93%) that most of the time (99.6%) a contingency plan was active (27).

Perhaps because of the persistent *dangerously overcrowded* outcome in the measurements of this study, the linear regression model cannot differentiate significant changes in *outcome,* independent of the predictor variables used.

CONCLUSIONS

When determining the level of ED occupancy using the NEDOCS scale, a dangerously overcrowded level was obtained most of the time; this result was more in agreement with the subjective perception of the emergency physicians than with that of the nursing staff. Of the hospital-related factors of service, processes, physical capacity and human resources, the one that had the strongest relationship with the level of occupancy was the number of patients hospitalized in the ED. It was not possible to determine the factors associated with the l*evel of ED occupancy by* means of a predictive model, basically because of the constant behavior of the *outcome* variable.

The most critical point that requires the greatest focus of attention is the intervention to establish measures to improve the outflow of patients who remain hospitalized in the ED for long periods of time, because they are there due to lack of space in areas such as general hospitalization where they can be placed correctly or due to delayed transfer to areas of less complexity and lack of processing of outpatient administrative procedures. This can be improved by articulating processes with these areas and generating strategies such as joint specialty and clinical management rounds to identify patients with potential outpatient management, and involve them in strategies such as early discharge or home management more quickly (including clear plans for safe discharge and signs and symptoms to consult the service again), as well as to identify patients susceptible to referral to a lower level of complexity and initiate the process as soon as possible.

Nevertheless, important aspects are highlighted in this study, since this is the first reported measurement of the level of occupancy in an ED in the city of Medellín based on the application of the NEDOCS scale. This could be the beginning of future work that can use the tool in different services and conditions, in order to generate diagnostic and occupancy level management recommendations that cover more health care institutions.

CONFLICT OF INTEREST

There are no conflicts of interest to be reported.

REFERENCES

1. Asplin BR, Magid DJ, Rhodes KV, Solberg LI, Lurie N, Camargo CA. A conceptual model of emergency department crowding. Ann Emer Med [Internet]. 2003;42(2):173-180. https://doi.org/10.1067/mem.2003.302
2. Estrada-Atehortúa AF, Zuluaga-Gómez M. Estrategias para la medición y el manejo de la sobreocupación de los servicios de urgencias de adultos en instituciones de alta complejidad con altos volúmenes de consulta. Revisión de la literatura. Iatreia [Internet]. 2019;33(1):68-77. https://doi.org/10.17533/udea.iatreia.34
3. Wang H, Robinson RD, Bunch K, Huggins CA, Watson K, Jayswal RD, et al. The inaccuracy of determining overcrowding status by using the National ED Overcrowding Study Tool. Am J Emerg Med [Internet]. 2014;32(10):1230-6. https://doi.org/10.1016/j.ajem.2014.07.032
4. Badr S, Nyce A, Awan T, Cortes D, Mowdawalla C, Rachoin JS. Measures of Emergency Department Crowding, a Systematic Review. How to Make Sense of a Long List. Open Access Emerg Med [Internet]. 2022;14:5-14. https://doi.org/10.2147/oaem.s338079
5. O`Connor E, Gatien M, Weir C, Calder L. Evaluating the effect of emergency department crowding on triage destination. Int J Emerg Med [Internet]. 2014;7(16):2-7. https://doi.org/10.1186/1865-1380-7-16
6. Lauque D, Khalemsky A, Boudi Z, Östlundh L, Xu C, Alsabri M, et al. Length-of-Stay in the Emergency Department and In-Hospital Mortality: A Systematic Review and Meta-Analysis. J Clin Med [Internet]. 2022;12(1):32. https://doi.org/10.3390/jcm12010032
7. Epstein SK, Huckins DS, Liu SW, Pallin DJ, Sullivan AF, Lipton RI, et al. Emergency department crowding and risk of preventable medical errors. Intern Emerg Med [Internet]. 2012;7(2):173-80. https://doi.org/10.1007/s11739-011-0702-8
8. Stehman CR, Testo Z, Gershaw RS, Kellogg AR. Burnout, Drop Out, Suicide: Physician Loss in Emergency Medicine, Part I. West J Emerg Med [Internet]. 2019;20(3):485-494. https://doi.org/10.5811/westjem.2019.4.40970
9. Austin EE, Blakely B, Tufanaru C, Selwood A, Braithwaite J, Clay-Williams R. Strategies to measure and improve emergency department performance: a scoping review. Scand J Trauma Resusc Emerg Med [Internet]. 2020 Jun 15;28(1):55. https://doi.org/10.1186/s13049-020-00749-2

10. Stang AS, Crotts J, Johnson DW, Hartling L, Guttmann A. Crowding measures associated with the quality of emergency department care: a systematic review. Acad Emerg Med [Internet]. 2015;22(6):643-56. https://doi.org/10.1111/acem.12682
11. Weiss SJ, Ernst AA, Sills MR, Quinn BJ, Johnson A, Nick TG. Development of a novel measure of overcrowding in a pediatric emergency department. Pediatr Emerg Care [Internet]. 2007;23(9):641-5. https://doi.org/10.1097/pec.0b013e31814a69e2
12. Eidstø A, Ylä-Mattila J, Tuominen J, Huhtala H, Palomäki A, Koivistoinen T. Emergency department crowding increases 10-day mortality for non-critical patients: a retrospective observational study. Intern Emerg Med [Internet]. 2024 Jan;19(1):175-181. https://doi.org/10.1007/s11739-023-03392-8
13. Hoot NR, Zhou C, Jones I, Aronsky D. Measuring and forecasting emergency department crowding in real time. Ann Emerg Med [Internet]. 2007;49(6):747-55. https://doi.org/10.1016/j.annemergmed.2007.01.017
14. Weiss SJ, Derlet R, Arndahl J, Ernst AA, Richards J, Fernández-Frankelton M, et al. Estimating the Degree of Emergency Department Overcrowding in Academic Medical Centers: Results of the National ED Overcrowding Study (NEDOCS). Acad Emer Med [Internet]. 2004 Jan;11(1):38-50. https://doi.org/10.1197/j.aem.2003.07.017
15. Garcia-Romero M, Rita-Gáfaro CG, Quintero-Manzano J, Angarita AB. NEDOCS vs subjective evaluation, ¿Is the health personnel of the emergency department aware of its overcrowding? Colomb Med (Cali) [Internet]. 2017 Jun 30;48(2):53-57. Disponible en: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5597093/
16. Castro-Canoa JA, Oliviella-Cohen E, Lineros-Montañez A, Sánchez-Pedraza R. Escala NEDOCS para medir congestión en urgencias: Estudio de validación en Colombia [Tesis]. Bogotá, Colombia; Universidad de Rosario. 2010. https://doi.org/10.48713/10336_2250
17. Lee YJ, Shin SD, Lee EJ, Cho JS, Cha WC. Emergency Department Overcrowding and Ambulance Turnaround Time. PLoS One [Internet]. 2015;10(6):e0130758. https://doi.org/10.1371/journal.pone.0130758
18. Giraldo-Hoyos JA, Peña-Arroyave T, Naranjo AF, Lopera YK. Caracterización de los traslados médicos no regulados desde diferentes instituciones prestadoras de salud hacia el Hospital Pablo Tobón Uribe de Medellín, en el año 2017. Med UPB [Internet]. 2019;38(2):114-9. https://doi.org/10.18566/medupb.v38n2.a03
19. Giunta DH, Pedretti AS, Elizondo CM, Grande-Ratti MF, González-Bernaldo de Quiros F, Waisman GD, et al. Descripción de las características del fenómeno Crowding en la Central de Emergencia de Adultos, en un hospital universitario de alta complejidad: estudio de cohorte retrospectiva. Rev med Chile [Internet]. 2017;145(5):557-63. http://dx.doi.org/10.4067/S0034-98872017000500001
20. Ilhan B, Kunt MM, Damarsoy FF, Demir MC, Aksu NM. NEDOCS: is it really useful for detecting emergency department overcrowding today? Medicine (Baltimore) [Internet]. 2020 Jul 10;99(28):e20478. https://doi.org/10.1097/md.0000000000020478
21. Yarmohammadian MH, Rezaei F, Haghshenas A, Tavakoli N. Overcrowding in emergency departments: A review of strategies to decrease future challenges. J Res Med Sci [Internet]. 2017;22(1):23. https://doi.org/10.4103%2F1735-1995.200277
22. Raj K, Baker K, Brierley S, Murray D. National Emergency Department Overcrowding Study tool is not useful in an Australian emergency department. Emerg Med Australas [Internet]. 2006;18(3):282–288. https://doi.org/10.1111/j.1742-6723.2006.00854.x
23. Colella Y, Di Laura D, Borrelli A, Triassi M, Amato F, Improta G. Overcrowding analysis in emergency department through indexes: a single center study. BMC Emerg Med [Internet]. 2022 Nov 18;22(1):181. https://doi.org/10.1186/s12873-022-00735-0
24. Metro salud. Alcaldía de Medellín emprende acciones para descongestionar servicios de urgencias [Internet]. 2016. [citado 2021 Ago 28]. Disponible en: http://www.metrosalud.gov.co/sedes/descongestionurgencias
25. Lowe J, Brown I, Durseti R, Gallegos M, Ribeira R, Pirrotta E, et al. Emergency Department Access During COVID-19: Disparities in Utilization by Race/Ethnicity, Insurance, and Income. West J Emerg Med [Internet]. 2021;22(3):552-60. https://doi.org/10.5811/westjem.2021.1.49279

26. Lee DD, Jung H, Lou W, Rauchwerger D, Chartier LB, Masood S, et al. The Impact of COVID-19 on a Large, Canadian Community Emergency Department. West J Emerg Med [Internet]. 2021;22(3):572-9. https://doi.org/10.5811/westjem.2021.1.50123
27. Sandhu P, Shah AB, Ahmad FB, Kerr J, Demeke HB, Graeden E, et al. Emergency Department and Intensive Care Unit Overcrowding and Ventilator Shortages in US Hospitals During the COVID-19 Pandemic, 2020-2021. Public Health Rep [Internet]. 2022;137(4):796-802. https://doi.org/10.1177%2F00333549221091781
28. Hospital Pablo Tobón Uribe. ¿Quiénes Somos? [Internet]. 2022 [citado 2022 Sep 11]. Disponible en: https://hptu.org/pages/quienes-somos