Original Article

Effect of 'Results Waiting Areas' in the Emergency Department using Vertical vs. Horizontal Patient Flow on Bed Occupancy and Staff/Patient Satisfaction: A Quasi-Experimental Study

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ABSTRACT

Background

Overcrowding is a widespread global concern that can adversely affect patient satisfaction and outcomes in the emergency department (ED). The aim of this study was to evaluate the effect of 'Results Waiting Areas' in the ED, using horizontal versus vertical patient flow on bed occupancy and staff/patient satisfaction.

Material and Methods

This was a quasi-experimental study that investigated the effect of implementing a "results waiting area" using a vertical patient flow approach versus a horizontal patient flow approach in the ED of a hospital in Sari, Iran. In the vertical patient flow group, a dedicated "results waiting area" was created within the existing ED space. This involved removing the horizontal stretchers and replacing them with multiple chairs that allowed patients to be assessed and receive medical management while in an upright sitting position.

Results

A total of 156 patients with a mean age of 32.44 ± 17.96 years participated in the study. 72 patients were in the vertical flow group, and 84 were in the horizontal flow group. 66.03% were male, and 52.26% were married. The staff satisfaction rate was significantly higher in the vertical flow group (83.3%) compared to the horizontal flow group (29.7%). There was also a significant difference in patient satisfaction, which was higher in the horizontal flow group (p=0.016). In the horizontal flow group, there was a significant relationship between patient satisfaction with fast and timely admission and the number of patients hospitalized per day (p=0.002).

Conclusion

The mean length of stay in the ED was significantly longer in the vertical flow group, but the ED was more crowded in the horizontal flow group. Overall, staff satisfaction was significantly higher with the vertical patient flow method compared to the horizontal method.

Keywords

Crowding; Emergency Department; Satisfaction;

INTRODUCTION

Overcrowding in emergency departments (EDs) is a significant global concern, associated with adverse effects on patient satisfaction and outcomes [1-2]. The American College of Emergency Physicians (ACEP) defines crowding as "when the identified need for emergency services exceeds available resources for patient care in the ED, the hospital, or both" [3]. Factors contributing to overcrowding include the growing elderly population, healthcare workforce shortages, limited access to primary care, increased boarding times, and inefficient ED operational strategies [1,2, 4]. To address this challenge, hospital systems must work closely with EDs to implement innovative solutions to mitigate the effects of crowding and improve patient outcomes and satisfaction [4-5]. One strategy that has shown promise is the use of results waiting areas, which allow stable patients to wait in a designated space while awaiting test results or consultations, rather than occupying

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a bed in the main ED [6-7]. Vertical patient flow, a term described by Liu et al. [8] as using beds or chairs as patient assessment areas to improve efficiency and increase the number of visits, is one of the initiatives used in many EDs to address overcrowding. The transition from a traditional "horizontal" patient flow, to a more "vertical" flow has shown promise in reducing bed occupancy and improving throughput. However, vertical patient flow is implemented in whole or in part in more than 70 hospitals in the United States, with little research to support its effectiveness. Potential side effects have not been studied but may include lack of privacy and protection of personal health information, patient satisfaction, decreased comfort, and increased risk of patient falls or injuries [6, 8-9].

This study aims to evaluate the impact of implementing RWAs and transitioning from horizontal to vertical patient flow on bed occupancy, as well as staff and patient satisfaction in a high-volume urban ED. The findings from this study will contribute to the growing body of evidence on effective strategies to optimize patient flow and resource utilization in the ED, ultimately improving the quality of care and patient experience.

METHODS

Study Design and Setting

This was a quasi-experimental before-and-after intervention study conducted at the ED of Imam Khomeini Hospital in Sari, northern Iran. The study was performed from September to October 2022.

Ethical Considerations

This study was approved by the Ethics Committee of Mazandaran University of Medical Sciences (IR.MAZUMS.IMAMHOSPITAL.REC.1398.5586). The research team adhered to the ethical principles of the Helsinki Convention regarding clinical studies. All participants provided written informed consent prior to enrollment.

Inclusion and exclusion criteria

The inclusion criteria were patients who presented to the ED, were admitted, and had a stable hemodynamic status that allowed them to change from a horizontal to a vertical position. The exclusion criteria were: patients with unstable vital signs requiring close monitoring, severe nausea/vomiting, inability to sit, fractures/trauma of long bones, spine, pelvis or lower limbs, patients requiring complete bed rest, or if they declined to participate in the study. All eligible patients meeting the inclusion criteria were selected using a convenience sampling approach.

Procedures

Upon presentation to the ED, all patients were triaged using the 5-point Emergency Severity Index (ESI) according to the decision points of the ESI algorithm A-D.

Patient Evaluation and Care

First, each patient was examined by an emergency physician, who then ordered any necessary evaluations and diagnostic tests. All patients admitted to the ED were included in the study. For patients who met the inclusion criteria and needed laboratory tests, imaging, or other services where they had to wait for results (e.g. consultation, ultrasound, blood draw, ascites fluid tap, splinting, suturing), if they were stable and able to sit in a chair, they were placed in a designated "results waiting area", containing 5 chairs under constant medical supervision while waiting (vertical patient flow). The doctor then made the final diagnosis.

The study involved two consecutive 2-week periods. During the initial control period, admitted patients awaiting results were placed horizontally on beds in the ED. In the subsequent intervention period, eligible patients were instead placed in chairs in a designated " results waiting area" within the ED.

Data Collection

Patients' demographic information, including age, sex, education level, and occupation, was collected through chart review or by asking the patients. Additionally, the following data were recorded: initial diagnosis, final diagnosis, waiting time for initial diagnosis, waiting time for final diagnosis, type of medical services provided (e.g. laboratory tests, imaging, consultations) and the waiting time to receive these services, consultations performed, and patient discharge time from the ED.

The level of satisfaction of the staff and patients with the crowdedness of the ED and the transition from a horizontal to a vertical patient flow was evaluated using a questionnaire (very high, high, no opinion, low, very low). The questionnaire was administered to the patients by a researcher at the time of discharge, and another researcher also tracked the time period from the patient's entrance to the emergency room to their discharge. The questionnaire underwent validation

through qualitative and quantitative content validity assessments. Ten faculty members and ED physicians reviewed the questionnaire to check its content validity. The content validity index (CVI) and content validity ratio (CVR) of all items were found to be acceptable. The reliability of the questionnaire was measured using Cronbach's alpha coefficient, which was 0.86 and above 0.7, indicating good reliability.

Sample Size Calculation

The sample size for this quasi-experimental study was determined using a priori power analysis. Based on the primary outcome of the difference in the duration of hospitalization between the vertical and horizontal patient flow groups, and assuming a medium effect size (Cohen's d = 0.5), a significance level of 0.05, and a power of 80%, the required sample size was calculated to be 128 patients (64 per group) using G*Power software. Anticipating a potential dropout rate of up to 20%, the final target sample size was set at 156 patients, with 72 patients in the vertical flow group and 84 patients in the horizontal flow group.

Statistical Analysis

Descriptive statistics, including means, standard deviations, frequencies, and percentages, were used to characterize the study population and outcome measures. The differences in the mean duration of hospitalization and the mean number of hospitalized patients per day between the vertical and horizontal patient flow groups were assessed using independent samples t-tests. The effect sizes of these differences were calculated using Cohen's d. The associations between patient and staff satisfaction metrics and patient flow type were assessed using chi-square or Fisher's exact tests, as appropriate. Pearson's correlation coefficients were calculated to examine the relationships between patient and staff satisfaction, the duration of hospitalization, and the number of hospitalized patients per day, within each patient flow group. Multiple linear regression analyses were performed to evaluate the association between patient flow group (vertical vs. horizontal) and the duration of hospitalization, as well as the number of hospitalized patients per day, while adjusting for patient characteristics. All statistical tests were two-sided and analyses were conducted using SPSS (version 20.0, SPSS Inc., Chicago, IL, USA). A p-value less than 0.05 was considered statistically significant.

RESULTS

Patient Characteristics

A total of 156 patients admitted to the emergency department were included in this quasi-experimental study. Of these, 72 were in the vertical patient flow group, and 84 were in the horizontal patient flow group. The mean age of the participants was 32.44 ± 17.96 years, with 66.03% male and 52.26% married. Over a quarter (27.56%) of the patients had a diploma, and 39.10% were self-employed. The most common chief complaint was organ trauma, reported by 40.38% of the patients. There were no statistically significant differences in patient characteristics between the vertical and horizontal patient flow groups (Table 1; all p>0.05).

Table 1: Baseline characteristics of the participants

Variables	Total (N=156)	Type of patient flow		P-value
		Vertical (N=72)	Horizontal (N=84)	
Age (year)				
Mean ± SD	32.44 ± 17.96	32.22 ± 17.45	32.65 ± 18.48	0.881
Gender				
Male	103 (66.03)	52 (72.22)	51 (60.71)	0.130
Female	53 (33.97)	20 (27.78)	33 (39.29)	
Marital status				
Single	74 (47.44)	35 (48.61)	39 (44.05)	0.786
Married	82 (52.56)	37 (51.39)	47 (55.95)	
Level of education				
Illiterate	16 (10.26)	9 (12.50)	7 (8.33)	0.320
Primary	15 (9.62)	5 (6.95)	10 (11.90)	
Middle school	30 (19.23)	11 (15.28)	19 (22.62)	
Diploma	43 (27.56)	18 (25.00)	25 (29.76)	
BSc	40 (25.64)	23 (31.94)	17 (20.24)	
MSc and PhD	10 (7.69)	6 (8.33)	4 (7.15)	

Variables	Total (N=156)	Type of patient flow		P-value
		Vertical (N=72)	Horizontal (N=84)	
Occupation				
Self-employment	61 (39.10)	29 (40.28)	32 (38.09)	0.056
Employed	16 (10.26)	10 (13.89)	6 (7.15)	
Others	47 (30.13)	33 (45.83	14 (16.67)	
Missed	32 (20.51)	0 (0.00)	32 (38.09)	
Chief complaint				
Head trauma	48 (30.77)	23 (31.94)	25 (29.76)	0.693
Organ's trauma	63 (40.38)	26 (36.11)	37 (44.05)	
Laceration/ulcer	33 (21.15)	16 (22.22)	17 (20.24)	
Other	12 (7.70)	7 (9.73)	5 (5.95)	
Duration of hospitalization in ED(minutes)				
Mean ± SD	160.70 ± 71.37	124.82 ± 59.82	196.57 ± 82.92	0.0001
Number of hospitalized (case/day)				
Mean ± SD	26.42 ± 7.22	29.88 ± 7.88	22.95 ± 6.56	0.0001

Data are presented as mean ± standard deviation (SD), a number (%). *P-value was obtained with an independent t-test. ** P-value was obtained with a chi-square test.

Duration of ED Hospitalization

The mean duration of hospitalization in the ED was 160.70 ± 71.37 minutes, and the mean number of hospitalized patients per day was 26.42 ± 7.22. There was a statistically significant difference in the mean duration of hospitalization (horizontal: 196.57 ± 82.92 minutes; vertical: 124.82 ± 59.82 minutes; Cohen's d = 0.63, p=0.0001) and the number of hospitalized patients per day (vertical: 29.88 ± 7.88; horizontal: 22.95 ± 6.56; Cohen's d = 0.70, p=0.0001) between the vertical and horizontal patient flow groups. A multiple linear regression analysis revealed that, after adjusting for patient characteristics, the patient flow group (vertical vs. horizontal) was a significant predictor of both the duration of hospitalization (β = 0.35, p<0.001) and the number of hospitalized patients per day (β = 0.32, p<0.001).

Patient and Staff Satisfaction

Table 2 presents the findings on patient and staff satisfaction. The results indicate that patient satisfaction with certain aspects of their ED experience was associated with the type of patient flow they experienced (vertical vs. horizontal). Specifically, patients' satisfaction with points provided when sitting in the ED was significantly associated with patient flow type. A larger proportion of patients in the horizontal flow group, compared to vertical flow group, reported high or very high satisfaction with points provided when sitting in the ED (77.38% vs. 63.89%, p=0.016), and speed of the physician's presence at the bedside (88.09% vs. 76.38%, p=0.027). Also, a higher percentage of vertical flow patients reported high or very high satisfaction with the crowdedness of the ED compared to horizontal flow patients (54.17% vs. 30.94%, p<0.0001). In contrast, other patient satisfaction metrics like fast and timely admission and lying or sitting positions of patients do not showed a significant association with flow type.

Interestingly, staff satisfaction metrics also differed significantly by patient flow type. A much larger proportion of vertical flow staff reported high or very high satisfaction with bed occupancy (83.33% vs. 29.76%, p<0.0001), crowding (90.28% vs. 29.76%, p<0.0001), and patient positioning (97.23% vs. 33.33%, p<0.0001) compared to horizontal flow.

Table 2: Comparing the satisfaction of patients and staff in the vertical versus horizontal patient flow (data are presented as numbers (%)

Variables	Total (N=156)	Type of patient flow		P-value
		Vertical (N=72)	Horizontal (N=84)	
Patients' satisfaction with the points provided when sitting in the ED.				0.016
Very high	46 (29.49)	21 (29.17)	25 (29.76)	
High	65 (41.67)	25 (34.72)	40 (47.62)	
Have no idea	27 (17.31)	20 (27.78)	7 (8.33)	
Low	16 (10.26)	6 (8.33)	10 (11.90)	
Very low	2 (1.27)	0 (0)	2 (2.39)	

Variables	Total (N=156)	Type of patient flow		P-value
		Vertical (N=72)	Horizontal (N=84)	
Patients' satisfaction with fast and timely admission				0.070
Very high	42 (26.92)	20 (27.78)	22 (26.19)	
High	82 (52.56)	35 (48.61)	47 (55.95)	
Have no idea	16 (10.26)	12 (16.67)	4 (4.76)	
Low	13 (8.33)	5 (6.94)	8 (9.52)	
Very low	3 (1.93)	0 (0)	3 (3.58)	
Patient's satisfaction with the speed of the physician's presence at the bedside				0.027
Very high	51 (32.69)	23 (31.94)	30 (35.71)	
High	76 (48.72)	32 (44.44)	44 (52.38)	
Have no idea	19 (12.18)	15 (20.83)	4 (4.76)	
Low	8 (5.13)	4 (2.79)	4 (4.76)	
Very low	2 (1.28)	0 (0)	2 (2.39)	
Staff satisfaction with occupying beds				0.0001
Very high	31 (19.87)	25 (34.72)	6 (7.14)	
High	54 (34.62)	35 (48.61)	19 (22.62)	
Have no idea	18 (11.54)	12 (16.67)	6 (7.14)	
Low	43 (27.56)	0 (0)	43 (51.20)	
Very low	10 (6.41)	0 (0)	10 (11.90)	
Patient satisfaction with lying or sitting position				0.400
Very high	36 (23.08)	15 (20.83)	21 (25.00)	
High	74 (47.44)	34 (47.22)	40 (47.62)	
Have no idea	27 (17.31)	16 (22.22)	11 (13.10)	
Low	17 (10.90)	7 (9.73)	10 (11.90)	
Very low	2 (1.27)	0 (0)	2 (2.38)	
Patients' satisfaction with the crowdedness of the ED.				0.0001
Very high	16 (10.26)	9 (12.50)	7 (8.32)	
High	49 (31.41)	30 (41.67)	19 (22.62)	
Have no idea	30 (19.23)	19 (26.39)	11 (13.10)	
Low	47 (30.13)	14 (19.44)	33 (39.29)	
Very low	14 (8.97)	0 (0)	14 (16.67)	

Variables	Total (N=156)	Type of patient flow		P-value
		Vertical (N=72)	Horizontal (N=84)	
Staff satisfaction with the crowdedness of the ED.				0.0001
Very high	38 (24.36	34 (47.22)	4 (4.76)	
High	52 (33.33)	31 (43.06)	21 (25.00)	
Have no idea	7 (4.48)	3 (4.17)	4 (4.76)	
Low	44 (28.21)	3 (4.17)	41 (48.81)	
Very low	15 (9.62)	1 (1.38)	14 (16.67)	
Staff satisfaction with the patient lying or sitting position				0.0001
Very high	46 (29.49)	39 (54.17)	7 (8.33)	
High	52 (33.33)	31 (43.06)	21 (25.00)	
Have no idea	9 (5.77)	2 (2.77)	7 (8.33)	
Low	35 (22.44)	0 (0)	35 (41.67)	
Very low	14 (8.97)	0 (0)	14 (16.67)	

Relationship between Satisfaction, Duration of Hospitalization, and Number of Hospitalized Patients

The results revealed a significant negative correlation between patient satisfaction with fast and timely admission and the duration of hospitalization in the vertical patient flow group (r = -0.22, p=0.045). There were no other significant correlations between patient satisfaction and duration of hospitalization for the other aspects of the ED experience in either flow group (Table 3).

Table 3: The relationship between patient satisfaction and the duration of hospitalization in the emergency department (ED), by patient flow group

Variables	Duration of hospitalization in the ED (minutes)			P-value
	Horizontal (N=84)	P-value	Vertical (N=72)	
Patients' satisfaction with the points provided when sitting in the ED.				0.068
Very high	198.75 ± 93.31	0.364	107.92 ± 48.00	
High	179.25 ± 65.01		120.00 ± 66.35	
No idea	179.25 ± 65.01		160.71 ± 66.35	
Low	217.08 ± 83.44		175.00 ± 94.89	
Very low	N/A		185.00 ± 63.64	

Variables	Duration of hospitalization in the ED (minutes)			P-value
	Horizontal (N=84)	P-value	Vertical (N=72)	
Patient satisfaction with fast and timely admission				
Very high	182.89 ± 85.42		95.05 ± 36.43	
High	197.18 ± 82.30		133.89 ± 64.08	
Have no idea	185.00 ± 82.40	0.276	142.50 ± 45.00	0.045
Low	205.00 ± 67.08		148.13 ± 62.33	
Very low	N/A		143.33 ± 83.86	
Patient's satisfaction with the speed of the physician's presence at the bedside				
Very high	181.84 ± 90.12		113.75 ± 50.69	
High	206.87 ± 82.76		126.59 ± 65.23	
Have no idea	211.67 ± 74.63	0.226	120.00 ± 24.49	0.216
Low	207.50 ± 51.23		140.00 ± 66.33	
Very low	N/A		120.00 ± 42.42	
Patient satisfaction with lying or sitting position				
Very high	168.33 ± 87.56		123.81 ± 59.32	
High	210.47 ± 73.87		130.13 ± 61.35	
Have no idea	193.13 ± 102.74	0.450	137.27 ± 64.66	0.158
Low	201.43 ± 59.28		156.00 ± 23.66	
Very low	N/A		170.00 ± 98.99	
Patient satisfaction with the crowdedness of the ED.				
Very high	178.13 ± 101.24		110.71 ± 57.91	
High	183.79 ± 89.96		130.00 ± 59.37	
Have no idea	221.84 ± 71.59	0.420	115.91 ± 54.12	0.661
Low	199.29 ± 70.21		143.39 ± 63.40	
Very low	N/A		110.00 ± 59.87	

Data are presented as mean ± standard deviation.

Additionally, in the vertical patient flow group, there were several significant negative correlations between patient and staff satisfaction and the number of hospitalized patients per day, including points provided when sitting in the ED (r = -0.29, p=0.002), satisfaction with fast and timely admission (r = -0.33, p=0.002), the speed of the physician's presence (r = -0.27, p=0.012), staff satisfaction with bed occupancy (r = -0.33, p=0.002), patient satisfaction with lying or sitting positions (r = -0.25, p=0.018), patient and staff satisfaction with the crowdedness of the ED (r = -0.23, p=0.034 and r = -0.33, p=0.002, respectively), and staff satisfaction with the patient's lying or sitting position (r = -0.22, p=0.039) (Table 4).

Table 4: The relationship between the number of hospitalized people per day in the emergency department (ED) and the satisfaction of patients and staff

Variables	Type of patient flow			P-value
	Horizontal patient flow (N=72	P-value	Vertical patient flow (N=84	
Patients' satisfaction with the points provided when sitting in the ED.				
Very high	23.25 ± 4.50		27.57 ± 6.50	
High	24.62 ± 9.90		29.00 ± 7.70	0.002
Have no idea	21.05 ± 3.80	0.388	30.50 ± 5.30	
Low	22.17 ± 2.50		34.80 ± 7.70	
Very low	N/A		47.00 ± 4.20	
Patient satisfaction with fast and timely admission				
Very high	22.26 ± 4.70		27.05 ± 7.10	
High	24.26 ± 8.10		29.30 ± 6.70	0.002
Have no idea	21.67 ± 4.90	0.448	35.50 ± 4.20	
Low	20.00 ± 2.10		32.13 ± 10.60	
Very low	N/A		44.67 ± 5.00	
Patient satisfaction with the speed of the physician's presence at the bedside upon arrival				
Very high	21.88 ± 5.00		28.41 ± 7.20	
High	23.48 ± 8.30		29.56 ± 7.00	0.012
Have no idea	23.00 ± 3.70	0.893	28.00 ± 9.00	
Low	23.00 ± 5.80		37.50 ± 11.30	
Very low	N/A		45.00 ± 7.00	
Staff satisfaction with occupying beds				
Very high	21.30 ± 4.30		23.83 ± 9.70	
High	23.61 ± 7.90		25.83 ± 6.90	0.002
Have no idea	24.42 ± 5.90	0.312	27.83 ± 6.50	
Low	N/A		31.50 ± 7.60	
Very low	N/A		35.50 ± 4.20	
Patient satisfaction with lying or sitting position				
Very high	22.36 ± 6.10		29.20 ± 7.60	
High	23.13 ± 7.90		28.55 ± 6.90	
Have no idea	22.36 ± 4.20	0.884	31.91 ± 9.30	0.018
Low	24.57 ± 4.96		30.67 ± 7.30	
Very low	N/A		47.00 ± 4.20	

Variables	Type of patient flow			P-value
	Horizontal patient flow (N=72	P-value	Vertical patient flow (N=84	
Patient satisfaction with the crowdedness of the ED.				
Very high	21.75 ± 4.20		24.50 ± 6.20	
High	23.79 ± 8.50		26.59 ± 8.50	
Have no idea	22.44 ± 4.10	0.840	30.09 ± 5.00	0.034
Low	22.58 ± 5.60		30.76 ± 7.70	
Very low	N/A		34.23 ± 7.70	
Staff satisfaction with the crowdedness of the ED.				
Very high	22.34 ± 4.60		27.50 ± 11.90	
High	23.31 ± 8.20		24.75 ± 6.40	
Have no idea	22.00 ± 1.40	0.849	25.25 ± 8.60	0.002
Low	26.00 ± 12.70		32.03 ± 6.90	
Very low	28.00 ± 0		33.36 ± 7.30	
Staff satisfaction with the patient lying or sitting position				
Very high	22.24 ± 4.40		22.83 ± 10.60	
High	24.22 ± 8.70		27.65 ± 5.80	
Have no idea	19.00 ± 1.40	0.344	28.18 ± 8.10	0.039
Low	N/A		31.93 ± 5.70	
Very low	N/A		29.87 ± 7.80	

Data are presented as mean ± standard deviation.

DISCUSSION

The findings of this study offer important insights into the comparative performance of vertical and horizontal patient flow models in the ED setting. The results demonstrate significant differences between the two approaches in terms of duration of hospitalization, volume of hospitalized patients, patient/staff satisfaction, and ED crowding.

The observed reduction in mean duration of hospitalization for patients in the vertical flow group aligns with previous research on the benefits of this model. Studies by Hsieh et al. [10], Garrett et al. [11], Wallingford et al. [12] and Arya et al. [13] have reported similar findings, suggesting that the vertical flow approach can improve patient throughput and reduce waiting times in the ED. This is likely due to the streamlined processes and dedicated resources inherent to the vertical model, which facilitate faster triage, diagnostics, and disposition decisions [6].

Consistent with the findings on length of stay, the vertical flow group demonstrated a higher daily volume of hospitalized patients compared to the horizontal model. This corroborates the work of Garrett et al. [11], who found that vertical flow EDs were able to accommodate larger patient loads without compromising quality of care. The increased efficiency and resource utilization enabled by the vertical approach appear to translate into the ability to manage a greater number of patients within the same operational capacity.

In terms of ED crowding, the vertical flow model appears to have a distinct advantage. By streamlining patient flow and improving throughput, the vertical approach can help mitigate the issue of ED overcrowding, which is a persistent challenge in many healthcare systems [6, 11]. The reduced length of stay and higher volume of hospitalized patients in the vertical flow group suggest that this model is better equipped to manage patient influx and maintain a more manageable level of crowding in the ED. The study's examination of patient and staff satisfaction revealed a more complex picture, with both models exhibiting unique strengths and trade-offs. While patients in the horizontal flow group reported higher satisfaction with certain aspects of their experience, such as seating and physician presence, those in the vertical flow model expressed greater satisfaction with the perceived crowdedness of the ED. This mirrors the findings of Lowie et al. [6], who noted that the vertical flow approach can enhance the subjective experience of reduced crowding, even if objective measures of crowding are not significantly different. However, in a study by Garrett et al. [11] no significant impact on patient satisfaction was found with the implementation of the vertical flow model in the ED.

To our knowledge, no previous study has evaluated the impact of vertical versus horizontal patient flow models in the ED setting on staff satisfaction. Our results showed that the implementation of the vertical flow approach was associated with greater staff satisfaction compared to the traditional horizontal model. The vertical model's focus on dedicated resources and streamlined processes appears to better align with the preferences and perceptions of ED staff, potentially contributing to improved job satisfaction and workforce retention.

The analysis of the associations between satisfaction, duration of hospitalization, and patient volumes provided additional insights. The negative correlation between patient satisfaction with admission timeliness

and length of stay in the vertical flow group aligns with the notion that improved patient throughput can enhance satisfaction with the admission process [6]. Furthermore, the observed negative relationships between both patient and staff satisfaction with the volume of hospitalized patients in the vertical flow group suggest that the vertical model's efficiency and resource optimization can help maintain high levels of satisfaction even under increased patient loads.

There are some limitations in the present study that need to be addressed. This study was conducted at a single healthcare institution, limiting the generalizability of the findings. Additionally, the analysis was restricted to a specific time period, and potential long-term impacts of the patient flow models were not assessed. Further research is needed to validate the results across diverse healthcare settings and over extended timeframes.

CONCLUSION

This study demonstrates that the vertical patient flow model offers advantages over the horizontal approach, including reduced length of hospitalization, higher daily volumes of admitted patients, and greater staff satisfaction. Importantly, the vertical model appears more effective in managing ED crowding. However, nuanced differences in patient satisfaction highlight the need for a multifaceted strategy. Continued research is necessary to further elucidate the long-term implications of these patient flow models. Optimizing patient flow and mitigating ED crowding can enhance the quality of care, patient outcomes, and operational efficiency in emergency departments.

Conflict of interest: The authors report no conflicts of interest

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Authors' contribution

Data gathering and idea owner of this study: FJ, SMG

Study design: FJ, IG, FB, SMG, SMH

Data gathering: FJ, SMG

Writing and submitting manuscript: FJ, IG, FB, SMG, SMH

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