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Redirection of low-acuity emergency department patients to nearby medical clinics using an electronic medical support system: effects on emergency department performance indicators

Anne-Laure Feral-Pierssens^{1,2,3,4,5*}, Isabelle Gaboury¹, Clément Carbonnier⁶ and Mylaine Breton¹

Abstract

Background Overcrowded emergency departments (EDs) are associated with higher morbidity and mortality and suboptimal quality-of-care. Most ED flow management strategies focus on early identification and redirection of low-acuity patients to primary care settings. To assess the impact of redirecting low-acuity ED patients to medical clinics using an electronic clinical decision support system on four ED performance indicators.

Methods We performed a retrospective observational study in the ED of a Canadian tertiary trauma center where a redirection process for low-acuity patients was implemented. The process was based on a clinical decision support system relying on an algorithm based on chief complaint, performed by nurses at triage and not involving physician assessment. All patients visiting the ED from 2013 to 2017 were included. We compared ED performance indicators before and after implementation of the redirection process (June 2015): length-of-triage, time-to-initial-physician-assessment, length-of-stay and rate of patients leaving without being seen. We performed an interrupted time series analysis adjusted for age, gender, time of visit, triage category and overcrowding.

Results Of 242,972 ED attendees over the study period, 9546 (8% of 121,116 post-intervention patients) were redirected to a nearby primary medical clinic. After the redirection process was implemented, length-of-triage increased by 1 min [1;2], time-to-initial assessment decreased by 13 min [-16;-11], length-of-stay for non-redirected patients increased by 29 min [13;44] ($p < 0.001$), minus 20 min [-42;1] ($p = 0.066$) for patients assigned to triage 5 category. The rate of patients leaving without being seen decreased by 2% [-3;-2] ($p < 0.001$).

Conclusion Implementing a redirection process for low-acuity ED patients based on a clinical support system was associated with improvements in two of four ED performance indicators.

Keywords Emergency health service, Healthcare system, Triage, Assessment of healthcare need

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Introduction

Although overcrowding of emergency departments (EDs) is strongly associated with downstream congestion, especially with patient boarding issues waiting for hospital beds [1, 2], the increasing trend of ED visits is also subject of concerns due to limited and overcrowded facilities. [3–6] ED visits from low-acuity patients are often considered as a substitute for other healthcare provider appointments and are sometimes incriminated as an overcrowding factor even though literature reports conflicting results and low levels of proof. [7–10] Defining these targeted patients is complex and not a matter of consensus. Depending on the authors and the interventions or models analyzed, the terms and target definitions vary, limiting comparisons. [11, 12] However, increased use of EDs and overcrowding and boarding issues have harmful consequences for patients, who experience sub-optimal quality-of-care and higher morbi-mortality rates, as well as ED staff, who report lower quality of work life. [1, 13, 14] Moreover, higher rates of patients leaving the ED before being seen by an emergency physician are often reported in overcrowded EDs. [14–18]

To reduce crowded EDs, some of them have focussed their intervention strategies on the early identification and redirection of low-acuity patients to other healthcare providers such as GPs working in different settings. [10] Various types of interventions have been studied, and most of them involve limiting patient input in the ED track. For example, in the Netherlands, Boecke et al. studied the implementation of a general physician (GP) working in the ED but dedicated to low-acuity patients in separate streams after triage. [19] They reported a high level of patient satisfaction, a decrease in additional tests performed and a decrease in ED length-of-stay for redirected patients. Both Ramlakhan et al. and Khangura et al. reviewed the impact of GPs working alongside the ED in walk-in clinics where patients either self-select before registering with the ED or are redirected after triage. [20, 21] They reported little to no evidence of improvement in patient outcomes such as care provision or waiting time. Reports on the effects and impacts of these management strategies are still ambiguous. The rate of redirected patients varies from 2 to 20% of ambulatory patients depending on the study. [19–25] These contradictory outcomes have led to controversies over the potential impact of such management strategies. [8–10] Limitations are mostly related to heterogeneity of the redirection processes implemented, which limits the reproducibility of the studied interventions in other contexts. [11, 24–26]

Redirection processes are often deployed to improve ED performance indicators as a proxy of quality-of-care. However, there is no consensus on the definitions of ED performance indicators and measures.

Time-to-initial-physician-assessment, ED length-of-stay, proportion of patients who leave without being seen by an emergency physician and occupancy rate are popular indicators associated with higher quality-of-care and performance. [26] Some studies investigating the effects of redirection strategies on ED performance indicators report a decrease in time-to-initial-assessment and length-of-stay before discharge or admission for remaining patients, whereas others report no changes. [19, 24] However, these studies present identification processes for low-acuity ED patients that are subjective and do not clearly define how patients are identified and selected, thereby limiting the generalizability of the processes and results to other care settings.

The aim of this study is to assess the effects of redirecting low-acuity ED patients to medical clinics using an electronic clinical decision support system on four ED performance indicators.

Methods

Setting

We performed a retrospective observational study in a tertiary trauma center of an urban academic hospital in Quebec, Canada, that sees 60,000 ED visits annually and where a system for redirecting low-acuity ED patients was implemented in June 2015. The redirection process was based on a clinical decision support system performed by nurses at triage and did not involve physician assessments.

In this redirection process, low-acuity patients are defined as those who can be safely redirected to a nearby collaborating medical clinic within 36 h. All participating clinics offered appointments with a GP and were located within 5 km of the redirecting hospital. The support system was developed through the collaborative work of ED physicians, triage nurses and GPs. The support system and its safety have been reported elsewhere. [27] The system's clinical decision relied on a verification process performed by the triage nurse, who determined whether the patient should be redirected. The decision is based on a four-step process. Figure 1 presents how the redirection decision is made and the steps necessary to complete the process: The triage nurse assesses the patient's situation, assigns the triage level according to the Canadian Triage and Acuity Scale (CTAS) and determines patient's chief complaint. Step 1: To assess if a patient is eligible for redirection, the triage nurse uses a clinical decision support system based on chief complaint. The complaint must be one of 53 pre-determined reasons (for example, headache, cough, low-back pain or rash). Using the clinical decision rule, the patient is first screened through a list of general prerequisites and formal contraindications to redirection (ex: unstable vital signs, chest pain, less than 6 months old...). Step 2: If the patient is

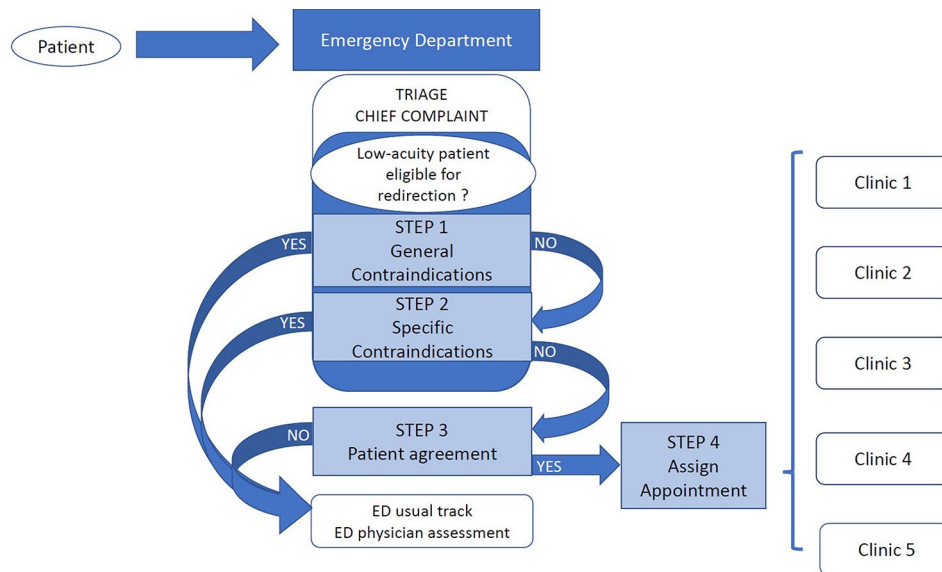


Fig. 1 Redirection process for low-acuity patients visiting the emergency department

Table 1 Description of emergency department (ED) performance indicators

Indicator	Description
Length-of-triage (min)	Delay between ED registration on arrival and the end of the triage process.
Time-to-initial-physician-assessment (min)	Delay between ED registration on arrival and first medical assessment by an emergency physician. This indicator is analyzed for ED patients who are not redirected.
Length-of-stay in the ED (min)	Delay between ED registration on arrival and ED discharge or admission.
Left without being seen (%)	Rate of patients who are not redirected and who leave the ED after triage but before being seen by an emergency physician (lost before physician assessment).

eligible for redirection, the nurse ensures that there is no specific contraindication associated with their main complaint. (ex for “low-back pain”: fever, major trauma, pregnancy...). Step 3: Once contraindications are ruled out, redirection is offered as an alternative to the ED visit. Redirection is not compulsory and the patient may refuse. Step 4: If the patient agrees, the triage nurse has real-time access through the support system to the participating clinics’ availabilities and has the ability to book an appointment. Appointments are scheduled within a maximum of 36 h. The redirection process is available 24/7. Patients who decline redirection follow the usual process through the ED.

Selection of participants

All patients visiting the ED between June 15th, 2013 and June 14th, 2017 were included. The intervention was launched on June 15th, 2015.

Data collection

Data were collected from the hospital’s electronic medical record system. For each patient, we collected the priority level at triage following the CTAS [28], the unit the patient was first assigned to (stretcher or ambulatory unit), the ED exit modality at the end of the consultation (redirected, discharged home, admitted to hospital, left without being seen or deceased) and the four ED performance indicators for each visit as displayed in Table 1. For each patient, the triage nurse reported whether redirection was accepted and whether they had an appointed GP. The primary care system in Quebec relies on the coordination of health trajectories through an appointed GP to whom patients are attached and who can refer to specialist physicians or to the hospital for specialized care. Patients not attached to a specific GP have more difficulties accessing healthcare. [29]

Four performance indicators were used to compare ED performance after implementation of the redirection process (Table 1).

All indicators were extracted from the electronic medical chart of each patient. ED registration is performed by an administrative employee on patient arrival. Length-of-triage corresponds to the duration between the creation (registration) and closure of the electronic triage sheet by the triage nurse. Time-to-initial-physician-assessment corresponds to the duration between registration and the creation of the clinical section of the electronic medical chart. Length-of-stay corresponds to the duration between creation of the medical chart on arrival and its final closure.

Analysis

We performed monocentric retrospective time interrupted series analysis. Descriptive statistics are presented as means \pm standard deviation (SD) if normally distributed and as medians [interquartile range; IQR] when appropriate. Categorical data are presented as numbers and percentages. A pre-post comparison of indicators was performed using Student's t-tests for continuous data and Chi-square tests for categorical data.

To compare longitudinal data, we first performed descriptive statistics for each performance indicator for the entire period of the study and separately for the pre- and post-intervention periods. Secondly, we performed interrupted time series (ITS) analysis as adjusted segmented regression. Such methodology is accurate in the presence of linear trends and independent residuals, which appeared from the descriptive statistics. [30] We adjusted for potential a priori confounding factors based on determinants of healthcare use and pathway and descriptive statistics: age (years), gender (male, female), month, day of visit (weekday vs. weekend), time of day (morning, afternoon, evening, night), triage category (CTAS categories), congestion and overall increasing trends of ED visits. Congestion was defined as the total number of patients registered with the ED 30 min before and 30 min after the registration of an index patient.

We also performed stratified analysis per triage category. Analyses were performed using Stata version 16.0 (StatCorp Ltd., College Station, TX, USA).

Results

Over the study period, 242,972 patients visited the ED, with 121,856 visits before and 121,116 visits after the implementation of the redirection process (Fig. 2). During the post-intervention period, 9546 patients were redirected to a nearby primary health clinic, representing 8% of all ED visits.

General characteristics of ED patients

The general characteristics of ED patients before and after implementation of the redirection process are presented in Table 2. After triage, 38% of all ED patients were assigned to triage category 4 or 5. The proportion of ED patients affiliated with a GP increased in the post-intervention period (47% vs. 49%, $p < 0.001$). For all ED patients, time-to-initial-assessment and length-of-stay decreased in the post-intervention period (96 [37;215] vs. 85 [34;189] minutes, $p < 0.001$ and 438 [258;855] vs. 407 [239;803] minutes, $p < 0.001$, respectively).

Redirected patients

In the post-intervention period, redirected patients were younger than other ED patients (39 [24;55] years vs. 52 years [33;71], $p < 0.001$). There were fewer patients with an appointed GP among redirected patients than other ED patients (43% vs. 50%, $p < 0.001$) (Table 3). In the post-intervention period, redirected patients who were assigned to triage category 5 had a median length-of-stay of 11 min ([7;37]) compared to 158 min [81;316] for non-redirected ED patients who were assigned to other triage categories ($p < 0.001$). The general characteristics of redirected patients are presented in Table 3.

ED performance indicators

Interrupted time series analysis of ED performance indicators indicated an increased **length-of-triage** for ED patients (1 min [1;2], $p < 0.001$). **Time-to-initial-assessment** for non-redirected ED patients decreased by 13 min [-16;-11] in the post-intervention period. **Length-of-stay** of non-redirected ED patients increased by 29 min [13;44] ($p < 0.001$) after implementation of the redirection process with differences when stratified on triage category: length-of-stay for patients assigned to triage 5 category decreased by 20 min [-42;1] ($p = 0.066$) while it did not differ for triage 3 & 4 categories and

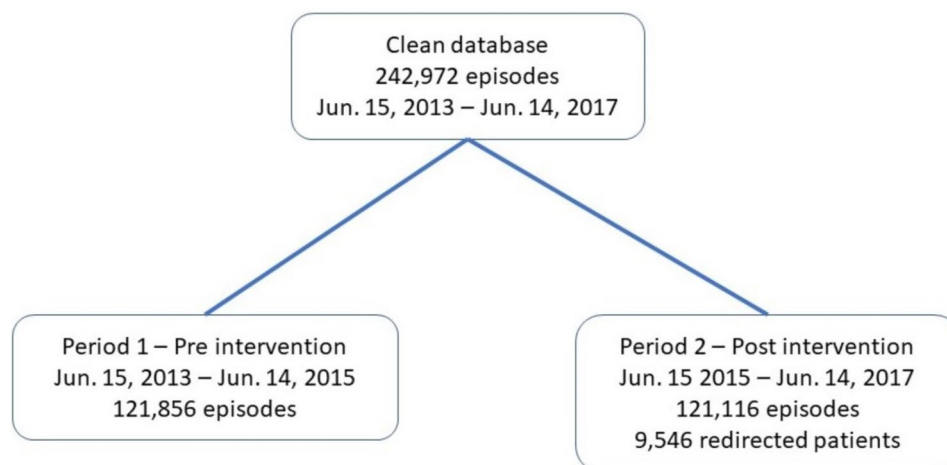


Fig. 2 Flow chart of the studied population

Table 2 Patient characteristics before and after implementation of the redirection process

	Total	Pre-intervention	Post-intervention	p-value*
Patients, N	242,972	121,116	121,856	
Redirected patients, n (%)	9,555 (4)	9 (0)	9,546 (8)	< 0.001
Demographics				
Sex ratio (F/M)	0.831	0.826	0.836	0.135
Age, median [Q1;Q3] (years)	51 [33;70]	51 [33;70]	51 [33;71]	0.057
Attached to GP, n (%)	116,592 (48)	56,939 (47)	59,653 (49)	< 0.001
Triage setting, n (%)				
Stretcher	97,243 (40)	49,289 (41)	47,954 (39)	< 0.001
Triage category 1	3,151 (1)	1,554 (1)	1,597 (1)	0.549
2	52,539 (22)	24,970 (21)	27,569 (23)	< 0.001
3	96,196 (40)	49,127 (41)	47,069 (39)	< 0.001
4	64,782 (27)	33,061 (27)	31,721 (26)	< 0.001
5	26,304 (11)	12,404 (10)	13,900 (11)	< 0.001
Delays, median [Q1;Q3] (min)				
Length-of-triage	6 [4;8]	5 [4;7]	6 [4;8]	< 0.001
Time-to-initial-assessment ¹	90 [37;215]	96 [37;215]	85 [34;189]	< 0.001
Length-of-stay ¹	423 [248;831]	438 [258;855]	407 [239;803]	< 0.001
ED outcome for all ED patients, n (%)				
Left without being seen	22,543 (9)	12,376 (10)	10,167 (8)	< 0.001
Discharged home ^o	164,362 (68)	85,425 (71)	78,937(65)	< 0.001
Admitted	37,333 (15)	19,091 (16)	18,242 (15)	< 0.001
Death	634 (0.3)	313 (0.3)	321 (0.3)	0.809

F: female. M: male. GP: general physician. ED: emergency department

*p-value comparing pre- and post-intervention groups: Chi-square test for categorical variables and Student's t-test for continuous variables

^o Redirected patients were not considered as discharged home

¹ for non-redirected ED patients

Table 3 Characteristics of ED patients admitted to the ED vs. redirected patients in the post-intervention period

	Total ED visits post-intervention	Not redirected	Redirected	p-value*
Patients, n	121,856	112,310	9,546	
Demographics				
Sex ratio (F/M)	0.8	0.8	1	< 0.001
Age, median [Q1;Q3] (years)	51 [33;71]	52 [34;72]	39 [24;55]	< 0.001
Age category, n (%) < 18	6,120 (5)	4,962 (4)	1,158 (12)	< 0.001
[18–50[	53,283 (44)	47,928 (43)	5,355 (56)	< 0.001
[50–75[	38,118 (31)	35,742 (32)	2,376 (25)	< 0.001
[75–85[	13,898 (11)	13,436 (12)	462 (5)	< 0.001
≥ 85	10,437 (9)	10,242 (9)	195 (2)	< 0.001
Attached to GP, n (%)	59,653 (49)	55,527 (50)	4,126 (43)	< 0.001
Triage setting, n (%)				
Triage category 1	1,597 (1)	1,597 (1)	0 (0)	< 0.001
2	27,569 (23)	27,490 (25)	79 (1)	< 0.001
3	47,069 (39)	45,515 (41)	1,554 (16)	< 0.001
4	31,721 (26)	27,419 (24)	4,302 (45)	< 0.001
5	13,900 (11)	10,289 (9)	3,611 (38)	< 0.001
Delays, Mean (standard deviation) / Median [Q1;Q3] (min)				
Length-of-triage	6 [4;8]	6 [4;8]	7 [5;10]	< 0.001
Length-of-stay	359 [189;665]	387 [223;718]	15 [8;85]	< 0.001

F: female. M: male. GP: general physician. ED: emergency department

*p-value comparing pre- and post-intervention groups: Chi-square test for categorical variables and Student's t-test for continuous variables

increased by 58 min [21;95] ($p=0.002$) for triage 2 category (Table 4). The proportion of patients who **left without being seen** by an emergency physician decreased after implementation of the redirection process (-2% [-3;-2], $p<0.001$) (Table 4). Stratified analysis by triage category showed a decrease in time-to-initial-assessment mostly among patients from triage categories 3 to 5. Time-to-initial assessment decreased by 23 min [-33;-13] ($p<0.001$) for patients assigned to triage category 5 and by 9 min [-13;-5] for patients assigned to triage category 3. The rate of patients leaving without being seen by an emergency physician decreased by 9% [-11;-7] ($p<0.001$) among patients assigned to triage category 5 and by 5% [-6;-4] ($p<0.001$) for patients assigned to triage category 4 (Table 4). The admission rate decreased by 1% [0;1], $p=0.034$.

Discussion

This study was performed on an exhaustive database and reports the effects of a reproducible redirection process for low-acuity ED patients on performance indicators. The implementation of this process was associated with a decrease in time-to-initial-assessment and a decrease in the rate of patients leaving the ED without being seen by an emergency physician. ED length-of-stay was similar before and after the intervention.

Redirected patients were younger than the rest of the ED population and were mostly assigned to lower triage categories. These demographic characteristics of low-acuity ED patients appear to be similar to those reported in the literature on patients with inadequate ED visits. [11, 12] We also report a lower rate of redirected patients attached to a GP compared to other ED patients. In Quebec, the healthcare pathway is built around the GP, who functions as a gatekeeper and directs patients through the system by referring them to specialists or to hospitals if needed. [31] However, attaching patients to a GP has been difficult for different populations, mainly for socially-deprived patients and those with low health literacy. [29, 32] For this specific population, the ED might be a way of entering an impervious healthcare system. Feral-Pierssens et al. reported that social deprivation is associated with a higher rate of ED visits but not with higher admission rates. [33] Thus, the ED might be used as a substitute strategy for patients confronted with difficulties accessing the healthcare system and a GP in particular. Naouri et al. investigated different definitions of inadequate ED visits and reported that social deprivation was indeed often associated with these type of ED visits and appeared to be linked to a lack of alternatives or to different barriers accessing healthcare. [12] Thus, the redirection process that was implemented here, which is performed after assessing the patient's medical needs then assigning them a personal appointment with a GP,

seems more appropriate for their overall healthcare trajectory. Indeed, patients are redirected to clinics where patients are followed and where they could consult again in the future. The identification of an available GP or healthcare resource could, thus, improve their overall healthcare use.

While the vast majority of redirected patients are aged between 18 and 75 years old, a small number of them are aged 85 and over. This population now represents around 7 to 10% of patients consulting adult EDs, and their trend is increasing. [34] This population is particularly heterogeneous in terms of health needs, and sensitive to changes in primary care provision. While some of them are vulnerable, fragile and dependent and have a high rate of hospital admission, others are frequent users of EDs. Some French studies estimate that they may correspond to nearly 3% of patients considered as having an inappropriate ED use, and more than 5% of these patients are, in fact, frequent users of EDs, a population that could be targeted by specific health and communication policies to improve their pathway within the healthcare system. [34, 35] In the future, it would be interesting to analyze more precisely the characteristics of the care pathways of these low-acuity elderly patients eligible to redirection.

The decrease in the delay between ED entrance and initial medical assessment is an improvement in terms of patient safety. Patients with severe conditions can be taken care of promptly, which improves outcomes and allows for possible triage mistakes to be rectified more quickly for less severe patients who may have waited longer. The rate of patients leaving without being seen by an emergency physician is a metric representing the accessibility of emergency care and safety. Patients may experience adverse health outcomes due to delays in seeking care elsewhere in the health network. Roby et al. reported that half of patients who left without being seen had a subsequent encounter with the health system within 3 weeks, 66% in the ED and 78% within 72 h, the vast majority of which were related to the first chief complaint. Among these visits, 14% resulted in a hospital admission within 3 weeks of the first ED visit. [36] Others have reported an increased risk of mortality within 2 to 7 days among patients who left without being seen compared to those who completed the ED visit and treatment when adjusting for temporal, hospital and ED visit variables. Thus, these patients present with higher ED re-attendance rates and an excess mortality risk. [37, 38] Implementation of a redirection process to a specific health provider, even one outside the ED, was associated with a drop in the rate of patients who left without being seen, which could help avoid missed opportunities to provide services during the first encounter.

This study is the first to analyze how ED performance indicators evolved after the implementation of a support

Table 4 Comparison of ED performance indicators before vs. after implementation of the redirection process. Results of interrupted time series by segmented adjusted regression

	Estimate [95%CI] (p-value)	
	All patients	Only non-redirectioned patients
Time-to-initial-assessment*, min		
All triage categories		-13 [-16;11] (<0.001)
Triage category 2		0 [-3;2] (0.766)
Triage category 3		-9 [-13;-5] (<0.001)
Triage category 4		-33 [-40;-26] (<0.001)
Triage category 5		-23 [-33;-13] (<0.001)
Left without being seen, %		
All triage categories	-2 [-3;-2] (<0.001)	-0.9 [-1;-0.4] (<0.001)
Triage category 2	-0.2 [-0.7;0.3] (0.415)	-0.2 [-0.7;0.3] (0.422)
Triage category 3	-0.5 [-1;0.2] (0.159)	-0.2 [-0.9;0.5] (0.589)
Triage category 4	-5 [-6;-4] (<0.001)	-2 [-3;-1] (<0.001)
Triage category 5	-9 [-11;-7] (<0.001)	-2 [-4;0] (0.076)
Length-of-stay, min		
All triage categories	-1 [-16;13] (0.868)	29 [13;44] (<0.001)
Triage category 2	57 [20;94] (0.002)	58 [21;95] (0.002)
Triage category 3	5 [-21;30] (0.728)	22 [-4;48] (0.100)
Triage category 4	-33 [-57;-8] (0.009)	27 [1;53] (0.042)
Triage category 5	-84 [-103;-64] (<0.001)	-20 [-42;1] (0.066)

Notes This table presents in the first column regressions of dependent variables on pre- versus post-intervention dummy variables, with adjustments for time trends. The regressions are adjusted for sex, age category, triage level, month of the year, day of the week and time of day (categorical) and congestion

system redirecting low-acuity ED patients. Based on a clinical decision support system performed by nurses at triage, it does not involve a physician assessment and its safety has already been studied. [27] Based on chief complaint and a contraindication assessment by a nurse, this system represents a paradigm shift in redirection strategies using the ED visit as an opportunity to insert low-acuity patients into an appropriate, efficient and relevant healthcare trajectory that could influence patients' subsequent encounters. However, the overall length-of-stay in the ED for admitted patients did not decrease after implementation of the redirection system. This is consistent with literature linking overcrowding to downstream rather than upstream congestion by patients needing hospital admission. [1] Thus, this redirection strategy should not be considered a perfect solution to overcrowding. Other models aimed at organizing the use of emergency or same-day care could be complementary and help better match patients' needs with accessible and available care. [39] Furthermore, because redirection strategies do not decrease ED length-of-stay, they should not be thought of as a one-shot diversion system for inadequate ED visits but rather as part of a long-term vision to assign the right care to the right patient on an individual level.

Limitations

This study has some limitations. Firstly, it is a monocentric study performed in a specific healthcare system, which could limit its generalizability. However, because the study used an exhaustive database and investigated a redirection process that was performed through a clinical support system based on a robust medical algorithm whose safety has been tested [40], the findings could be transposed to other settings in terms of patients eligible for redirection. The results may only differ if the upstream healthcare system is not fully able to absorb redirected patients. Redirection processes and their impact on ED performance indicators depend on the ability to identify eligible patients and redirect them efficiently.

Secondly, the retrospective nature of the study prevented us from identifying and comparing patients eligible for redirection pre-intervention vs. redirected patients post-intervention. The identification process of eligible patients based on their reason for visiting and contraindications rather than simple triage categories prevented us from assessing the proportion of low-acuity patients eligible for redirection before the intervention. However, overestimation of our results is unlikely because the aim of the study was focused on overall ED performance indicators before and after implementation of the redirection process. Nevertheless, future prospective studies should be conducted to compare individual outcomes of patients eligible for redirection between

those who are redirected or not. This would allow for investigation of the specifics of their short- and long-term healthcare trajectories and outcomes.

Finally, other factors such as organizational or structural changes within the ED (human resources, hospital management, and policies) and external factors such as the implementation or disappearance of care providers in the ED territory could not be taken into account. Nevertheless, we were able to control for the global trend in ED flow which seemed to follow the general trend in Quebec EDs over the period. An exhaustive analysis taking these different parameters into account in a prospective study would shed further light on how they might interact with the introduction of a redirection process.

Conclusion

This study investigated the implementation of a redirection process for low-acuity ED patients at an academic trauma center. The process is based on a reproducible and transposable clinical support system performed by nurses at triage and was associated with improvements in two ED performance indicators (time-to-initial-physician-assessment and rate of patients leaving the ED without being seen by an emergency physician), but it was not associated with improvements in ED length-of-stay. Based on chief complaint and contraindication assessments by a nurse, this system represents a paradigm shift in redirection strategies using the ED visit as an opportunity to insert low-acuity patients into an efficient and appropriate healthcare trajectory that could influence patients' subsequent encounters. The identification of an available GP or healthcare resource may indeed improve their overall healthcare use. However, redirection strategies should not be considered a perfect or unique solution to overcrowding situations but should be thought of and implemented as a useful tool to assign patients to the right care provider without increasing the risk of a perforated safety net.

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s12873-024-01080-0>.

Supplementary Material 1

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Author contributions

ALFP had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. Concept and design: ALFP, MB, IG. Acquisition, analysis, or interpretation of data: ALFP, CC. Drafting of the manuscript: ALFP. Critical revision of the manuscript for important intellectual content: IG, MB. Statistical analysis: CC. The authors read and approved the final manuscript.

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Data availability

The data underlying this article cannot be shared publicly due to federal and provincial legislations protecting personal data and materials in Canada and Quebec. Access to data and material can be provided upon request to the corresponding author.

Declarations

Ethics approval and consent to participate

This study has been approved by the institutional review board and ethics committee (Comité scientifique de la recherche (CSR) and Comité d'éthique de la recherche (CER) | CISSS de la Montérégie-Centre - April 2020). According to Canadian law, this study was designed and performed through denormalized data. The need for written informed consent was waived.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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