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Impact of the implementation of a fast-track on emergency department length of stay and quality of care indicators in the Champagne-Ardenne region: a before–after study

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ABSTRACT

Objectives We aimed to evaluate the effect of the implementation of a fast-track on emergency department (ED) length of stay (LOS) and quality of care indicators.

Design Adjusted before–after analysis.

Setting A large hospital in the Champagne-Ardenne region, France.

Participants Patients admitted to the ED between 13 January 2015 and 13 January 2017.

Intervention Implementation of a fast-track for patients with small injuries or benign medical conditions (13 January 2016).

Primary and secondary outcome measures Proportion of patients with LOS ≥4 hours and proportion of access block situations (when patients cannot access an appropriate hospital bed within 8 hours). 7-day readmissions and 30-day readmissions.

Results The ED of the intervention hospital registered 53 768 stays in 2016 and 57 965 in 2017 (+7.8%). In the intervention hospital, the median LOS was 215 min before the intervention and 186 min after the intervention. The exponentiated before–after estimator for ED LOS ≥4 hours was 0.79; 95% CI 0.77 to 0.81. The exponentiated before–after estimator for access block was 1.19; 95% CI 1.13 to 1.25. There was an increase in the proportion of 30 day readmissions in the intervention hospital (from 11.4% to 12.3%). After the intervention, the proportion of patients leaving without being seen by a physician decreased from 10.0% to 5.4%.

Conclusions The implementation of a fast-track was associated with a decrease in stays lasting ≥4 hours without a decrease in access block. Further studies are needed to evaluate the causes of variability in ED LOS and their connections to quality of care indicators.

INTRODUCTION

The number of annual emergency department (ED) visits has doubled between 1980 and 2004 in France,[1] and is still rising (+3.7% between 2014 and 2015). This phenomenon has been observed in most developed countries,[2] and is a challenge for physicians and policy-makers. ED crowding was defined by the American College of Emergency Physicians as a mismatch between the need for emergency care and the ED's ability to provide this care.[3] ED crowding has been associated with longer ED length of stay (LOS),[4] inadequate pain management,[5] and worse patient outcomes.[6] A crowded ED may sometimes need to fall back on ambulance diversion, redirecting patients to nearby hospitals. Finding the best organisation for EDs is therefore a public health priority with ethical implications.[3] The causes of ED crowding include increased demand from patients, epidemics, lack of trained staff and lack of hospital beds.[7] Numerous scores have been proposed to measure ED crowding (EDWIN, NEDOCS, READI, Work Score) however their predictive power typically does not outperform simpler indicators such as bed occupancy.[8 9] Time series analysis can predict ED activity with a Relative Mean Absolute Performance of 90%.[10] A shorter LOS results in less complications,[11 12] higher odds of survival for severe patients,[13] increased patient satisfaction[14 15] and lower healthcare spending.[16] The optimisation of

Strengths and limitations of this study

► We measured the effect of the implementation of a fast-track on length of stay and quality of care indicators.
► We controlled for potential confounders (primary diagnosis, severity…) with a multivariable analysis by logistic regression. The uncertainty induced by missing values was accounted for by pooling estimates from multiple imputations.
► The intervention was the only major change in the hospital under study.
► Further studies could include more hospitals.

patient flow has been studied extensively.[17 18] Numerous strategies have been proposed to regulate patient flow in the ED: care coordination teams, whose mission involves orienting older patients towards appropriate healthcare, observation units (caring for patients up to 72 hours), chest pain units, home-based healthcare.[19] A common strategy is the use of fast-tracks, dedicated pathways aimed towards the fast delivery of healthcare for patients with benign medical conditions scheduled for rapid discharge. Fast-tracks have been implemented in small and larger hospitals.[20] In 2002, 58% of 17 surveyed Australian public hospitals functioned with a fast-track.[19] A Monte-Carlo simulation showed that implementing a fast-track with a dedicated nurse could shorten median waiting times up to 35%.[21] Previous studies have evaluated the effect of implementing a fast-track,[22–25] however the length of these studies was short, typically less than 6 months. One 2-year study with a fast-track staffed with mid-level providers did not adjust for patient severity.[26] The aim of this study was to assess the impact of an ED restructuring with the implementation of a fast-track on ED LOS in the setting of a large hospital in France. Secondary objectives were to study predictors of ED LOS, and to assess the effect of the ED restructuration on 7-day readmissions, 30-day readmissions and the proportion of patients leaving without being seen.

METHODS
We conducted a before–after analysis with adjustment on confounders.

Population
The region in which the study took place is one of the least densely populated regions in France. The age structure of the region resembles the pooled age structure of the rest of the country. The intervention hospital (Troyes Hospital) was a large hospital with 442 medical beds, 127 surgical beds and 63 beds dedicated to gynaecology and obstetrics, serving an area of approximately 40 kilometres radius (25 miles). The ED hosted an observation unit.

Patient and public involvement
Patients were not involved in the design or analysis of this study.

Intervention
The intervention included an extension of the ED from 15 to 27 consultation rooms and the opening of a fast-track for patients with small injuries or benign medical conditions. The fast-track in the intervention hospital had six rooms. The fast-track is a healthcare pathway for the assessment and treatment of low-severity patients, situated in a dedicated area of the ED. The intervention was implemented on 13 January 2016. Two ED physicians managed adult patients and paediatric traumatology in the fast-track. When ED physicians were not available, they were replaced by residents. Gynaecology and psychiatry

Table 1 Patient State (PS) classification for patients admitted to the emergency department

PS class	Description
PS1	Patient with moderate treatment, discharged from emergency department.
PS2	Patient with major treatment, discharged from emergency department.
PS3	Patient with moderate treatment, hospitalised after emergency department stay.
PS4	Patient with major treatment, hospitalised after emergency department stay.
PS5	Patients requiring immediate treatment, not elsewhere classified.
PS6	Patients requiring immediate intensive care/resuscitation.
PS7	Died in emergency department.

patients could also be managed in dedicated areas of the fast-track. Entry criteria for the fast-track were predefined in a protocol (see online supplementary appendix 1).

Outcomes
The main outcome was an ED LOS ≥4 hours.[27 28] LOS was defined as the time elapsed between registration in the ED to the time the patient leaves the ED. The secondary outcome was access block, defined by the Australasian College for Emergency Medicine as the situation where patients who need hospital care cannot access an appropriate hospital bed within a reasonable delay (8 hours).[29] We used the Patient State (PS) classification[10] presented in table 1 to identify patients that needed to be admitted to the hospital (PS 3, 4, 5, 6 and 7). Time to physician appraisal and LOS were extracted from local hospital databases (data extracted from Resurgences© in the intervention hospital). Other quality of care indicators included the number of patients leaving without being seen[30] and the monthly proportion of 30-day and 7-day readmissions.[31]

Statistical methods
Continuous variables were summarised with means and SD or medians and the IQR. Categorical variables were presented with absolute frequencies and proportions. A descriptive analysis was carried out for LOS by period. Differences between the period before the intervention and the period after the intervention were compared with Student's t-test or with the Mann-Whitney U test for asymmetrically distributed variables, and with the χ^2 test for categorical variables. Summary statistics were provided for the waiting times of patients with selected diagnoses (pneumonia, stroke, myocardial infarction and heart failure). To facilitate modelling, LOS was transformed into a binary variable using thresholds classically found in the literature.[28] Separate models were fitted to study the primary outcome and access block. The effect of the intervention on the primary outcome was evaluated for
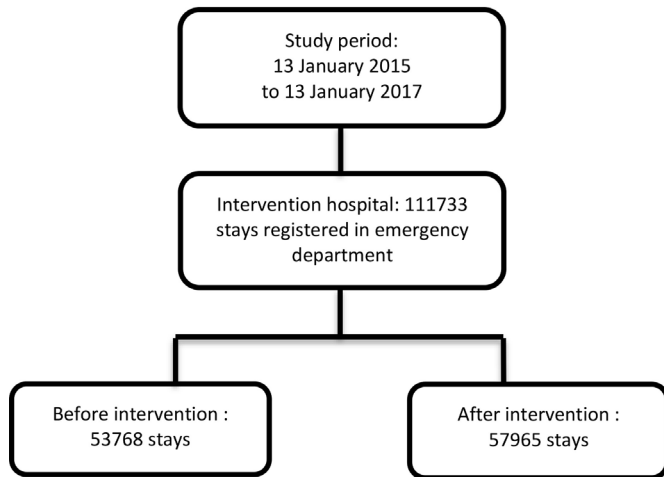
Study period:
13 January 2015
to 13 January 2017

Intervention hospital: 111733
stays registered in emergency
department

Before intervention :
53768 stays

After intervention :
57965 stays

Figure 1 Flow chart.

all patients. The effect of the intervention on access block was evaluated in an analysis restricted to patients who needed to be hospitalised after their ED stay. Multivariable logistic regression models were estimated to adjust for confounders. The model was Logit(p)=α + ϖP+T'τ +X'β, with p being the probability of the outcome, α the intercept, P an indicator variable for period, T a vector of additional time variables (effect of being admitted during the night, the weekend or winter months) and X a vector of individual-level covariates. Age was grouped in categories relevant to clinical practice. Primary diagnosis was defined using chapters of the International Classification of Disease 10th revision (ICD-10) to avoid problems

in estimation due to sparse data. Patient severity was included in the model using the PS classification.[10] Time variables included indicator variables for admission during the night (22:00–06:00 hours), and during weekends (Saturday and Sunday). An indicator variable for December and January, where influenza epidemics often occur, was included in the model. The study sample was a convenience sample with a time window constructed symmetrically around the intervention, allowing to control for seasonal effects. Missing data were treated by multiple imputation with m=20 imputations. The proportion of patients leaving without being seen was a secondary outcome. Due to the paucity of information on these patients, it was not included as an dependent variable for multivariable analysis. Statistical analysis, data management and figures were realised using R V.3.5.3 (www.r-project.org).[32]

RESULTS

Between 13 January 2015 and 13 January 2017, 111733 ED stays were registered in the intervention hospital (figure 1).

There were 53768 stays in 2016 and 57965 stays in 2017 (+7.8%). Regarding human resources, physicians increased from 11.5 to 14.5 full-time equivalents (FTE), nurses from 35.3 to 36.8 FTE, and assistant nurses from 16.8 to 19.5 FTE. The median LOS was 215 min (IQR Q1–Q3: 111–361) before the intervention and 186 min (98–340) after the intervention (table 2). The proportion

Table 2 Demographic characteristics of study population, length of stay and readmissions in the intervention hospital

	Intervention		
	2015–2016*	2016–2017†	
	Mean (SD), median (Q1–Q3) or n (%)	Mean (SD), median (Q1–Q3) or n (%)	P value
n	53768	57965	–
Age (years): mean (SD)	40.4 (27.3)	39.8 (27.4)	<0.001‡
Sex: *female–n* (%)	26712 (49.7)	29235 (50.4)	0.01§
Length of stay (min): median (Q1– Q3)	215 (111–361)	186 (98–340)	<0.001‡
7-day readmissions: *n (%)*	3177 (5.9)	3642 (6.3)	0.01§
30-day readmissions: *n* (%)	6105 (11.4)	7129 (12.3)	<0.001§
Patients admitted to hospital after emergency department: *n*	14795	14864	–
Length of stay (min): median (Q1–Q3)	316 (181–465)	333 (187–490)	<0.001‡
Patients not admitted to hospital after emergency department			
n	38971	43100	–
Length of stay (min): median (Q1–Q3)	185 (97–310)	155 (86–272)	<0.001‡

Q1–Q3: IQR
*13/01/2015 to morning of 13/01/2016.
†13/01/2016 afternoon to 13/01/2017.
‡Mann-Whitney U test.
§χ^2 test.

of patients with LOS <4 hours changed from 55.2% to 60.6%. Within the subgroups of patients subsequently admitted to the hospital, patients consulting for pneumonia had a decrease in median time to physician assessment after the intervention: from 87 min (41–173) to 79 min (36–165). Stroke patients also had decreased median waiting times: from 77 (34–155) to 62 (33–132) minutes. The time to physician assessment remained unchanged for patients consulting for myocardial infarction and heart failure: from 61 (31–149) before the intervention to 63 (30–150) minutes after the intervention.

The exponentiated before–after estimator was 0.788 (95% CI 0.767 to 0.810, p<0.0001), therefore the intervention successfully reduced the number of ED stays with LOS ≥4 hours (table 3). However, the estimate for access block was 1.188 (95% CI 1.126 to 1.253, p<0.001): the intervention did not seem effective in helping the patients who needed it to access an appropriate hospital bed in a reasonable amount of time (<8 hours). In 4.8% of cases, none of the scores that constituted the PS classification were present. These cases were essentially patients who left the ED without being seen. Age was linearly related with LOS, with younger patients having a shorter LOS. Weekends were associated with a shorter LOS. Patients admitted for injuries (ICD-10 codes S00 to T98) and skin problems (L00 to L99) tended to have a short LOS, while patients admitted for neurological diseases (G00–G99) tended to have a longer LOS. Trends in daily median LOS are shown in figure 2.

Effect on quality of care indicators

Overall, 12.0% of stays were 30-day readmissions. Most readmissions (6.1%) occurred within the first 7 days. There was a trend for increasing 30-day readmissions during the study period (figure 3). Seven-day readmissions increased from 5.9% to 6.3% in the intervention group. After the intervention, the proportion of patients leaving without being seen by a physician decreased from 10.0% to 5.4%.

DISCUSSION

Our study showed that implementing a fast-track can decrease the median LOS and number of stays lasting ≥4 hours in the ED of a large general hospital. We did not observe a decrease in LOS for patients requiring hospitalisation. However, the LOS for severe patients may have been limited by hospital-level bed availability rather than ED-related factors.[33] Indeed, other studies have found that the implementation of a fast-track did not adversely affect LOS for patients subsequently admitted to the hospital.[34]

The addition of new beds to the ED could explain part of our results. However, the addition of new beds does not guarantee improved access to care. In a study by Han *et al*, the time between ambulance diversion episodes was not significantly different after expanding an ED from 28 to 53 beds.[35]

Asplin *et al* consider the ED as a system with three components: *input, throughput* and *output*.[36] The input component includes events, diseases or other factors that contribute to the demand for urgent care. Throughput includes triage, room placement, diagnosis and treatment. The implementation of the fast-track can accelerate throughput for patients not subsequently admitted to the hospital. The decrease in LOS can be explained by decreased crowding due to rapid patient discharge, floorplan modifications allowing faster patient transfers, or physician and nurse role adjustments.[37 38] Fast-tracks can efficiently coexist with other patient streams, such as tracks dedicated to complex ambulant patients.[39] Regarding output, the limiting factor for ED LOS is often lack of available hospital beds. Some authors have suggested that an occupancy of 85% is a suitable target to ensure that new patients are not left without beds.[40] This seems difficult to implement under current conditions. A systematic review of 220 articles discussing strategies to prevent 'access block'[29] mentions interventions to diminish the number of patients admitted to the ED and observation wards.[41] Other solutions to prevent ED crowding are: sharing optimal care processes,[42] enrolling additional staff[8] or eventually redirecting patients towards other centres.[7] Causes of increased demand for urgent care include the ageing of populations, with a higher prevalence of chronic diseases, the scarcity of primary care and changing perceptions of what is considered urgent. Solitude is a major driver of ED consultations.[43] The efficacy of gatekeeping procedures has yet to be evaluated.[44] The patients that frequently consult in the ED, however, are often disadvantaged by a low socio-economic status[45] and can be considered a high-risk group regarding morbidity and mortality.[46] Prior contact with the ED could help improve communication with the patient, although an effect on the number of ED admissions remains to be established.[47] Pain is a major complaint in the ED, and patients with chronic pain could be more likely to consult.[48] Access to programmed care is crucial, and patients who cannot access programmed care will come back to the ED. In an Australian study, around half of patients would prefer to see a general practitioner for a similar problem than to be treated in the emergency fast-track.[49] In this regard, what is happening in EDs can be seen as a mirror of the dysfunctions in a healthcare system.[50]

After the implementation of the fast-track, the number of patients registered in the ED increased by 7.8%. This is unlikely to be a fluctuation in epidemiological trends, but rather reflects an increased demand generated by an easier access to timely care. Patients leaving without being seen diminished from 10.0% to 5.4%, similar to the proportions in studies by Combs *et al*[51] and Sanchez *et al*.[26]

Among other quality of care indicators, we evaluated ED 7-day and 30-day readmissions.[52] The main rationale for including these indicators was to appreciate the extent by which the decrease in LOS was explained by readmissions of the same patients. Seven-day readmissions

Table 3 Multivariable logistic regression for length of stay ≥4hours and access block

Variable	OR (emergency department length of stay ≥4hours for all patients)*	95% CI	ORs (access block: emergency department length of stay ≥8hours for hospitalised patients)*	95% CI
Period: after intervention (reference=before intervention)	0.788	0.767 to 0.810	1.188	1.126 to 1.253
7-day readmission	0.833	0.786 to 0.882	0.867	0.773 to 0.973
8–30 days readmission	0.974	0.918 to 1.033	0.938	0.849 to 1.037
Weekend day	0.936	0.908 to 0.966	0.761	0.714 to 0.811
Night	0.594	0.572 to 0.618	0.878	0.811 to 0.950
Principal diagnosis (ICD-10 Chapter)				
Injury, poisoning	0.559	0.508 to 0.616	0.641	0.568 to 0.723
Diseases of the nervous system	2.113	1.846 to 2.419	1.269	1.065 to 1.511
Skin and subcutaneous tissue	0.466	0.404 to 0.537	0.573	0.413 to 0.795
Neoplasms	1.175	0.843 to 1.637	2.098	1.486 to 2.963
Diseases of the circulatory system	1 (Reference)	–	1 (Reference)	–
Month: December and January (reference=other months)	1.159	1.118 to 1.202	1.49	1.390 to 1.597
Severity (PS classification)				
PS1	1 (Reference)	–	–	–
PS2	1.890	1.668 to 2.142	–	–
PS3	2.234	2.157 to 2.313	1 (Reference)	–
PS4	1.669	1.560 to 1.785	0.804	0.747 to 0.865
PS5	0.470	0.395 to 0.560	0.397	0.316 to 0.499
PS6	0.336	0.268 to 0.420	0.246	0.176 to 0.344
PS7	0.315	0.201 to 0.492	0.333	0.175 to 0.637
Sex: female (reference=male)	0.994	0.966 to 1.022	1.072	1.014 to 1.134
Age (years)				
50–64	1.611	1.547 to 1.679	1.387	1.271 to 1.514
65–74	2.152	2.041 to 2.269	1.681	1.532 to 1.846
75–89	3.367	3.210 to 3.532	2.025	1.873 to 2.189
≥90	4.330	3.970 to 4.721	2.117	1.906 to 2.352
0–17	0.292	0.280 to 0.304	0.099	0.082 to 0.120
18–50	1 (Reference)	–	1 (Reference)	–

ICD-10: International Classification of Disease, 10th revision.
*Multivariable analysis adjusted for age, sex, time of the day (night-time or daytime), time in the week (weekend day or weekday), time of the year (December and January or other months, admission diagnosis (grouped using ICD-10 chapters) and severity (using the PS classification).
ICD-10, International Classification of Disease 10th revision; PS, Patient State.
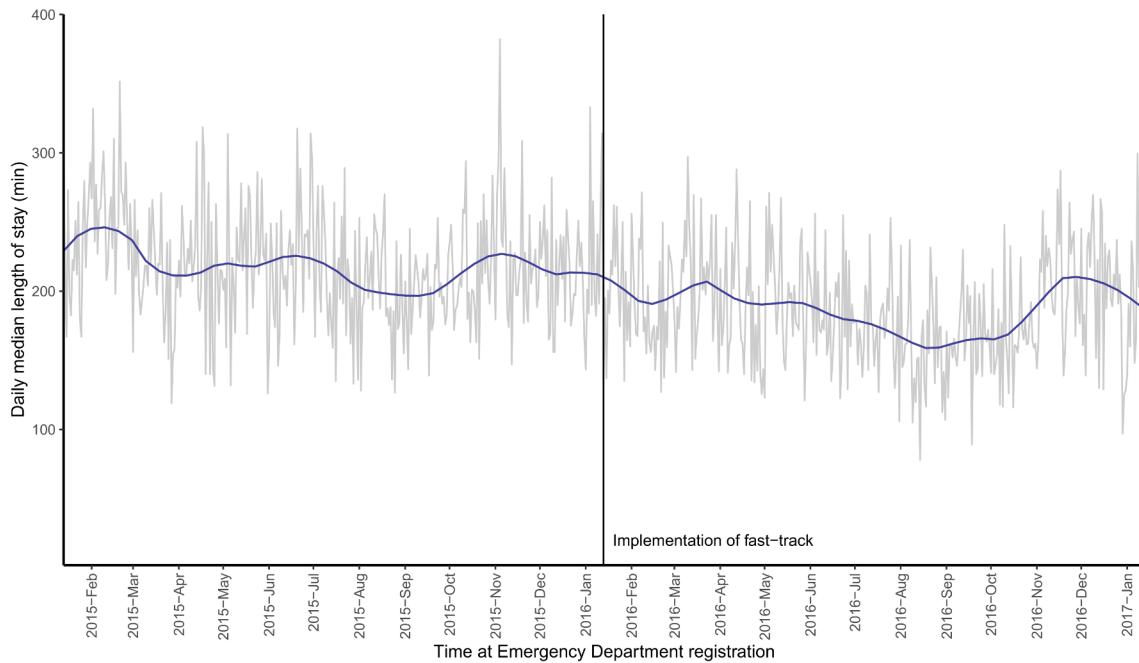
Figure 2 Daily median emergency department length of stay during the study period (trends obtained by locally weighted regression).

increased after the implementation of the fast-track. Patients coming back to the hospital within 7 days had shorter lengths of stay during the readmission. One possible explanation is the availability of the patient's recent history, making medical assessment simpler. EDs may have a role to play in preventing hospital readmissions.[53] However, recent studies show that hospital readmissions are often not avoidable, and are largely influenced by factors on which hospitals have no control, like socioeconomic status.[31 54] As is often the case, these
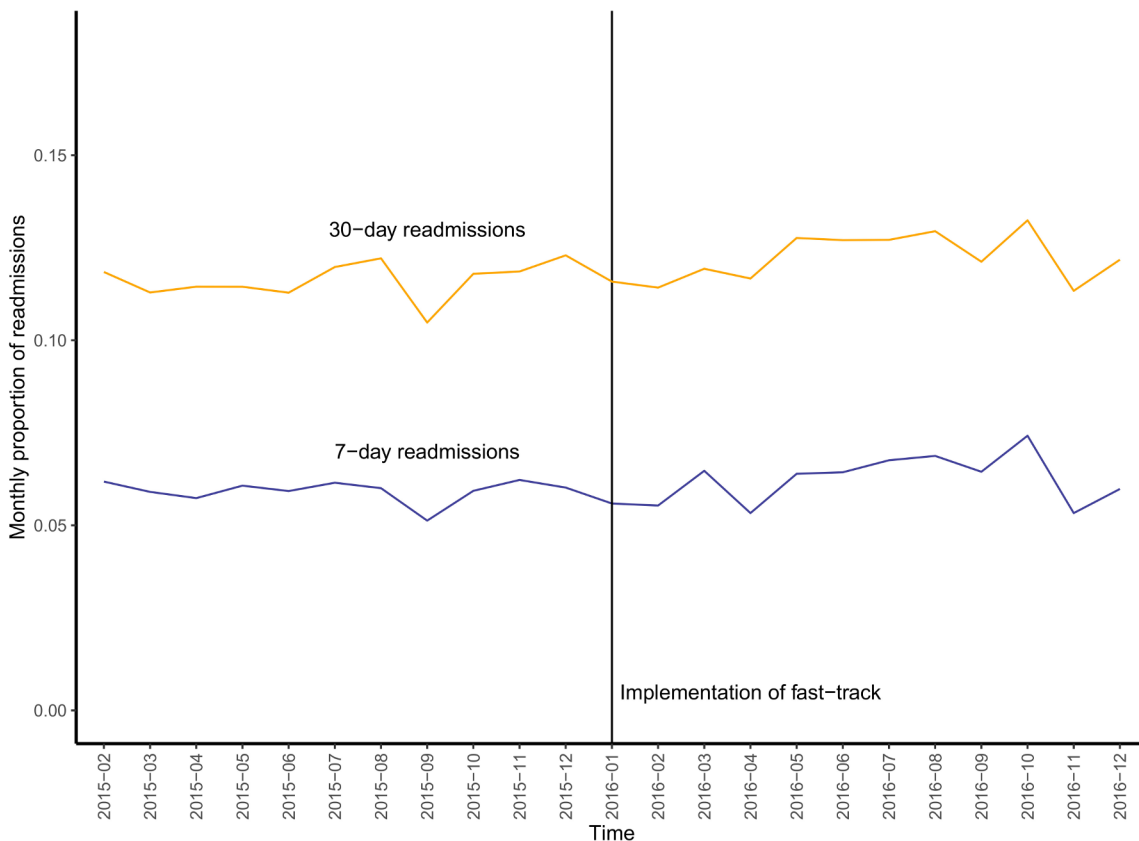
Figure 3 Proportion of emergency department 7-day and 30-day readmissions during the study period.

indicators need to be appraised in conjunction with other quality of care indicators.

The intervention was the only major change in the ED during this period. The major limitation of our study was that the effect of implementing a fast-track was confounded with the addition of staff and new beds to the ED to allow it to function effectively under increased constraints. However, the reported increase in FTEs was due to the administrative transfer of staff from the mobile unit for emergencies and intensive care. Only one additional nurse was fully allocated to the ED. As the mobile unit's main activity is to intervene outside of the hospital, it is unlikely that the observed changes in LOS were entirely explained by the increase in human resources. Moreover, because supplemental beds were added to the ED as part of the intervention, the ratio of staff to beds decreased. A multiple imputation was carried out to account for the uncertainty induced by missing PS severity scores, with m=20 imputations. Patients who left without being seen were kept in the imputation model. As these patients were more frequent in the period before the intervention, and their LOS was shorter than the rest of the population (median 156 min), the efficacy of the intervention regarding LOS could be underestimated. To conclude, our study showed an increase in short stays for low acuity patients following the implementation of the fast-track. In this regard, the fast-track consolidated the ED's role of compensating deficiencies in access to primary care, without favourably impacting LOS for severe patients. Hospital-level bed availability is critical to ensure efficient healthcare for patients registered to the ED. Studies including more hospitals and a larger array of quality of care indicators are warranted to estimate the effect of implementing a fast-track on ED performance and population health outcomes.

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