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The Impact of a Flexible Care Area on Throughput Measures in an Academic Emergency Department

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Abstract

Introduction—Crowding in emergency departments is a multifaceted problem. We hypothesized that implementing an on-call "Flexible Care Area" (FCA), utilizing multiple front-end throughput solutions, would reduce emergency department (ED) length of stay (LOS).

Methods—This retrospective study evaluates the impact of an FCA on ED throughput at one hospital over a two-year period (2011–2012). The average arrival-to-room time, arrival-to-physician time, LOS, number of inpatient admissions, and number of discharges during FCA hours were collected, comparing days with and without FCA functionality.

Results—The FCA was open 165 days in 2011 and 252 days in 2012. The mean daily ED census as well as number of ED visits and inpatient admissions during FCA hours were higher on days with FCA functionality than without. Total ED LOS was shorter for Emergency Severity Index (ESI) 3 patients on days with FCA than days without it in 2011, but this finding was not repeated in 2012. ESI 4 patients had shorter LOS on FCA days in both years. The arrival-to-room and arrival-to-physician times showed variable improvement for ESI 3 and 4 patients over the study period. There was no statistically significant difference for these measures when evaluating ESI levels 2 and 5.

Discussion—Implementing upfront throughput solutions through use of the FCA correlated with reduced ED LOS for all ESI 3–4 patients, not just those who were seen in FCA.

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INTRODUCTION

Emergency departments (EDs) are overwhelmed with crowding. The rate the public accesses emergency care continues to outpace the available resources, and according to the Institute of Medicine, the situation is considered a national epidemic.[1] Moreover, the number of emergency departments has declined over time, causing an imbalance in supply and demand.[2] Average ED wait times have increased 25% from 2003 to 2009, with longer wait times noted in urban emergency departments when compared to non-urban emergency departments.[3] These crowded conditions and prolonged wait times can jeopardize quality of care and patient safety. In particular, crowding negatively impacts pain treatment.[4]

This problem has not gone unnoticed; several methods have been proposed to address ED crowding and its downstream effects. One common strategy is the use of a "fast track," where lower acuity patients are seen and treated. This concept is not a new one to emergency care and numerous papers have identified that fast track units can successfully reduce ED length of stay (LOS) and ultimately improve ED throughput.[5–6] Other methods focus on front-end solutions and include immediate rooming, triage based protocols, and physicians/practitioners in triage.[7] One study found that initiation of treatment initiatives in a reconfigured waiting room led to decreased LOS and left without being seen (LWBS) rates as well as decreased patient diversion.[8] Several reports have highlighted successful outcomes in approaches that maximize space and start treatment earlier in the patient's ED visit.[9–11]

Another front-end approach is to keep patients "vertical." This simply means that when patients are able to receive evaluation and treatment without the need for a stretcher, they should. The underlying philosophy is that vertical patients require less space, can easily mobilize to areas like radiology, and can sit in a chair for intravenous therapies or to wait for discharge instructions. Utilizing the vertical patient model, particularly through a fast track area, has been implemented at many of the United States academic medical centers surveyed in a recent study.[12] Inherent to utilizing this model is the need to define which patients would qualify for such an approach.

Recognizing national trends and anticipating future needs, an interdisciplinary work group was assembled at our hospital to explore and develop strategies designed to improve ED throughput. Incorporating lean process improvement, the discussions from this group resulted in the creation of a space designed to initiate patient evaluation and treatment on the front end of a patient's visit. The area operated on an as-needed basis and was designated the flexible care area (FCA). The FCA consisted of three rooms, staffed by an emergency physician, a nurse and an ED technician from 4pm–11pm. It targeted the evaluation and treatment of low and moderate acuity patients, all while keeping patients "vertical," as described above. Unlike typical fast track areas, the FCA purposefully prioritized evaluating patients with moderate acuity in order to expedite diagnostic test ordering. The primary throughput measure targeted was total ED LOS, though ideally other measures such as arrival-to-room time and arrival-to-physician time would also improve by implementing this initiative.

Purpose

The purpose of this study was to evaluate the impact of implementing the FCA on ED throughput measures.

METHODS

Setting

This 34-bed emergency department exists within a 566-bed academic medical center in a mid-size Midwestern city. The emergency department is a Level 1 adult and pediatric trauma center and had an annual ED census of 44,989 patients in 2011 and 46,937 patients in 2012.

Design

This retrospective study of administrative data available within our electronic health record (EHR) analyzed the impact of FCA on multiple measures of ED throughput during a two-year period (1/1/2011–12/31/2012). We first ascertained which days had FCA available during this two-year period. Then, the EHR was queried to yield average daily measures of ED throughput including LOS, arrival-to-room time, and arrival-to-physician time for all patients seen in the ED, whether seen in FCA or not. The primary endpoint was total ED LOS, defined as the time period from patient arrival to final disposition: Either admission or discharge. The secondary endpoints were defined as the time that elapsed between patient arrival and assignment to a room (arrival-to-room) and the time from patient arrival until the time that a physician was assigned to the patient (arrival-to-physician time). All of these events are time-stamped in the EHR and regularly analyzed by ED administrative staff. The electronic time stamps allowed for automated retrieval of these time intervals, thereby eliminating any error that may have otherwise been introduced by manual data abstraction.

The Emergency Severity Index (ESI) triage system, a five-level triage tool that is used nationally, is based on patient acuity and anticipated resources. It is a validated tool that reliably categorizes patients as ESI levels1 through 5, with 1 representing the most life-threatening conditions and level 5 requiring no resources.[13] All of the data were stratified by ESI level and year (2011 or 2012). It was hypothesized that those patients with lower acuity (ESI levels 3–5) would benefit the most from the use of FCA. In contrast, sicker patients (ESI levels 1–2) infrequently come through the waiting room for triage, and by definition, should be roomed immediately for evaluation and stabilization. Our study, therefore, focused on ESI levels 2–5. Other data were also collected to compare the days with and without FCA, including daily ED census as well as patient arrivals per hour, inpatient admissions, from the ED, and ED discharges during FCA hours. The number of patients who LWBS was also studied.

Analysis

The purpose of implementing the FCA was to reduce patient throughput times on high volume days. Therefore, we conducted two separate analyses based on patient volume (all days and “high volume” days). A “high-volume” day was *a priori* defined as one that exceeded 120 patient visits. Using only census days with greater than 120 patient visits, the

previously mentioned throughput measures were compared on days with and without FCA availability. In addition, these throughput measures were also compared for all days with FCA available versus the days without FCA, regardless of the actual daily patient volume. Instead of quantifying the time saved for patients seen in FCA, throughput measures were analyzed for all ED patients.

Data were collected in a single Microsoft Excel 2010 file (Microsoft Corp, Redmond, WA). All data analysis was done in R (Version 3.1.0, Vienna, Austria). The point estimate and 95% confidence interval were calculated for each throughput measure. Comparisons between days with and without FCA availability were conducted using two-sample t-tests. A cutoff p-value of 0.05 was used to define statistical significance. Institutional review board exemption was obtained since no individual patient data were collected.

RESULTS

Characteristics of Days With and Without Flexible Care Area Availability

There were 165 days (45.2%) with FCA available in 2011 and 252 days (68.9%) with FCA available in 2012, totaling 417 days (57%) over the two-year period. There were statistically significant differences between the total ED census and number of FCA visits during FCA operational hours during the two years studied (Table 1). LWBS rate was also statistically different between days with FCA availability versus those without during 2012 and during the two-year period. During 2011, this number was not statistically different (Table 1). The number of inpatient admissions from the ED during FCA hours was not statistically different between days with and without FCA availability for each individual year, but reached statistical significance over the entire study period (15.8 per day with FCA and 15.2 per day without FCA) (Table 1).

Main Outcome: Length of Stay

The primary endpoint of this study was ED LOS and the secondary endpoints were arrival-to-room time and arrival-to-physician time. There was no statistically significant difference in any of these throughput measures for patients triaged as ESI level 2 for individual years and for the combined 2-year study period, nor were there significant differences when evaluating only high volume days. For ED LOS, there was a statistically significant 16-minute decrease for ESI level 3 patients on high volume days in 2011 (227 ± 6.1 min vs 242.2 ± 7.2 min, $p=0.002$), but no difference in 2012 (240.4 ± 4.3 min vs 235.2 ± 6.2 min, $p=0.14$) or over the two-year study period (234.1 ± 3.4 min vs 232.3 ± 3.6 min, $p=0.47$) (Figure). Regardless of year or volume, ED LOS was significantly decreased during days with FCA compared with days without FCA for ESI level 4 patients (127.7 ± 5.1 min vs 144.6 ± 5.2 min, $p<0.001$ in 2011; 136.9 ± 4.3 min vs 148.6 ± 6.4 min, $p=0.003$ in 2012; and 133.3 ± 3.3 min vs 146 ± 4, $p<0.001$ for 2011–2012) (Figure). There was no difference in this measure for ESI level 5 patients in 2011, 2012, or over the entire study period (Table 2).

Secondary Outcome: Arrival-To-Room Time

Unlike ED LOS, our secondary outcomes had different effects on patients triaged as ESI levels 3 and 4. For ESI level 3 patients, there was a 7-minute decrease in arrival-to-room

time on high-volume days with FCA in 2011, though there was an increase in arrival-to-room times for days with FCA in 2012, and no difference when evaluating the entire two-year period (Table 3). For ESI level 4 patients, there was a 4-minute decrease in arrival-to-room time in 2011, with a 10-minute reduction noted on high-volume days. This reduction was not observed in 2012; though a 6-minute reduced arrival-to-room time was revealed during the cumulative period data for high-volume days only (Table 3).

Secondary Outcome: Arrival-To-Physician Time

Similar to arrival-to-room times, arrival-to-physician times were not definitively improved for ESI level 3 patients over the study period. In 2011, there was a 5-minute decrease in this measure on high-volume days only. However, there was a 5-minute increase in this measure in 2012 and a 2-minute increase over the entire study period for ESI level 3 patients (Table 3). For ESI level 4 patients, there was a 4-minute reduction in arrival-to-physician time for days with FCA in 2011, and a 10-minute reduction for this measure when only evaluating high-volume days (Table 3). A statistically significant change in this measure was not observed in 2012, although there was a 5-minute reduction on high-volume days with FCA when evaluating the entire study period (Table 3). Finally, there was a significant decrease in arrival-to-physician time for ESI level 5 patients on high-volume days with FCA in 2012 (36.4 min [95%CI 33.25–39.59] vs 44.5 min [95%CI 37.53–51.38]); however this finding was not replicated in 2011 or during the overall study period.

DISCUSSION

Crowding continues to be a critical issue in ED throughput, often affecting the quality of patient care. The impact of implementing a flexible care area (FCA) on multiple throughput metrics, including total ED length of stay (LOS), arrival-to-room time, and arrival-to-physician time, stratified by emergency severity index (ESI) level and year of implementation, was analyzed in this study. Stratifying the data according to ESI level in particular facilitated a deeper understanding of the type of patients who benefited most from front-end interventions and a vertical-flow of patients.

ESI Level 2

Patients triaged to ESI level 2 typically have a shorter wait, if any, in the waiting room, and may not be able to be vertical, as required when using the FCA. Because of their higher acuity and higher risk for deterioration, they are usually roomed and seen by a physician early in their ED visit, whether FCA is operational or not. Thus, it is not surprising that a statistically significant improvement on throughput measures was not discernable by the presence of FCA for these patients (Table 2).

ESI Level 3

The impact of FCA on specific measures of throughput for ESI level 3 patients was mixed (Table 3, Figure). When the two years of data were reviewed separately, the first year (2011) of data supported a statistically significant decrease in arrival-to-room time, arrival-to–physician time, and ED LOS on high census days (>120 ED visits) when FCA was available. However, there was no difference for these measures in the second year or

combined two years of data. The reasons vary for these mixed findings. First, patients who are triaged level 3 often utilize many resources (lab, imaging, procedures, etc.). However, because they may not be deemed as "sick," they may experience a longer wait time prior to getting these tests completed. Additionally, more patients are triaged as ESI level 3 than the other individual ESI levels. Due to an increase in the number of ESI level 4 and 5 patients in 2012, there may not have been enough ESI level 3 patients seen in FCA to ascertain a difference for the overall ED LOS outcome for all ED patients. Moreover, the practice of nursing staff implementing more physician-delegated protocols may have increased. This may have decreased the ED LOS for all patients, regardless of FCA availability.

Therefore, while the results suggest that this group of patients could experience shorter throughput measures when FCA is used effectively, the optimal utilization is not clearly defined by this study. A recently published study highlighted interventions intended specifically for the ESI 3 patients and reported statistically significant reductions in LOS and LWBS rates. These patients were placed in a specific geographic area of rooms and hallway spaces that were staffed by a physician and two registered nurses dedicated specifically to this group.[14] More innovation and further study are needed for improving throughput on the ESI 3 patients.

ESI Levels 4 and 5

All of the throughput measures studied on high census days for patients triaged ESI level 4 demonstrated a statistically significant decrease for ED LOS, arrival-to-room time and arrival-to-physician time with an operational FCA (Table 3, Figure). Typically patients who are triaged a level 4 can remain "vertical" throughout their ED visit, which may hasten movement through the ED as they receive testing and treatment. Regardless of the existence of FCA, no differences were observed with the ESI level 5 patients (Table 2). Rationale for this observation may be twofold. First, these patients generally do not require any resources. Such patients cannot take advantage of FCA's ability to expedite their diagnostic evaluation and treatment. Furthermore, the sample size for ESI level 5 patients was observed to be much smaller than other categories of ESI triage levels, perhaps impeding the ability to conclude a statistically significant result.

Left without Being Seen Rates

During the second year of study, both the census and LWBS rates increased (Table 1). However, on days when the FCA was operationalized, the LWBS rate had a statistically significant reduction. The FCA concept allows patients to be evaluated sooner so that their diagnostic tests are ordered earlier and they are "waiting with a purpose." Front-end interventions are implemented sooner, including IV placement, lab collection and radiology testing. For example, a patient with nausea, vomiting, and diarrhea could receive IV therapy, anti-emetics and lab specimen collection before an ED bed is available. By the time the patient arrives in an ED room, the lab work may have been resulted, and the patient may feel better. This concept may reduce the number of patients leaving who have the perception that they are being ignored. Overall, patient safety is enhanced with a reduction in the LWBS rate.

LIMITATIONS

Due to its retrospective methodology, this study has some limitations. First, there could be multiple unmeasured confounders regarding when FCA was utilized or not. Controlling for this was attempted by evaluating days with high patient volumes (>120 visits) and not using historical data as a control. However, other variables that impact patient throughput were not evaluated in this study, including number of trauma patients and stroke codes seen during FCA hours. There may also be non-differential information bias regarding throughput metrics because the data generated by our automated data pull was not verified, though the data does have face validity. Additionally, external validity is difficult to evaluate for this study. Individual centers may have varying degrees of impact with using an FCA-like paradigm, depending on physician acceptance of nursing-driven orders and proportion of lower acuity (ESI levels 4 & 5) seen. Finally, many comparisons were done, using multiple variables in the data analysis, and used a single cutoff p-value of 0.05 instead of using an adjusted value (e.g. Bonferroni correction). This may instill type 1 error into the study results.

CONCLUSION

The FCA began as a pilot project of three makeshift, quasi-private rooms constructed from partitions and curtains in an underused portion of the ED waiting room. Today, after a substantial remodeling, the FCA consists of three private exam rooms and a designated work area for the ED staff. Some of the emergency nurses who worked in the FCA reported that they enjoyed the close proximity to the other treatment team members. Working in a smaller, more contained environment with limited patients was thought to potentially improve efficiency for ED workflow. Future developments include possibly expanding the hours of operation, incorporating advanced practice providers, and expanding the use of the space.

Consistent with previous studies,[12] a measurable impact on some of the desired throughput measures was observed by using a combination of initiatives designed to improve ED patient flow. The results of this study illustrate that FCA implementation correlated with a reduction in multiple throughput metrics, particularly for ESI level 3 and 4 patients, as well as a decreased LWBS rate. While the absolute time saved per patient was less than 30 minutes for ED LOS, it should be reiterated that this was the average patient time savings for all ED patients during FCA hours, not just those seen in FCA. The clinical significance, therefore, has an important impact for all patients in the ED in terms of decreasing their LOS.

Potential areas for future investigation could include measuring patient satisfaction when evaluation and treatment begins in the FCA. Likewise, inquiry into staff satisfaction during FCA hours of operation could also be a worthwhile effort. The impact of using physician-delegated protocols on throughput and patient outcomes is another needed area of study.

Implications for Nursing Practice

Emergency departments are characterized as chaotic and unpredictable environments. Nurses should be aware of studies evaluating methods for improving patient experience in this setting, of which ED LOS is a chief factor, and advocate for such improvements when appropriate. Strategies for optimizing ED throughput must be multi-faceted and flexible. As crowding continues to overwhelm emergency departments, the need for alternative strategies to improve throughput has never been greater.

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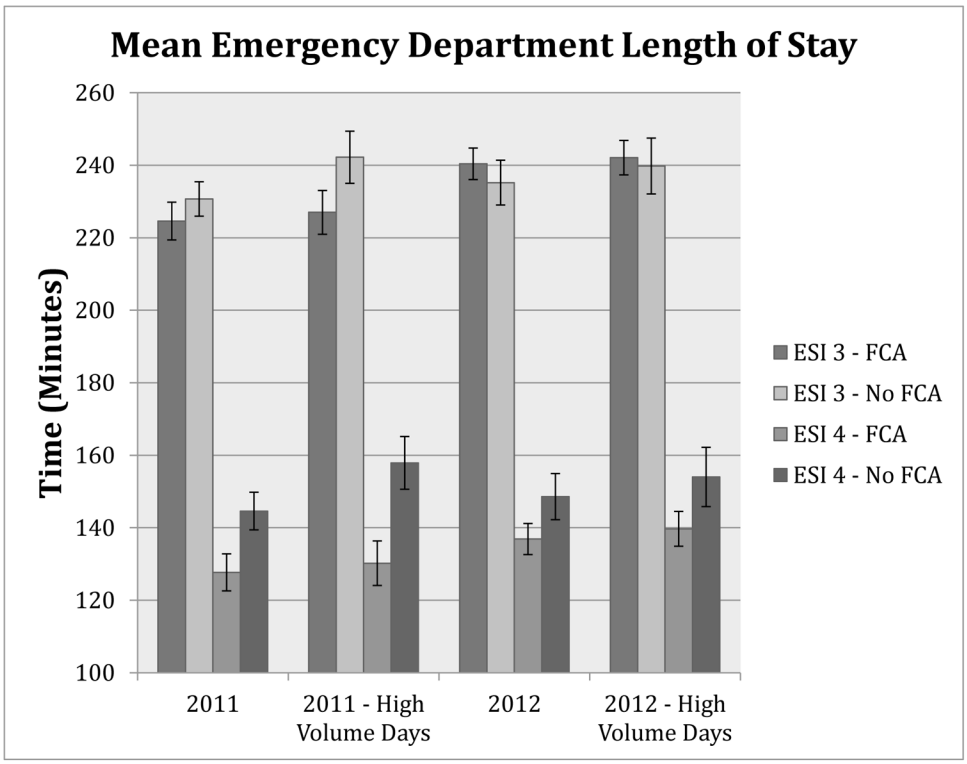

Figure.

Mean Emergency Department Length of Stay for Patients with Emergency Severity Index (ESI) levels 3 and 4, reported as means with error bars signifying 95% confidence intervals. High volume = >120 visits per day; FCA = Flexible Care Area.

Table 1

Characteristics of days with and without Flexible Care Area Availability, reported as means (minutes) with 95% confidence intervals

	FCA Available	Daily Patient Census	P-value	Number of ED Visits	P-value	Inpatient Admissions	P-value	Left Without Being Seen	P-value
2011	+	127.5 ± 1.98	***	56.1 ± 1.3	*	14.5 ± 0.6		1.7 ± 0.3	
	−	119.8 ± 1.8		53.8 ± 1.3		14.9 ± 0.6		1.6 ± 0.2	
2012	+	133.5 ± 1.6	***	58.5 ± 1.1	***	16.7 ± 1.5		2.0 ± 0.3	*
	−	121.3 ± 2.1		55.3 ± 1.5		15.7 ± 0.8		1.5 ± 0.2	
2011–2012	+	131.1 ± 1.3	***	57.6 ± 0.8	***	15.8 ± 0.4	*	1.9 ± 0.2	*
	−	120.3 ± 1.3		54.4 ± 1		15.2 ± 0.5		1.6 ± 0.2	

Daily patient census = Daily ED patient census; Number of ED visits = number of ED visits during FCA hours; Inpatient admissions = number of inpatient admissions from the ED during FCA hours; Left without being seen = number of patients who left the ED per day without being medically evaluated. Values are presented as means (minutes) with 95% confidence intervals. P-values are reported categorically: No asterisk = p-value >0.05;

* p-value <0.05;

** p-value <0.01;

*** p-value <0.001.

Table 2

Throughput metrics (emergency department length of stay, arrival-to-room, and arrival-to-physician time) for Emergency Severity Index Levels 2 and 5.

ESI Level 2									
	ED LOS			Arrival-to-Room			Arrival-to-Physician		
	FCA Present	FCA Absent	P-value	FCA Present	FCA Absent	P-value	FCA Present	FCA Absent	P-value
2011	226.5 ± 6	223.7 ± 5.8		7.6 ± 0.8	7.8 ± 0.9		17 ± 1.3	16.9 ± 1.2	
2011 High Volume Day	225.9 ± 7	227.6 ± 8.6		7.9 ± 1	8.1 ± 1.3		17 ± 0.5	17.5 ± 1.8	
2012	228.3 ± 5	228.3 ± 6.9		9.2 ± 0.4	9.5 ± 1.1		19.5 ± 1.1	20.2 ± 1.7	
2012 High Volume Day	228 ± 5.8	225.7 ± 8.6		9.3 ± 0.9	9.2 ± 1.3		19.7 ± 1.3	20.2 ± 2.3	
2011–2012	227.6 ± 3.9	225.4 ± 4.4		8.6 ± 0.6	8.8 ± 1.1		18.5 ± 0.8	18.1 ± 1	
2011–2012 High Volume Day	227.3 ± 4.5	226.9 ± 6.2		8.8 ± 0.7	8.5 ± 0.9		18.7 ± 1	18.5 ± 1.4	

ESI Level 5									
	ED LOS			Arrival-to-Room			Arrival-to-Physician		
	FCA Present	FCA Absent	P-value	FCA Present	FCA Absent	P-value	FCA Present	FCA Absent	P-value
2011	93 ± 12	95.7 ± 11.1		19.4 ± 3.1	19.3 ± 2.6		32.5 ± 5.6	29.6 ± 3.2	
2011 High Volume Day	95.8 ± 14.4	106.9 ± 18		19.4 ± 3.5	19.5 ± 3.8		31.1 ± 6.7	29.9 ± 4.9	
2012	93.1 ± 9.3	103 ± 17.9		22.7 ± 2.3	23.2 ± 3.9		35.2 ± 2.9	37.3 ± 4.8	
2012 High Volume Day	92 ± 8.8	117.4 ± 28.9		23.4 ± 2.5	26.4 ± 5.5		36.4 ± 3.2	44.5 ± 6.9	*
2011–2012	93.1 ± 7.3	97.9 ± 9.3		21.4 ± 1.8	20.7 ± 2.2		34.1 ± 2.8	32.4 ± 2.7	
2011–2012 High Volume Day	93.5 ± 7.8	110.2 ± 15		21.9 ± 2.1	22.2 ± 3.2		34.5 ± 3.1	35.6 ± 4.1	

Values are reported as means (minutes) ± 95% confidence intervals. FCA Present = values for days when the FCA was available; FCA absent = values for days when the FCA was not available; High Volume Day = Days when the ED Census was >120. P-values are reported categorically: No asterisk = p-value >0.05;

* p-value <0.05;

** p-value <0.01;

*** p-value <0.001.

Table 3

Arrival-to-Room and Arrival-to-Physician times (min) for Emergency Severity Index Levels 3 and 4.

Emergency Severity Index Level 3						
	Arrival-to-Room Time			Arrival-to-Physician Time		
	FCA Present	FCA Absent	P-value	FCA Present	FCA Absent	P-value
2011	17.2 ± 1.7	18.2 ± 1.4		29.6 ± 1.0	30.3 ± 1.7	
2011 High Volume Day	19.2 ± 2.1	26.6 ± 4.9	**	31.1 ± 2.3	36.8 ± 2.4	***
2012	19.8 ± 1.6	15.7 ± 1.4	***	33.5 ± 1.9	28.1 ± 1.9	***
2012 High Volume Day	21.5 ± 1.8	18.9 ± 2.0		35.7 ± 2.0	31.5 ± 2.8	*
2011–2012	18.8 ± 1.1	17.3 ± 1.0		31.6 ± 1.3	29.5 ± 1.3	*
2011–2012 High Volume Day	20.7 ± 1.3	21.8 ± 1.4		34.1 ± 1.5	34.8 ± 1.8	

Emergency Severity Index Level 4						
	Arrival-to-Room Time			Arrival-to-Physician Time		
	FCA Present	FCA Absent	P-value	FCA Present	FCA Absent	P-value
2011	20.3 ± 1.8	24.3 ± 2.2	**	30.7 ± 2.1	34.6 ± 2.3	*
2011 High Volume Day	22.7 ± 2.2	32.3 ± 3.3	***	33.7 ± 2.6	43.3 ± 3.4	***
2012	22.1 ± 1.4	21.4 ± 2.0		34.5 ± 1.7	32.8 ± 2.3	
2012 High Volume Day	23.4 ± 1.6	25.1 ± 2.7		36.2 ± 1.8	36.8 ± 3.1	
2011–2012	21.4 ± 1.1	23.2 ± 1.6		33.0 ± 1.3	33.9 ± 1.7	
2011–2012 High Volume Day	23.1 ± 1.3	29.5 ± 2.3	***	35.3 ± 1.5	40.8 ± 2.4	***

Values are reported as means (minutes) ± 95% confidence intervals. FCA Present = values for days when the FCA was available; FCA absent = values for days when the FCA was not available; High Volume Day = Days when the ED Census was >120. P-values are reported categorically: No asterisk = p-value >0.05;

* p-value <0.05;

** p-value <0.01;

*** p-value <0.001.