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RESEARCH REPORT

THE EFFECT OF PARAMEDICS IN EMERGENCY DEPARTMENT TRIAGE ON AMBULANCE PATIENT OFFLOAD TIMES: A RETROSPECTIVE OBSERVATIONAL STUDY

Chris Kuhner, MD[1]; John Su, MD*[1]; Eric Quinn, MD[1]; Jennifer Wolin, MD[1]; Joshua Kimbrell, NRP, FP-C[2]; Matt Samuel Friedman, MD[1]; David Lobel, MD[1]; Eitan Dickman, MD[1]; David Eng, MD[1,3]

Author Affiliations: 1. Maimonides Medical Center in Brooklyn, NY, USA. 2. Fire Department of New York, NY, USA. 3. Department of Emergency Medicine, SUNY Downstate College of Medicine, Brooklyn, NY, USA.

**Corresponding Author*: jsu@maimonidesmed.org

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ABSTRACT:

Background: Emergency Department (ED) overcrowding limits patient care in the prehospital and hospital system. A program was implemented to decrease the time to patient handoff from EMS arrival to ED staff, also known as the delivery interval and total turnaround interval. Paramedics were added to the ED ambulance triage staff to receive verbal reports and perform certain tasks done traditionally by nurses. We hypothesized adding paramedics to the ED triage process would reduce delivery interval times and total turnaround times.

Methods: This was a retrospective observational study comparing delivery and turnaround intervals for patients brought to the ED by ambulance, before and after the addition of a paramedic in triage. The study period included all adult ED patients brought in by ambulance between 11 AM and 11 PM. Pediatric patients (<21 years old), direct-to-inpatient interfacility transfers, and critical patients requiring immediate care in the resuscitation area and thus bypassing normal triage processes were excluded. The data was analyzed with two-sample t-tests with a confidence interval of a = 0.05.

Results: Delivery interval pre-implementation of the program was 15:48 minutes (95% CI [15:28, 16:09]) compared to 14:04 minutes (95% CI [13:44, 14:25]) post-implementation. The mean turnaround interval pre-implementation was 35:21 minutes (95% CI [35:01, 35:42]) and 36:04 minutes (95% CI [35:40, 36:29]) post-implementation. The mean difference for the delivery interval was shortened by 01:44 minutes ($p<0.0001$; 95% CI [01:15, 02:13]). The mean turnaround interval increased by 00:43 seconds ($p<0.01$; 95% CI [00:11, 01:16]).

Conclusion: Staffing a paramedic in ED triage decreased delivery interval by 1:44 minutes but did not affect ambulance turnaround times. Further research is needed to determine if the decrease in delivery interval improved patient outcomes and ways to translate the time saved in the delivery interval to total turnaround times.

INTRODUCTION

Emergency department (ED) crowding is a multifactorial problem with a myriad of downstream effects, one of which results in delays in transferring patients from emergency medical services

(EMS) to hospital staff (Morley, 2018; Derlet, 2001; Hwang, 2011; Schull, 2001). Not only is care delayed, but EMS providers waiting to hand off patients are consequently unavailable to respond to calls for other subsequent patients in need (Li, 2019; Eckstein, 2004; Cone, 1998; Pham, 2006).

The problem has become serious enough that some services have considered billing hospitals for their time delays as an incentive to help tackle this problem (Wolfberg, 2021). The American Ambulance Association (AAA) provides EMS leaders with a "Wall Time Toolkit" that encourages agencies to engage with hospital staff to find creative solutions with an emphasis on EMTALA responsibilities and transportation officers that coordinate patient arrivals (AAA, 2022). The California Hospital Association (CHA) issued a similar toolkit that described effective strategies such as integrated quality improvement initiatives between hospitals and EMS departments, regular reports to ED administrators, and dedicated protocols for reducing offload time (CHA, 2014).

At Hernando County EMS and Fire Services, offload times have proved disruptive enough for commissioners to approve a fine of over $200 hourly for hospitals with offload intervals over thirty minutes in duration (Burns, 2022). Another EMS agency has successfully utilized a transportation destination officer to coordinate incoming EMS crews and reduce simultaneous arrivals (Scharf, 2022). The COVID-19 global pandemic has only worsened the problem with increased ED length of stay for admitted patients as well as nursing shortages caused by stress to front-line healthcare workers, early retirement, or more staffing moving into short-term contractual work (Baugh, 2020; Lucero, 2021; Sandhu, 2022).

A common operational intervention to tackle ED overcrowding and ambulance offload delays has traditionally been ambulance diversion. In a 2011 position statement, the National Association of EMS Physicians stated that the time it takes to transfer a patient to an ED stretcher and for the ED staff to assume the responsibility of the care of the patient may have more impact on ambulance turnaround times than diversion towards another accepting facility (Cooney, 2011). By traveling to a further facility, the time to return to service may be as long, if not longer, than going to the nearest facility facing overcrowding. One strategy to shorten delivery interval, or time from EMS arrival to patient handoff to ED staff that avoids ambulance diversion is placing a paramedic in ambulance triage. In particular, paramedics who already function under physician medical direction can easily transition to hospital-based physician extenders, providing a natural and potential solution to continued hospital staffing shortages (Oglesby, 2007). Silvestri et al. (2014) demonstrated that an ED paramedic-staffing model focused on receiving EMS-arrived patients when the ED is at full bed capacity significantly reduced the delivery interval time for EMS units.

In this New York City ED, EMS crews experienced a mean of 15:48 minutes before patient handoff and a total turnaround interval from arrival to back-in-service time of 35:21 minutes. A push was made to reduce this time to improve patient experience, patient safety, and EMS system performance. We aimed to replicate the approach described in Silvestri et al. by staffing paramedics in our ED triage from 11 a.m. to 11 p.m. to reduce delivery interval and turnaround times. The primary outcome of this study seeks to assess the impact of adding one paramedic to ED triage on these two intervals. Adding

paramedics to the ED triage process would reduce delivery interval times and total turnaround times.

MATERIALS & METHODS

Study Design

This retrospective observational pre-post-study design involved patients transported to an urban hospital ED via the 911 EMS system. The hospital supplies fourteen BLS and ALS ambulances for the 911 system, and paramedics in this study were hospital employees who staff the 911 system and interfacility transport units. The ED staffing plan included paramedics working 11 a.m. to 11 p.m. 7 days a week, which matched peak patient arrivals per hour. Outside these hours, the standard triage process using triage nurses and a physician was utilized. Analysis of our wall-time performance showed that turnaround interval times are lengthiest during these hours, and we proposed using affiliated paramedics to reduce turnaround time. Paramedics were paired with triage nurses to train them in the offload process on shift. No formal didactics were employed. The primary responsibility of ED paramedics was to receive EMS hand-offs and assume care for patients who arrived via EMS until a triage nurse was available for the patient. ED paramedics also placed intravenous peripheral catheters, obtained vital signs, performed electrocardiograms, and provided other basic life support functions.

The "turnaround interval," the total time that an ambulance spends at the hospital, is the sum between the "delivery interval" and the "recovery interval" (Carter, 2007; Cooney, 2011; Oglesby, 2007). The delivery interval began when the paramedics arrived at the hospital with the patient and ended when the EMS paramedic transferred care to the ED triage provider. This traditionally ends with a signature from the receiving clinician. The "recovery interval" began when the delivery interval was completed and terminated when the ambulance and crew were ready to return to service.

Setting

This study occurred in a tertiary-care 711-bed teaching hospital in New York City with an annual ED volume of 105,000 patients. The ED is an adult level I trauma center, a pediatric level II trauma center, and hosts an emergency medicine residency program. During the study periods, there were 68 ED beds, including a 14-bed pediatric, and 4-bed resuscitation areas. This ED does not have a waiting room. All patients, after registration and triage, are immediately assigned to an ED bed. Temporary care spaces can be created if all ED beds are full. Approximately 32% of the annual ED volume arrives via EMS. The overall admission rate for ED patients is 27%. The hospital-based EMS system has 14 ambulances that receive approximately 60,000 911 dispatches annually and transport patients to the main medical center and other unaffiliated hospitals. The hospital also receives patients who arrive via ambulance from private EMS agencies, fire-based agencies, volunteer agencies, and other hospital-based agencies. We only collected the data of patients who arrived via the hospital's own EMS system, which accounted for 43% of the patients who arrived in ambulance triage. The study authors could not obtain records of patients transported by other EMS agencies.

Selection of Participants

All patients were deemed eligible if they arrived via the hospital-based EMS service to ambulance triage during the study periods. Patients excluded include pediatric patients (<21 years old), inpatient interfacility transfers, and critically ill patients directed straight to the resuscitation bay and bypassed ambulance triage. Three cohorts were separated in our data collection:

1. a pre-paramedic implementation cohort measured from March 1st, 2021, to August 31st, 2021
2. A wash-out period cohort measured from September 1st, 2021 to October 31st, 2021 while paramedics were undergoing ED orientation and having their initial shifts
3. A post-paramedic implementation cohort measured during November 1st, 2021 to April 30th, 2022.
4. All cohorts had their data collected during the same days of the week and time of day (Figure 1).

Methods of Measurement

Data was collected from HealthEMS (Sansio Inc., Duluth, MN), an electronic patient care record system that this hospital-based EMS uses for documentation and is stored in a secure cloud. Paramedics documented the time of arrival at the ED ambulance entrance after patient care was transferred to ED triage staff and the time of ED departure. The "turnaround interval" is the total time an ambulance spends at the hospital and is comprises the delivery and recovery interval. The delivery interval begins on arrival to the ED and ends when handoff is given to ED staff. The recovery interval begins after handoff and ends when the ambulance is fully stocked and ready to return to service.

Data Analysis

Statistical differences were calculated using IBM SPSS (IBM Corp, Armonk, NY). Significance was set at an alpha of 0.05. A two-sample t-test was used to compare the means of delivery interval, recovery interval, and turnaround interval. The data was assumed to be normally distributed. The means, along with 95% confidence intervals, are reported.

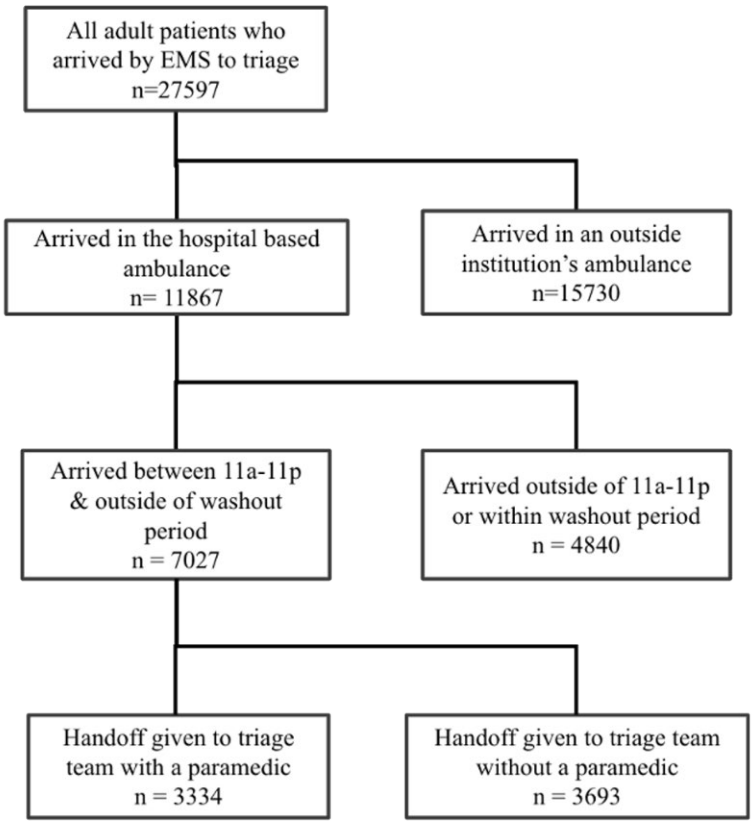

Figure 1. Flowchart of Inclusion and Exclusion of Ambulance Arrived Patient.

Ethical Considerations

This study was approved by the Institutional Review Board at Maimonides Medical Center, and all authors disclose that they are employees at Maimonides Medical Center, the institution hosting the study.

RESULTS

During the study period, 11,867 patients were transported by the hospital-based ambulance service. Patients who arrived outside of the 11a-11p time frame and in the washout period were excluded. This resulted in 3,693 patients in the pre-paramedic group and 3,334 patients in the post-paramedic group (Figure 1).

To control for changes in the hospital or EMS system that may have confounded the delivery interval, baseline characteristics before and after implementation are shown (Table 1). Hospital factors included the mean number of triage RNs, paramedic staffing, ED bed spaces, and the mean number of triage physician staff. EMS factors included the number of hospital-based 911 ambulances in service and ambulance arrivals per hour during the specified study period. Staffing numbers of outside EMS agencies that offload patients in this urban ED could not be identified. The hospital was on diversion for 0.8% of the study period, guided by the EMS system following other states in moving away from a diversion model (Burke, 2010). These characteristics, except paramedic staffing, were similar in the pre-and post-paramedic implementation phases.

There were statistically significant time differences in delivery interval, recovery interval, and turnaround interval between the two cohorts. In particular, the delivery interval was decreased in the post-paramedic cohort to 14:04 minutes (95% CI [13:44, 14:25]) when compared to the pre-paramedic group of 15:48 minutes (95% CI [15:28, 16:09]), with a mean difference of 01:44 minutes (p<0.0001; 95% CI [01:15, 02:13]). Interestingly, the recovery interval period was longer in the post-paramedic cohort at 22:00 minutes (95% CI [21:34, 22:26]) compared to the pre-paramedic group of 19:33 minutes (95% CI [19:11, 19:55]), with a mean difference of 02:27 minutes (p<0.0001; 95% CI [01:53, 03:01]). Overall, the turnaround interval was marginally longer in the post-paramedic

Characteristics	Pre-Paramedics	Post-Paramedics
ED Triage Factors		
RN staffing	2.3	2.2
Paramedic staffing 11a-11p	0	1
ED beds	68	68
Triage MD staffing	1	1
EMS Factors		
Mean # of hospital-based EMS units	14	14
Ambulance patients per hour 11a-11p	6.2	6.3

Table 1. Comparison of ED Triage Factors and EMS Factors Pre- and Post-Implementation.

Interval	Delivery		Recovery		Total Turnaround	
	Pre	Post	Pre	Post	Pre	Post
Time +/- Standard Dev	15:48 +/- 10:35	14:04 +/- 9:33	19:33 +/- 11:23	22:00 +/- 12:12	35:21 +/- 10:44	36:04 +/- 11:40
95% CI	15:28, 16:09	13:44, 14:25	19:11, 19:55	21:34, 22:26	35:01, 35:42	35:40, 36:29
Mean difference	-1:44		+2:27		+00:43	
95% CI	1:15, 2:13		1:53, 3:01		00:11, 01:16	
p-value	<0.0001		<0.0001		<0.01	

Table 2. Delivery, Recovery, and Turnaround Intervals Pre- and Post-Paramedic Intervention.

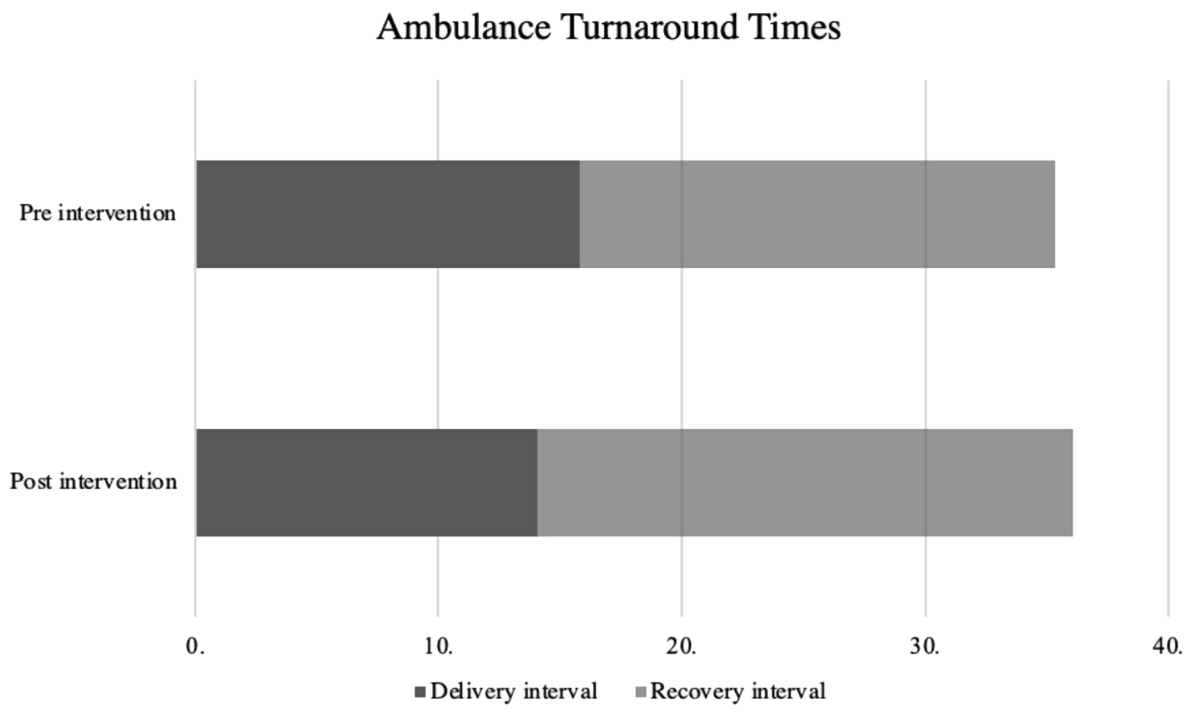

Figure 2. Delivery Interval, Recovery Interval, and Ambulance Turnaround Times Pre- and Post-Intervention.

group at 36:04 minutes (95% CI [35:40, 36:29]) compared to the pre-paramedic group at 35:21 minutes (95% CI [35:01, 35:42]) with a mean difference of 00:43 seconds ($p<0.01$; 95% CI [00:11, 01:16]) (Table 2 & Figure 2).

DISCUSSION

Few studies examine the effects of employing paramedics in the hospital (Li, 2019). To date, even fewer studies assess the role of paramedics in the ED triage setting. This study differs from Silvestri et al. (2014), in which paramedics received EMS hand-offs and also staffed hallway care spaces. This study demonstrates that having one additional paramedic staffing the triage area reduced delivery intervals by 1 minute and 44 seconds. Although it did not decrease overall turnaround times, the delivery interval is still an important metric to track as patients can receive a higher level of care earlier in the healthcare process (Crilly, 2015). This model has also been found outside the United States in Britain and Canada. In Britain, paramedics were successfully used in ED triage staffing, and many participants felt that their prehospital training transitioned well to the diagnostic reasoning skills needed for triage. In Nova Scotia, Canada, paramedics incorporated into the ED improved the quality of handoff and the collaborative interprofessional dynamic between EMS and in-hospital staff (Whalen 2018).

Though not objectively captured in the results, this paramedic intervention had positive feedback from our ED and EMS staff. ED personnel reported being "thankful for the extra set of hands" to offload certain patient care duties, especially during the peak patient arrival hours that this study captured. This allowed ED patients to initiate their evaluation and management sooner, which may have changed patient outcomes (Dawson,

2022). While we did not find a clear benefit in ambulance turnaround times, the paramedics did appear to improve patient care in the ED by offloading tasks from nursing and other ancillary medical staff (Greaves, 2017). Furthermore, 911 EMS personnel commented how the patient handoff process was "streamlined thanks to having a familiar colleague." Additionally, having a paramedic in triage may have prevented the need to up-staff nursing personnel to maintain ambulance turnaround times, who were already short-staffed and continuing to face hiring shortages (Pourmand, 2023).

The recovery and turnaround intervals were longer in the post-paramedic intervention with a mean difference of 2 minutes 27 seconds, and 43 seconds, respectively. This finding contrasted with Silvestri et al. (2014), which found an overall reduction in turnaround intervals after three paramedics were introduced to help with patient care after EMS hand-off. This could be explained by the number of paramedics employed in that study and the further responsibilities given to them. Our study employed one paramedic explicitly staffed in the ED triage area and showed how modifying this single variable decreased delivery interval times. Other factors involved in the turnaround interval are different from those in the delivery interval. This program did not modify the recovery interval, which makes up half of the turnaround interval and involves a progression of steps to prepare the ambulance for the next assignment. Improving training for EMS personnel before involvement in triage targeting delays in the recovery interval could have successfully translated to decreased total turnaround times.

We noticed that limited available hospital stretchers prevented EMS paramedics from transitioning into the recovery interval. Even though patient care was transferred over, paramedics could not bring the EMS stretcher back to the ambulance for their next assignment as it remained occupied. This period was also negatively impacted by supply shortages in the ED, which prevented restocking and further increased the recovery interval. If the decrease in delivery interval had been translated into the total turnaround interval for every ambulance arrival, it would be roughly 800 ambulance hours saved. However, maintaining turnaround intervals steady during this period of high staff turnover and logistical shortages is still an operationally important outcome. This initiative could also lead to cost-saving benefits without compromising patient care. For example, in this system, the cost of adding a paramedic to triage is 30% lower than adding a nursing staff to ED triage.

LIMITATIONS

We attempted to consider some baseline factors that could have confounded this intervention, including ED staffing, ED bed space, ED triage physician staffing, and ED triage nurse staffing. Even though the means of ED ambulance arrivals were unchanged, this likely disguised a certain amount of variability in the peaks and troughs of patient arrivals during the COVID-19 pandemic (Baugh, 2020). ED staffing, although unchanged numerically, was constantly reshuffled intra-shift. Many nurses and ancillary staff also left during this period and were replaced with new staff who may have been inexperienced with the hospital system and ambulance triage workflow. There could have been an even more dramatic effect in the decrease in delivery interval if staff turnover and patient presentation rates were in line with a pre-pandemic period.

One outcome we were interested in but did not examine was if earlier patient handoff affected ED patient length of stay. Additional research can also look into this intervention's effect on time to be seen by a physician or time to treatment initiation for ambulance-arrived patients. We also did not subdivide delivery interval and turnaround time based on patient characteristics, such as specific chief complaints or comorbidities. For example, one could imagine chest pain patients who arrived by BLS ambulance may be through triage more quickly because the triage paramedic could obtain an EKG more rapidly.

This study took place at a single, urban hospital with its own hospital-based EMS service. It may not be generalizable to other centers where EMS providers may not also be hospital employees. Diverting paramedics from the 911 system when there is a nationwide staffing shortage may not be an option for many systems (Quaile, 2015; Cash, 2022). We did not find as significant of a reduction in delivery interval times as in Silvestri et al. (2014). However, in their study, EMS routinely had turnaround times close to an hour that fell to 38 minutes. The mean turnaround time in our study pre-implementation was only 35 minutes, which was shorter than the post-implementation times in Silvestri et al. (2014). This intervention may be more effective in areas with longer offload delays. Another limitation of this study was that we only captured data from the hospital-affiliated EMS agencies transporting to the receiving ED. We are curious to know if these conclusions would still hold if all external EMS agency data had been captured.

Traditionally, interventions to improve ED flow often involve multiple measures at once to move the needle of one outcome in one direction (Bodnar, 2022). One of our outcomes was achieved with the single intervention of adding a paramedic to triage. A more effective strategy to decrease total turnaround times likely involves intervening in the recovery and delivery interval. Besides the positive operational impact, the financial impact in this system of adding a paramedic to ED triage is 30% lower than adding a nursing staff to ED triage. This also frees finite nursing staff resources to be placed in other roles.

CONCLUSION & FUTURE DIRECTION

This study showed that paramedics working in ED triage decreases the delivery interval, which allows the patient to begin their hospital-based care earlier. While there was a reduction in delivery time, we do not know if this difference impacted patient outcomes. Further research is needed to determine if the decrease in delivery interval improved patient outcomes and ways to translate the time saved in the delivery interval to total turnaround times. Potential solutions to decreasing the recovery interval include removing ambulance restocking bottlenecks, increasing stretcher availability, easier access to ambulance cleaning supplies, and staff incentives.

The program could also be expanded to include more roles for the ED paramedic. Burns et al. (2022) showed that a transportation destination officer who works to reduce simultaneous arrivals could reduce offload time, so expanding the role of a paramedic in triage to organize inbound ambulance arrivals deserves further study. This strategy, along with process improvement monitoring and fines for increased wall time, may yield better results. Lastly, the quality of ED handoffs between EMS and ED paramedics and finally to the triage nurse must also be investigated to ensure the decrease in delivery interval did not result in loss of important patient care information.

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