

An Emergency Department Paramedic Staffing Model Significantly Improves EMS Transport Unit Offload Time – A Novel Approach to an ED Crowding Challenge

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Abstract

Objective: We assessed the impact of emergency department (ED) paramedic staffing on emergency medical services (EMS) unit offload time, an intervention designed to assist with EMS unit patient offload when the ED is at full bed capacity.

Methods: This prospective pre/post intervention study assessed patients offloaded via the regional EMS system at an urban tertiary care teaching hospital. Three groups were compared: 1) a pre-paramedic group with data obtained prior to any paramedics staffing the ED; 2) a transition (control) group with data obtained during paramedic orientation; and 3) a post-paramedic group with data measured after paramedics were staffing the ED. Research assistants stationed in the ambulance bay of the ED enrolled a convenience sample of patients for seven consecutive days and recorded offload time as patients were brought in by EMS. The primary outcome measure was offload time (the interval between patient arrival via EMS and transfer of patient care to an ED stretcher).

Results: A total of 519 offloaded patients were assessed: 207 in the pre-paramedic period, 93 in the transition (control) period and 219 in the post-paramedic period. Overall median offload times (in minutes) in the pre-paramedic and post-paramedic groups were 10 [IQR 4-32] versus 4 [IQR 1-16] respectively ($p < 0.001$). In those who were triaged directly to an ED bed the median offload times were 14 [IQR 3-40] and 4 [IQR 1-16] respectively ($p < 0.001$). The proportion of patients offloaded within 5 minutes went from 29% before the paramedic intervention to 53% after ($p < 0.001$). The proportion of patients offloaded within 30 minutes went from 66% before paramedics to 83% ($p < 0.001$) after and those offloaded within 60 minutes went from 87% to almost 100% ($p < 0.001$).

Conclusion: An ED paramedic-staffing model focused on receiving EMS-arrived patients at times when the ED is at full bed capacity significantly reduced the offload time for EMS units.

Keywords: Paramedics; Emergency medical services; Emergency department; Crowding; Offload time

Introduction

Nationwide emergency department (ED) crowding is a multifactor problem that has previously been well described in the literature [1-3]. Crowding impacts ED bed capacity by limiting the number of available stretchers to place patients who arrive via the emergency medical services (EMS) system. Reduced ED bed capacity also leads to hospital diversion [4,5], a mechanism whereby EMS personnel are left caring for patients in their ambulances until another facility can be identified. These circumstances cause significant delays in transferring patients from emergency medical services (EMS) to definitive ED care [6]. Furthermore, when paramedics transport a patient to a crowded ED, they must wait in the ED with their patient on the ambulance stretcher until an ED stretcher becomes available. These waits can span from a few minutes to several hours. During this time, the paramedic and ambulance are out of service to respond to additional

calls. Whether the cause is ambulance diversion or delayed offload of patients to a stretcher, when multiple ambulances are out of service communities are left in a state of reduced EMS availability to respond to 9-1-1 calls [6,7].

Studies addressing solutions aimed at increasing ambulance availability are few and use strategies such as increasing ED throughput [8] or increasing ED bed capacity [9]. In communities across the country, hospital systems are distinct entities from the EMS systems that serve them. A novel approach to reducing offload time and accelerating transfer of care is to improve the coordination between these two systems. A strategy that transfers patient care to ED personnel soon after arrival at the nearest appropriate ED would minimize the effect of reduced EMS unit availability.

In a 2011 position statement, the National Association of EMS Physicians (NAEMSP) stated that ambulance offload delay (the time to transfer to an ED stretcher and for ED staff to assume responsibility for the care of the patient) [10,11] will likely have more impact on ambulance turnaround time than ambulance diversion. They

recommend that EMS administrators and medical directors work with hospital administrators, ED staff and ED administrators to improve system efficiency by addressing both ambulance diversions and offload delay. One strategy to expedite the transfer of patient care to ED personnel is to further integrate the prehospital system into the ED using hospital or ED-employed paramedics [12]. ED paramedics may be assigned to the same ED locations where multiple EMS paramedics were previously monitoring their patients for extended periods of time and may assume their duties. No prior studies in the literature could be identified that investigated the impact of ED paramedics on ED throughput, EMS unit availability, or EMS offload times. This study assessed the impact of ED paramedic staffing on EMS unit offload time, an intervention designed to assist with EMS unit patient offload when the ED is at full bed capacity.

Methods

Study design

This prospective quasi-experimental pre and post study included patients brought to the study ED via the regional EMS system. Prior to the initiation of the study, the study medical center made a commitment to hire a group of paramedics to staff the ED. The paramedics completed an ED orientation program and were hired within the nursing reporting line as hospital employees. The ED staffing plan involved paramedics working 11 am to 11 pm 7 days a week. This time frame was chosen because it represents the peak time for patient arrivals per hour. Paramedic assignments involved staffing the hallway locations to monitor patients who would otherwise be monitored by EMS agency paramedics. The paramedics essentially performed patient assessments and monitoring. Their ED skills were limited to non-medicated IV insertion, venipuncture, 12-lead electrocardiogram (ECG) and other basic life support skills. Unlike the out-of-hospital environment, the ED paramedics did not administer any medications and did not perform advanced airway maneuvers. The primary responsibility of the ED paramedics was to take over care for patients who arrive via EMS. The study was designed to evaluate offload time before the ED paramedics were hired and compare it to offload time after the ED paramedics were hired. A control group was also included which involved offload time of patients while the ED paramedics were undergoing orientation.

Setting

This study took place in the ED of an urban, tertiary care, 1,121 bed teaching facility in central Florida. It is the primary site for an accredited emergency medicine residency through the Accreditation Council for Graduate Medical Education (ACGME). The ED sees a combined adult and pediatric volume of approximately 92,000 patients per year and is an adult and pediatric level I trauma center. During the study periods, there were 58 ED beds, including a 13-bed fast track area, a 13-bed pediatric area and a 5-bed resuscitation area. Approximately 25% of the annual ED volume arrives via EMS, and has a 55% admission rate. The study ED participates in an Advisory Council comprised of the leadership of seven acute care hospitals and

the regional EMS system. Several years prior to the initiation of this study, the Advisory Council implemented a “no diversion” policy, whereby none of the area EDs would ever be on ambulance diversion. This study received an expedited review, and was exempt from full review, by the Institutional Review Board.

Selection of participants

All patients transported via EMS during the study periods were eligible to be included. Data was collected on 3 groups of transported patients: 1) a pre-paramedic group measured during 12/2005 (12/12/05-12/18/05) prior to any paramedics staffing the ED; 2) a transition period group (control group) measured as paramedics were undergoing their orientation (3 non-consecutive days between 05/03/06-05/12/06); and 3) a post-paramedic staffing group measured after paramedics were staffing the ED (07/17/06-07/23/06). The pre- and post-paramedics group study periods were the same days of the week and time of day. Research assistants stationed in the ambulance bay of the ED enrolled a convenience sample of patients from 11am-11pm for 7 consecutive days and recorded offload time on a data form as patients were brought in by EMS. Patients were excluded if they were trauma alerts, stroke alerts or directly admitted to the hospital. The primary outcome measure was offload time (the interval between patient arrival via EMS and transfer of patient care to an ED stretcher). Patient arrival time was defined as the time noted as the EMS crew rolled the patient through the double-door entrance to the ED.

Methods of measurement

A cell phone noting the atomic time was utilized for all measurements. The time of arrival was noted as soon as an EMS crew with a patient on their gurney crossed the threshold of the ED ambulance entrance. The time of transfer of patient care was noted when the patient was physically transferred from the EMS stretcher to the ED bed, and the EMS paramedic delivered a verbal care report to the ED staff assuming care (either an ED nurse or ED paramedic). The time interval between arrival time and transfer time defined the offload time.

Primary data analysis

Data were described using proportions and means with 95% confidence intervals [95%CI] as well as medians with interquartile range [IQR]. Data were assessed for variance and distribution. Comparisons between the groups were performed using Chi-squared or Fisher’s Exact test and Mann-Whitney U. Multiple comparisons were assessed using Tamhane’s T2 Test. Significance was set at an alpha of 0.05.

Results

Over the entire study period, a total of 519 offloaded patients were assessed: 207 in the pre-paramedic period, 93 in the transition (control) period and 219 in the post-paramedic period. Table 1 describes the patient characteristics of all 3 groups.

Characteristic	Before Paramedics [95% CI] N=207	After Paramedics [95% CI]	P-Value	Transition (Control) [95% CI]
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		N=219		N=93
Mean Age (years±SD) [95% CI] Range (years)	46 (±25) [43-50] (0.1-96)	43 (±23) [40-46] (0.1-99)	0.17	50 (±23) [45-55] (0.8-97)
Gender % Male	113 (55%) [48-61%]	117 (54%) [47-60%]	0.92	40 (43%) [33-53%]
Triaged to the Waiting Room (%)	41 (20%) [14-25%]	54 (25%) [19-30%]	0.25	15 (16%) [9-24%]
Admission (for those triaged directly to an ED bed) (%) N=331	(N=166) 85 (51%) [44-59%]	(N=165) 81 (49%) [41-57%]	0.74	(N=78) 47 (60%) [49-71%]
Trauma related complaints (%)	69 (33%) [27-40%]	82 (37%) [31-44%]	0.42	17 (18%) [10-26%]
Triage Category (%)	10 (5%) [2-8%]	12 (5%) [2-9%]	0.99	4 (4%) [0-9%]
Red (High acuity)	36 (17%) [12-23]	36 (16%) [11-21]	0.76 0.79	17 (18%) [10-26%]
Yellow (Moderate acuity)	161 (78%) [72-83]	160 (73%) [67-79%]	0.23	72 (77%) [75-79%]
Green (Low acuity)	0 [0]	11 (5%) [2-8%]		0 [0]
Transfer				
EMS Delivery Unit (%)	167 (81%) [75-86%]	180 (82%) [77-87%]	0.71	77 (83%) [75-91%]
EMS Unit #R1	15 (7%) [4-11%]	13 (6%) [3-9%]	0.70 0.99	6 (6%) [1-12%]
EMS Unit #O1	8 (4%) [1-7%]	8 (4%) [1-6%]	0.99	4 (4%) [0-9%]
EMS Unit #H1	17 (8%) [4-12%]	18 (8%) [5-12%]		6 (7%) [1-12%]
EMS Unit #OT				
Offload Time in minutes (triaged to an ED bed) Mean [95%CI] Median [IQR] [*]	(N=166) 32 [25-40] 14 [3-40]	(N=165) 13 [11-15] 4 [1-16]	<0.001	(N=78) 35 [27-42] 21 [9-40]
Offload Time in minutes (triaged to waiting room) Mean [95%CI] Median [IQR] [*]	(N=41) 11 [8-13] 10 [10-10]	(N=54) 2 [1-3] 1 [1-1]	<0.001	(N=15) 18 [9-27] 15 [4-33]
Offload Time in minutes Mean [95%CI] Median [IQR] [*]	28 [22-35] 10 [4-32]	10 [8-12] 4 [1-16]	<0.001	32 [25-39] 21 [9-40]
[*] Interquartile Range				

Table 1: Characteristics of the 519 patients included in the study

There were no statistically significant differences between the groups. In particular, there were no differences between the pre and post-paramedic groups in any of the baseline characteristics (Table 1). There were 409 (79%) patients triaged directly to an ED bed and 110

(21%) triaged to the waiting room). Overall median offload times (in minutes) in the pre-paramedic and post-paramedic groups were 10 [IQR 4-32] versus 4 [IQR 1-16] respectively (p<0.001). In those who were triaged directly to an ED bed the median offload times were 14

[IQR 3-40] and 4 [IQR 1-16] respectively ($p < 0.001$) and in those who were triaged to the waiting room the median offload times were 10 [IQR 10-10] and 1 [1-1] respectively ($p < 0.001$).

After adjusting for multiple comparisons, offload times did not differ significantly between the pre-paramedic group and the transition (control) group ($p = 0.82$) but there was a significant difference in offload time between the post-paramedic group and the transition (control) group ($p < 0.001$) (Figure 1).

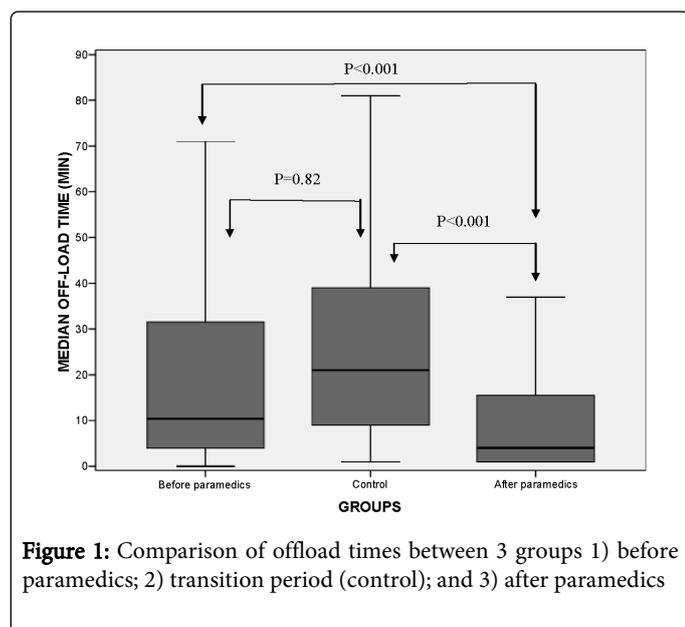


Figure 1: Comparison of offload times between 3 groups 1) before paramedics; 2) transition period (control); and 3) after paramedics

Table 2 describes the proportion of patients offloaded within 5,10,15,20,30 and 60 minutes of arrival. The proportion of patients offloaded within 5 minutes went from 29% before the paramedic intervention to 53% after ($p < 0.001$).

OffLoad Time (minutes)	Before Paramedics N=207 (%)	After Paramedics N=219 (%)	P-Value
Offloaded within 5 minutes	60 (29)	116 (53)	<0.001
Offloaded within 10 minutes	113 (55)	135 (62)	0.14
Offloaded within 15 minutes	127 (61)	164 (75)	<0.001
Offloaded within 20 minutes	137 (66)	181 (83)	<0.001
Offloaded within 30 minutes	155 (74)	206 (94)	<0.001

Offloaded within 60 minutes	181 (87)	218 (99%)	<0.001
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Table 2: Cumulative number of patients in each of the offload time intervals

The proportion of patients offloaded within 30 minutes went from 66% before paramedics to 83% ($p < 0.001$) after and those offloaded within 60 minutes went from 87% to almost 100% ($p < 0.001$). In the pre-paramedic group patients waited up to 4.7 hours to be offloaded whereas the maximum offload time after paramedics were staffing was 2 hours. A scatterplot of the offload times pre and post-intervention is shown in (Figure 2). All offloads in the post-intervention group occurred within one hour with the exception of one outlier at 2 hours.

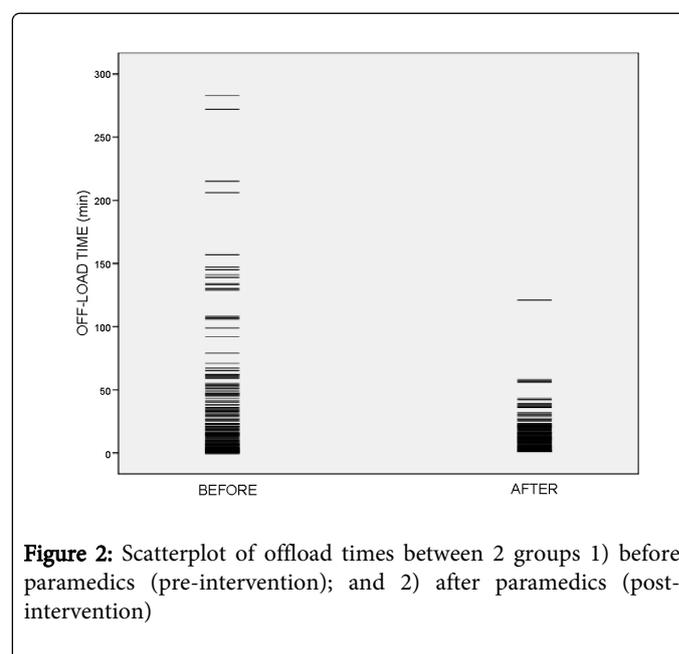


Figure 2: Scatterplot of offload times between 2 groups 1) before paramedics (pre-intervention); and 2) after paramedics (post-intervention)

In order to verify if differences between the pre and post-paramedic intervention were due to extraneous hospital or EMS system changes we compared baseline factors in the pre and post periods. System factors in both the hospital and EMS settings included ED staffing volumes (RN's and MD's), ED bed availability, ED volume, EMS transports, EMS units available, and agency data on offload times. All factors were comparable and very similar in the pre and post-paramedic periods (Table 3). Interestingly, even the mean offload time per the agency data decreased from 58 minutes to 38 minutes after the intervention.

Characteristics	Before Paramedics ¹	After Paramedics ²
Hospital Factors		
Mean RN (\pm SD) ³	17.14 \pm 1.46	16.29 \pm 1.25
Paramedic staff #	0	2.57 \pm 0.53

# ED beds	58	58
MD Staff Number	6	6
ED volume ⁴	1,031	1,058
% ⁴ EMS arrivals	(287/1031) 27.8%	(302/1058) 28.5%
% ⁴ EMS arrivals admitted	(159/287) 55.4%	(152/302) 50.3%
EMS Factors		
Mean # EMS units	23	23
# 911 Transports	181	211
Mean off-load (min) per agency data	50.88	37.96
Unit-hour utilization	0.39	0.42
¹ 12/12/2005 to 12/18/2005 ² 07/17/2006 to 07/23/2006 ³ RN's on duty from 11am – to – 11pm during study periods ⁴ Total # patients registered from 11am-11pm during study periods		

Table 3: Comparison of Hospital and EMS Factors in the Before and After Study Periods

Discussion

To date, this is among the first studies to recommend hospital-employed paramedic staffing in the emergency department as a means of decreasing offload times and improving EMS availability to the community. This study demonstrates the positive impact emergency department paramedic staffing had on reducing EMS unit offload times. Offload time decreased markedly at several time-points over the first 5, 15, 30 and 60 minutes after ambulance arrival. Offload times were not only significantly reduced after the paramedic intervention offload but times were cut over by over 65%. Moreover, prior to the intervention patients were waiting up to 5 hours to be transferred to a stretcher compared to a maximum wait-time of one hour following the paramedic staffing model. Although, the results were not presented here, the impact this paramedic intervention was felt system wide as evidenced by the reduced offload times recorded at the EMS agency level as well.

Prior to the study, the EMS unit would remain in a “delayed offload” status and were monitored by EMS (non-hospital employed) personnel in the corridors. This was a sub-optimal solution for everyone concerned, including patients. With the introduction of hospital-employed paramedics, significant improvements were seen both in the prehospital setting and in the hospital emergency department. The overall reduction in offload intervals enabled the EMS units to return to service quicker, and allowed increased availability to respond to 9-1-1 calls. On the hospital side, it permitted ED patients who were previously in the “delayed offload” status to have their evaluation and management initiated sooner.

Ambulance diversion has been well described in the literature as a consequence of ED crowding [13, 14]. During intervals of ambulance diversion, patient throughput processes cannot be initiated and EMS units are stagnant. While multifactorial approaches are necessary to address ED crowding, the approach taken in this study is simple and has led to marked reduction in delayed offload problems. Hospital

systems that collaborate with EMS systems to increase EMS unit availability can generate solutions synergistically.

The results of this study address a key issue raised by the National Association of EMS Physicians (NAEMSP), that improving ambulance offload delay is just as, if not more, important than reducing ambulance diversion. A systematic review by Pham et al. found that ambulance diversion is associated with ED crowding and may be reducible. The review showed that ED management solutions, such as observation units and algorithms, minimally reduced diversion. However, hospital throughput-based initiatives including increased resources and staffing had an important impact on decreasing diversion [15]. While ambulance diversion may help one hospital deal with ED crowding, it leaves other ED's to absorb the burden. Attempts have been made to reduce or eliminate diversion in some communities [16]. But the effect on offload delay is usually a negative one [17].

Hospital-employed paramedic staffing in the emergency department is a very novel solution to decreasing offload times and improving EMS availability to the community. It is unique because it marries two systems (EMS and hospital) into one. Paramedics are hired by the hospital and work hand in hand with their colleagues in the field. The paramedics have an appreciation for both their colleagues in the field and for the ED staff with whom they work on a daily basis. The experience has been touted by all fronts as being a positive step toward ED crowding and throughput.

Clearly such an intervention has the potential to improve patient care, increase ambulance unit availability, decrease burden on nursing staff to offload patients and improve ED throughput.

Limitations

Limitations to this study include the inability to control for all confounding variables that may exist in the hospital and EMS systems. We did, however, try to take into consideration some baseline factors such as ED staffing, ED bed availability, ED volume, EMS transports,

and EMS units available. Although we did not directly measure the impact on the EMS system we did note that the mean offload load time per the agency data decreased from 51 minutes to 38 minutes after the intervention. This study was conducted at a single level one trauma center in a single EMS system and may not generalize to other centers such as community hospitals. Additionally, we did not measure the impact of this intervention on any ED crowding metrics in our hospital. This study was not intended as a solution to ED crowding; rather it was an approach to one of the consequences of crowding. Although we did not demonstrate an impact on patient throughput intervals, this study does provide an alternative strategy to diversion of EMS-arrived patients. It may be useful for other hospitals to explore this option. Future studies are needed to measure the impact of this intervention on objective measures of crowding.

Conclusion

A hospital employee emergency department paramedic-staffing model primarily focused on receiving EMS arrived patients at times when the ED is at full bed capacity significantly reduced the offload time for EMS units. The resulting decreased offload time allows for increased EMS unit availability in the field. Hospital systems that collaborate with EMS systems to increase EMS unit availability can generate solutions synergistically.

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