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Utilizing an emergency medicine stabilization team to provide critical care in a rural health system

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ABSTRACT

Introduction: Over the past decade, Emergency Department (ED) patient volumes have increased more than available hospital ICU capacity. This has led to increased boarding and crowding in EDs, requiring new methods of providing intensive care. Many hospitals nationwide have developed ICU boarding mitigation strategies at the hospital and ED level or implemented ED-based resuscitative care units to improve patient care and disposition. However, these have been described in the setting of larger medical centers without broader application to rural, community ED environments. The authors herein have created an ED model utilizing a physician and nurse on-call team to provide improved care to critically ill patients requiring resuscitation when an ICU bed is not immediately available.

Goals: The goal of this paper is to describe a novel approach to providing critical care in a rural health system. A community health system-based resuscitation team named Emergency Medicine Stabilization Team, or EMSTAT, was developed as a mobile team consisting of one emergency physician and one emergency or critical care nurse. The authors present data from the first 12 months of the program including diagnoses, procedures, temporal trends, and lengths of stay.

Results: Over the course of twelve months, EMSTAT was contacted for 195 patients and ultimately traveled to bedside for 131 cases. The three most common diagnoses seen were sepsis, respiratory failure, and diabetic emergencies. 99 documented procedures were performed; the most common were central venous catheters, arterial lines, and intubations. 104 patients were admitted to the intensive care unit, while the other 27 were either downgraded to a lower level of care, discharged, transitioned to palliative care, or died.

Discussion: Over a twelve-month period, the authors describe a novel rural community-based mobile critical care team. This team demonstrated the ability to quickly arrive at bedside, continue resuscitation, acquire a disposition, and provide individualized critical are. This model serves as a roadmap for developing similar community based-resuscitation programs.

1. Introduction

Emergency Departments (ED) represent a primary point of healthcare entry in the US. EDs triage and stabilize patients, and across the country, are responsible for a mean patient admission rate of 38.9% [1]. ED patient volumes have increased by 30% in the past decade, and visits for critically ill patients have risen by 80% within the same time frame [2]. Despite these changing patient volume dynamics, there has not been concordant growth in hospital capacity, and this has resulted in an increase of critical care boarding within the ED [1].

ED boarding has clinical significance, including longer ICU length of stay, increased duration of mechanical ventilation and increased patient mortality [3–9]. Health systems have developed three categories of mitigation strategies to combat ED boarding for ICU patients: hospital level solutions, ED level solutions, and ED-based resuscitative care units (RCU) [2]. At the hospital level, strategies focus on matching admission demand with capacity within a hospital system [2]. The University of Maryland Medical System, for example, has created a novel position for an Access Center Physician. This role has improved visibility of available resources system-wide to facilitate admissions and transfers. ED level solutions have included hybrid ED/ICU teams to see and treat ICU patients boarding in the ED [2,10,11]. Lastly, RCUs are areas of dedicated space within the ED that provide short-term critical care in or near the ED [12,13,].

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While many hospitals nationwide have implemented these ICU boarding mitigation strategies, to our knowledge, these have all been described in the setting of larger medical centers. However, smaller community hospitals have not escaped the worsening environment of increased ED boarding and crowding. The authors herein have created a physician and nurse on-call ED model coined Emergency Medicine Stabilization Team (EMSTAT) to provide improved care to critically ill patients requiring resuscitation when an ICU bed is not immediately available. EMSTAT employs a "go-team" element of providers on call to support ICU patients boarding in rural EDs that destabilize or require high resource utilization.

2. Background

2.1. Shore Regional Health System

University of Maryland Shore Regional Health (UM SRH) is a four-site network of community hospitals/freestanding EDs located on the Eastern Shore, Maryland. These hospitals are affiliated with the University of Maryland and collectively hold 86 ED beds, 103 licensed hospital beds and 10 ICU beds. University of Maryland Queen Annes Emergency Center is a freestanding emergency department with 16 beds and annual volume of 15,000. University of Maryland Shore Medical Center at Chestertown is a state-designated "rural hospital" and has 16 emergency department beds and up to 25 inpatient beds. It has an annual volume of 13,000. University of Maryland Shore Medical Center at Cambridge is a freestanding medical facility with 22 emergency department beds and 6 ED observation beds. Its annual volume is 19,000. University of Maryland Shore Medical Center at Easton is the largest hospital within the network, with 32 emergency department beds, 98 inpatient beds, and 10 ICU beds. It has an annual volume of 33,000. It is the only site in the system with ICU beds. Due to the surgical, cardiac, and neurosurgical patients that require the ICU post-procedure and the reality of a local and nationwide critical nursing shortage, the ICU is often at or near capacity. As a result, the emergency departments in our system sometime have difficulty finding beds for their ICU admissions. This leads to prolonged emergency department stays, which has been demonstrated in literature to result in increased morbidity and mortality

Internal data indicate ICU patients spend upwards of seven hours in our emergency departments. The emergency physician is tasked with spending an extraordinary amount of time making telephone calls to other hospitals to locate an available bed. Additionally, long transport times take EMS teams out of service for hours, creating the domino effect of increasing time for other patients awaiting transfer between facilities. Furthermore, while an ICU patient is awaiting admission or transfer, nursing is often tasked with providing ICU-level care in addition to emergency care for other patients, as opposed to the recommended 1:1 or 2:1 patient-to-nurse ratio for these patients.

The authors describe a new model of healthcare delivery that addresses stabilization and transfer of critically ill patients to a higher level of care when immediate disposition is unavailable.

2.2. Emergency Medicine Stabilization Team (EMSTAT)

EMSTAT consists of a team of emergency physicians (EP) and nurses. EPs either have a strong interest in critical care or are dually boarded in emergency medicine/critical care. Initially, any EM physician in the UM SRH group was invited to rotate through the team. To stay on the team, those EPs are required to work at least one shift per month to maintain their skill set. Additionally, providers are required to complete the Fundamental Critical Care Support (FCCS) course developed by the Society of Critical Care Medicine upon joining the team and will be required to do so every two years thereafter, should they remain part of EMSTAT.

EMSTAT coverage included 12-h shifts staffed by a single EP and nurse, who were on call from 12 pm to 12 am on Monday through Friday. These dates and coverage times were chosen after review of patient volumes to capture the peak daily and weekly ED utilization times.

3. Methods

The data herein are retrospective, collected during routine clinical care, treated in compliance with the Security Rule and the Privacy Rule of Heathcare Insurance Portability and Accountability Act (HIPAA). This study was exempt from review by the University of Maryland Institutional Review Board.

3.1. Team activation process

Two types of patients triggered an EMSTAT activation. The first type involved patients within the Emergency Department who were being cared for by an ED provider. EMSTAT was notified by the ED provider if that provider determined that ICU level care was ultimately required, there were no immediately available inpatient ICU beds (defined as within 4 h), and the patient was utilizing a high level of ED resources or at risk for rapid deterioration. Upon notification, the EMSTAT physician performed a brief case review to determine appropriateness of activation. Activation criteria were designed with flexibility and geared toward off-loading ED resources. For clarity, these criteria included, but were not limited to performing critical procedures, managing critical medications such as vasopressor drips, managing ventilation settings and devices, or any other time and labor-intensive component of patient care. If appropriate, EMSTAT would respond to patient bedside to take sign out from the primary nurse and physician to assume further patient care. EMSTAT would then perform resuscitative measures as needed, develop a treatment plan, and arrange for final disposition. Additionally, EMSTAT physicians had the option of traveling with the transport crew, if needed. The case activation ended at time of patient transport off the ED floor to the appropriate level of care.

The second category of EMSTAT activation involved patients who were already admitted to the inpatient medical service at Chestertown Hospital, specifically. In these cases, EMSTAT was contacted, and would accept cases and patient care as described above. These EMSTAT activations involved creating a new patient plan and arrangement for final disposition by way of upgraded level of care or transport to a different, often larger, facility. A key distinction in this process is that the hospitalist retained primary responsibility of the patient. Logistically, this created situations where patients benefited from transport out of an inpatient floor into an ED bed for optimal care. These patients were subject to a rural hospital EMTALA exemption, which facilitated EMSTAT's ability to arrange transport and disposition to another facility. In these cases, the patient would remain under the primary care of the hospitalist and EMSTAT would work in collaboration with the admitting team before final disposition.

In either type of activation, EMSTAT physicians had the ability to call the primary team, give verbal orders, request certain items to be made available (ex: central line kit, ultrasound, chest tube, intubation supplies, etc.), and otherwise direct care as needed while en-route to expedite any necessary critical interventions. The four sites are all within approximately 50 miles of each other. To balance expeditious responses with provider residences, the requirement was made for a response time of under an hour to each site.

In the event the patient was still in the emergency department at 12 am when the call period ended, the EMSTAT physician signed care back to the ED attending if they were awaiting transport or still had ongoing workup pending. If they were downgraded from ICU, care was transitioned to the hospitalist.

These processes are outlines in Fig. 1 below.

Notably, EMSTAT underwent a pilot period between May 16, 2021, through June 4, 2021, at which point initial utilization was reviewed and EMSTAT activities were paused. After initial utilization review during the trial period, EMSTAT effort was continuously initiated on July 5,

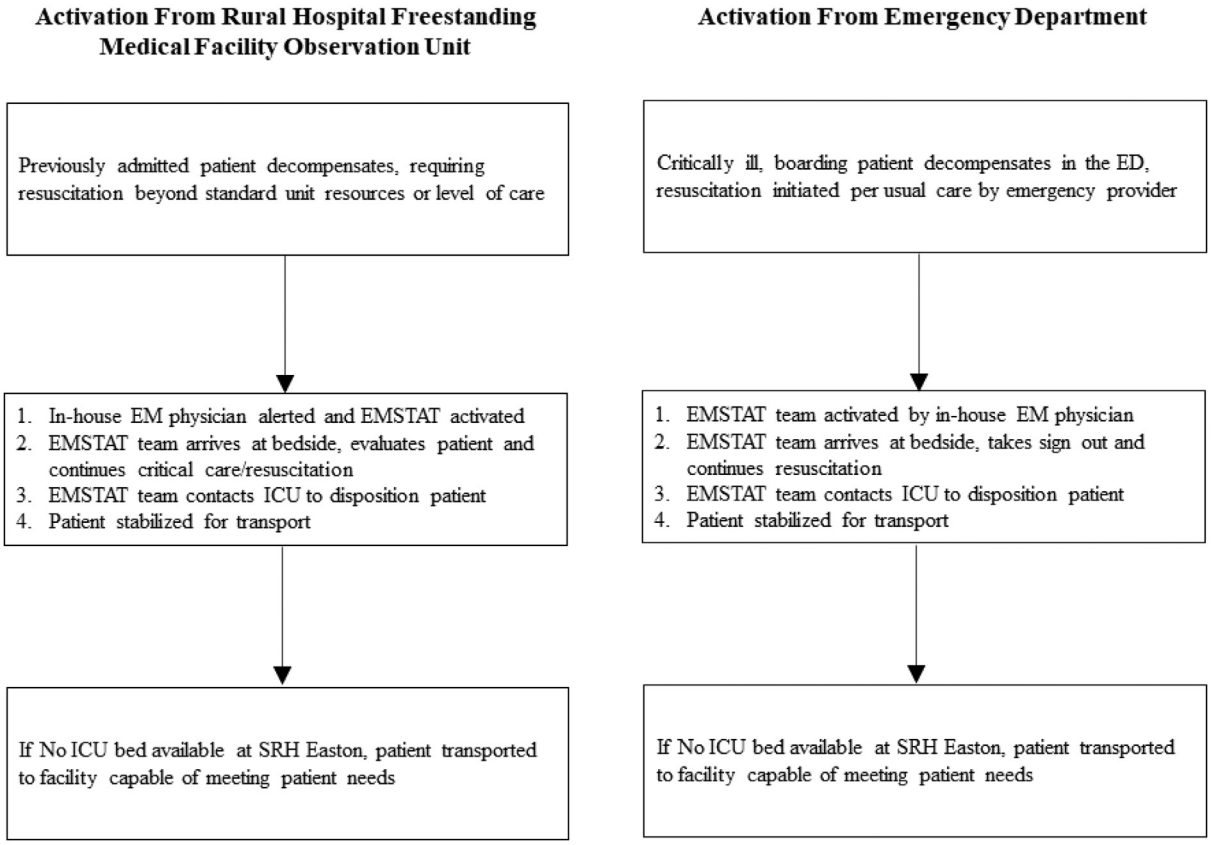

Fig. 1. EMSTAT Activation Process.

2021. Thus, the data encompasses a twelve-calendar month period, with a 30-day gap during the initial review period between pilot and full implementation (Table 2).

4. Results

The EMSTAT study group had 195 patients included in data analysis, inclusive of activated and non-activated cases. The most common diagnoses were sepsis, respiratory failure, diabetic ketoacidosis/hyperosmolar hyperglycemic syndrome, which combine to represent 60% of all cases (Table 1). Most of the calls were from UM Shore Medical Center at Easton, representing 63% of calls (Fig. 2). Calls averaged 16 per month (average of 22 weekdays per month), a 73% activation rate (Fig. 3). Mondays had the highest call volume per day of week, and most calls occurred between 12 noon and 4 pm (Figs. 4 and 5).

Table 1
Study participant diagnosis.

	EMSTAT Cases	
Total Patients	195	
Diagnosis		
Bradycardia	3	1.5%
Cardiac Arrest	8	4%
Cardiogenic Shock	12	6%
CVA/ICH	7	4%
Delirium Tremens	6	3%
DKA/HHS	20	10%
GI Bleed	12	6%
Hemorrhagic Shock	3	1.5%
Hepatic Failure	3	1.5%
Hypertensive Emergency	1	0.5%
Hypotension	10	5%
Overdose	1	0.5%
Pancytopenia	1	0.5%
Respiratory Failure	47	24%
Rhabdomyolysis	1	0.5%
Sepsis	50	26%
Status Epilepticus	10	5%

4.1. EMSTAT utilization and patient dispositions

Over the full twelve-month period, EMSTAT was called 195 times, resulting in 131 activations. Of calls that did not result in activation, the cause for decline fell into categories of (i) conflict with an already activated EMSTAT provider, (ii) patient not ICU appropriate, (iii) initiation call to EMSTAT fell outside of the team on-call hours, (vi) EMSTAT physician was able to assist with patient disposition by phone, (v) there was no EMSTAT provider available, and (vi) miscellaneous other reasons further detailed in Fig. 6.

The physician response time ranged from 0 min (cases when the physician was in the department on a separate call and consulted) to 120 min. The average response time was 33 min. The total call time from initial contact to disposition was on average 285 min, or 4.75 h (Table 4). The disposition was defined as (i) patient physically leaving the department, (ii) the EMSTAT team signing out care to the primary team (either patient stabilized and a new call required EMSTAT activation or patient disposition downgraded from ICU), or (iii) the EMSTAT team signed out to the primary team due to the call time finishing at midnight.

Table 3 outlines the documented procedures performed by EMSTAT physicians. Central venous catheters, arterial lines, and intubations comprised the majority of procedures. Routine procedures such as ultrasound-guided peripheral IV placement and ventilator management were not consistently documented. When documented, they were counted and included.

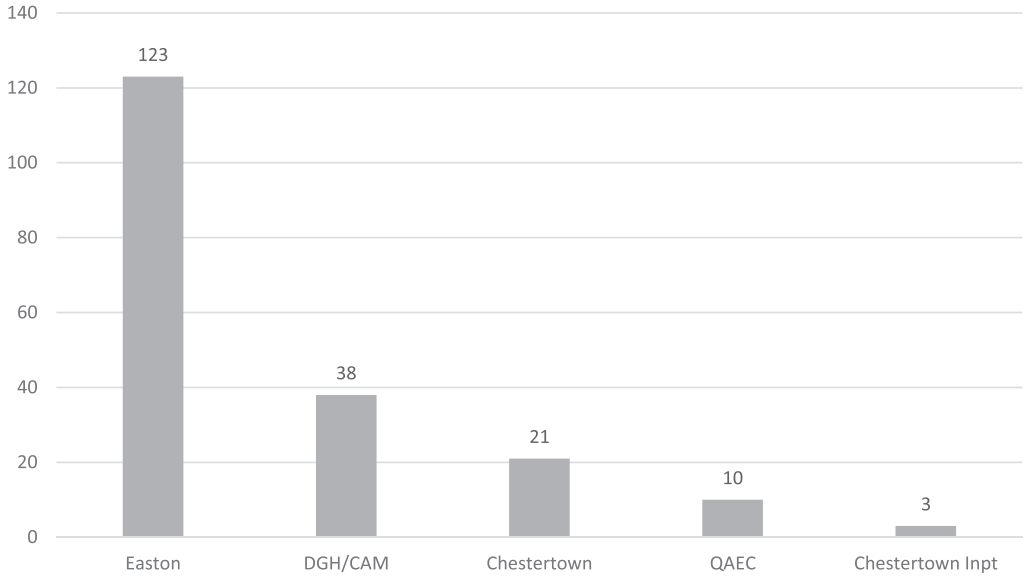

Fig. 2. Calls by Site.

EMSTAT responded to 131 activations. Of these patient activations, 104 were ultimately admitted to an ICU level of care. 27 patients were able to be downgraded from an initial ICU level of care. They were subsequently admitted to a medical floor, discharged, placed on palliative care in the ED or expired.

5. Discussion

Critically ill patients boarding in the emergency department have become increasingly common, and this has been shown to increase morbidity and mortality [5,9]. The authors describe a novel, rural emergency department-based program to combat this trend. Our program uses and on-call physician and nurse team to provide ongoing ED resuscitation and bridge the gap to definitive ICU care. This fills the void between ED management and ultimate ICU transfer in cases of high resource demand or in the deterioration of boarding patients already admitted to an ICU. It off-loads Emergency department clinicians to enable improved ED throughput for remaining ED patients, while also affording critical patients 1:1 nursing and clinician care while they remain unstable. Simultaneously, the physician can also begin working toward the definitive disposition, including conversations with consultants, admitting clinicians, and facilities with available ICU bed space. If a patient requires transfer out of the ED, EMSTAT nurses can quickly coordinate with the ambulance company to arrange transport. Often, EMSTAT nurses had pre-existing working relationships with critical care transport nurses, leading to more efficient and prompter communication surrounding transport.

The initial pilot program and subsequent ten months of activity demonstrates the feasibility of such a program in a rural setting and is the first study to examine such feasibility and benefit. This serves as a model for other rural health systems throughout the country who struggle with similar barriers to definitive ICU care.

The data described here reviews 131 cases of intervention on critically ill patients boarding in rural, community EDs. These activations encompassed a broad range of cases familiar to every ED physician, often involving patients who had already been admitted to inpatient services, but was boarding in the ED and deteriorated, or who were utilizing a disproportionate amount of ED resources in the pilot community sites. We note that additional utilization potential existed within the analysis period, as 27 possible EMSTAT activations were not pursued due to

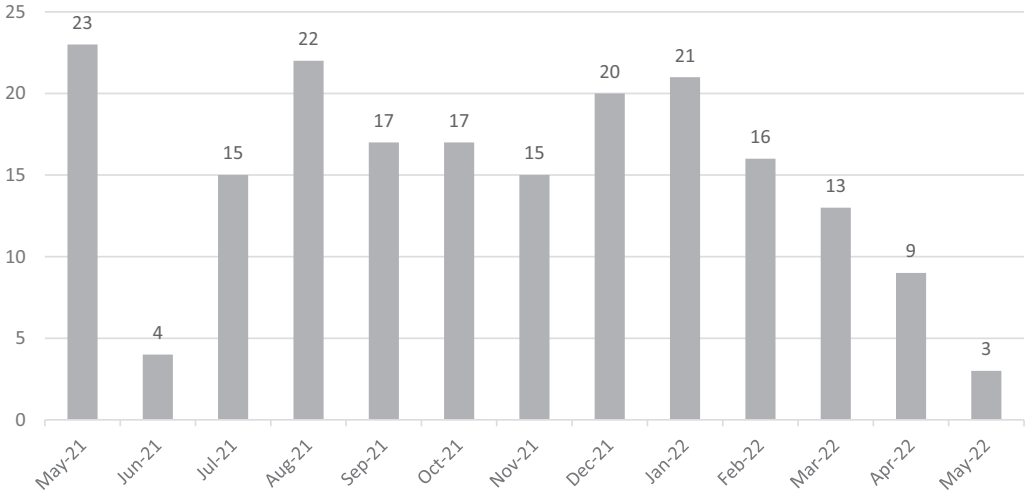

Fig. 3. Calls by Month.

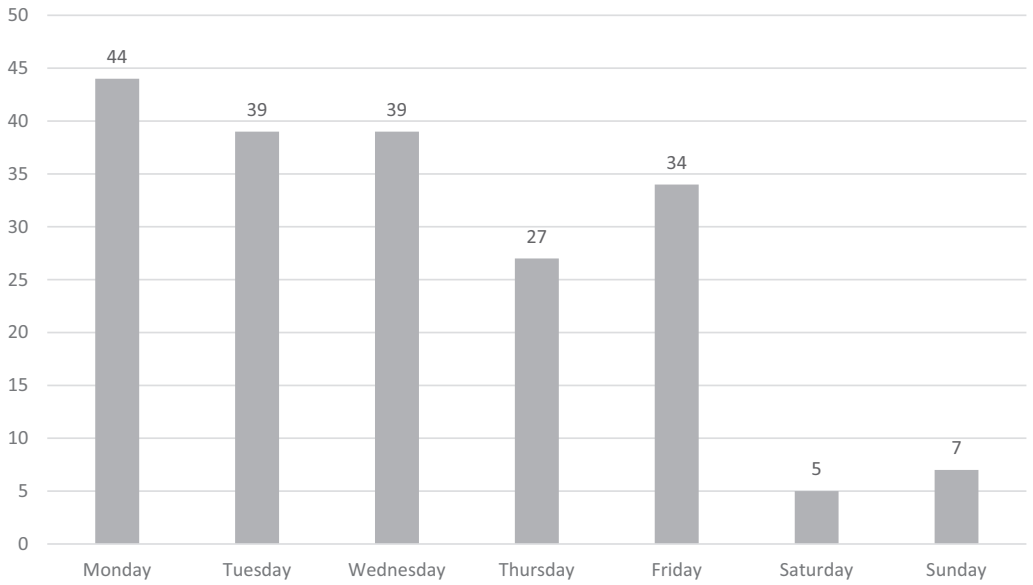

Fig. 4. Calls by Day of Week.

limited staffing and availability. EMSTAT was also able to assist with 14 cases via telephone consultation (7% of all calls). This may be an area for further development and does have existing precedent; an ED-ICU telemedicine approach was trialed at a large, non-profit tertiary medical center with encouraging results, leading to an ability to transition a meaningful percentage of patients to a lower, non-ICU level of care and decreased in-hospital mortality for those patients under ED-ICU telemedical care. While a telemedical approach may not alleviate resource strain in rural EDs, it may provide benefits to boarding ICU patients [14,15].

5.1. Strengths

The authors were unable to find any other similar models of providing critical care in a rural health system. The model of providing ED intensivist and ED intensive care units is known, but largely based in tertiary or quaternary hospitals, offering dedicated ED-ICU space (University of Maryland Medical System CCRU, University of Michigan EC3, Stony Brook ED-ICU), or relying in in-house critical care response teams as in the case of Henry Ford Hospital [11,12,16]. Trends in crowding and boarding, coupled with limited hospital capacity are unlikely to be alleviated in the near future, creating ongoing opportunities for improved patient care of boarding patients in the ED that programs like EMSTAT may offer. University of Maryland's CCRU, for example, has decreased transfer time and time to operating room for critically ill patients [17]. While dedicated physical space may not be feasible in rural and resource limited settings, EMSTAT did off load ED personnel challenges to allow lower acuity patients to be seen and dispositioned while maintaining the standard of care for critical patients.

5.2. Limitations

This paper has several limitations. Our data are collected from single rural health system and may not be generalizable. However, as many emergency departments around the country face similar increases in ED ICU boarding, we feel that this model can serve as a road map for

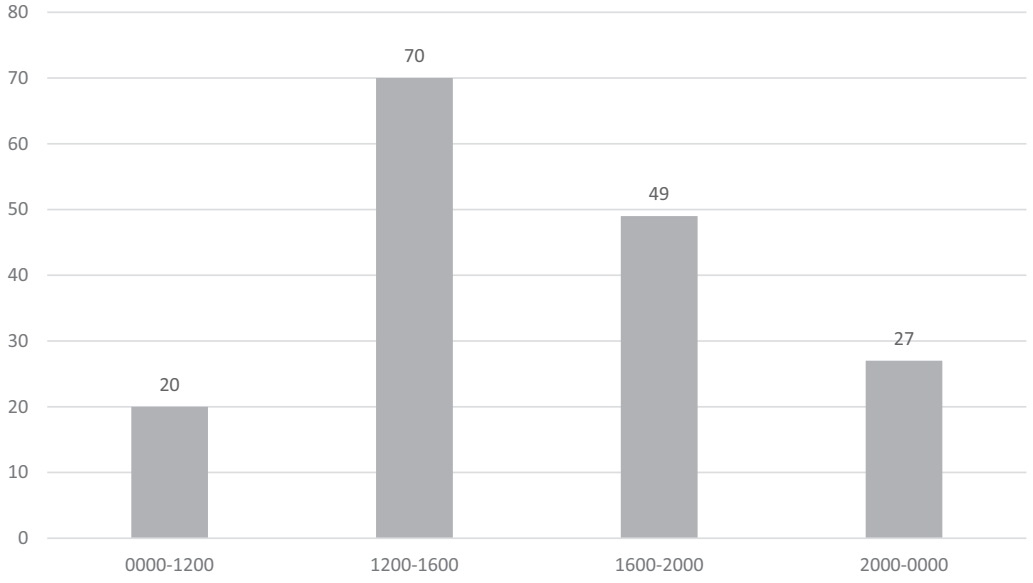

Fig. 5. Calls by Time of Day.

Table 2
Patient disposition data.

Call Data	
Total Calls	195
Accepted Calls	131
Admitted to ICU	104
Downgrade from ICU Status	
IMC	2
Med-Surg Telemetry	16
Discharge	2
Palliative	3
Deceased	4

Table 3
Documented billable procedures.

CVC[1]	39
Arterial Line	20
Intubation	12
Chest Tube/Pigtail	3
POCUS[2]	9
Ventilator Management	10
US guided PIV[3]	6
Total	99

[1] Central venous catheter.
[2] Point-of-Care Ultrasound.
[3] Peripheral IV.

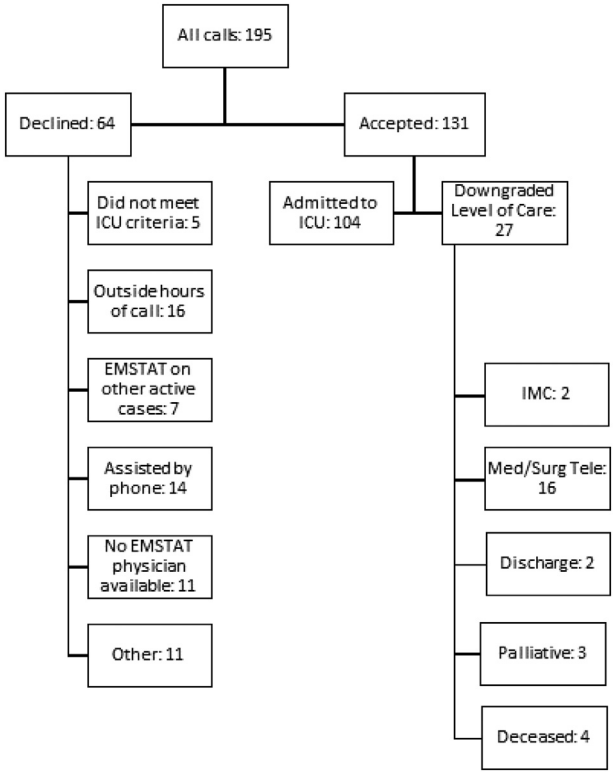

Fig. 6. Patient disposition flow chart.

potential incorporation and adjustment to other systems' needs. The authors firmly believe that this program provides value for all involved parties, including patients, ED clinicians, and hospital systems. However, a data-driven definition and comparison of flow metrics, such as ED length of stay, proved to be difficult to analyze with consistency. These difficulties arise from the inherent flexibly of the EMSTAT program related to varied EMSTAT activation times over the course of a patient's stay in the Emergency Department. For example, in some cases the team was activated immediately at the patient's arrival in the facility. In other cases, patients had been boarding for multiple hours or shifts. This variability created a challenge to marking a unified basis of comparison relative to a control group not seen by EMSTAT, potentially introducing a systemic bias into statistical comparisons. Similarly, the authors did not explore mortality differences or other patient-oriented outcomes. Given the current environment with limited ICU availability, we felt that a paper describing our novel model should be presented at this time.

6. Conclusion

The authors present a novel model for providing ED-based critical care in a rural health system. Utilizing a call-based nurse and physician team allows for rapid bedside presence to deliver ongoing resuscitation and offload the main emergency department. The availability of this team allows in-situ providers to focus on care of other ED patients and relieves demand on nurses. EMSTAT also demonstrated an ability to downgrade and even discharge patients, freeing downstream ICU resources and beds after EMSTAT intervention. While encouraging, this model requires future research to investigating whether the observed benefits lead to statistical improvements in ED flow metrics, decreases in morbidity and mortality, and decreased ICU and hospital lengths of stay. The financial viability of such a program also merits further investigation to best understand monetary strategies to ensure long-term success. Crowding and boarding are likely to continue creating challenges to ED care and disposition, necessitating further trial and development of novel patient care strategies within the ED.

Table 4
EMSTAT Physician Metrics.

Average Response Time (min)	33
Range Response Time (min)	0–140
Total time from call to disposition (min)	285
Total time from call to disposition (hrs)	4.75

CRediT authorship contribution statement

Eric Klotz: Writing – review & editing, Writing – original draft, Supervision, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Reed Macy:** Writing – original draft, Methodology, Formal analysis, Data curation. **Steven Obrzut:** Writing – review & editing, Writing – original draft, Methodology, Data curation. **Walter Atha:** Writing – review & editing, Writing – original draft, Methodology, Data curation. **Rhamin Ligon:** Writing – review & editing, Writing – original draft, Methodology, Data curation. **Jessica Fluharty:** Writing – review & editing, Writing – original draft, Methodology, Data curation. **William Huffner:** Writing – review & editing, Writing – original draft, Methodology, Data curation.

Declaration of Competing Interest

The authors declare none.

The authors declare no overlap with previous publications, and this manuscript is not currently under consideration elsewhere.

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