Effectiveness of collaboration between emergency department and intensive care unit teams on mortality rates of patients presenting with critical illness: a quantitative systematic review protocol

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Review objective: The objective of this review is to identify the effectiveness of collaboration between emergency department (ED) and intensive care unit teams on mortality rates of critically ill adult patients in the ED.

Keywords: Collaboration; critical illness; emergency department; intensive care; patient mortality


Background

Adult patients with critical care needs are receiving substandard care and face higher risks of mortality in emergency departments (EDs) worldwide.¹, ² Early intervention and treatment, fundamental elements to stabilizing critically ill patients and preventing decompensation,³, ⁴, ⁵, ⁶ are not adequately delivered in EDs.⁵, ⁶, ⁸ Furthermore, the care initiated in the ED heavily impacts the mortality rates of critically ill patients.², ³ One study identified that delays in receiving treatment in the ED were responsible for over 50% of sentinel events occurring in the hospital.⁴ Another study showed a 3.5-fold increase in mortality rates related to a delay in treatment greater than 4 hours.⁵ Mortality rates increase 1.5% for each hour a patient waits in the ED for transfer to critical care.¹⁰ The current state of our EDs – showing high mortality rates for critically ill patients – highlights the need for crucial improvements.¹⁰

For most patients, the ED serves as an entry point into the healthcare system.¹¹ Traditionally, the ED is designed to appropriately triage, diagnose, stabilize and transfer patients to medical, surgical, cardiac, neurological, step-down or critical care units.⁹, ¹¹ The number and acuteness of patients in the United States (U.S.) who access the hospital system via the ED are increasing.¹⁰ A retrospective study found that between 2001 and 2009 annual visits by critically ill patients to U.S. EDs increased by a staggering 79%.¹² Critically ill patients warrant emergent special care interventions in the ED and may require prolonged resuscitation efforts.⁵, ⁶, ¹³, ¹⁴ The Society of Critical Care Medicine defines a critically ill patient as someone who presents with “severe physiological instability requiring technical and/or artificial life support”¹⁵(p.3) and requires intensive care unit (ICU) level of care.

Early identification and triaging of critically ill patients in the ED is essential to determine the level of care they will require in the ED. For this purpose, multiple triage tools are in existence. Two examples are the Manchester Triage System (MTS)¹³, ¹⁶, ¹⁷ and the Emergency Severity Index (ESI).¹³, ¹⁸ The MTS uses a color structure and readily identifies critical patients. Red warrants immediate attention, and orange warrants a response within five minutes.¹⁶, ¹⁷ The ESI scale utilizes a numbering system from one to five. Patients with threat to life or organ function who require resuscitation, such as in trauma or cardiac arrest cases, are classified as ESI level 1.¹⁸ An ESI level 2 rating is designated for patients who are “reasonably likely”¹⁸(p.238) to have a threat to life or organ function and might need resuscitation; these patients require constant monitoring and complex diagnostic studies.

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Although tools are available for ED providers to triage patients appropriately, there is still the need for more resources to provide patients with ICU level care in the ED, with the goal of preventing adverse outcomes.\textsuperscript{1,5-7,12} An ICU level of care may include early interventions such as multiple fluid boluses and vasoressor use or invasive procedures such as intubation or central line placements.\textsuperscript{7} However, achieving an ICU level of care, especially when incorporating post-resuscitation efforts in an ED setting, is difficult to attain. One contributing factor is the lack of experience and training of ED providers, both physicians and nurses, in providing treatments for critically ill patients.\textsuperscript{7} Another contributing factor is time constraints in caring for these complex patients, who need monitoring and evaluation while managing multiple patients.\textsuperscript{6,8,19} Compounding these factors is the issue of overcrowding in the ED. In the United Kingdom and Australia, overcrowding in EDs is recognized as a public health crisis. This crisis has caused a change in legislation in these countries where ED completion time must be between a four- and six-hour time period.\textsuperscript{10}

Patients in the ED who have been seen by a provider and are awaiting transfer to an in-patient unit become known as ED boarders.\textsuperscript{5} The care of critically ill ED boarders is time consuming and strains the limited resources of the ED; this creates tremendous pressure on already overwhelmed staff, who manage a large range of patients with different needs and diagnoses.\textsuperscript{8} The level of care that critically ill ED patients demand often over extends the manpower of the ED staff to safely oversee all patients in the ED.\textsuperscript{5,8} As the influx of critically ill patients continues to rise, the demand for ICU beds far surpasses their availability.\textsuperscript{1,2,20} A shortage of ICU beds coupled with the risk for increased mortality associated with boarding in the ED has led hospitals in several countries, including Turkey, Taiwan and the U.S., to implement collaborative early intervention programs between the ED and ICU.\textsuperscript{1,5,7,10,21}

An ED-ICU collaboration is the creation of a cohesive relationship between both departments to support the specialized needs of patients who are critically ill. This collaboration can occur in many forms such as ED intensive care unit (EDICU), medical emergency team (MET) and ICU medical alert team (MAT).\textsuperscript{19,22,23} Each model of care is used as an early intervention program to deliver critical care to patients while collaborating with other teams. The EDICU model of care provides critically ill patients with critical care treatments while in the ED awaiting an in-patient ICU bed. The EDICU has various models of practice from management by ED intensivists, ED physicians trained in critical care, to patient co-management between the ED and critical care departments.\textsuperscript{1,5,7} The MET model involves a team of specialized healthcare providers trained to care for patients with critical illnesses.\textsuperscript{22-24} The team is available around the clock via a paging system or other hospital alert system because they are not in one centralized location. When activated, the MET team responds to a specific area and collaborates with the primary physician to prevent further worsening of a patient’s condition. In the MAT model, the ED team activates an alarm notifying the MAT team of a patient who needs an ICU bed. Prior to initiating the alarm, the ED team stabilizes the patient and determines the need for an ICU bed. The handoff between the ED and MAT team occurs at the patient’s bedside and the MAT team – a physician, physician assistant and nurse from the medical ICU – assumes full care of the patient once the alert is triggered.\textsuperscript{25} The MAT team assumes the care for the patient in the ED while the patient awaits a bed in the ICU. Carrington and Barnes found that a lower ICU admission threshold for borderline ICU patients and a “collaborative culture” between the ICU and ED teams demonstrated considerable decrease in mortality.\textsuperscript{26}

Mortality is analyzed in different ways across the literature. Many studies analyze mortality as in-hospital or in-patient mortality, which is defined as mortality occurring during a patient’s hospital stay.\textsuperscript{1-3,5,8,14} Although most studies measure mortality rate based on in-hospital mortality, the U.S. Centers for Medicare and Medicaid Services (CMS) utilize a 30-day mortality rate as a standardized measurement for five medical conditions and one surgical procedure.\textsuperscript{27} This is in line with “promoting high-quality, patient-centered care and accountability.”\textsuperscript{28 (para. 1)} Although in-hospital mortality includes the time period up until discharge, 30-day mortality is a standardized measurement beginning at admission and includes the post-discharge time period.\textsuperscript{27} Other studies define mortality outcomes further to include ICU mortality,\textsuperscript{2,3} 10-day mortality beginning from ED presentation\textsuperscript{21} or seven-day mortality post-discharge from the ED.\textsuperscript{21}

The aim of this review is to evaluate the effectiveness of collaboration between ED and ICU teams on
the mortality rate of critically ill adult patients who present to the ED. A search of MEDLINE, Cumulative Index to Nursing and Allied Health Literature (CINAHL), the JBI Database of Systematic Reviews and Implementation Reports and the Cochrane Database of Systematic Reviews was performed, and no existing or ongoing systematic review on this topic was identified.

**Inclusion criteria**

**Types of participants**
The current review will consider studies that include male and female adult patients, 18 years and older, who are in the ED with a critical illness and meet criteria for ICU admission. For the purpose of this review, critical illness is defined as a “severe physiological instability requiring technical and/or artificial life support.” These patients with critical illness require skilled providers, respiratory support and close monitoring of hemodynamics – proven to improve outcomes in this population – which makes them eligible for ICU admission. 

**Type of intervention**
The current review will consider studies that focus on collaboration between the ED and the ICU in the management of critically ill patients boarding in the ED. For the purpose of this review, a collaboration is considered a cohesive relationship in the acute management of the critically ill patient beyond the initial resuscitation and stabilization period. Examples of collaborative models include the EDICU, MAT and MET, each with the goal of initiating early ICU care for critically ill patients while they are still in the ED.

**Types of comparators**
The current review will consider studies that include usual care as a comparator.

**Outcomes**
The current review will consider studies that include all-cause mortality at any time periods including 30-day mortality rates and in-hospital mortality rates. The 30-day mortality rate is a standardized measurement utilized by CMS to evaluate patient outcomes from the date of admission. The in-hospital mortality rate refers to the time period spanning the length of one hospital admission.

**Types of studies**
The current review will consider experimental designs including randomized controlled trials and quasi-experimental studies for inclusion. In the absence of these, this review will consider observational and quantitative descriptive study designs such as before and after studies, prospective and retrospective cohort studies, case-control studies, analytical cross-sectional studies, case series, individual case reports and descriptive cross-sectional studies for inclusion.

**Search strategy**
The search strategy aims to find both published and unpublished studies. A three-step search strategy will be utilized in this review. An initial limited search of PubMed and CINAHL will be undertaken followed by an analysis of the text words contained in the title and abstract, and of the index terms used to describe an article. A second search using all identified keywords and index terms will then be undertaken across all included databases. Third, the reference list of all identified reports and articles will be searched for additional studies. Studies published in English will be considered for inclusion in this review. Studies published from the inception of databases searched through the present date of the review will be considered for inclusion in this review.

The databases to be searched include:

**PubMed, CINAHL, Embase and Cochrane Central Register of Controlled Trials (CENTRAL)**

The search for unpublished studies will include:


Initial keywords to be used will be:

- critical illness, emergency department, intensive care unit, mortality and collaboration.

**Assessment of methodological quality**
Papers selected for retrieval will be assessed by two independent reviewers for methodological validity prior to inclusion in the review using standardized
critical appraisal instruments from the Joanna Briggs Institute Meta-Analysis of Statistics Assessment and Review Instrument (JBI-MAStARI) (Appendix I). Any disagreements that arise between the reviewers will be resolved through discussion or with a third reviewer.

Data extraction
Data will be extracted from papers included in the review by two independent reviewers using the standardized data extraction tool from JBI-MAStARI (Appendix II). The data extracted will include specific details about the interventions, populations, study methods and outcomes of significance to the review question and specific objectives. Any disagreements that arise between the reviewers will be resolved through discussion or with a third reviewer. Reviewers will attempt to contact study authors to seek missing data or provide clarity in reported results.

Data synthesis
Quantitative data will, where possible, be pooled in statistical meta-analysis using JBI-MAStARI. All results will be subject to double data entry. Effect sizes expressed as odds ratio (for categorical data) and weighted mean differences (for continuous data) and their 95% confidence intervals will be calculated for analysis. Heterogeneity will be assessed statistically using the standard chi-square and also explored using subgroup analyses based on the different study designs included in this review. Where statistical pooling is not possible, the findings will be presented in narrative form including tables and figures to aid in data presentation, where appropriate.

Acknowledgements
The current review will partially fulfill degree requirements for successful completion of the Doctorate of Nursing Practice Program at Pace University, College of Health Professions, New York, NY for Svetlana Direktor, Elizabeth Hynes, Kerchelle McDowald and Anna Sahadeo.

References
27. Centers for Medicare and Medicaid Services. 30-day unplanned readmission and death measures.n.d.; Available from https://www.medicare.gov/HospitalCompare/Data/30-day-measures.html. [Cited March 12, 2016; Internet].
## JBI Critical Appraisal Checklist for Randomised Control / Pseudo-randomised Trial

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<th>Question</th>
<th>Yes</th>
<th>No</th>
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<td>1. Was the assignment to treatment groups truly random?</td>
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<td>2. Were participants blinded to treatment allocation?</td>
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<td>3. Was allocation to treatment groups concealed from the allocator?</td>
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<td>4. Were the outcomes of people who withdrew described and included in the analyses?</td>
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<td>5. Were those assessing outcomes blind to the treatment allocation?</td>
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<td>6. Were the control and treatment groups comparable at entry?</td>
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<td>7. Were groups treated identically other than for the named interventions</td>
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<td>8. Were outcomes measured in the same way for all groups?</td>
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<td>9. Were outcomes measured in a reliable way?</td>
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<td>10. Was appropriate statistical analysis used?</td>
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Overall appraisal: Include □ Exclude □ Seek further info. □

Comments (Including reason for exclusion)

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# JBI Critical Appraisal Checklist for Descriptive / Case Series

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<td>1. Was study based on a random or pseudo-random sample?</td>
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<td>2. Were the criteria for inclusion in the sample clearly defined?</td>
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<td>3. Were confounding factors identified and strategies to deal with them stated?</td>
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<td>4. Were outcomes assessed using objective criteria?</td>
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<td>5. If comparisons are being made, was there sufficient descriptions of the groups?</td>
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<td>6. Was follow up carried out over a sufficient time period?</td>
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Overall appraisal: Include [ ] Exclude [ ] Seek further info [ ]

Comments (including reason for exclusion):

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# JBI Critical Appraisal Checklist for Comparable Cohort/Case Control

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<td>1. Is sample representative of patients in the population as a whole?</td>
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<td>2. Are the patients at a similar point in the course of their condition/illness?</td>
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<td>3. Has bias been minimised in relation to selection of cases and of controls?</td>
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**Overall appraisal:**
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- Seek further info. □

**Comments (including reason for exclusion)**

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Appendix II: Data extraction instruments

MAStARI data extraction instrument

JBI Data Extraction Form for Experimental / Observational Studies

Reviewer ______________________, Date ______________________

Author ______________________, Year ______________________

Journal ______________________, Record Number ______________________

**Study Method**

- RCT [ ]
- Quasi-RCT [ ]
- Longitudinal [ ]
- Retrospective [ ]
- Observational [ ]
- Other [ ]

**Participants**

Setting

Population

**Sample size**

Group A ________________  Group B ________________

**Interventions**

Intervention A

Intervention B

Authors Conclusions:

Reviewers Conclusions:
### Study results

#### Dichotomous data

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#### Continuous data

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