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The University of Michigan Emergency Critical Care Center (EC3) Provides Timely Intensive Care to Critically Ill Patients in the Emergency Department

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Summary

An increasing volume of patients presenting for acute care can create a need for more ICU beds and intensivists and lead to longer wait times and boarding of critically ill patients in the emergency department (ED).[1] Data suggest that boarding of critically ill patients for more than 6 hours in the emergency department leads to poorer outcomes and increased mortality.[2,3] To address this issue, University of Michigan Health, part of Michigan Medicine, developed an ED-based ICU, the first of its kind, in its 1,000-bed adult hospital. The University of Michigan Emergency Critical Care Center (EC3) opened on February 16, 2015, as a 7,800-square-foot unit with five resuscitation or trauma bays and nine critical care patient rooms immediately adjacent to the main ED.4 The goal of EC3 is to deliver early, aggressive, evidence-based critical care to the most acutely ill and injured patients arriving to the ED.

Prior to opening EC3, all ED patients requiring ongoing critical care were evaluated and treated by the ED team in resuscitation bays or regular ED rooms until an inpatient ICU bed became available or the patient no longer required critical care and was admitted to a non-ICU level of care.

Studies of the EC3 initiative have found promising outcomes, including modest but significant decreases in mortality (14.1% reduction in adjusted 30-day mortality for ED patients in the post-EC3 cohort; number needed to treat [NNT]=220 patients to reduce 1 death at 30 days),[5] reduced ICU utilization (12.9% reduction in the post-EC3 cohort; NNT=179 patients to reduce 1 ICU admission), quicker patient turnover, and shorter hospital stays.[5,6]

The EC3 care team is comprised of emergency medicine (EM) physicians (with or without critical care fellowship training), house staff (primarily EM residents and critical care fellows), physician assistants (with critical care training), ED nurses (with additional ICU training), respiratory therapists, and pharmacists. The

patient-to-nurse ratio is the same as most traditional inpatient ICUs at 2:1.[7] EC3 has treated over 16,000 patients to date.

For this type of innovation to ultimately be successful, EC3 leadership recommend that care be evidenced-based and protocol-driven, yet the care team remain flexible and nimble enough to adapt to the constantly changing conditions inherent within the world of emergency medicine. Further, EC3 leadership emphasize that all care providers need to remain well-versed in the knowledge and skillsets needed to provide both EM-centric resuscitation and stabilization as well as the early and continuing critical care knowledge and skillsets more traditionally found in inpatient ICUs. Obtaining these knowledge and skills requires the innovating organization to provide continual training and evaluation and feedback to the care team. Additionally, since the initiative requires significant resources, it is important to keep thorough data pre- and post-implementation to demonstrate impact on patient-centric outcomes.

Contact the Innovator

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Date First Implemented

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Problem Addressed

Critically ill patients have time-sensitive conditions that worsen without early access to intensive care. In the United States, 33% of ICU admissions from the ED have an ED length of stay longer than six hours.[10] This problem has worsened in recent decades.[11] Critically ill patients who experience a delay longer than six hours from arriving at the ED to transfer to the ICU have longer hospital stays and worse clinical outcomes than those with timely transfer to the ICU.[12] Several studies have found that increases in the length of time a critically ill or injured patient is held in the ED are associated with increases in mortality.[13,14] Boarding critical patients in the ED also stresses the ED system which can impact safety for all patients.[8]

Description of the Innovative Activity

To improve care for critically ill patients in the ED, University of Michigan Health developed an ED-based ICU within the adult ED of its adult hospital. The hospital has 1,000 beds and receives around 70,000 patients a year.[6] The EC3 ED-based ICU opened on February 16, 2015, as a 7,800-square-foot unit with

five resuscitation or trauma bays and nine patient rooms immediately adjacent to the main ED in what was formerly a pediatric ED. In the first few years of implementation, on average, EC3 clinicians treated approximately seven patients per day.[5]

Prior to the innovation, all patients requiring ongoing ICU-level care were evaluated and treated by the main ED team until an inpatient ICU bed became available or the patient no longer required critical care.

Common indications for transfer from the ED to EC3 include severe sepsis or septic shock; altered mental status; overdose; major electrolyte disturbances, including diabetic ketoacidosis; gastrointestinal tract bleeding; respiratory distress or failure; congestive heart failure; and undifferentiated hypotension.[5] Patients leave EC3 either for admission to the ICU, or to lower levels of care if they have stabilized and no longer require ICU care. A smaller percentage will be discharged out of the hospital directly from EC3 while some patients receive end-of-life care in EC3.

Staffing of the EC3 includes one EM attending physician and one or two residents, fellows, or physician assistants. The attending physician supervises a team that includes critical care fellows, a special cohort of ED physician assistants and ED nurses, and respiratory therapists and pharmacists. Attending physicians are a combination of both dually board-certified EM/critical care medicine specialists as well as emergency medicine faculty members who have undergone a customized two-day Fundamentals of Critical Care Support course (using materials from the Society of Critical Care Medicine). The patient-to-nurse ratio is 2:1.[5]

According to the EC3 team, one benefit of the initiative is that, since all clinicians are trained and board-certified in emergency medicine, the EC3 clinicians can see all patients that enter through the ED which helps to maximize use of the space and resource allocation.

EC3 is part of the Division of Critical Care within the Department of Emergency Medicine at Michigan Medicine. In addition to providing clinical care, EC3 serves as a training site for medical students, residents, fellows, and other trainees from a range of disciplines. EC3 is also a site for multidisciplinary research on emergency critical care delivery and has an ongoing collaboration with the Weil Institute for Critical Care Research and Innovation. Ongoing research endeavors include patient outcomes research; research on novel patient care diagnostics, therapeutics, and emerging technologies; research on the impact of the care model on cardiac arrest, extracorporeal life support, sepsis, and respiratory failure; as well as research on the utilization of early detection systems for hemodynamic decompensation.[7]

Context of the Innovation

Emergency department visits for critically ill patients in the United States increased by 80% between 2006 and 2014, from 2.8 to 5.2 million.[15] The increase is believed to have been driven by a growing older population,[16] and clinical conditions such as sepsis, chronic obstructive pulmonary disease, and diabetes mellitus.[6] Ideally, patients with these conditions and other critically ill patients are admitted to an ICU. However, overcrowding has meant that ICU admissions can be delayed, which increases the risk of decline

for critically ill and injured patients.

Traditionally, emergency care and critical care are separate specialties. Emergency critical care is an emerging field that focuses on managing and monitoring ED patients that have a critical, life-threatening illness or injury.[19] ED intensivists, trained in managing critically ill patients, can advise other ED clinicians, and can manage patients after ICU admission.[17]

Results

A before-and-after study looked at patient outcomes and resource use associated with EC3 implementation. The pre-EC3 cohort included 168,877 visits from September 2, 2012, to February 15, 2015 (896 days), when the EC3 opened. The post-EC3 cohort included 180,433 visits from February 16, 2015, to July 31, 2017 (896 days). All visits with physicians were included. When comparing outcomes, the study adjusted for sex, age at ED visit (in five-year increments), a modified version of the Charlson Comorbidity Index, and the Emergency Severity Index (a triage algorithm that assigns a score from 1, indicating the most urgent, through 5, indicating the least urgent).[5]

The risk-adjusted 30-day mortality rate among all ED patients decreased from 2.13% pre-EC3 to 1.83% post-EC3. The risk-adjusted rate of ED admission to ICU decreased with implementation of EC3 (pre-EC3, 3.2%; post-EC3, 2.7%; adjusted odds ratio, 0.80), equaling roughly 220 lives saved per year.[5]

A smaller study of patients with upper gastrointestinal bleeding (UGIB) found that the time from ED presentation to transfer to the ICU was more likely to be under six hours after for patients treated in the EC3, after EC3 opened, compared to a cohort of patients with UGIB treated prior to implementation.[4] Among critically ill patients with UGIB, the mean hospital length of stay was shorter for those treated in EC3 than for those that went from ED to ICU (6.2 vs. 7.3 days) prior to the opening of EC3. In the post-EC3 cohort (including all ED patients), fewer ED patients with UGIB were admitted to a non-EC3 ICU (9.3% vs. 19.4%) compared to all ED patients with UGIB before EC3 opened.[4]

EC3 leaders report that there are other promising clinical outcomes associated with EC3, including, but not limited to, fewer patients with intracerebral brain hemorrhage *not* admitted to an ICU, reduced hospital mortality for patients with leukostasis, early delivery of palliative care for ED patients at end of life, and improved compliance with lung protective ventilation strategies.

Innovation Patient Safety Focus

This patient safety innovation addresses the problem of longer ICU stays and worse clinical outcomes that are the result of boarding critically ill patients in the ED, when compared to outcomes when patients are moved more quickly to the ICU.[5] This problem is typically due to limited ICU capacity as ED patient volume has increased by 30% in the last 10 years without a concomitant rise in ICU capacity.[8]

Planning and Development Process

Sites should be mindful that planning for EC3 took several years. For the pre-implementation planning phase, facility efforts should focus on:

- Determining the problem that they are trying to solve and collecting baseline data
- Establishing a steering committee that includes representation from all roles in the ED as well as medical and nursing directors from inpatient ICUs
- Assessing facility, equipment, financial, and staffing resources
- Reviewing the evidence base for existing patient care pathways
- Discussing how to change the ED-focused culture to one that embraces not only emergent diagnosis and resuscitation, but also early and ongoing critical care provision

Resources Used and Skills Needed

Resources and skills needed for the intervention, according to EC3 leaders, include:

- A steering committee that includes clinicians, administrators, and other stakeholders. For EC3 the steering committee is comprised of the inpatient ICU medical director, a nursing director from each inpatient ICU, trauma surgery leadership, the emergency medicine chairman, the division chief of critical care, the EC3 director of operations, the emergency medicine director of operations, the ED clinical nurse specialist, ED nurse manager, and ad hoc representatives from respiratory therapy, pharmacy, supply chain, etc.
- Space and appropriate equipment in the ED to deliver ongoing critical care
- Substantial financial investment to pay for operations (primarily staffing)
- A multidisciplinary team of clinicians with critical care training to implement the initiative on the ground
- Commitment from all levels of staff to a culture of emergency critical care provision, knowledge acquisition, skill development and continuing education
- Dedicated care team members on each shift (i.e., doctors, nurses, house staff, advanced practice providers, respiratory therapists, pharmacists) to provide continuous ICU-level care
- Staff that are motivated, collaborative, innovative, nimble, and able to adjust to the needs of the patient population
- Extensive orientation training (e.g., ED nurses currently staffing the EC3 attended the American Association of Critical-Care Nurses' Essentials of Critical Care Nursing course and underwent an eight-week preceptorship in the medical center’s inpatient ICUs)
- Patient rooms that are large enough and have technology to support all resuscitation and critical care delivery needs, while also allowing for group learning[9]
- Robust data collection systems that allow for ongoing analysis of process and outcomes measures

Funding Sources

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Getting Started with This Innovation

To get started with the innovation, the EC3 leaders suggest the following:

- Be clear on the problem your organization is trying to solve and the innovation goals.
- Begin to get buy-in from all levels of staff and promote the issues addressed by the innovation as hospital-level concerns.
- Identify interested clinicians and ensure proper training.
- Implement data collection processes.
- Ensure adequate staffing and material resources.

Sustaining This Innovation

To support the sustainability of the innovation, EC3 leaders recommend that sites do the following:

- Ensure adoption and support of the initiative by the entire institution, and make sure that staff view ED patients as everyone’s patients.
- Identify ED-trained clinicians who are motivated and interested in the critical care work.
- Maintain a patient-focused culture.
- Emphasize collaboration, agility, and innovation.
- Support data collection and research that show a return on financial investment.
- Recruit a diverse team of staff.
- Collect and value feedback from all team members.
- Provide training opportunities.

Adoption Considerations Use by Others (Use By Other Organizations)

Since 2015, the EC3 team has had discussions about their care model with 29 different health systems and agencies representing 29 unique institutions across 14 states and 5 countries. The team has presented at national and international conferences and published over 15 manuscripts on the impact of this model of care on patient-centric outcomes, resource utilization, staff training, and educational impacts. The leadership team has also served on many national and international task forces to help further define this model of care, standardize its implementation, and measure its outcomes. Several ED-based ICUs are currently in operation in the U.S., each with its own patient care and staffing model.[8]

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Footnotes

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Evidence Rating Footnote

FYI: You may notice that the PSNet Innovations Exchange has recently been updated (April 2022) to remove the evidence rating section. For more information or questions, please email psnetsupport@ahrq.hhs.gov.