Received: 1 December 2023 | Revised: 16 May 2024 | Accepted: 17 May 2024

DOI: 10.1002/emp2.13211

JACEP OPEN
JOURNAL OF THE AMERICAN COLLEGE OF EMERGENCY PHYSICIANS OPEN
A GLOBAL JOURNAL OF EMERGENCY MEDICINE
Open Access
WILEY

CLINICAL CONCEPTS

The Practice of Emergency Medicine

Rearranging the furniture: A blueprint for reappropriating fixed resources to create an emergency department resuscitative care unit

Angela Barskaya MD[1,2] | Liliya Abrukin MD, MPH[1] | Christopher McStay MD, MBA[1]

[1]Department of Emergency Medicine, Columbia University, New York, New York, USA

[2]Division of Pulmonary, Allergy and Critical Care Medicine, Department of Medicine, Columbia University, New York, New York, USA

Correspondence
Angela Barskaya, MD, Department of Emergency Medicine, Columbia University, New York, NY, USA.
Email: ab5045@cumc.columbia.edu

Abstract

Emergency department (ED) care teams face challenges in providing timely, high-quality care to critically ill patients because of competing patient care priorities and a multitude of system strains, including patient boarding. Patients who are boarding in the ED experience increased morbidity and mortality, and this is particularly true for those who are critically ill. Geography-based models for critical care delivery in the ED range from resuscitation bays to full-fledged ED intensive care units. Studies have shown that such models can improve patient survival without affecting cost. Here, we describe how we reappropriated limited fixed resources to create a critical care resuscitation unit in a busy, urban, academic ED. Our objective is to provide a blueprint for similar models, paying particular attention to operations, clinical care, education, and financial stability.

KEYWORDS

critical care medicine, emergency critical care, emergency department critical care, emergency department intensive care unit, resuscitation care units, resuscitative care unit

1 | BACKGROUND

Emergency departments (EDs) across the United States have seen accelerated growth in patient volume that has markedly outpaced population growth. From 2006 to 2014, ED volume increased 14.8%, compared with a 6.9% increase in the US population over that time.[1,2] Despite this trend, hospitals are closing and patient acuity is rising, with increased demand for intensive care unit (ICU) beds.[3] When ICU capacity is strained, critically ill patients experience adverse outcomes, such as decreased critical care delivery and increased mortality.[4–7]

EDs have been weighted with the responsibility of boarding and caring for these critically ill patients while they await inpatient ICU capacity. Boarding of ICU patients in the ED is associated with increased morbidity and mortality,[8–10] and insufficient health care capacity and consequent ED crowding have been recognized as health care crises requiring multifactorial solutions.[11,12] EDs have responded by creating various models of critical care delivery. These models include the emergency critical care physician consult and formalized training for ED resuscitationists. The most common such model, however, is the resuscitative care unit (RCU), which may range from a hybrid ED-embedded unit to an independent ICU.[13–17]

Although the anatomy of an RCU may vary according to local needs, the overall goal remains the timely provision of ICU-level care to critically ill patients.[18,19] RCUs have been shown to improve clinical outcomes and reduce ICU admissions.[20,21] Furthermore, these quality improvements have been accomplished with no change in cost,

Supervising Editor: Nicholas Johson, MD.

suggesting added value to the greater health care system.[22] Moreover, the RCU model has been demonstrated to be sustainable.[23]

Given the current limitations in health care resources in terms of workers, physical bed capacity, equipment, and critical care delivery, it may erroneously seem that building an RCU is unmanageable.[24,25] In this article, we refute this assumption. With the aim of providing a blueprint for similar models of critical care delivery in the ED, we describe the creation of an RCU in a fixed-resource, urban, academic medical center. Multiple iterations of geographically based ED care subdivisions have been described in the literature. To our knowledge, however, no publications have delineated an entirely resource-neutral creation of such spaces.

2 | INCEPTION

The creation of an RCU in the setting of fixed resources requires intentional restructuring and purposeful innovation. We undertook this process in an urban academic quaternary care center with more than 100,000 annual ED visits to create the ED critical care resuscitation unit (CCR). The aim of the CCR was to provide team-based, timely, evidence-based care for critically ill patients within a dedicated space in the ED. In our example, the CCR is a hybrid subdivision of the ED, comprising geographically co-located rooms with distinct functions, although confluent with the main ED space. Care is primarily focused on patients identified during triage, but may also include caring for patients later identified in the ED, decompensating inpatient boarders, and critically ill ED patients awaiting ICU bed capacity. The patient disposition goal is an inpatient team and unit, as ICU capacity allows.

2.1 | Assumptions

Creation of a hybrid RCU entails the following assumptions:

1. The ED treats an adequate volume of critically ill patients. Given the known increase in ED patient volume and acuity coupled with inadequate inpatient capacity, this assumption is likely true for many academic and/or tertiary or quaternary medical centers. The assumption of patient volume includes any patient requiring focused nursing care, such as procedural sedation and many time-consuming procedures. Our patient volume and acuity are such that insufficient volume of critically ill patients for the space is a rarity; accordingly, low-acuity patients will not generally be seen in the CCR. This resource is protected.
2. Departmental staffing allowances support appropriate staffing of the RCU. Meeting this assumption is a challenge given critical staffing shortages, particularly in the post-COVID-19 period; however, this is possible with thoughtful reorganization. Neither the volume nor the acuity of the patients will change; thus, staffing can be largely unchanged. Given current ICU capacity strain limiting inpatient beds, ED length of stay (LOS) will be similar, although this may very common among institutions. ED staffing should be restructured to better optimize care delivery, reduce context switching, and allow more focused attention for both critically ill and non-critically ill patients in their respective care areas.
3. All staff members have or will obtain appropriate training. Given the baseline capabilities of an ED, health care professionals and nursing staff have much of the skill set required to provide care in a hybrid RCU. Consideration should be given to expanding these capabilities through further training (formal or informal). Specific patient care inclusions are outlined in Table 1.

TABLE 1 Patient care inclusion by system: pathologies managed and patients included in the critical care resuscitative unit.

Respiratory	Mechanical ventilation
	Non-invasive positive pressure ventilation
	Procedures including intubation, chest tube placement, thoracentesis, fiberoptic laryngoscopy, VV ECMO cannulation
Cardiovascular	Shock
	Arrest
	Unstable dysrhythmias
	Vasopressors
	Antihypertensive drips
	STEMI
	Procedures including procedural sedation, central line placement, dialysis line insertion, hemodialysis, transvenous pacemaker insertion, Blakemore tube insertion, VA ECMO cannulation
Neurologic	Status epilepticus
	Intracranial hemorrhage
	Stroke requiring thrombolytics and/or embolectomy
Other medical	Diabetic ketoacidosis
	Drug overdose
	Gastrointestinal bleeding
	Severe electrolyte abnormalities
	Severe acid/base disturbances
	End-of-life
	Other medical emergencies
Operative trauma or operative non-trauma	Multisystem trauma
	Neurologic trauma
	Non-trauma surgical emergencies including aortic dissection, ruptured abdominal aortic aneurysm, perforated bowel, etc.

Abbreviations: ECMO, extracorporeal membrane oxygenation; STEMI, ST-segment elevation myocardial infarction; VA, venoarterial; VV, venovenous.

2.2 | Constraints

There are numerous constraints when creating an RCU with fixed resources. In our experience, the most limiting constraint was the

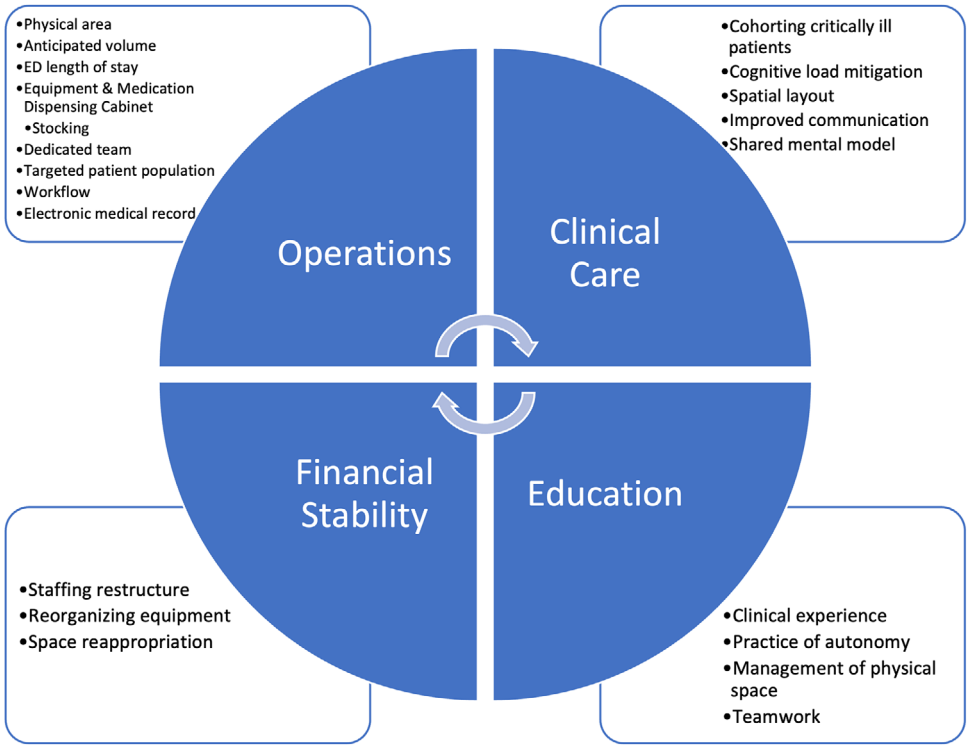

FIGURE 1 Core components. Four core components in the creation of a resource-neutral hybrid critical care resuscitation unit in the emergency department. ED, emergency department.

inability to structurally alter the ED layout. Our footprint per patient care space was limited, and we could not substantially redesign the rooms. The current layout was creatively reimagined, and a preexisting area was selected and repurposed, with careful attention paid to patient and team location and patient flow. The patient care team must be flexible and agile in placing and moving patients and in providing care in less-than-optimal areas.

Another constraint is staffing. In our example, budgeting constraints required the use of existing staffing across all service lines. Reorganizing existing staff should be expected to provide, at a minimum, continued delivery of the same quality of care. Ideally, however, care is improved through the formation of dedicated teams with shared mental models and the consequent reduction in context switching.

3 | FOUR PILLARS OF CREATION BY REAPPROPRIATION

Innovation through intentional reappropriation of current resources is cemented in four pillars: operations, clinical care, education, and financial stability (Figure 1).

3.1 | Operations

Operational structure is the foundational pillar in the creation of the CCR and has multiple layers. The first layer is the physical area, which should have enough consecutive beds for the anticipated patient volume. In the case of the CCR, we predicted anticipated volume by using existing data for daily ICU and step-down admissions, acute strokes, ST-segment elevation myocardial infarctions (STEMIs), and patients requiring ventilatory and pressure support. To determine the necessary area size, we balanced the anticipated volume with the predicted LOS and the distribution of patient presentation times. Given unchanged patient population characteristics, our ED LOS did not increase after CCR implementation.

Other area considerations include adjacent workstations for the primary CCR team members. The workstations should be confluent with the patient care space, near enough to visualize monitors and hear alarms. Traffic through the area should be curtailed to minimize distractions. The CCR should be near a medication dispensing cabinet, emergency medical service (EMS) triage, and imaging. The medication dispensing cabinet should be stocked with medications for critically ill patients, including but not limited to vasoactive medications, broad-spectrum antibiotics, and intubation medications. The layout should allow space for equipment, including an ultrasound machine and airway and procedural equipment with dedicated wall outlets. The equipment layout should be specified and adhered to. The area should be stocked by usual ED protocol, with a notable exception that the CCR should be a priority to restock.

The second layer of operational structure is a dedicated team. Our primary CCR team consists of a senior ED resident, ED registered nurses, and an ED patient care technician (PCT). Nursing staffing is flexible for providing ICU-level care, with ratios of 1:1 to 1:3 depend-

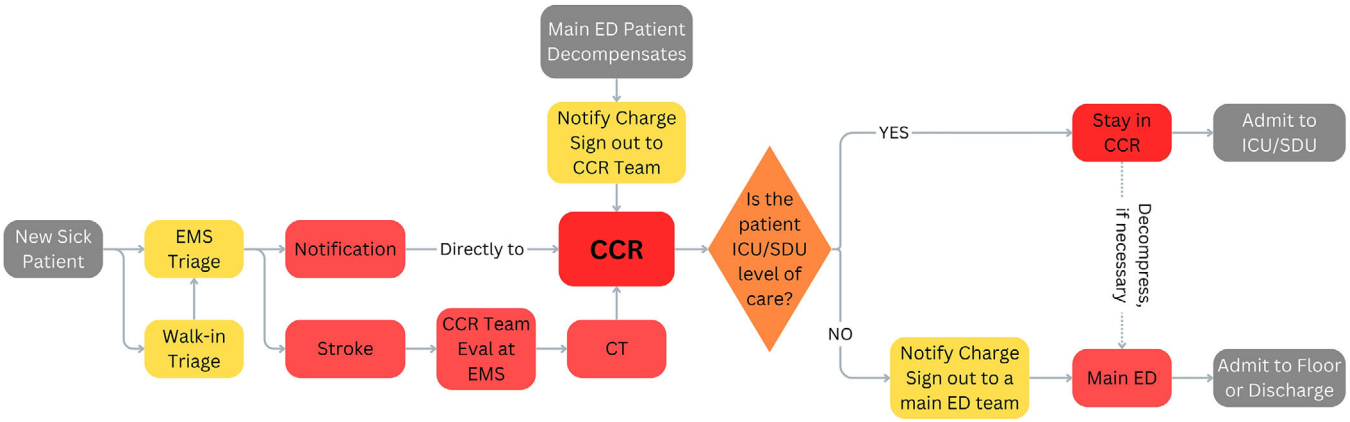

FIGURE 2 Critical care resuscitation unit process flow. Description of patient flow through the critical care resuscitation unit (CCR), including downgrading and upgrading patients. CT, computed tomography; ED, emergency department; EMS, emergency medical services; ICU, intensive care unit; SDU, step-down unit.

ing on immediate needs. Indirect members of the CCR team include ED attendings, charge nurses, backup nursing staff, ED pharmacies, respiratory therapists, junior residents, and advanced practice professionals. The roles of all team members should be specified. Attendings are available within the ED but are not co-located with the CCR team; they come to the CCR to staff cases with the senior resident. The charge nurse can assist with patient flow in and out of the CCR. Backup nurses should be identified and be readily available in the case of surge-level patient volume or acuity demands that exceed the capacity of CCR nurses.

After defining a space and a team, the target patient population was identified. In our CCR, the indications included but were not limited to acute strokes, STEMIs, shock, and respiratory failure (Table 1). We also identified exclusions, but these were not limiting and remained flexible.

Patient movement workflows must be explicit but flexible. The CCR model is both a "pull" and a "push" model. The workflow should define how to pull patients into the CCR from the walk-in or EMS triage populations, how to accept patients pushed from the main ED who decompensate or require higher levels of care, and how to transfer out patients who no longer require critical care (Figure 2). Using simulation to test this workflow is highly effective. Recommended simulations include a critically ill patient presenting via EMS and a decompensating main ED patient requiring transfer to the CCR. These simulation runs will ensure that all aspects of patient care, from registration to equipment, are considered. In our case, we were prompted to create an airway cart and to standardize bedside registration for emergent cases.

Finally, the use of the electronic medical records (EMRs) should be optimized. We created a separate team and tab to allow for easy visualization of CCR patients in the EMR. The patients were also visible on each attending's list. Specific EMR sign-in roles were created for all CCR team members such that each team member would receive the intended notifications and could be easily reached by any clinician in the hospital system.

We publicized the CCR "go-live" date and its capabilities and workflow through email, faculty and staff meetings, and education conferences. Both nursing and physician leaders were physically present during the rollout period to ensure workflow fidelity and to resolve issues in real time. We elicited feedback through QR codes, meetings, and town halls and actively revised workflows in response.

3.2 | Clinical care

While EDs are well prepared to provide a broad range of clinical care, strains on the current health care system make excellence in clinical care challenging. The CCR cohorts included critically ill patients with a predefined, dedicated team, allowing for focused attention, minimized distractions, and streamlined care. Separate teams and dedicated care spaces decrease context switching, improve team dynamics, and promote a shared mental model. Additionally, removing critically ill patients from the main ED team's responsibilities reduces cognitive load, thus decreasing strain and optimizing care of the non-critically ill ED patients.

Cohorting critically ill patients benefits consulting and inpatient teams and streamlines communication. The spatial layout allows consultants to see their critically ill patients in tandem and communicate in real time with the CCR team. Delays in enacting recommendations are minimized. Ancillary service professionals and other specialized health care practitioners, including respiratory therapists, can provide more efficient team-based care.

3.3 | Education

Because the CCR optimizes the health care team's exposure to critically ill patients, it creates numerous avenues for education. A knowledge base is established through clinical experience, the practice of autonomy, management of the physical space, and working within the team.[26] In our case, the primary physician in the CCR is a senior ED resident who has the benefit of providing undivided attention to critically ill patients. The resident presents cases to an ED attending; however, as the sole physician physically located in the CCR, the

resident maintains a sense of autonomy. Junior residents from the main ED can supplement the needs of the senior resident in the CCR, including placing initial orders and in the case of a surge. Two attendings alternate from the main ED to staff patients. Management of the physical space becomes a skillset to master, requiring agility and adaptiveness to ensure appropriate patient flow in the setting of high acuity and volume. Quality care is contingent on optimal team dynamics, with members learning how to be part of a high-performing team. Team leaders and members are successful when there is psychological safety, dependability, structure, clarity, meaning, and impact.[27] The CCR integrates the practice of all these skills.

Education for our nurses and physicians targets workflow and clinical care, including lectures, modules, and group discussions. Many residents, however, will continue to work in systems without an RCU-based model and must learn to identify and treat these patients in any setting. Having junior residents assist in these cases and having all residents work in the main ED will assist in decreasing location bias, but one must always remain vigilant of common biases in the ED.

3.4 | Financial stability

Budget constraints typically make large projects challenging to execute. Because we reappropriated existing resources, our project did not directly impact departmental or hospital finances. The necessary equipment was reorganized and relocated from the larger ED. For example, a video laryngoscope and an ultrasound machine were permanently rehoused in the CCR. Carts were created for airway, procedures, and nursing supplies. Other equipment necessary for high-acuity, low-occurrence events was stored nearby. The ED already stocked the needed supplies, and no new equipment purchases were necessary. Reorganizing equipment in an RCU allows for streamlined care with an unchanged budget.

The number of staff and shift times in the department remained unchanged with creation of the CCR, although staffing was restructured accordingly. The role of senior ED resident remained unchanged, although relocated to the physical CCR space. The nursing and PCT distribution were altered to provide appropriate ratios for the CCR. All care teams were optimized so that their attention was focused on their portion of the ED patient population.

4 | CULMINATION

Introduction of the CCR was met with both elated support and hesitation. Staffing was a particular concern and could be assuaged through dynamic improvements in workflow. The CCR saw more than 5000 patients in the year since its inception in February 2023. Of the patients who initially slotted for the CCR upon triage, 71% were admitted. Of the admitted patients, 21% needed ICU level of care. This did not encompass our step-down unit, which cares for a sick cohort of patients, including those receiving non-invasive positive pressure ventilation and those with severe metabolic disturbances. Fifteen patients were admitted to the palliative care unit. The CCR has received remarkably positive feedback. Limitations and challenges to the CCR model include space constraints requiring team flexibility. Despite the non-optimized space, care provision improved from before to after implementation of the CCR given the dedicated agile team in proximity to the necessary equipment.

Studies assessing the clinical efficacy of the CCR model are ongoing. Preliminary data show both quantitative and qualitative improvements, including improved stroke patient nursing reassessments, improved time to stroke patient thrombolytic administration and improved sepsis metrics, as well as improved team member perceptions of patient care. This sentiment was echoed by specialty consultants and inpatient medicine teams, who cited optimized patient care, improved communication, and better teamwork.

5 | CONCLUSIONS

Current strains on the health care system make providing excellent care to critically ill ED patients a challenge. EDs with fixed resources can improve the care of critically ill patients by intentionally reappropriating and restructuring existing spaces and care teams on the foundations of operations, clinical care, education, and financial stability.

AUTHOR CONTRIBUTIONS

Angela Barskaya created the initial draft. Angela Barskaya, Liliya Abrukin, and Christopher McStay conceived the concept and made substantial contributions to the revision of the manuscript. Liliya Abrukin and Christopher McStay provided significant administrative and technical support.

ACKNOWLEDGMENTS

The authors thank the entire Columbia ED CCR operational team, including Nursing Director Vepuka Kauari, DNP, Nursing Supervisor Marly Sam, RN, and Medical Director Betty Chang, MD. The authors would like to thank Jennifer Holmes for her invaluable editorial assistance.

CONFLICT OF INTEREST STATEMENT

The authors declare they have no conflicts of interest.

FUNDING INFORMATION

The authors received no specific funding for this work.

REFERENCES

ORCID

Angela Barskaya MD https://orcid.org/0009-0009-3141-0663

1. Moore BJ, Liang L. *Costs of Emergency Department Visits in the United States, 2017. HCUP Statistical Brief #268*. Rockville, MD: Agency for Healthcare Research and Quality; 2020. https://www.hcup-us.ahrq.gov/reports/statbriefs/sb268-ED-Costs-2017.pdf

2. Moore BJ, Stocks C, Owens PL. *Trends in Emergency Department Visits, 2006–2014. HCUP Statistical Brief #227*. Rockville, MD: Agency for Healthcare Research and Quality; 2017. https://www.hcup-us.ahrq.gov/reports/statbriefs/sb227-Emergency-Department-Visit-Trends.pdf
3. Mullins PM, Goyal M, Pines JM. National growth in intensive care unit admissions from emergency departments in the United States from 2002 to 2009. *Acad Emerg Med*. 2013;20(5):479-486. doi:10.1111/acem.12134
4. Halpern SD. ICU capacity strain and the quality and allocation of critical care. *Curr Opin Crit Care*. 2011;17(6):648-657. doi:10.1097/MCC.0b013e32834c7a53
5. Duggal A, Mathews K. Impact of ICU strain on outcomes. *Curr Opin Crit Care*. 2022;28(6):667-673. doi:10.1097/MCC.0000000000000993
6. Pilcher D, Hensman T, Bihari S, et al. Measuring the impact of ICU strain on mortality, after-hours discharge, discharge delay, inter-hospital transfer, and readmission in Australia with the activity index. *Crit Care Med*. 2023;51(12):1623-1637. doi:10.1097/CCM.0000000000005985
7. Chalfin DB, Trzeciak S, Likourezos A, Baumann BM, Dellinger RP, DELAY-ED study group. Impact of delayed transfer of critically ill patients from the emergency department to the intensive care unit. *Crit Care Med*. 2007;35(6):1477-1483. doi:10.1097/01.CCM.0000266585.74905.5A
8. Mohr NM, Wessman BT, Bassin B, et al. Boarding of critically ill patients in the emergency department. *JACEP Open*. 2020;1:423-431. doi:10.1002/emp2.12107
9. Singer AJ, Thode HC Jr, Viccellio P, Pines JM. The association between length of emergency department boarding and mortality. *Acad Emerg Med*. 2011;18(12):1324-1329. doi:10.1111/j.1553-2712.2011.01236.x
10. Groenland CNL, Termorshuizen F, Rietdijk WJR, et al. Emergency department to ICU time is associated with hospital mortality: a registry analysis of 14,788 patients from six University Hospitals in The Netherlands. *Crit Care Med*. 2019;47(11):1564-1571. doi:10.1097/CCM.0000000000003957
11. Kelen GD, Wolfe R, D'Onofrio G, et al. Emergency department crowding: the canary in the health care system. *NEJM Catal*. 2021. doi:10.1056/CAT.21.0217
12. McKenna P, Heslin SM, Viccellio P, et al. Emergency department and hospital crowding: causes, consequences, and cures. *Clin Exp Emerg Med*. 2019;6(3):189-195. doi:10.15441/ceem.18.022
13. Jayaprakash N, Pflaum-Carlson J, Gardner-Gray J, et al. Critical care delivery solutions in the emergency department: evolving models in caring for ICU boarders. *Ann Emerg Med*. 2020;76:709-716. doi:10.1016/j.annemergmed.2020.05.007
14. Jayaprakash N, Pflaum-Carlson J, Gardner-Gray J, et al. Accelerated critical therapy now in the emergency department using an early intervention team: the impact of early critical care consultation for ICU boarders. *Crit Care Explor*. 2022;4(3):e0660. doi:10.1097/CCE.0000000000000660
15. Mitarai T, Gordon AJ, Nudelman MJR, et al. Association of an emergency critical care program with survival and early downgrade among critically ill medical patients in the emergency department. *Crit Care Med*. 2023;51(6):731-741. doi:10.1097/CCM.0000000000005835
16. Bracey A, Tichauer MB, Wu GP, et al. Blueprint for the development of resuscitation and emergency critical care fellowships. *AEM Educ Train*. 2023;7(5):e10905. doi:10.1002/aet2.10905
17. Mermiri M, Mavrovounis G, Chatzis D, et al. Critical emergency medicine and the resuscitative care unit. *Acute Crit Care*. 2021;36(1):22-28. doi:10.4266/acc.2020.00521
18. Leibner E, Spiegel R, Hsu CH, et al. Anatomy of resuscitative care unit: expanding the borders of traditional intensive care units. *Emerg Med J*. 2019;36:364-368. doi:10.1136/emermed-2019-208455
19. Wessman BT, Mohr NM. Emergency department ICUs add value. *Crit Care Med*. 2022;50(8):1265-1267. doi:10.1097/CCM.0000000000004708
20. Gunnerson KJ, Bassin BS, Havey RA, et al. Association of an emergency department-based intensive care unit with survival and inpatient intensive care unit admissions. *JAMA Netw Open*. 2019;2(7):e197584. doi:10.1001/jamanetworkopen.2019.7584
21. Anesi GL, Chelluri J, Qasim ZA, et al. Association of an emergency department-embedded critical care unit with hospital outcomes and intensive care unit use. *Ann Am Thorac Soc*. 2020;17(12):1599-1609. doi:10.1513/AnnalsATS.201912-912OC
22. Bassin BS, Haas NL, Sefa N, et al. Cost-effectiveness of an emergency department-based intensive care unit. *JAMA Netw Open*. 2022;5(9):e2233649. doi:10.1001/jamanetworkopen.2022.33649
23. Powell E, Sahadzic I, Najafali D, et al. Is the critical care resuscitation unit sustainable: a 5-year experience of a beneficial and novel model. *Crit Care Res Pract*. 2022;2022:6171598. doi:10.1155/2022/6171598
24. Anesi GL, Kerlin MP. The impact of resource limitations on care delivery and outcomes: routine variation, the coronavirus disease 2019 pandemic, and persistent shortage. *Curr Opin Crit Care*. 2021;27(5):513-519. doi:10.1097/MCC.0000000000000859
25. Anesi GL, Lynch Y, Evans L. A conceptual and adaptable approach to hospital preparedness for acute surge events due to emerging infectious diseases. *Crit Care Explor*. 2020;2(4):e0110. doi:10.1097/CCE.0000000000000110
26. Haas K, Haas M, Mitchell M, et al. The clinical learning environment of an emergency department-based intensive care unit: one institution's experience. *Trends Anaesth Crit Care*. 2022;45:1-4. doi:10.1016/j.tacc.2022.03.004
27. Rozovsky J. *The Five Keys to a Successful Google Team*. Google People Operations. November 17, 2015. https://www.michigan.gov/-/media/Project/Websites/mdhhs/Folder4/Folder10/Folder3/Folder110/Folder2/Folder210/Folder1/Folder310/Google-and-Psychological-Safety.pdf?rev=7786b2b9ade041e78828f839eccc8b75

How to cite this article: Barskaya A, Abrukin L, McStay C. Rearranging the furniture: A blueprint for reappropriating fixed resources to create an emergency department resuscitative care unit. *JACEP Open*. 2024;5:e13211. https://doi.org/10.1002/emp2.13211