



The Journal of
COLLEGIATE EMERGENCY MEDICAL SERVICES

ISSN: 2576-3687 (Print) 2576-3695 (Online) | Journal Website: www.collegeems.com

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**Adhitya Balaji, Jacob Robishaw-Denton, David L. Rodgers, Andrew K. Watters,
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Citation (AMA Style): Balaji A, Robishaw-Denton J, Rodgers D, Watters A, Lardaro T, Savett S. Innovation in Collegiate Emergency Medical Services. *J Coll Emerg Med Serv.* 2025; 7(1): 4-8. <https://doi.org/10.30542/JCEMS.2025.07.01.01>

Electronic Link: <https://doi.org/10.30542/JCEMS.2025.07.01.01>

Published Online: January 5, 2025

Published in Print: February 21, 2025 (Volume 7: Issue 1)



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Innovation in Collegiate Emergency Medical Services

Adhitya Balaji, BS, EMT; Jacob Robishaw-Denton, BS, EMT; David L. Rodgers, EdD, NRP; Andrew K. Watters, MD; Thomas Lardaro, MD, MPH; Scott C. Savett, PhD, EMT

Keywords: collegiate-based emergency medical services; innovation | **Corresponding Author and Author Affiliations:** Listed at the end of this article

Campus-based emergency medical service (CBEMS) is a specific niche of emergency medicine, characterized by a variety of unique challenges and opportunities for growth and advancement. The continuous improvement of the EMS field is crucial, and collegiate EMS agencies, with their ties to academic institutions, serve as an ideal setting for piloting innovations and advancements. In the following editorial, we review the current technology utilized by many EMS agencies and explore the various advances that may be coming soon to the prehospital world. This editorial is organized based on ease of implementation by CBEMS agencies – short, moderate, and long-term.

Through the support of *The Journal of Collegiate Emergency Medical Services* and the National Collegiate Emergency Medical Services Foundation, the authors of this editorial come from a wide range of backgrounds. All authors are highly involved in the field of EMS, serving in medical director and leadership roles across the country. Additionally, all authors have extensive clinical experience in emergency medicine and EMS, advocating for the expansion of CBEMS agencies, and actively conduct EMS research. These research interests range from simulation-based education and the implementation of new technologies to enhancing clinical practice and operations. These backgrounds make this group of authors ideal to review potential uses of current and future innovations in EMS.

Adhitya Balaji, BS, EMT is a second-year medical student at the Indiana University School of Medicine. He serves as the graduate advisor for Intra Collegiate EMS, the collegiate EMS agency on the IU-Bloomington campus. Adhitya also serves as a Co-Director of Outreach for The Journal of Collegiate Emergency Medical Services. He hopes to pursue a career as an emergency medicine physician with an interest in prehospital care. **Jacob Robishaw-Denton, BS, EMT** is a fourth-year medical student at the University of Arizona College of Medicine – Tucson hoping to match into Emergency Medicine and a shift supervisor at University of Arizona EMS. Jacob also serves as a Co-Director of Outreach for The Journal of Collegiate Emergency Medical Services. **David Rodgers, EdD, NRP, FAHA, FASSH**, is the Director of the Interprofessional Simulation Center and an Assistant Professor of Clinical Medicine at the Indiana University School of Medicine. He serves as the faculty advisor for Intra Collegiate EMS at IU, the student-run EMS agency on the IU-Bloomington campus. **Andrew Watters, MD, FACEP, FAWM, DiMM**, graduated from the Indiana University School of Medicine and attended emergency medicine residency at the University of Arizona in Tucson. He is currently a Professor of Emergency Medicine for the Indiana University School of Medicine in Bloomington, Indiana. Dr. Watters works as medical director for several area EMS agencies, including Intra Collegiate EMS at IU. He is also an associate medical director for IU Health LifeLine. **Thomas Lardaro, MD, MPH**, is the EMS Section Chief at the Yale School of Medicine and medical director for Yale New Haven Health System's Office of Emergency Preparedness. **Scott C. Savett, PhD, EMT**, has been the Vice President of the National Collegiate EMS Foundation since 1998. He has been involved in collegiate EMS since 1991 and has served with campus EMS organizations at Ursinus College, Indiana University, and Clemson University.

We then discuss our Call for Papers for an upcoming special edition in *The Journal of Collegiate Emergency Medical Services* regarding innovations in the field of collegiate EMS, highlighting the importance of continuous improvement and the need for your contributions.

Short-Term Implementation

Computer-aided dispatch (CAD) systems are programs that assist in assigning specific units to emergency calls. Originally integrated into police, fire, and EMS in the late 1970s, CAD systems are driven mostly by advances in computing hardware that made technology more compact and readily available on the market.¹ Over the last several decades, various advances have allowed for continual improvement in CAD capability. Notable examples include integrating GPS tracking for field units and advanced mathematical models that can predict resource needs for emergency calls.² While it may not be as helpful for collegiate EMS agencies that only staff one unit daily, CAD is vital to the efficient utilization and deployment of emergency personnel in most EMS systems, along with campus police.

Radio communication has often been identified as a weakness in many systems, especially during inter-agency responses such as mass gatherings such as sporting events on campus. Interoperability between agencies is challenging, with different frequencies, encryption models, and equipment limitations impacting range and building penetration. These newer technologies will benefit CBEMS, as they cover large events inside stadiums and coliseums such as sports or concerts, while allowing for adequate interoperability.

Twelve-lead electrocardiograms (ECGs) have become a versatile diagnostic tool in prehospital care, particularly for evaluating and triaging patients with chest pain. In 2019, the National EMS Scope of Practice expanded the BLS scope of practice for Emergency Medical Technicians (EMTs) to allow for acquisition and transmission of 12-lead ECGs.³ This skill allows BLS units to potentially identify ST-elevation myocardial infarctions (STEMIs) or other cardiac abnormalities in collaboration with medical control and the emergency department physician. With most CBEMS agencies staffing at the BLS level, multi-lead ECG transmission to receiving hospitals by BLS units improves the triage of suspected cardiac patients to receive treatments in the cardiac catheterization laboratory.⁴

Lastly, one of the most prominent pieces of technology brought to EMS, and healthcare in general, is the implementation of electronic medical records (EMRs). Many EMS agencies have transitioned from paper records to EMRs within the past few years. However, CBEMS agencies, along with a minor portion of EMS agencies, tend to fall behind the norm for many reasons, including financial and technical challenges.⁵ However, despite these challenges, EMRs provide the potential to improve clinical care by implementing continuous quality improvement (CQI) in more detail utilizing data analytics and providing online access to medical direction – compared to reviewing paper charts. A 2012 study by Newgard et al. found that electronic data processing identified a larger pool of patients for CQI with strong validity compared to traditionally manual methods.⁶ This emphasizes the utility of EMRs for data mining while ensuring quality data is entered into patient records. Similarly, a review by Porter et al. found that although there were several barriers to implementing EMRs in EMS, they allow EMS agencies to improve documentation and data-driven operational and clinical decisions, resulting in a higher quality of patient care.⁷

Moderate-Term Implementation

As EMS continues to transition from a system focused primarily on emergency response to an integral part of the healthcare system, it is essential to highlight innovations with the potential to improve the workflow and patient care of EMS providers for both emergency and non-emergency responses.

Recently, there has been increased discussion centered around incorporating innovations from other healthcare fields and public safety agencies. Most of these technological improvements are centered around improving communication, transparency, and preparedness, particularly regarding education and operations. These include an increased emphasis on simulation-based education, the integration of telehealth, and the potential for artificial intelligence in EMS.

Simulation-based education has been well-established in the medical field, and is becoming an increasingly effective teaching modality, particularly in emergency medicine. The Accreditation Council for Graduate Medical Education (ACGME), the oversight board responsible for the accreditation of residency programs in the US, requires emergency medicine residents to perform a minimum number of critical procedures before graduation. However, recognizing the value of simulation, the ACGME allows for rare procedures, such as cricothyrotomy and pericardiocentesis, to be performed using simulation. This highlights the utility of simulation for both skill acquisition and maintenance of low-frequency high-acuity skills, such as chest tube placement and intubations. This is highly relevant to CBEMS as many agencies have low run volumes, inherently making all skills low frequency, which would allow simulation to supplement clinical experience in developing new providers.

The most significant concern regarding simulation is the potential cost of utilizing high-technology simulators. CBEMS agencies

nationwide have wide variations in funding sources for operations and education. While some CBEMS agencies are fully integrated into and subsidized by their respective universities, others contract with campus and community units to support their agency.⁸ When taking this within the context of rising costs in supplies and equipment, as seen in a recent National Association of Emergency Medical Technicians survey of 450 agencies nationwide, many CBEMS agencies may believe that simulation-based education isn't a feasible option.⁹ However, there are methods of integrating simulation into CBEMS education curricula, regardless of budget. When considering simulation, most people initially gravitate towards high-technology manikins. While these simulators can help improve the experience of training sessions, they are by no means a requirement. Other simulation methods can utilize low technology manikins, volunteer actors, tabletop scenarios, and moulage. A recent article in the *Journal of Emergency Medical Services* highlights how effective EMS education is focused on developing clear objectives, realistic scenarios, and productive debriefing to supplement the education of EMS professionals.¹⁰

Long-Term Implementation

Many recent advances in telehealth have the potential to revolutionize how certain events are handled in EMS. Mental health crisis events on campus have slowly been increasing over the past few years, but this isn't new to EMS by any means.¹¹ As a whole, emergency services have been increasingly responding to mental health patients, which are typically low acuity. With increasing mental health events on and off campus, CBEMS agencies need to become more comfortable with managing these situations. Although most CBEMS agencies are not undergoing staffing shortages, there is a prominent issue within the larger field of EMS concerning workforce retention and recruitment. This shortage requires innovative solutions to provide the best patient care possible. A 2022 study performed in Australia found that the utilization of telehealth mental health nurses resulted in fewer ambulance dispatches, which allowed for more optimal resource allocation and minimal expense increases.¹² Similar results were found in a study performed by the Houston Fire Department, which resulted in a 56% absolute reduction in ambulance transports.¹³ These studies provide an avenue for CBEMS to explore in the future as resources to consult, similar to medical control, as access to adequate mental health care becomes increasingly strained in the face of a nationwide collegiate mental health crisis.¹⁴

Additionally, developments in geolocation have included the development of tracking programs that go beyond traditional two-dimensional location (latitude and longitude) to include altitude or elevation, such as Tactical Assault Kit (TAK) (<https://tak.gov/>) and CalTopo (<https://caltopo.com/>).¹⁵ While historical usage has been limited to military and government agencies, tracking technology has recently been released to public safety agencies. These technologies also allow for integration of mutual aid agencies, better improving interoperability at large events.¹⁶ With greater accuracy, this technology can potentially refine geolocation in CAD systems to the individual level. With three-dimensional

locating capabilities, CBEMS is well-positioned to utilize the technology at large gatherings such as sporting events or concerts.

With the explosion of publicly available artificial intelligence (AI) platforms, such as ChatGPT and Microsoft Copilot, there have been large strides in understanding potential implications and uses for AI in emergency services and medicine. AI usage can vary widely, including clinician use for charting patient care reports, retrospective chart review for quality assurance/quality improvement (QA/QI), previously mentioned ECG interpretation, advising EMS operations, and development of education and training programs. The paramount issue regarding this advancement is the understanding that AI should enhance the clinician, not replace provider judgment.

As previously mentioned, EMS is facing a nationwide staffing shortage, which is confounded by increased burnout rates of prehospital providers. A 2020 study by Crowe et al. in *JACEP Open* found that EMS professionals facing high job demands experienced a 10-fold increase in odds of burnout. High job demands included factors such as time pressure and run volume.¹⁷ As typical with any aspect of medicine, corresponding patient charting following a patient encounter contributes to job demands. This becomes increasingly cumbersome in emergency medicine and EMS when run volumes and patterns can be difficult to predict, along with patients' varying acuity levels.¹⁸ The utilization of AI can potentially decrease the burden on providers for charting, which could ultimately provide some relief in terms of burnout. The sphere of AI utilization in patient charting is currently growing with the development of startup companies such as OneChart.¹⁹ Although CBEMS agencies typically have lower run volumes preventing the development of traditional burnout, CBEMS providers face unique challenges which can be alleviated with the utilization of AI-based charting software. The biggest challenge for CBEMS providers is the time they spend on runs and performing EMS duties, compared to their studies and other extracurricular activities. AI-based charting software can assist CBEMS providers in reducing the time they spend writing patient care reports to get back to their academic pursuits more quickly.

Continuous quality improvement through chart review is integral to research, improvement, and patient safety. While chart review is critical, manually entering each record and extracting relevant information can be highly burdensome. Additionally, chart review can be cost-prohibitive for healthcare organizations, which could be a deterring factor from emphasizing a culture of quality improvement.²⁰ AI can help reduce these costs by automating chart review in certain respects. However, a key aspect to consider when utilizing AI for chart review is that it is no replacement for human review, particularly for complex cases. Human chart reviewers can understand nuances that AI may not. The role of AI in quality review is still being developed, and its role in healthcare is continually being explored.²¹

As previously mentioned, field activation for STEMIs allows the hospital to be prepared to go straight to the cardiac catheterization

lab. This decreases door-to-balloon times, a standard quality metric for field STEMI activations, and is associated with reduced mortality.²² However, false positive activations are extremely common with prehospital STEMI diagnosis.²³ Artificial intelligence could improve the accuracy of ECG interpretation to guide clinical practice. Baker et al. recently published a retrospective cohort study assessing AI-driven prehospital ECG interpretation. This study found no difference in false-positive rates of STEMIs between AI software and native ECG monitor software interpretation. However, the AI-based software did not miss any STEMIs, while the native ECG software missed 5% of STEMIs in this study. This highlights how AI has the potential to increase the accuracy of STEMI identification, but more studies are required to validate this finding.

Lastly, AI has the potential to impact EMS operations. Multiple models exist within CBEMS, such as event-standby, non-transport, and transport services. Additionally, there are many response models within EMS as a whole, including static and system status management (SSM).²⁴ Static models include stationing ambulances in fixed locations, such as fire and EMS stations. In contrast, a system status model focuses on the redeployment of assets throughout the response area at various posts, depending on call volumes and locations. The ultimate goal of SSM is to get the quickest, most appropriate asset to the patient. However, predicting where the next call will occur is a difficult task. While there have been attempts at creating a predictive model, AI can potentially develop a more reliable model that accounts for variations in call volume based on regional differences. AI could be used in the CBEMS setting to suggest crew levels based on historical events from prior years (e.g., an increase in orthopedic injuries during a soccer camp), campus health surveillance (e.g., a recent uptick in visits to the campus health center for respiratory symptoms), or anticipated weather-related responses.

Ultimately, AI has the potential to impact EMS and CBEMS to enhance clinical care and improve patient outcomes. However, the current knowledge base regarding AI's limitations and capabilities for advising EMS operations has many limitations. A major risk is the potential for patient data breaches and Health Insurance Portability and Accountability Act (HIPAA) violations. As Marks et al. discusses, HIPAA was written in a period before technology and may not adequately protect patient information in today's digital landscape.²⁵ While deidentified data can be used with AI, it is not entirely risk-free, as such data can potentially be reidentified or misused, causing harm.

Instead of focusing solely on whether AI software complies with HIPAA, users should critically evaluate the type of information being inputted and consider its potential for harm. Additionally, Federspiel et al. warn about AI's broader threats to public health, such as its role in spreading targeted misinformation.²⁶ The COVID-19 pandemic highlighted the dangers of misinformation, and AI could amplify these issues.²⁷ Therefore, responsible use of AI and careful oversight are essential to minimize risks and ensure ethical implementation. This presents an opportunity for

more research to be completed in this sphere of AI in healthcare.²⁸

Conclusion and Call for Papers

As discussed, the field of EMS is one of continuous innovation, with many new advances on the horizon, including simulation-based education, telemedicine for mental health, and the utilization of artificial intelligence in EMS. Even so, the current literature is barren regarding advancements in EMS, with most of it being a decade old. Given the unique position of collegiate EMS at academic centers, it is an optimal environment for the development of future innovations in EMS.

This editorial only scratches the surface concerning innovations in collegiate EMS. There are so many areas of technology this editorial didn't touch on, such as ambulance patient compartment safety, the use of hybrid powertrain technology, and novel emergency warning devices (lights and sirens). There's also operational technology, such as dispatch/response apps, which CBEMS agencies can potentially be using already.

As such, *The Journal of Collegiate Emergency Medical Services* invites you to respond to our Call for Papers for an upcoming special edition. Manuscripts for this edition should discuss recent innovations and improvements your collegiate EMS agency has implemented and their resulting impact on patient care and agency operations. Both best practices and research manuscripts will be considered for publication. Please submit any manuscripts to abalaji@jcems.org. We look forward to hearing from you!

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Author Affiliations: From Indiana University School of Medicine (A.B., D.R., A.D.). From University of Arizona College of Medicine – Tucson (J.R.). From Yale School of Medicine (T.L.). From National Collegiate EMS Foundation (S.S.).

Address for Correspondence: Adhitya Balaji | adbalaji@iu.edu

Conflicts of Interest/Funding Sources: By the JCEMS Submission Declaration Form, all authors are required to disclose all potential conflicts of interest and funding sources. A.B and J.R. serve in uncompensated editorial roles for JCEMS. All authors declared that they have no other conflicts of interest. All authors declared that they did not receive funding to conduct the research and/or writing associated with this work.

Authorship Criteria: By the JCEMS Submission Declaration Form, all authors are required to attest to meeting the four ICMJE.org authorship criteria: (1) Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work; AND (2) Drafting the work or revising it critically for important intellectual content; AND (3) Final approval of the version to be published; AND (4) Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Submission History: Received November 26, 2024; accepted for publication December 10, 2024

Published in Print: February 21, 2025 (Volume 7, Issue 1)

Reviewer Information: In accordance with JCEMS editorial policy, Editorial manuscripts are reviewed by the JCEMS Editorial Board and published by the Editor-in-Chief or designee. JCEMS thanks the Editorial Board members who contributed to the review of this work.

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Electronic Link: <https://doi.org/10.30542/JCEMS.2025.07.01.01>