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THE ASSOCIATION BETWEEN PANDEMIC-RELATED INSTRUCTIONAL DELIVERY MODIFICATIONS AND EMERGENCY MEDICAL TECHNICIAN (EMT) FIRST ATTEMPT PASS RATES: A SINGLE CENTER RETROSPECTIVE STUDY

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ABSTRACT

Background: The COVID-19 pandemic represents a sentinel healthcare education event. Mandatory shutdowns of educational institutions, combined with increased demand for skilled healthcare personnel, highlighted obstacles to maintaining a stable workforce. To ensure continuity, many emergency medical services (EMS) educational institutions emergently transitioned in-person learning to digital formats, resulting in concerns regarding learning outcomes. This study investigated the impact of alternative instructional methods used during the COVID-19 pandemic.

Methods: The study is a retrospective review of prospectively collected data for EMT candidates from a single community college-based program who completed a first attempt of the didactic component of the National Registry EMT Certification examination from course sections ending between January 1, 2019, and December 31, 2020. Pre-COVID-19 first-attempt exam outcomes (115 students) were compared to first-attempt outcomes of Emergency Remote (ER) (48 students) and COVID Distance Learning Hybrid (DL) (94 students). Descriptive statistics were calculated, and multivariable-adjusted odds ratios (aOR) with 95% confidence intervals (CI) were computed to explore outcome differences.

Results: Didactic outcomes of 257 EMT students were evaluated. First-pass rates for ER and DL models compared to the traditional pre-COVID learning format (control group, 81.73%, ER group, 87.5%, DL group, 89.6%). There was no significant difference in first-attempt pass rates between students in the pre-COVID model (aOR = 1.00), the ER EMT model (aOR = 1.56, 95% CI [0.588 - 4.156]), and the DL EMT model (aOR = 1.88, 95% CI [0.836 - 4.212]). Retest rates and pre-/post-COVID-19 restrictions were not evaluated.

Conclusions: This study suggests alternative instructional formats are at least as effective as the traditional pre-COVID format in preparing students for the NREMT examination and therefore viable options for EMT education. Further research is needed to identify best practices for implementing virtual learning modalities in EMS education and to assess impacts on competency and workforce readiness.

INTRODUCTION

The COVID-19 pandemic represents a significant sentinel event in modern society. While the long-term effects of the pandemic

are still unclear, considerable short-term impacts across healthcare and education sectors have already been acknowledged. Mandatory shutdowns of educational institutions and increased demand for skilled healthcare personnel highlighted pre-existing challenges surrounding how to maintain a stable workforce. Cash et al. (2021) pointed out that although concerns regarding staff recruitment and retention were a primary focus, ensuring that educational programs were accessible during full-scale shutdowns represented another major challenge during pandemic protocols.

Compared to other developed countries, EMS education in the United States still straddles the line between vocational training and higher education, with 90% of American EMS programs issuing certificates rather than degrees (Ball et al., 2021). Although many institutions of higher education have actively embraced digitization as a means to reduce educational barriers, supplement existing in-person learning, and stabilize the workforce (Haffar et al., 2023; Mintz et al., 2020), the pandemic tested the implementation readiness of all educational programs (Al-Yateem et al., 2021). In order to mitigate disruptions due to emergency closures, virtual learning was adopted as the primary mode of education at an unprecedented speed and scope (Mintz et al., 2020).

Before COVID-19, many American EMS educational programs needed the pre-existing infrastructure, including financial and staffing resources, to implement virtual learning effectively (March et al., 2021). To prevent destabilizing the EMS workforce during the pandemic, educational stakeholders rapidly adapted traditional, in-person instructional methods to virtual platforms (Cash et al., 2021; Powell et al., 2022; Whitfield et al., 2021). Successful implementation of virtual learning depends upon four critical factors: the attitudes and IT competencies of instructors; students' discipline and time management skills; information technology reliability and infrastructure; and institutional support (Aini et al., 2020).

Access to reliable high-speed internet was one of the primary limiting factors to the success of virtual learning implementation initiatives (Dahiya et al., 2021). In 2019, the Federal Communications Commission (FCC) estimated that approximately 21 million Americans could not access reliable home internet service. The digital divide was most evident in low-income, rural, and tribal communities (Sanders & Scanlon, 2021), populations that historically struggled with achieving educational and healthcare equity and were especially vulnerable during the pandemic (Alvidrez et al., 2019; Wiemers et al., 2020).

Like many other healthcare educational programs, EMS faced additional challenges adapting to virtual learning (Gardanova et al., 2023). Significant portions of curricular content, such as hands-on skills training and experiential clinical rotations, only sometimes effectively translate to remote platforms (Allred et al., 2021; Gardanova et al., 2023). Beyond disrupting classroom access and altering the standard integration of traditional lab skills sessions into the didactic curriculum, pandemic protocols limited the availability of field and clinical learning opportunities due to site restrictions (Cash et al., 2021; Perkins et al., 2020). These interruptions to the pedagogical structure potentially impacted students' ability to synthesize didactic, psychomotor, and clinical knowledge while reducing or eliminating opportunities to develop professional affective skills, mentor-mentee relationships, and experience humanistic patient interactions (Mintz et al., 2020). The forced transition to digital learning formats unearthed concerns regarding alternative

learning methods' impacts on entry-level EMS providers' learning outcomes and overall competency levels (Allred et al., 2021; Perkins et al., 2020).

The study uniquely delved into the impact of alternative instructional methods used for EMT education during the COVID-19 pandemic. To date, a limited body of literature addresses the efficacy of virtual learning in EMS education (Cash et al., 2021), and an even smaller body of research investigates COVID-19's impact on EMS education and workforce availability (March et al., 2021). The goal was to determine the efficacy of a virtual learning didactic format regarding students' academic outcomes. This would provide insight for future EMS educational research and allow educational leaders to make sound, evidence-based decisions.

METHODS

Study Design and Setting

The IRB reviewed this research and determined to meet the criteria for exemption under protocol #20210304C. The study is a retrospective review of prospectively collected data for a single community college-based EMT program. It explores the impact of two alternative instructional methods –Emergency Remote (ER) and COVID Distance Learning Hybrid (DL)-- on students' performance on the National Registry of Emergency Medical Technicians (NREMT) certification compared to a historical control of traditional instruction. Inclusion criteria consisted of students who completed a first attempt of the National Registry EMS Certification examination for EMT candidates from course sections ending between January 1, 2019, and December 31, 2020.

Intervention

Before the pandemic, the traditional EMT course consisted of 132 synchronous, face-to-face learning hours (70 hours of didactic lecture, 62 hours of integrated lab), and 50 hours of asynchronous supplemental lecture content. The historical control consists of a 115-student cohort from course sections ending between January 1, 2019, and December 31, 2019.

Emergency Remote is defined as learning that took place during the immediate shutdown phase of the COVID-19 pandemic. Students signed up for the traditional course with no expected change to the format prior to the commencement of classes. 50% of instruction was delivered as planned before shutdowns forced a rapid change to instructional strategies, resulting in the final 50% of didactic instruction delivered via synchronous Zoom sessions. The remaining labs and tests were delayed until the end of the course (June 1-23, 2020) and administered on campus in a traditionally proctored environment with COVID-19 safety precautions in place.

Students who participated in the COVID Distance Learning Hybrid registered for a class with the complete understanding that the class's instructional format did not adhere to the traditional learning format. All lectures were delivered via synchronous Zoom sessions, and labs and tests were administered in person, on campus, and in the traditional sequence rather than at the end of the program.

All cohorts were required to pass the course's psychomotor component and a cumulative simulation scenario exam before they were eligible to schedule the National Registry didactic exam.

Measures/Outcomes

The National Registry EMT exam is a computer adaptive test that evaluates a candidate's ability to apply the knowledge expected of an entry-level provider. Candidates have two hours to complete the exam, designed to automatically calibrate each exam item's difficulty level based on the individual's performance on earlier questions. The exam continues until the allotted time is met or the candidate has answered the minimum number of questions necessary to determine with a 95% CI that the passing standard has been achieved or is impossible to attain (National Registry of Emergency Medical Technicians, n.d.). According to the National Registry Data Dashboard, the EMT exam has a 68% first-attempt success rate.

Data regarding students' first-attempt outcomes were collected from a single EMT program's National Registry completion report. Students were considered to have a successful outcome if they passed the EMT certification on their first recorded attempt. This study compared initial EMT certification exam outcome rates from class sections impacted by COVID-19, Emergency Remote (ER), and COVID Distance Learning Hybrid (DL) learning modifications to initial EMT certification exam outcomes from the control, pre-COVID, traditional learning format.

Statistical Analysis

Data were analyzed using descriptive methods and logistic regression. Mean first-attempt pass rates were calculated and compared. Multivariable logistic regression was used to determine the adjusted odds ratio (aOR) of achieving the outcome variable of passing the NREMT exam on the first attempt for each independent variable (instructional method: either ER or DL). The control was historical first-attempt pass rates of students from the same program who participated in original EMT classes before the COVID-19 pandemic, with traditional learning methods.

RESULTS

This study evaluated the outcomes of 257 EMT students who met the inclusion criteria. Inclusion criteria consisted of students who completed a first attempt of the National Registry EMS Certification examination for EMT candidates from course sections ending between January 1, 2019, and December 31, 2020. Successful completion outcomes were evaluated according to which educational method was implemented. These outcomes were compared to successful completion outcomes for traditional learning. Table 1 shows students' mean first-attempt pass rates overall and by the instructional method.

Instructional Method	n	Mean First Attempt Pass Rate
Traditional	115	81.73%
Emergency Remote	48	87.50%
Distance Learning Hybrid	94	89.36%
Overall	257	85.60%

Table 1. Instructional methods and mean first attempt pass rate.

This study holds significant implications for EMS education. It examined the likelihood of students passing the National Registry of Emergency Medical Technicians (NRE-

MT) exam on their first attempt in the Emergency Remote and COVID Hybrid DL models compared to the traditional pre-COVID learning format. The results, which are crucial for EMS education stakeholders, indicated that students who participated in the Emergency Remote model had a 1.56 adjusted odds ratio (aOR) of passing the exam on their first attempt, with a 95% confidence interval (CI) of 0.588-4.156. Similarly, students who participated in the COVID Hybrid DL model had a 1.88 adjusted odds ratio (aOR) of passing the exam on their first attempt, with a 95% confidence interval (CI) of 0.836-4.212 (Table 2).

Regressor	B	aOR	CI 95%
Traditional Hybrid EMT Pre-COVID (referent)		1.00	(1,1)
Emergency Remote EMT	0.37	1.56	(0.588-4.156)
Post COVID Hybrid DL EMT	0.63	1.88	(0.836-4.212)
Constant	1.50	4.48	(2.789, 7.184)
Number of Cases	257.00		
-2 log likelihood	-104.60		
Note: B = Logistic regression coefficient and OR = Odds ratio. * p<.05, ** p<.01, *** p</001			

Table 2. First attempt pass rate regressed on instructional method.

These findings suggest that students in the Emergency Remote and COVID Hybrid DL models are equally likely to pass the NREMT exam on their first attempt as students in the traditional pre-COVID learning format (Figure 1). However, it is important to note that while the results did not show a significant difference between the groups, this was a single program with more internal consistency than multi-center studies. While the instructional method varied, the same four instructors taught in all three conditions with frequent meetings to ensure section consistency.

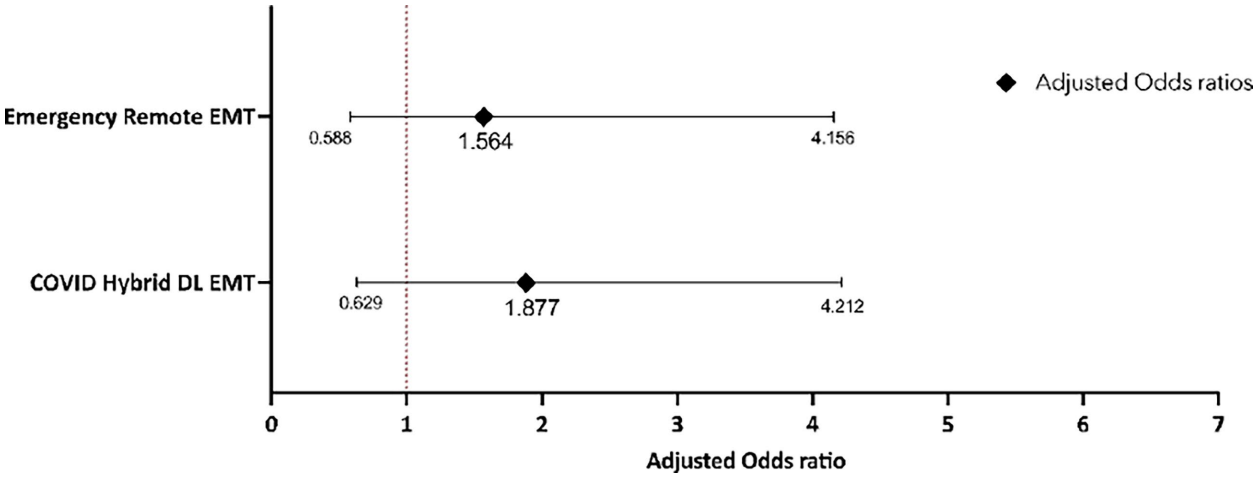

Figure 1. Association between instructional delivery modifications and EMT first attempt pass rates.

DISCUSSION

As vital healthcare system components, EMS professionals bridge the gap between the field and the hospital (Ball et al., 2021), bringing life-saving care directly to patients. The COVID-19 pandemic highlighted critical areas of strain within current practices, including existing barriers to obtaining EMS education and a realistic assessment of disaster preparedness undertaken by EMS education stakeholders. Given the ongoing healthcare shortage and the ever-looming possibility of another disruptive event, EMS education

stakeholders must investigate viable alternatives to traditional learning formats to guarantee a stable, uninterrupted workforce.

We determined that virtual remote learning methods prepared students for the NREMT examination just as effectively as traditional learning formats. Our finding is supported by Powell et al.'s 2022 national study of EMT and paramedic candidates, which found no statistically significant difference in NREMT first-pass rates for students participating in virtual learning versus traditional learning. Virtual learning is an effective instructional modality in other healthcare educational settings, including medical school, promoting consistent, successful outcomes in emergency remote and planned virtual learning settings (Allred et al., 2021; Anthony & Noel, 2020).

In the aftermath of the COVID-19 pandemic, Cash et al. (2021) identified EMS education program availability and accessibility as one of national EMS stakeholders' top eight research priorities. Geography is one of the main barriers to acquiring certification due to limited access to conveniently located EMS training programs (Cash et al., 2022). Approximately 22% of the United States population is greater than 30 miles from an available EMS program, with rural areas being the most underserved (Cash et al., 2022). Beyond reducing existing geographic limitations, virtual learning overcomes many constraints and challenges that prohibit adult learners from participating in EMS training programs, such as work schedules, family obligations, and other commitments (Osam et al., 2017). Expanding the EMS curriculum into digital learning applications is a practical and viable approach to help increase and stabilize the EMS workforce by offering adult learners flexible learning options that better suit their personal and professional lives (Bokolo, 2020).

In order to ensure the continuity of a stable, uninterrupted workforce, it is the responsibility of national EMS education stakeholders to guarantee that valid, reliable, and accessible methods for education are available. Although digital learning methods are effective in other medical education programs (Allred et al., 2021), EMS educational programs often lack the financial and personnel resources required to develop content, access digital materials, and participate in necessary professional development to ensure student engagement (Allred et al., 2021; Ball et al., 2021). Successful implementation requires thoughtful consideration to overcoming known challenges to virtual learning, including, but not limited to, access to a reliable internet connection, student engagement and motivation, limitations of instructors' digital literacy, and modification of curricular content for the virtual setting (Aini et al., 2020; Allred et al., 2021; Gardanova et al., 2023). This study underscores the need for further research in best practices for applying virtual learning modalities in EMS education, including cost and time-effective methods for professional, content, and resource development, inviting EMS education stakeholders to be part of this ongoing process.

LIMITATIONS

Study results are limited to students who participated in an EMT original course from a single program. Success rates from other EMS training programs that transitioned to virtual learning during COVID-19 restrictions, such as initial paramedic or refresher courses, were not evaluated. However, our results are supported by the results of studies exploring first-time NREMT exam pass rates for paramedics and EMTs (Powell et al.,

2022), studies investigating success rates of EMS refresher courses delivered via distance learning (March et al., 2021), and studies investigating the efficacy of virtual learning in other healthcare fields (Pei & Wu, 2019; Vallée et al., 2020). This study did not address potential confounding factors, such as COVID-19-related stress, test availability and administration procedure changes, and extended course completion time (Powell et al., 2022). Although Powell et al. (2022) noted a 14% decrease in NREMT examination administration during COVID-19, no significant differences in test administration were noted in the evaluated EMT program. One hundred fifteen students from this program took the NREMT EMT exam in 2019 compared to 122 in 2020. Forty-seven students participated in the Emergency Remote Teaching in early 2020, and 75 students enrolled in the planned DL hybrid in the fall of 2020. It is essential to note that during the remote teaching condition, the program experienced much higher attrition in the EMT program. Due to a radical shift in special COVID-19-related policies, students were granted a longer window for withdrawal with a full tuition refund. Typically, this withdrawal and refund period is limited to the first week of the semester. However, COVID-19-related policies extended this grace period to May 2020, 14 weeks into the 16-week semester.

Additionally, student success rates may have been impacted by alterations in work and life obligations, such as remote work or furloughs, or unspecified shifts in the demographics of students enrolling in healthcare-related programs during COVID-19.

CONCLUSION

This study was designed to explore the potential impact of Emergency Remote and Distance Learning Hybrid instructional methods relative to traditional EMT outcomes on the National Registry of Emergency Medical Technicians (NREMT) first-attempt pass rate. The analysis revealed no significant association between the two methods, suggesting that virtual learning is at least as effective as traditional formats in preparing students for the NREMT examination.

The similarity in the first attempt pass rates between the two learning formats presents a notable opportunity to transform the current Emergency Medical Services (EMS) education landscape. This transformation could entail increasing the accessibility and availability of EMS education, particularly to students from rural or underserved areas. By leveraging virtual learning platforms, it may be possible to overcome some logistical barriers, such as geographic and resource limitations, that often hinder students' access to traditional EMS education.

It is important to note that the present study's findings are limited to the specific context of NREMT first-attempt pass rates and may not be generalizable to other EMS education outcomes, including, but not limited to, skills competencies, affective competencies, cumulative pass rates, and student satisfaction. Therefore, further research is essential to comprehensively assess the effectiveness of virtual learning in EMS education, particularly regarding its impact on students' knowledge and practical skills. Nonetheless, the present study's results provide valuable insights into the potential benefits of virtual learning in EMS education, which could guide the development of more inclusive and innovative EMS education models.

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