

BRIEF REPORT

The Impact of Tele-Education on Family Medicine Clerkship Students' Learning Outcomes

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ABSTRACT

Background and Objectives: The COVID-19 pandemic necessitated rapid changes to medical education for student and patient protection. A dearth of published US studies examine resulting clinical education outcomes due to pandemic-induced curricula changes. We describe adaptations made to a family medicine clerkship to move it from traditional in-person delivery to virtual only, and then from virtual to hybrid; and compare educational outcomes of students across delivery types.

Methods: We stratified 386 medical students in their third year completing their 8-week family medicine clerkship by type of content delivery, including in person, virtual only, and hybrid instruction. We examined the impact of these changes on three clerkship learning outcomes: the midblock assessment score, the National Board of Medical Examiners (NBME) exam score, and the final numeric score (FNS).

Results: In our sample, 164 (42.5%) received content in person, 36 (9.3%) received virtual only, and 186 (48.2%) received hybrid content. Students receiving virtual only ($M=76.4$, $SD=9.1$) had significantly higher midblock assessment scores ($F=8.06$, $df=2$, $P=.0004$) than students receiving hybrid ($M=71.7$, $SD=8.8$) and in-person training ($M=74.5$, $SD=7.2$). No significant differences existed in students' NBME exam scores or FNSs across delivery types.

Conclusions: Students receiving virtual-only or hybrid content performed at least as well on three clerkship-related educational outcomes as their pre-COVID peers participating in person. Further research is needed to understand how changes to medical education affected student learning and skill development.

INTRODUCTION

The COVID-19 pandemic necessitated changes to medical education content and delivery,^{1–3} but how these changes affected student learning, particularly the clinical components in the third and fourth years of medical school, is not clear. Given the broad potential impact of pandemic curriculum changes, conducting evidence-based assessments to understand the effect on medical education is important. However, much of the relevant literature is international,^{4–8} focuses on preclinical education outcomes,^{9–13} or examines interpersonal or psychological outcomes instead of educational ones.^{14–18} Other studies examine online versus in-person education prior to the pandemic or speculate about the long-term impact.^{19–22} The few relevant studies primarily focus on surgical education.^{23–25} Virtually nothing has been published on the effect of the pandemic on primary care medical education.

This paper focuses on third-year medical students (MS3s) completing their family medicine clerkship²⁶ at West Virginia

University (WVU) and aims to (a) describe changes made due to the pandemic, and to (b) compare educational outcomes for students completing the clerkship in person, virtually, or with a hybrid model of delivery.

The clerkship educates students on the physical, psychological, social, and spiritual needs of patients and families. In addition to supervised interactions with patients, MS3s practice taking patient histories and physical write ups (H&Ps), present patient cases, and participate in various workshops. At WVU, the 8-week clerkship includes participation in 4 weeks of clinical assignments both on campus and at a community site.

METHODS

This retrospective study examined the impact content modifications and delivery had on MS3 educational outcomes from two campuses of the WVU Department of Family Medicine: Morgantown and Charleston (Appendix 1). Teams on both campuses collaborated to ensure equivalent modification and

content delivery using a shared timeline.

Participants included 386 MS3 students completing their clerkship at either campus between July 2, 2018, and June 17, 2022. We adapted the content and delivery of the five major clerkship components, including didactics, clinical experience, case logs, community experience, and standardized patients.

Types of Educational Content Delivery

Following national guidelines on the timeline for educational content delivery from the Association of American Medical Colleges²⁷, we delivered clerkship content in three ways:

1. **In person.** Until February 28, 2020, students participated in traditional in-person clinical training in ambulatory, inpatient, and community settings.
2. **Virtual only.** From March 20, 2020, to August 30, 2020, students moved to virtual-only learning. This included activities such as participating in inpatient rounds virtually, viewing electronic health records remotely, interacting with standardized patients for H&Ps, and participating virtually in ambulatory telehealth visits with faculty and residents.
3. **Hybrid.** We transitioned to hybrid learning September 1, 2020, following students' return to clinic with restrictions (ie, mandatory mask, hygiene, and social distancing protocols) and present outcomes for hybrid clerkship students up to June 17, 2022.

Educational Outcomes Assessed

We examined three educational outcomes associated with the family medicine clerkship: (a) the midblock assessment score, (b) the National Board of Medical Examiners (NBME) subject exam, and (c) the final numeric score (FNS). Two are standardized exams and one is the clerkship final grade. We used the same grading structure across content delivery types but adjusted the relative weights of the grading components (Table 1).

Statistical Analysis

We analyzed data using SAS version 9.4 (SAS Institute). We assessed normality with the Shapiro-Wilk test. We performed two sample *t* tests or Wilcoxon rank sum tests to compare students' learning outcomes between campuses. We used one-way analysis of variance (ANOVA) or the Kruskal-Wallis test to examine differences in educational outcomes stratified by content delivery type. All tests were two-sided, and *P* values <.05 were considered statistically significant. This study was exempted from review by the WVU Institutional Review Board (Protocol #2209650754).

RESULTS

Of 386 MS3s, 232 (60.1%) attended the Morgantown campus and 154 (39.9%) attended the Charleston campus. A comparison for equivalence revealed no significant differences in students' midblock assessment scores and NBME exam scores between campuses. However, students from Charleston (mean [M]=89.2, standard deviation [SD]=2.5) had significantly

higher FNSs than students from Morgantown (M=88.4, SD=3.0). Table 2 presents the characteristics of the student sample.

With respect to content delivery type, 164 (42.5%) received clerkship content in person, 36 (9.3%) virtually, and 186 (48.2%) in hybrid format. An ANOVA followed by Tukey's HSD test showed a significant difference in mean student midblock assessment scores across content delivery type ($F=8.06$, $df=2$, $P=.0004$). Specifically, students receiving virtual-only training (M=76.4, SD=9.1) had significantly higher midblock assessment scores than students receiving hybrid (M=71.7, SD=8.8) or in-person training (M=74.5, SD=7.2). A Kruskal-Wallis test revealed no significant differences in students' NBME exam scores or FNSs across the three types of content delivery (Table 3).

DISCUSSION

We found no significant differences in clerkship students' NBME exam scores and FNSs with respect to content delivery type. This finding is consistent with limited literature on the impact of the pandemic on student learning outcomes, which found no significant differences in NBME exam scores for MS3s in their surgical clerkship pre- and postpandemic.^{23,25} In addition, virtual-only students' midblock assessment scores were significantly higher than those of in-person and hybrid students. Because this exam is based on Aquifer cases that take a significant amount of time to review, we suspect virtual students had more time to complete these cases than their in-person and hybrid peers.

Finding no significant differences in students' NBME exam scores or FNSs based on educational content delivery type is noteworthy. Medical educators worldwide had to pivot quickly and change the way curricula were delivered with no specialized training in tele-education. To ensure that students were prepared for standardized exams and clinical practice, educators created innovative ways of simulating clinical experience. This study provided one snapshot of how we attempted to provide equivalent education across delivery types during our family medicine clerkship.

This study had known limitations. The cross-sectional design prevented us from making causal conclusions. Further, the metrics we present overlap in the students they summarize (ie, the midblock exam score and the NBME exam score made up a combined total of 30% of the FNS). Despite overlap, the data are critical indicators of clerkship performance. Additionally, only 9.3% of the sample received virtual-only training. Variability in scores was relatively low, however, increasing confidence that these results are reliable. Despite limitations, this study contributes to our understanding of how medical students' clinical education was affected by the pandemic.

CONCLUSIONS

These data suggest that our clerkship students received at least equivalent clinical instruction across in-person, virtual-only, and hybrid delivery types as reflected in three educational outcomes. Students' performance satisfied national requirements

TABLE 1. Clerkship FNS Grade Weighting Across Educational Content Delivery Types

	In person	Virtual only	Hybrid
	% of FNS	% of FNS	% of FNS
Clinical component			
Clinic preceptor evaluations	20	60	40
Oral presentations	5	5	5
History and physicals	5	5	5
Community preceptor evaluations	20	–	20
Advisor evaluations	20	–	–
	70	70	70
Exam component			
Midblock assessment	5	5	5
Equated percent correct score on NBME family medicine shelf exam	25	25	25
	30	30	30
Total % of FNS	100	100	100

Abbreviations: FNS, final numeric score; NBME, National Board of Medical Examiners

TABLE 2. Characteristics of MS3 Family Medicine Clerkship and Students (N=386)

Characteristics	n	%
Clerkship location		
Morgantown	232	60.1
Charleston	154	39.9
Content delivery type		
In person	164	42.5
Hybrid	186	48.2
Virtual	36	9.3
	M	SD
Midquiz	73.4	8.3
Final exam	79.3	5.9
Grade	88.7	2.8

Abbreviations: MS3, third-year medical students; M, mean; SD, standard deviation

TABLE 3. Mean Student Midblock Assessment, NBME Exam, and FNS by Campus and Type of Content Delivery (N=386)

Campus	n	Midblock Assessment			NBME exam			FNS		
		M	SD	P	M	SD	P	M	SD	P
Morgantown	232	73.3	8.3	.99 ^a	79.6	5.6	.41 ^b	88.4	3.0	.008 ^b
Charleston	154	73.3	8.4		79.0	6.3		89.2	2.5	
Type of delivery										
In person	164	74.5 ^c	7.2	.0004 ^c	79.2	5.5	.91 ^d	89.1	2.7	.06 ^d
Virtual only	36	76.4 ^f	9.1		80.1	5.7		88.3	2.6	
Hybrid	186	71.7 ^{e,f}	8.8		79.1	6.3		88.3	3.0	

Abbreviations: NBME, National Board of Medical Examiners; FNS, final numeric score; M, mean; SD=standard deviation

^aValue from t test^bValue from Wilcoxon rank sum test^cValue from ANOVA^dValue from Kruskal–Wallis test^eIn-person training versus hybrid training, significant; multiple comparison procedure (Tukey's HSD test)^fHybrid training versus virtual training, significant; multiple comparison procedure (Tukey's HSD test)

for content mastery across delivery types. Perhaps this says as much about our students' resilience as it does about curricula changes. More research is needed to understand what characteristics or factors mediated or moderated student learning. We also need to set standards for increasingly technology-based medical education going forward to ensure that the next generation of physicians provides high-quality care to patients.

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