



# Implementation and Evaluation of a Trainee Orientation Manual in an Intensive Care Unit Rotation

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## ABSTRACT

**Background:** The intensive care unit (ICU) rotation places trainees in a fast-paced, high-intensity environment that requires complex patient care and multidisciplinary coordination. Trainees seek continuous medical knowledge acquisition while tasked with learning ICU-specific workflows, procedures, and policies. The unfamiliarity with rotation logistics and administrative roles and expectations could hinder the ICU rotation learning experience. A lack of standardization and material for trainee orientation

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to administrative ICU tasks and workflows could affect the trainee's rotation performance and overall learner satisfaction.

**Objective:** We evaluated the implementation of an ICU trainee manual to provide trainees with a source of orientation for rotation logistics and nonclinical ICU tasks. We assessed its impact on content retention, learners' satisfaction with the manual, and overall ICU rotation experience.

**Methods:** We designed an observational, prospective cohort study that included all trainees scheduled to rotate in the ICU during the 2020–2021 academic year. The ICU manual was delivered electronically and was available throughout the academic year. Trainees received a survey before their first ICU rotation (pretest) and 6 months after their first ICU rotation (retest) to assess content retention, trainees' perception of the ICU manual, and overall rotation satisfaction.

**Results:** A total of 95 trainees completed the pretest survey, and 61 completed the retest survey. The target cohort response rate for each survey was 100%. Pretest scores were higher than the matched retest scores (41 of 48 [interquartile range, 37–44] vs. 38 of 48 [34–41];  $P < 0.001$ ). The median ICU manual satisfaction score was 32 of 40 (26–36.5). We found positive correlations between ICU manual trainee satisfaction score and the retest score ( $r[59] = 0.320$ ;  $P = 0.01$ ) and ICU rotation trainee satisfaction level ( $r[59] = 0.909$ ;  $P < 0.001$ ).

**Conclusion:** Implementing an ICU manual to orient trainees to their ICU clinical rotation was well received and showed continued retention of orientation content. Higher ICU rotation trainee satisfaction levels were related to a positive perception of the ICU manual.

**Keywords:**

ICU orientation; graduate medical education; critical care medicine

The American College of Graduate Medical Education provides instructions for the implementation of mandatory intensive care unit (ICU) rotations for several clinical training programs (1, 2). ICU rotations offer specific challenges to trainees that result from: 1) unfamiliarity with the field, 2) the complexity of patient conditions and the care provided, 3) the fast-paced clinical setting, 4) the required multitasking skills, 5) the multidisciplinary care plan coordination, 6) the

incorporation of many hospital patient safety procedures and protocols, 7) the demanding working hours, and 8) the strain on physical and emotional stamina that relates to greater burnout (3–5). ICU rotation orientation offers the opportunity for the trainee to become familiar with the ICU setting, clarify roles and responsibilities, and facilitate the adaptation to a new culture of hospital guidelines, policies, and patient safety initiatives that must be fulfilled for an

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This article has a data supplement, which is accessible at the Supplements tab.

efficient workflow (6). Most U.S. medical schools do not require formal experience in ICUs in their curricula (7). ICU preparedness educational curricula for ICU clinical clerkship (8, 9) and residency rotations (10) have been well received among trainees, although the need for widespread internship orientation programs and longitudinal assessment is unlikely met at present.

Most instructional strategies for critical care education and trainee orientation have focused on the acquisition of clinical care skills (7, 11–17). Although some medical education initiatives have been proven effective outside clinical knowledge and procedural skills (18–20), there is a lack of literature on strategies for orienting the trainee to the ICU in clinical tasks that are not directly related, such as workflows, protocols, and healthcare systems. Less is known about the impact of enhancing the orientation of these nonclinical ICU tasks in trainees' overall ICU learning experience. Founded on cognitive load theory (21) and its application in clinical education (22), providing an optimal trainee orientation may result in: 1) reduction in ICU distractors (i.e., extraneous load) and 2) enhancement of skills to optimize the performance of complex ICU tasks (i.e., intrinsic load) while 3) focusing on the development and integration of new knowledge frameworks in long-term memory (i.e., germane load) for future clinical practice.

Faculty availability, inconsistencies in orientation material covered by different faculty members, longitudinal refresher needs, and time restrictions could further hinder a practical rotation orientation. The implementation of an ICU manual could rely on seasoned trainees to provide continuous direction to inexperienced

trainees (i.e., peer-assisted instruction and supervision [23]) using a comprehensive yet consistent orientation information resource. This approach expands the pool of supervisors, overcoming the challenges of a time-restricted faculty and enhancing trainees' rotation learning environment.

Our study aimed to implement and evaluate the impact of an ICU manual (*see* the data supplement) on trainees' logistic orientation to their ICU clinical rotation. We hypothesize that implementing an ICU manual for an ICU clinical rotation will promote trainee rotation logistic content retention and will reveal high trainee satisfaction levels with the ICU manual as an orientation source.

## METHODS

### Study Design

We designed an exploratory, observational, prospective single-center cohort study (24). Our study was conducted in Hospital Corporation of America (HCA) Florida Aventura Hospital, a fully accredited community-based teaching hospital in Aventura, Florida. Our ICU is a 51-bed medical surgical open ICU staffed by trauma and medical in-house and community-based intensivists. All trainees rotating through the medical-surgical ICU as part of their program during the 2020–2021 academic year were included in the study. Trainees who were authors or trainees rotating in the trauma ICU were excluded. Table 1 shows details of the data collected from each trainee.

### ICU Orientation Manual

The standard delivery of ICU clinical rotation objectives for trainees in our institution was performed by accessing a document stored in the institutional graduate medical education (GME) web-based program management system

**Table 1.** Baseline trainee characteristics (N = 95)

Characteristic	Value
GME program	
Internal medicine	44 (46.3%)
Emergency medicine	24 (25.3%)
Transitional year	14 (14.7%)
Pulmonary/pulmonary critical care fellowship	13 (13.7%)
PGY level	
PGY 1	40 (42.1%)
PGY 2	29 (30.5%)
PGY 3	13 (13.7%)
PGY 4	4 (4.2%)
PGY 5	4 (4.2%)
PGY 6	5 (5.3%)
ITE score*	69.2 ± 7.4
ITE score percentile*	50.8 ± 25.2
ITE PCCM section score <sup>†</sup>	69.1 ± 8.0
Prior weeks of ICU experience <sup>‡</sup>	
Median	4
Interquartile range	0–10
Prior ICU experience by group <sup>‡</sup>	
No experience	38 (40.4%)
1–4 wk	13 (13.8%)
5–12 wk	31 (33.0%)
>12 wk	12 (12.8%)
ICU manual survey completed as instructed <sup>§</sup>	
Yes	80 (87.0%)
No	12 (13.0%)
Time of first ICU rotation	
First half of academic year	82 (86.3%)
Second half of academic year	13 (13.7%)

*Definition of abbreviations:* GME = graduate medical education; ICU = intensive care unit; ITE = in-training examination; PCCM = pulmonary and critical care medicine; PGY = postgraduate year; SD = standard deviation. Data presented as mean ± standard deviation where applicable.

\*A total of 67 internal medicine and emergency medicine residents had data available for analysis.

<sup>†</sup>A total of 43 internal medicine residents had data available for analysis.

<sup>‡</sup>"ICU experience" indicates the trainee's ICU rotation weeks within their current GME program. A total of 94 trainees had data available for analysis.

<sup>§</sup>A total of three trainees were excluded from analysis as a result of entry error.

(i.e., MedHub). This document included 1) a rotation description, 2) goals and objectives from each of the six core American College of Graduate Medical Education clinical competencies, and 3) rotation evaluation tools.

The first version of the ICU manual was created in 2017 by three critical care medicine attending physicians with several years of experience as core faculty members for GME programs at our institution (i.e., lead faculty). The purpose of the manual was 1) to enhance the established trainee orientation process, 2) to expand and support the supervising faculty-driven orientation content, 3) to provide a standardized source of orientation for all rotating trainees, and 4) to promote trainees' familiarity with hospital policies, workflows, and patient safety practices. Over a period of 2 months, lead faculty members periodically met to discuss the manual structure content and provide revisions. Concurrently, four staffing intensivists, two ICU nurse leaders, one quality department hospital representative, and three chief residents were asked to review the manual and provide feedback. Their input was reviewed and incorporated or rejected based on lead faculty agreement. The final version of the manual was composed of 15 sections and 4 attachments. The authors obtained ICU manual approval and endorsement from our hospital's critical care committee (CCC). The CCC includes the ICU medical and trauma director, four staff physicians, ICU nursing representatives, respiratory therapy representatives, nutrition representatives, rehabilitation directors, internal medicine residents, and quality department representatives. The manual was distributed electronically by email and through MedHub. Its review was mandatory for all trainees before

their first ICU rotation day, and each program's leadership reinforced this practice.

Updated manual versions were released during the following 3 years, incorporating feedback, current rotation logistics, and hospital processes. Rotating trainees, intensivists, ICU nurses, hospital administrators, CCC members, and GME program directors provided continuous feedback. One faculty member provided an in-depth revision with the three incoming internal medicine chief residents at the end of each academic year.

### Survey Instruments

We first conducted a literature review that revealed no existing or potentially relevant surveys on ICU rotation orientation manuals. We created a survey instrument for this study to measure ICU manual content retention (content survey). The survey was deployed electronically (through Google Forms; Google LLC) before each trainee's first ICU rotation (pretest) and 6 months after the end of their first ICU rotation (retest). We also evaluated each trainee's perception of the ICU manual and trainee ICU rotation satisfaction during the survey retest (satisfaction survey).

Faculty members had informal meetings with rotating trainees (we did not conduct focused interviews) and solicited their insight on ICU manual content and challenges in retention. Through regular monthly meetings, the CCC provided lead faculty insight into the trainees' current patient safety practices and compliance with hospital processes. The faculty identified four domains within the ICU manual for content retention assessment: 1) rotation structure and workflow, 2) clinical documentation, 3) clinical care workflow, and 4) equipment and procedures. Following item-writing best

practices (25), the lead faculty developed a 50-item questionnaire. Three faculty members and one quality department representative provided expert validation, with 100% agreement required for each item. A final 48-item questionnaire was approved (*see* the data supplement). Each correct answer was assigned a value of 1, for a total score of 48 points.

The lead faculty also created a 4-item, 10-point Likert scale questionnaire to assess trainees' satisfaction with the ICU manual as an orientation source (format, content, and delivery), and a total survey score was obtained from the sum of all item points (from 1 to 10), with a maximal value of 40. The faculty developed an additional 10-point Likert scale questionnaire to measure trainees' overall ICU rotation satisfaction (*see* the data supplement).

We piloted all three surveys using the delivery platform on three representative individuals (graduating internal medicine chief residents). We then relocated two content survey items in a different domain and modified minor grammar of item statements for clarity. All surveys were nonanonymous and mandatory. Trainees received their pretest and retest content survey results.

### Statistical Analysis

Categorical variables are described as frequency (percentage) and were analyzed for significance using a  $\chi^2$  or Fisher exact test. Continuous variables are described as mean (standard deviation) and median (interquartile range [IQR]). Continuous variables were analyzed for significance using the Mann-Whitney *U* test for non-parametric variables and the *t* test for parametric variables. Comparison of paired pretest and retest scores were analyzed using the Wilcoxon signed-rank test. Pearson's product-moment or Spearman's

rank-order correlation coefficients were calculated to assess the association between continuous variables. Trainees who responded after 24 weeks were assigned a value of 24 weeks for the variable "weeks since last ICU rotation." The four-item questionnaire ICU manual trainee satisfaction survey was assessed for internal consistency using Cronbach's  $\alpha$  reliability coefficient. We considered a two-sided *P* value of less than 0.05 to indicate statistical significance with a 95% confidence interval. We performed analyses using SPSS statistical software (version 1.0.0.1461, 64-bit edition; IBM Corp) and STATA software (version 17; StataCorp).

### Ethical Considerations

This study received institutional review board exemption and was approved for the conduct of research without explicit consent from the participants.

### RESULTS

Ninety-five trainees rotated in the ICU during the academic year and completed the ICU manual pretest (100% response rate). Table 1 shows the cohort characteristics. Most trainees were internal medicine trainees (46.3%) in their first or second year (72.6%) who acknowledged completing the ICU manual survey as instructed (88.4%) and had their first ICU rotation scheduled in the first half of the academic year (86.3%). A total of 40.4% of trainees had no ICU experience in their current GME programs. There was no significant difference in median pretest scores within subgroups (Table E1 in the data supplement). We found no association between the pretest score and in-training examination (ITE) score, ITE percentile, ITE pulmonary and critical care medicine (PCCM) section score, or number of weeks of ICU experience in

**Table 2.** Pretest and retest performance by trainees who remained active after the conclusion of the academic year ( $n = 61$ )

Subgroup	Median Score (IQR)		P Value (Pre vs. Retest)
	Pretest	Retest	
Pretest 48-point score	41 (37–44)	38 (34–41)	<0.001
Rotation structure and workflow 13-point score section	11 (9.5–12)	10 (9–11)	<0.001
Documentation 18-point score section	15 (14–17)	15 (14–17)	0.92
Clinical care 9-point score section	8 (7–9)	6 (6–7.5)	<0.001
Equipment and procedures 8-point score section	6 (5–7)	6 (5–7)	0.43

Definition of abbreviation: IQR = interquartile range.

the trainees' current GME program (Table E2 in data supplement).

All 61 trainees who remained active after the conclusion of the academic year completed the retest (100% response rate). They were primarily internal medicine trainees (88.5%) with a median of 16 (8–24) weeks since their last ICU rotation. Approximately half of the trainees (52.5%) had completed their previous ICU rotation more than 12 weeks before taking the retest (Table E3 in the data supplement).

Trainees' median pretest score was higher than their matched retest score (41 [37–44] vs. 38 [34–41];  $P < 0.001$ ) (Table 2). A significant difference was observed in the “rotation structure and workflow” (11 [9.5–12] vs. 10 [9–11];  $P < 0.001$ ) and “clinical care” (8 [7–9] vs. 6 [6–7.5];  $P < 0.001$ ) sections. Table 3 reports the differences between the pretest and retest scores among subgroups. The decrease in median test score between the pretest and retest was significant among emergency medicine residents (39.5 [36–43.5] vs. 33 [30–36.75];  $P < 0.01$ ) and PCCM fellows (44 [39–46] vs. 39 [36–40];  $P < 0.03$ ). Postgraduate year 1 trainees had a

significant decrease in median score from the pretest to the retest (40.5 [36.75–43] vs. 37 [34–41];  $P = 0.02$ ). There was a significantly lower median retest score among trainees who had reported no ICU experience (41 [37.25–42.75] vs. 37 [35–41];  $P = 0.03$ ) or 1–4 weeks of ICU experience (40 [36–44.75] vs. 33 [28.25–35.75];  $P = 0.01$ ) during their initial enrollment. Median retest scores were significantly lower in trainees who had their first ICU rotation during the first half of the academic year versus the second half of the academic year (42 [37.75–44] vs. 38 [35.75–41];  $P < 0.01$ ) and in those who had their last ICU rotation more than 12 weeks before the time of the retest (41 [37–44] vs. 36 [33–42];  $P < 0.01$ ). We found a significant inverse correlation between trainee retest scores and the number of weeks since their last ICU rotation ( $r[59] = -0.381$ ;  $P = 0.01$ ).

All 61 trainees completed the ICU manual trainee satisfaction survey. The survey showed a high level of internal consistency ( $\alpha = 0.962$ ). The median ICU manual satisfaction total score was 32 (26–36.5). We found significant positive correlations between the ICU manual



**Table 3.** Test performance comparison by subgroup

Subgroup	n (%)	Median Score (IQR)		P Value (Pre- vs. Retest)
		Pretest	Retest	
<b>GME program*</b>				
Internal medicine	30 (49.2)	41.5 (37–43)	39.5 (37–42.25)	0.40
Emergency medicine	24 (39.3)	39.5 (36–43.5)	33 (30–36.75)	<0.01
Pulmonary/pulmonary critical care fellowship	7 (11.5)	44 (39–46)	39 (36–40)	0.03
<b>PGY level</b>				
PGY 1	26 (42.6)	40.5 (36.75–43)	37 (34–41)	0.02
PGY 2	27 (44.3)	41 (37–44)	38 (33–42)	0.12
PGY 3	1 (1.6)	4 (43)	38 (38)	NA
PGY 4	4 (6.6)	45 (42.5–46)	39.5 (39–40)	0.07
PGY 5	3 (4.9)	39 (37)	36 (31)	0.28
<b>Prior ICU experience in groups†</b>				
No experience	24 (39.3)	41 (37.25–42.75)	37 (35–41)	0.03
1–4 wk	12 (19.7)	40 (36–44.75)	33 (28.25–35.75)	0.01
5–12 wk	20 (32.8)	42 (37–43.75)	39 (38–43)	0.68
>12 wk	5 (8.2)	44 (38–45)	39 (33.5–40)	0.08
<b>Time of first ICU rotation</b>				
First half of the academic year	50 (82.0)	42 (37.75–44)	38 (35.75–41)	<0.01
Second half of the academic year	11 (18.0)	38 (36–42)	33 (30–39)	0.11
<b>Weeks since the last ICU rotation by groups</b>				
<1 wk	4 (6.6)	44.5 (40.75–46)	37.5 (37–39.5)	0.07
1–4 wk	6 (9.8)	38.5 (33–41.5)	39 (34.75–43.5)	0.69
5–12 wk	19 (31.1)	42 (38–43)	39 (37–42)	0.14
>12 wk	32 (52.5)	41 (37–44)	36 (33–42)	<0.01

*Definition of abbreviations:* GME = graduate medical education; ICU = intensive care unit; IQR = interquartile range; NA = not applicable; PGY = postgraduate year.

\*Trainees from the transitional year were unavailable for retesting and were excluded from reporting.

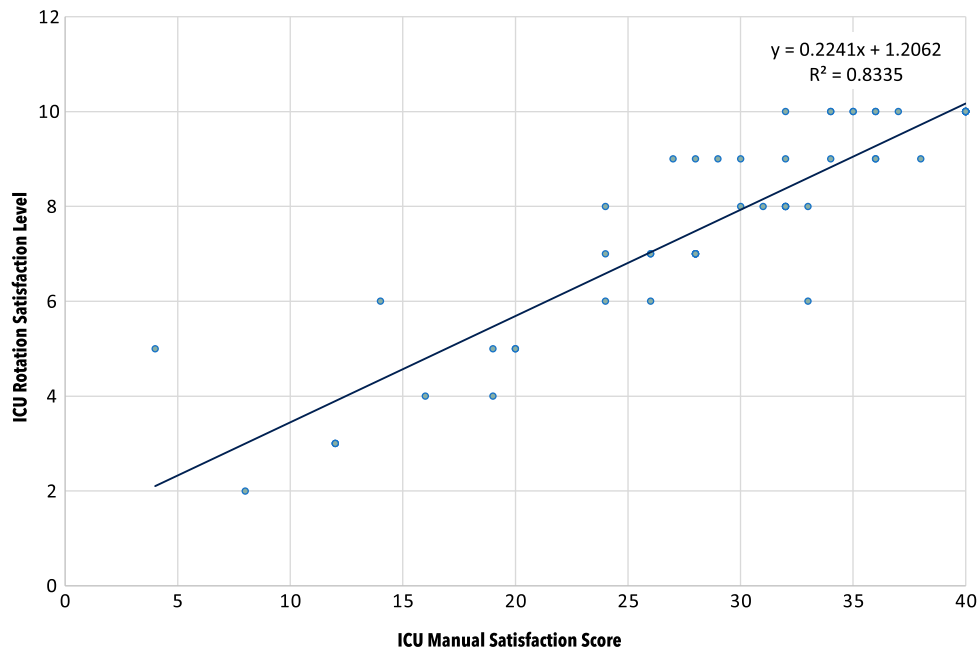
†“ICU experience” indicates the trainee’s ICU rotation weeks within their current GME program.

trainee satisfaction total score and the retest score ( $r[59] = 0.320$ ;  $P = 0.01$ ) (Table E4 in the data supplement) and the ICU rotation trainee satisfaction level ( $r[59] = 0.909$ ;  $P < 0.001$ ) (Figure 1).

## DISCUSSION

The implementation of an ICU orientation manual provided trainees with a practical and standardized orientation tool for their rotation. The manual was





**Figure 1.** Correlation between intensive care unit (ICU) manual satisfaction survey score and rotation satisfaction level (significant correlation,  $P < 0.001$ ).

well received among trainees, who reported high satisfaction levels that positively correlated with overall ICU rotation satisfaction.

Several educational strategies to enhance the preparedness of the medical trainee to care for critically ill patients have focused on clinical knowledge and procedural skills acquisition (7–17, 23) and, to a lesser extent, nonclinical administrative tasks (6, 18–20, 23), which trainees found useful and to enhance their clinical skills (6). Cognitive load theory (21) suggests several approaches to improve learner performance. Clinical knowledge learning in the ICU (i.e., germane load) could be enhanced by an ICU environment that decreases distractions (i.e., extraneous load), and their education could be improved by reducing the inherited complexities of ICU clinical care (i.e., intrinsic load). The ICU manual is an educational tool to mitigate inherent burdens in a complex learning environment. Using the example of a trainee planning to insert a

central venous catheter, the trainee should be familiar with equipment selection and accessibility, procedural consent, safety checklists, and preprocedural healthcare team coordination (i.e., intrinsic load). Using the manual, the trainee could shift their focus to revising procedural steps and gaining motor skills (i.e., germane load), enhancing their learning. Using the manual could also decrease task distractors (i.e., extraneous load) such as delays in finding supplies, incorrect supplies selection, inadequate preprocedural documentation, and unnecessary procedure interruptions. Trainee subgroups did not show a difference in pretest performance. One would have expected senior trainees to score higher because of their prior cumulative ICU rotation experience. On the contrary, they could be more likely to experience policy changes and rotate in different ICU settings and be less inclined to revisit manual versions because of an assumption of familiarity with the information from prior rotations.

Retest scores were lower than the pretest scores. Memory retention decreased throughout time (26), and the process of forgetting starts as soon as 1 week after the initial educational activity (27). Retest scores were lower among emergency medicine residents and PCCM fellows and sustained among internal medicine residents. Residents are heterogeneous groups of learners with extensive program curricular variability in the amount of ICU rotations during their training (2 months for emergency medicine and as long as 6 months for internal medicine residents in our institution), a common finding in teaching ICUs. Expectations for fellows are different from those for residents. Their team leader role could remove them from daily ICU rotation logistics and nonclinical tasks that are mainly accomplished by residents. The fellows' curriculum exposed them to various ICU rotation settings at multiple facilities, contributing to recall bias. Our study challenges the assumption that senior trainees are more experienced in ICU orientation content. We must point out that the score change was small, albeit significant, and overall content retention was sustained.

Coronavirus disease (COVID-19) significantly affected medical education, including transitioning to virtual platforms, modifying educational curricula, and redeploying junior physicians to ICU frontlines (28, 29). We believe that high patient surges, unusual workflows, limited availability of supervising faculty because of clinical demands, and national and institutional policy shifts throughout the academic year due to the pandemic hindered the ICU orientation process. COVID-19–related content survey items significantly changed the percentage of

answers from correct to incorrect, confirming its impact on the orientation process.

Trainees reported a high satisfaction level with the ICU manual. A positive perception of the orientation material could support trainees' interest and promote proactive preparation for their upcoming rotation. The manual provides a reliable and uniform source of continuous information for self-paced review. It supports conflict resolution within a trainee's rotation and addresses several frequent questions that trainees might not be comfortable asking their supervisors, facilitating a successful rotation experience. Trainees identified the ICU manual as a trustworthy orientation source tailored to their needs, with updated information and, inclusive of their feedback, a strategy linked to high trainee orientation satisfaction (30).

The deployment of the ICU manual in other user-friendly formats (31) that support new communication channels used by younger trainee generations (32, 33) might expand its relatability and reach. Key ideas our study generated while incorporating trainee feedback include: 1) the display of QR (quick response) codes in ICU areas to access specific ICU manual sections, 2) targeted 1- to 2-minute educational videos on challenging orientation content highlighted by our study, 3) transition of the ICU manual to a smartphone application, 4) scheduled minilectures during trainee didactics for longitudinal content recall, and 5) incorporation of gamification for content engagement.

Poor rotation orientation is associated with decreased resident well-being (34). Addressing learners' needs through orientation could counteract the potential distress generated by a complex, challenging,

fast-paced ICU rotation. We found a strong correlation among trainees between the ICU manual and ICU rotation satisfaction levels, supporting the idea that our ICU orientation manual promotes a positive ICU rotation experience. Several factors can influence a trainee's rotation satisfaction, such as: 1) potential trainee "halo effect," 2) educational value variability, 3) effective mentorship, 4) clinical workload, 5) uniqueness of patients cared for, 6) trainee motivation, and 7) personal life interferences. Many of these factors are unpredictable in the trainee journey and are challenging to evaluate.

### Limitations

Our study has several limitations: 1) its single-center design partially restricts its applicability to other ICU settings, 2) one third of trainees had graduated and did not complete the retest survey, 3) the study is underpowered to detect significant findings in small-size GME programs, and 4) we did not control for individual rotation experiences or the number of times the ICU manual was accessed throughout the year, which could have led to different retention rates.

### Conclusions

In conclusion, a multidisciplinary team approach to developing an ICU trainee orientation manual for clinical rotations provides trainees with a comprehensive orientation resource. Trainees exhibited sustained content retention of the orientation information, with differences within training programs and training years. Trainees positively associated their satisfaction with the ICU manual and overall ICU rotation. Our study provides additional insight to the medical education community on the ICU rotation orientation process of GME trainees.

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