ORIGINAL RESEARCH

Moving toward Interprofessional Teaching in the Intensive Care Unit

A Mixed Methods Study

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ABSTRACT

Background: There is an evolving focus on interprofessional education (IPE) to promote teamwork and collaboration in health professions education. Studies in medical students have shown that exposure to IPE leads to perceived improvements in interprofessional communication, effective work in healthcare teams, and understanding of professional limitations. Most research focuses on IPE in undergraduate medical education; less is known about how this functions in graduate medical education.

Objective: To develop and implement a lecture-based intensive care unit (ICU) educational curriculum, incorporating content delivery by interprofessional team members (IPMs), and to use a mixed methods approach to explore learner and IPM perceptions surrounding the benefits and opportunities with this model of education.

Methods: A standardized curriculum of core topics in critical care medicine was designed and implemented as a recurring interactive lecture series over the course

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of a medical ICU rotation at an academic hospital. The lectures were delivered by pulmonary and critical care attendings or fellows and IPMs, including pharmacists, dietitians, advanced practice providers, and physical therapists. Internal medicine residents' perceptions of faculty engagement in teaching, involvement in interprofessional care teams, and educational value of the rotation were analyzed quantitatively before and after intervention. Semistructured focus groups with residents and IPMs were held after implementation to explore the experience, motivations, and effectiveness of IPMs as educators. Themes were identified using a deductive approach, with coding by multiple team members.

Results: Before lecture series implementation, 57 residents completed end-of-rotation evaluations. The average score for perceived faculty engagement and interest in teaching was 4.16 out of 5 (standard deviation [SD], 1.05). Forty-five residents completed evaluations after implementation, and the perception of faculty interest in teaching was not statistically different at 4.20 (SD, 0.92; $P = 0.98$). Qualitative themes emerging from the focus groups included investment, shared goals and motivation for teaching, specialized knowledge and mutual respect, improving patient care, engagement and environment, downsides, and, finally, prioritization.

Conclusion: Teaching by IPMs can be integrated into a lecture-based curriculum in an academic ICU. After implementation, residents identified that engagement of IPMs as teachers may lead to improved understanding of roles and responsibilities and mutual respect. IPMs cite sharing of specialized knowledge and return on investment as motivations for teaching.

Keywords:
interprofessional education; critical care; themes; curriculum

Critical care medicine is a foundational component of undergraduate medical education (UME) and graduate medical education (GME). Basic understanding of critical care topics is essential to providing quality patient care and communicating effectively within the interprofessional team for medical residents. Fundamental knowledge of critical care topics is especially important to internal medicine trainees, as general internists often participate in the care of critically ill patients in nonacademic medical centers (1–3). Despite this recognized need, there is no general framework or formal curriculum for critical care education in most teaching intensive care units (ICUs) (4) outside of experiential learning from caring for patients. In addition, the high acuity and unpredictability of patient illness and competing demands on time make it difficult to reliably carve out dedicated time for teaching (5). Ultimately, trainees are reliant on the supervising fellow and attending physicians to teach relevant topics when time and patient acuity allow, leading to variable education delivery, differential understanding of key topics, and limited interprofessional input.

Interprofessional education (IPE) occurs when learners and educators from two or more health professions jointly come together to learn, with a goal of promoting shared knowledge and collaboration in practice. A recent study found that the majority of medical students exposed to IPE believed that it improved interprofessional communication, helped them become more effective healthcare team members, and

improved their understanding of their own professional limitations (6). Although the benefits of IPE have been widely promoted and studied in UME, studies regarding integration and application of IPE in the GME setting are lacking (7, 8). The ICU is a unique clinical learning environment because of its inherent multiprofessional nature. In many ICUs, interprofessional team members (IPMs) are already integrated into daily rounds, and whether during rounds or at the bedside, pharmacists, nurses, respiratory therapists, and other allied health professionals all provide education to trainees (9). Interestingly, however, physicians and IPM perceptions of teaching frequency differ, and IPMs report infrequent invitations or opportunities to teach formally in the clinical setting (9). Finding ways to successfully integrate IPE into GME learning environments is a desirable goal, as IPE is purported to promote better understanding of each other's roles, which may in turn help improve uptake of evidence-based practices (7, 9).

The initial objective of this project was to develop and implement a formal educational curriculum of core critical care topics, with a focus on content delivery by IPMs. Before this intervention there was no standardized educational curriculum in place in our ICU. The secondary objective was to use quantitative and qualitative research methods to explore learner and IPM perceptions surrounding the benefits and opportunities related to this model of education in the clinical setting. We hypothesized that learners' perceptions of attending physician engagement in teaching and whether they believed that they worked in interprofessional teams would increase after implementation of a standardized lecture-based curriculum using IPMs as teachers.

METHODS

Setting

This study was conducted in the medical ICU (MICU) at the University of Minnesota Medical Center. The University of Minnesota Medical Center is a large tertiary-care academic medical center in the upper Midwest. Our MICU is a multiprofessional environment with integrated teaching teams consisting of attending physicians; fellows; internal medicine, medicine-dermatology, and medicine-pediatrics residents (henceforth referred to as "residents"); medical students; and advanced practice providers (APPs). Our medical teams, including residents, share a workspace with the ICU pharmacists and dietitians and work closely with other IPMs in direct patient care.

Preintervention State

Before intervention, no teaching curriculum existed in our MICU. Teaching happened at the bedside or during rounds, at the discretion of attending physicians. IPMs participated in rounds and often provided relevant teaching pearls as they felt comfortable and were appropriate to the clinical context. The extent to which either of these occurred was not formally assessed. Feedback was received from learners verbally and in free-text comments on the rotation evaluation expressing residents' desire for more consistent and structured learning opportunities. To better understand opportunities for improvement, study members (A.K., J.W., and K.P.) informally met with a pulmonary and critical care fellow (K.C.) and a chief resident for discussion and brainstorming. Members of this group believed that a lecture-based standardized curriculum was the best way to sustainably implement, formalize, and incorporate dedicated teaching time in the MICU.

Intervention

In the spring of 2022, a group of pulmonary and critical care physicians (A.K., J.W., K.C., and K.P.) designed a standardized curriculum of core topics in critical care to be delivered as interactive lectures over the course of the 4-week MICU rotation (Figure 1). This was modeled after available online review of other institutions' curricula but did not follow a standardized curriculum design process. PowerPoint slide decks were created by respective IPMs as well as the same group of critical care attendings and were reviewed collectively for content and accuracy. The lectures were designed to last 20–25 minutes in duration and occur three times weekly. They were intended to be delivered by attending intensivists, pulmonary and critical care fellows, and IPMs (Figure 1). Whenever IPMs gave lectures, attendings and fellows were asked to participate as part of the audience, allowing for IPM interaction and to enhance discussion. To protect time for education, nursing staff members were asked to hold

	Monday	Tuesday	Wednesday	Thursday	Friday
Week 1	Resident switch day	ICU Orientation: Critical Care APP	Sedation and Analgesia: Pharmacist	Early Mobility in the ICU: PT or OT staff	Shock - Fellow or Attending
Week 2	Vasopressors: Pharmacist	Sepsis: Fellow or Attending		Respiratory Failure: Invasive Mechanical Ventilation: Fellow or Attending	Intern Academic Half Day Education
Week 3		Nutrition in the ICU: Registered Dietician	Respiratory Failure: Non-Invasive Ventilation: Fellow or Attending	Acute Respiratory Distress Syndrome: Fellow or Attending	
Week 4	Renal Failure and Renal Replacement Therapy: Nephrology APP	End of life care: Fellow or Attending		Bleeding and transfusions: Fellow or Attending	Senior Resident Academic Half Day Education

Figure 1. Lecture schedule for medical ICU curriculum and assigned staff. APP = advanced practice provider; ICU = intensive care unit; OT = occupational therapy; PT = physical therapy.

all nonurgent calls and pages during this period. In May 2022, an abbreviated lecture series was initiated with two lectures per week, on a 2-month trial basis, for feasibility and general feedback. Completion of lectures on scheduled days during this trial period was audited prospectively by the ICU pharmacists. The lecture series was scaled to three mornings per week and fully implemented starting in July 2022.

Focus Groups

To better characterize perceptions, benefits, and opportunities surrounding this model of IPE in the clinical setting, focus groups were conducted. All residents completing a MICU rotation after curriculum implementation (July 2022) were eligible and invited to participate in the focus groups. Invitations identifying the investigators and introducing the research project and goals were sent to eligible participants via e-mail. Resident focus groups were moderated by a hospitalist physician with experience in qualitative research in medical education (M.A.S.). The IPMs were invited via e-mail to participate in a separate focus group, also moderated by a hospitalist physician with experience in qualitative research in medical education (A.P.J.O.). Resident focus groups were conducted in person in the internal medicine administrative offices. The IPM focus group was conducted virtually. Only focus group participants and the moderator were present. Participant names, year of training, and gender were blinded to K.P., J.W., and A.K. At the beginning of each focus group, the participants were reminded that they were not required to answer questions if they did not feel comfortable and that their responses would be deidentified before coding. All participation was voluntary, and no compensation was provided, although a meal was provided for resident participants. All participants consented to having their focus group audio recorded and transcribed verbatim using third-party software (Amazon Web Services, Amazon Transcription); transcripts were not returned to participants for review. Structured interview questions were used to guide discussion in all focus groups (Figure 2). The questions were designed to explore the effectiveness of the standardized curriculum and the motivations, benefits, and potential shortcomings of using IPMs to deliver this curriculum in the ICU.

Questions for resident focus group:
1) What is the value of learning from interprofessional healthcare team members?
2) What things related to care of critically ill patients can you best learn from interprofessional healthcare team members?
3) Are there any negative consequences to receiving education from interprofessional healthcare team members as opposed to physicians?
4) Has receiving education (e.g. lectures) from interprofessional healthcare team members changed your perception on the value of working in an interprofessional team?
5) If you are planning to incorporate medical education in your future job, would you incorporate teaching from interprofessional healthcare team members?

Questions for Interprofessional team focus group:
1) What is the value of learning from interprofessional healthcare team members?
2) What is your motivation for giving lectures to the ICU trainees?
3) What things related to care of critically ill patients can best be learned from interprofessional healthcare team members?
4) Are there any negative consequences to providing education to trainees in the MICU?
5) How can we help support you in making this educational opportunity more productive?

Figure 2. Question guide for focus groups. ICU = intensive care unit; MICU = medical intensive care unit.

Themes from focus group transcripts were identified using a deductive approach by investigators (A.P.J.O. and K.P.). Coding was performed by four members of the study team (A.K., J.W., A.P.J.O., and K.P.) using NVivo software (version 14), and differences were resolved by group discussion.

MICU rotation evaluations completed by residents were retrospectively reviewed for data regarding resident perceptions of faculty engagement in teaching, perception of work in interprofessional teams, and overall educational value of the rotation (Figure 3). Rotation evaluations from July 2020 to April 2022 were used to establish a baseline before intervention, whereas rotation evaluations from July 2022 to September 2023 represented the postintervention period. Rotation evaluation data were analyzed using descriptive statistics and Wilcoxon test (R version 4.3.1). The study was approved by the University of Minnesota Institutional Review Board.

RESULTS

Quantitative Results

MICU rotation evaluations were analyzed for learners' perceptions of "engagement of faculty in teaching," "overall educational value of the rotation," and whether or not they "worked in an interprofessional team." These questions were selected because they already existed on the rotation evaluation and could serve to establish a preintervention baseline. Notably, these were standard residency rotation evaluations and were not intended to evaluate this project specifically. Some residents may have completed the evaluation more than once because of being assigned the rotation multiple times over the study period. Responses to the questions about faculty engagement and educational value were scored on a 5-point scale, with 1 being "poor" and 5 being "excellent," whereas working in an interprofessional team was answered yes or no. Before intervention, 57/85 (67%) learners completed rotation evaluations, compared with 45/78 learners (58%) after intervention. Before intervention, 48 (84%) respondents said "yes" to working in an interprofessional team, compared with 40 (89%) after intervention ($P = 0.35$) (Table 1). The mean score for perceived engagement of faculty was 4.16 out of 5 (standard deviation [SD], 1.05) before intervention compared with a mean of 4.20 out of 5 (SD, 0.92) after intervention ($P = 0.98$). Residents' perception of overall educational value of the rotation did not change significantly over the study period. The mean score was 4.37 out of 5 (SD, 0.94) before intervention compared with 4.47 out of 5 (SD, 0.69; $P = 0.95$).

Qualitative Results

Three focus groups were held during the spring of 2023 (after implementation), including two for residents and one for IPMs. Sixty-three residents were invited to participate, and a combined total of 10 residents attended the focus groups, referred to as (FG1, R) and (FG2, R). Resident participants included seven females and three males. All participants (9) were senior residents (post-graduate yr 2–5), and the majority (8) were internal medicine residents; there was 1 medicine-pediatrics resident. In the focus group for IPMs, all five educators were invited and participated (two pharmacists [PharmD], one registered dietitian [RD], one nephrology advanced practice provider [Neph APP], and one physical therapist [PT]; three females, two males). The average length of the focus groups was 39 minutes (FG1, 36:30 min; FG2, 50:00 min; and IPM, 29:07 min). Residents' groups were separate from IPM groups to eliminate observation bias during reporting perceptions.

7/8/2021 New Innovations::Evaluations

Subject Name
Status
Employer
Program
Rotation
Evaluation Dates

Evaluated by: **Evaluator Name**
Status
Employer
Program

Resident Evaluates a Rotation

Instructions:
Please complete this regarding your recent time on this rotation

Rotation Curricular Goals

1* Please evaluate the adequacy of patient volume on this rotation.

Just Right	Insufficient Volume	Volume Overload
○	○	○

Clinical Experience: Case-Mix

2* Please evaluate the appropriateness of patient case mix for this rotation.

Poor	Fair	Good	Very Good	Excellent	Cannot Evaluate
○	○	○	○	○	○

Faculty Engagement

3* Please evaluate the engagement of faculty in teaching on this rotation.

Poor	Fair	Good	Very Good	Excellent	Cannot Evaluate
○	○	○	○	○	○

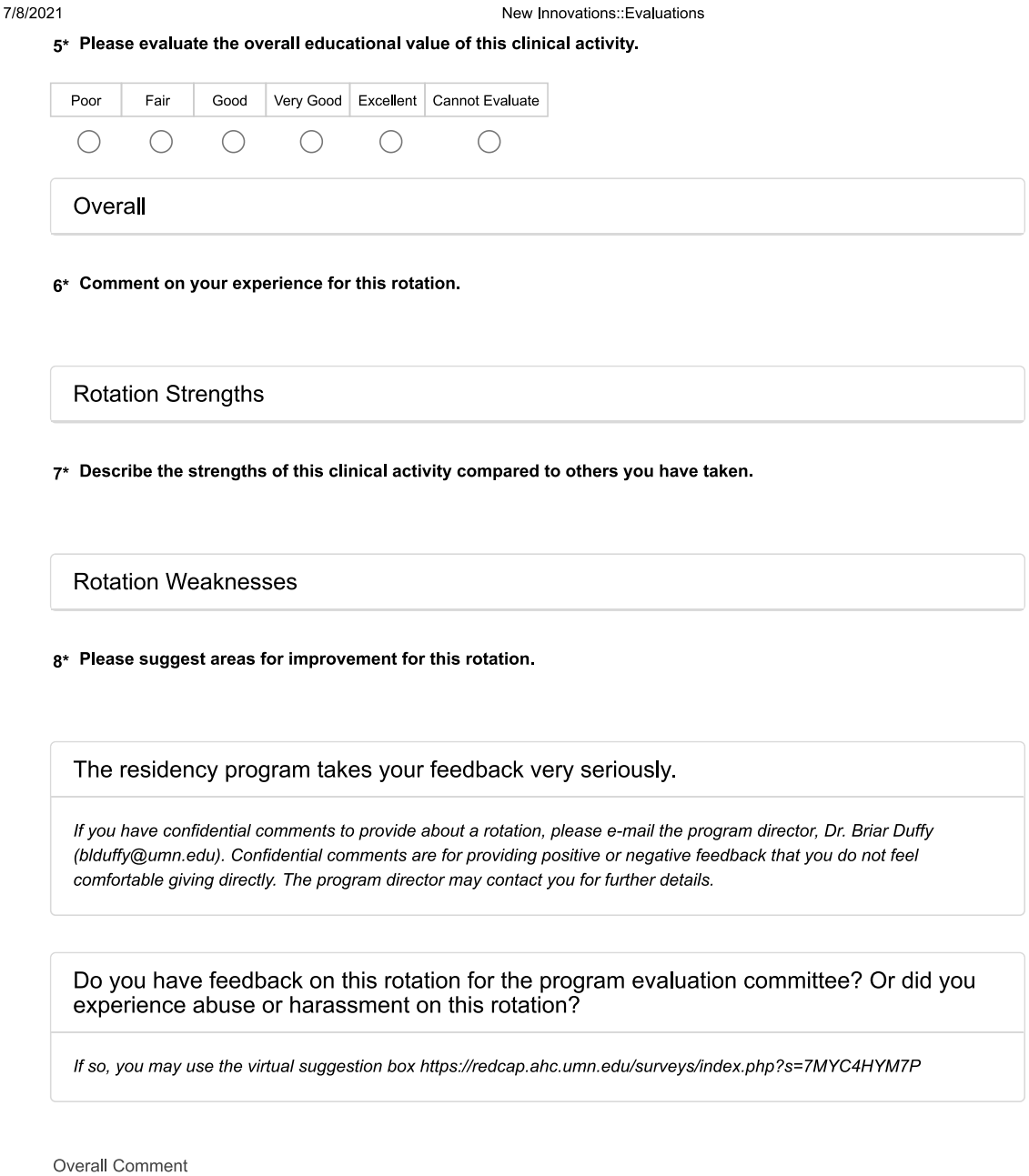
Interprofessional Teams

4* Did you work within an interprofessional healthcare team (i.e. discharge rounds) during your time on this rotation?

○ Yes
○ No
○ N/A

Rotation Value

Figure 3. Intensive care unit (ICU) rotation evaluation form sample which is typically completed by rotating residents upon completion of medical intensive care unit (MICU) rotation.



7/8/2021 New Innovations::Evaluations

5* Please evaluate the overall educational value of this clinical activity.

Poor	Fair	Good	Very Good	Excellent	Cannot Evaluate
○	○	○	○	○	○

Overall

6* Comment on your experience for this rotation.

Rotation Strengths

7* Describe the strengths of this clinical activity compared to others you have taken.

Rotation Weaknesses

8* Please suggest areas for improvement for this rotation.

The residency program takes your feedback very seriously.

If you have confidential comments to provide about a rotation, please e-mail the program director, Dr. Briar Duffy (blduffy@umn.edu). Confidential comments are for providing positive or negative feedback that you do not feel comfortable giving directly. The program director may contact you for further details.

Do you have feedback on this rotation for the program evaluation committee? Or did you experience abuse or harassment on this rotation?

If so, you may use the virtual suggestion box https://redcap.ahc.umn.edu/surveys/index.php?s=7MYC4HYM7P

Overall Comment

Figure 3. *(Continued).*

Inductive thematic saturation was achieved by the lack of emerging new themes toward the end of each focus group discussion as observed by moderators (M.A.S. and A.P.J.O.).

Thematic content analysis identified six main themes, generated across all focus groups, related to the perception of IPM as educators. These themes were: *1*) investment, shared goals and motivation for teaching; *2*) specialized knowledge and mutual respect; *3*) improving patient care; *4*) engagement and environment; *5*) downsides to a standardized curriculum featuring IPMs as educators; and *6*) prioritization of education, including by IPMs. Descriptions of themes and key quote examples are outlined in Table 2.

Table 1. Pre and postintervention resident evaluations quantitative results

	Before Intervention (Excluding Pilot Study)						After Intervention						
	n	Mean	SD	Median	Range	IQR	*n*	Mean	SD	Median	Range	IQR	*P* Value
Engagement of faculty	57	4.16	1.05	5	4	1	45	4.20	0.92	4	3	1	0.98
Overall educational value of the rotation	57	4.37	0.94	5	4	1	45	4.47	0.69	5	2	1	0.95
Working in interprofessional team, yes	48 (84.2%)	—	—	—	—	—	40 (88.9%)	—	—	—	—	—	0.35

Definition of abbreviations: IQR = interquartile range; SD = standard deviation.
P value indicates the significance of the difference between pre and postintervention groups (Wilcox test for engagement of faculty and overall educational value of the rotation, chi-square test for working in interprofessional team).

Theme 1: Investment, Shared Goals and Motivation for Teaching

Participants expressed motivational aspects and long-term investment regarding IPE, such as the feeling of commitment to teach the next generation of providers, the opportunity to positively impact practice in the existing environment, and the chance to help narrow the gap of differing perspectives between disciplines. Some examples of key quotes representing this theme include:

> *"All of these doctors need to know some amount of nutrition and being able to sit down and really discuss why it's important instead of just every so often being able to talk about it in rounds. I've also heard from residents, students, and attendings, that that information that they learned is very valuable."* (FG3, RD)

> *"People need to be on the same page about stuff… I think that it's going to allow for more input and if there is collaborative interprofessional teaching, people are going to know the same information."* (FG2, R)

Theme 2: Specialized Knowledge and Mutual Respect

Participants shed light on how learning clinical information from different disciplines could be a valuable educational experience. Comments consistently acknowledge the expertise of individual disciplines in patient care and suggest that integrating teaching by IPMs into a standardized curriculum could help forge relationships among different professionals serving the same patient. Representative quotes include:

> *"Most doctors take a single nutrition class in their entire career. I have to really advocate for the importance of nutrition. I truly think it's helping make these providers better, knowing that it's coming from the expert who sees this. This is literally what I do every single day instead of them learning this from somebody who took a single class about it."* (FG3, RD)

> *"I really appreciated getting to see the perspectives from nutrition, from nursing, from pharmacy, specifically in these lectures because I think it just introduces you to the scope of everyone's expertise a little bit better and reminds you again, how to best use your resources."* (FG2, R)

Theme 3: Improving Patient Care

This theme highlights the initiative focused on optimizing the quality, effectiveness, or safety of care delivery, as a collaborative goal. There was general agreement between participants about how engaging and learning from different professionals can lead to a common goal of improving patient outcomes. The theme additionally captured consensus from participants regarding a sense of commitment to placing the

Table 2. Identified themes with description and key quote examples for each theme

Theme	Description	Key and Illuminating Quotes
Investment, shared goals, and motivation for teaching	Commitment to education for personal or collective future gains; all members of the group working toward a common purpose; intrinsic and extrinsic factors driving an individual to participate in curriculum delivery	*"But using the folks that are there, nurses, respiratory therapists, dietitians, pharmacists, all of the folks in there who can provide their piece of experience to this patient's care makes our jobs easier."* (FG2, R) *"You know a lot of the students and residents have told us that they really appreciate it (teaching), because, we're trying to focus on some of these big topics that they really need to know as they progress throughout their career."* (FG3, PharmD) *"All of these doctors need to know some amount of nutrition and being able to sit down and really discuss why it's important instead of just every so often being able to talk about it in rounds. I've also heard from residents, students, and attendings that information they learned is very valuable."* (FG3, RD) *"I think it also makes my job a little bit easier if we can be more on the same page early on from the beginning."* (FG3, PT) *"People need to be on the same page about stuff… I think that it's going to allow for more input and if there is collaborative interprofessional teaching, people are going to know the same information."* (FG2, R) *"I think we all work at an academic hospital because we're interested in learning as well as teaching. So part of it's just the environment which we work in."* (FG3, PharmD)
Specialized knowledge and mutual respect	The recognition of different interprofessional specialty areas of knowledge and appreciation of their inherent worth or value	*"The doctors don't have to be the expert across the board in all the areas. You can and should rely on other disciplines."* (FG3, PT) *"[The pharmacist] and I have gone on many tangents during my talks that I think are helpful to see. You know that everybody's coming at it from a little different angle."* (FG3, Neph APP) *"The pharmacists are approaching rounds, approaching antibiotic selection from the common goal of helping the patient, but still maybe a different underlying focus. So at least it made me a little more judicious at times with antibiotics."* (FG1, R) *"Most doctors take a single nutrition class in their entire career. I have to really advocate for the importance of nutrition. I truly think it's helping make these providers better, knowing that it's coming from the expert who sees this. This is literally what I do every single day instead of them [residents] learning this from somebody who took a single class about it."* (FG3, RD) *"I really appreciated getting to see the perspectives from nutrition, from nursing, from pharmacy, specifically in these lectures because I think it just introduces you to the scope of everyone's expertise a little bit better and reminds you again, how to best use your resources."* (FG2, R)
Improving patient care	Effort or initiative aimed at optimizing the quality, effectiveness, or safety of care delivery	*"Also it just reminds you that we're all here for the patient. […] We're seeing all interprofessional disciplines actually talking about patient care. This is the same patient that I'm trying to help with. So you might as well learn from what they're doing because ultimately you're giving the best care."* (FG2, R)

Table 2. *Continued.*

Theme	Description	Key and Illuminating Quotes
		"I think it also helps you really learn how to utilize the right people in the hospital, it feels always like it is a little easier to get things done." (FG2, R) *"There's some big, broad areas of medicine that I think a pharmacist can definitely assist them with. One of them is antibiotics. I find it's a deficit in most physicians just understanding MICs, and how the antibiotic works and the dosing, and what would be a better one for which bug you're growing."* (FG3, PharmD) *"In regards to being able to communicate with a team, for example, if a patient is quickly decompensating, when there is that morale there, when there is already that inclusivity, then people are going to be more willing to be receptive to different viewpoints, which I think is also really important."* (FG2, R) *"It helps seeing things from their (IPM) perspective and having that sort of influence the way you do things or keeping them in mind when you're putting in an order or what have you … knowing the resources you have."* (FG1, R)
Engagement and environment	Degree of involvement or active participation in learning and curriculum delivery and the surrounding conditions and circumstances influencing participation, interest, or commitment to education and learning	*"I think learning can happen from anyone at anytime, even including patients."* (FG2, R) *"There's always all these distractions during rounds with so many other things going on. And this is just we're in one room together. This is the topic we're talking about right now, and we can all take the time to ask questions and everything. So it's been really helpful."* (FG3, RD) *"I think letting the floor [ICU nurses] know that we have education at that time, so we're not getting disrupted unless it's important to be called about."* (FG2, R) *"Most of our staff [attending physicians] will fill in as they see fit. So it's not just us up there lecturing. We do get a lot of staff involvement and discussion with the fellows as well."* (FG3, PharmD) *"Just the benefit of learning how to work in a team and trying to come to an agreement when you might not necessarily agree on everything."* (FG2, R)
Downsides to standardized curriculum featuring IPMs as educators	Disadvantages perceived around IPE in the ICU and limitations to delivering or participating in it	*"I still work 6 A.M. to 4 P.M., and it doesn't matter if we have the teaching as well as 2-1/2 hours of other meetings. We have to get all our work done in that time."* (FG3, PharmD) *"We're a billing provider as well. So we have expectations in our productivity. So just being able to put time aside for going, and then teaching is certainly not something we can bill for."* (FG3, PT) *"You're going to have times when you are going to incorporate interprofessional (staff) and you are going to have folks who disagree with your view."* (FG2, R) *"We have limited capacity for education in the sense of our time so we can't learn everything from physicians. [Learning from] the pharmacist then becomes a competing interest. There are times where depending on what our inherent priorities are for education, having to learn from other people, aside from physicians, may in theory be a negative."* (FG2, R) *"I think that if census is quite high, [having the lecture] might disrupt rounding such that you're not able to pre-round on everyone in the way that you would like to."* (FG1, R)

Table 2. *Continued.*

Theme	Description	Key and Illuminating Quotes
Prioritization of education, including by IPMs	Importance of consistent curriculum delivery; recognition of the value that IPMs provide as teachers; the importance of role modeling by attending physicians	*"There are certain attendings that are more devoted to it [standardized lecture curriculum] than others, and I would say that we're all pretty invested in it. So there's just a handful of attendings who don't seem to see the value and it's kind of frustrating."* (FG3, PharmD) *"The other perspective you can look at too is, if you incorporate medical education and you incorporate other teaching it to other professional groups, you're also signaling to those groups that they're important, they're valuable."* (FG2, R) *"There's some other team-building dynamics there when you bring them [IPMs] in. You are saying your input is valuable in the setting, I want you to be here and show these trainees, etc., what's going on. [...] You are showing from a team perspective that you value that."* (FG2, R)

Definition of abbreviations: ICU = intensive care unit; IPE = interprofessional education; IPM = interprofessional team member; MIC = minimal inhibitory concentration.

patient at the center of their daily activities in the ICU.

> *"There's some big, broad areas of medicine that I think a pharmacist can definitely assist them with. One of them is antibiotics. I find it's a deficit in most physicians just understanding MICs, and how the antibiotic works and the dosing, and what would be a better one for which bug you're growing."* (FG3, PharmD)

> *"Also it just reminds you that we're all here for the patient. Yes. We're a resident. Yes. We're training, yes, we're learning, but we're all here for patients. We're seeing all interprofessional disciplines actually talking about patient care. This is the same patient that I'm trying to help with. So you might as well learn from what they're doing because ultimately you're giving the best care."* (FG2, R)

Theme 4: Engagement and Environment

In this theme, participants explained how dynamic the hospital environment can be and how striving to create an environment conducive to learning was important. Engagement with the curriculum, including use of IPMs as teachers, by all parties was also described as beneficial.

> *"I think letting the floor know that we have education at that time, so we're not getting disrupted unless it's important to be called about."* (FG2, R)

> *"Most of our staff [attending physicians] will fill in as they see fit. So it's not just us up there lecturing. We do get a lot of staff involvement and discussion with the fellows as well."* (FG3, PharmD)

> *"Just the benefit of learning how to work in a team and trying to come to an agreement when you might not necessarily agree on everything."* (FG2, R)

Theme 5: Downsides to a Standardized Curriculum Featuring IPMs as Educators

Focus group participants were queried directly regarding downsides of using IPMs as teachers in a standardized curriculum such as this one. Both residents and IPMs identified many limitations, making this one of the most prevalent themes. Time constraints were a notable limitation described by both groups:

> *"I still work 6:00 A.M. to 4:00 P.M., and it doesn't matter if we have the teaching as well as 2-1/2 hours of other meetings. We have to get all our work done in that time."* (FG3, PharmD)

> *"We're a billing provider as well. So we have expectations in our productivity. So just being able to put time aside for going, and then teaching is certainly not something we can bill for."* (FG3, PT)

With specific respect to using IPMs as teachers, one resident stated:

> *"We have a limited capacity for education in the sense of our time so we can't learn everything from physicians. [Learning from] the pharmacist then becomes a competing interest. There are times where depending on what our inherent priorities are for education, having to learn from other people, aside from physicians, may in theory be a negative."* (FG2, R)

Theme 6: Prioritization of Education, Including by IPMs

This was a relatively smaller theme that examined the importance of consistent curriculum delivery as well as recognition of the value that IPMs provide as teachers. Multiple parties identified the key role attending physicians play in role modeling the importance of IPE and teaching by IPMs. Selective quotes include:

> *"There are certain attendings that are more devoted to it [standardized lecture curriculum] than others, and I would say that we're all pretty invested in it. So there's just a handful of attendings who don't seem to see the value and it's kind of frustrating."* (FG3, PharmD)

> *"The other perspective you can look at too is, if you incorporate medical education and you incorporate others teaching it to other professional groups, you're also signaling to those groups that they're important, they're valuable."* (FG2, R)

> *"There's some other team building dynamics there when you bring them [IPMs] in. You are saying your input is valuable in the setting, I want you to be here and show these trainees, etc., what's going on. […] You are showing from a team perspective that you value that."* (FG2, R)

DISCUSSION

There has been growing interest in interprofessional collaboration and its effects on patient care in the United States, particularly as the existing healthcare system grows increasingly complex. More than two decades ago, the National Academy of Medicine identified increasing opportunities for IPE as a key pillar to culture change (10). Since then, reports of successful incorporation of IPE in UME have ballooned, whereas comparatively less has been reported on IPE initiatives in GME (11, 12). Our study shows that teaching by IPMs can be integrated into a standardized lecture curriculum in an academic ICU environment. As we had no curriculum in place in our ICU before this project, we hypothesized that implementing the ICU lectures featuring IPMs would be beneficial and unique for two reasons. First, it allows for IPM, attending physician, fellow, and learner interaction during the lectures independent from patient care; second, it showcases IPMs in a formal teaching role. Although no significant differences were identified on pre- and postintervention assessments from learners in terms of perceptions of faculty engagement in teaching and educational value, we still found positive reception of the curriculum and collective acknowledgment of the benefits of IPE through the qualitative portion of the study. We believe that using IPMs for curriculum delivery may have increased awareness of being part of an interprofessional team. Similar to findings shared by Rak and colleagues, our focus groups consistently identified themes of increased mutual respect and understanding, shared goals, and a commitment from educators to invest in teaching to improve the quality of patient care (13). This is especially important given the number of challenges identified to providing effective education in the clinical learning environment. Existing literature is sparse with respect to formal assessment of interventions for IPE in the ICU, and our study is among the first to describe the perspectives and motivations of IPMs.

The ICU is a particularly ripe environment for the institution of IPE, largely because of its inherent team-based approach to care delivery and the physical proximity of IPMs to learners. However, despite the routine presence and participation of IPMs on rounds, IPMs infrequently engage in formal teaching, and there are significant differences in perceptions of teaching frequency across disciplines. Although formal incorporation of IPE in the ICU setting has been shown to be well accepted and feasible, little is known about how this can best be accomplished, particularly in an unpredictable clinical setting (14). Some studies have suggested that IPE would optimally be delivered in a case-based, just-in-time, and interactive format (13). Compared with this proposed model of IPE, our curriculum was unique in that we engaged IPMs to help curate and deliver specialty relevant content in a structured lecture format. Focus group dialogue suggests that this model of curriculum delivery was well received by residents and IPMs in our study, suggesting it is a viable way of incorporating IPE into GME. Furthermore, by elevating IPMs as educators, they may become more likely to teach on rounds as well.

Implementation of IPE is not without unique challenges. A recent study exploring nursing perspectives regarding teaching residents in the ICU identified time constraints and unknown learner needs as barriers to nursing delivery of IPE (15). The pressure of time constraints was mentioned repeatedly by both residents and IPMs in our focus groups. Residents reported difficulty in balancing patient care with education, particularly during periods of high ICU census or patient acuity. We attempted to mitigate this by asking nursing staff to hold nonurgent pages and phone calls during this education time and by having either attending physicians, fellows, or APPs field any calls or pages still received. We also encouraged flexibility to shift lectures to later in the day when necessitated by patient care responsibilities. IPMs reported additional challenges, namely that their clinical workload is not decreased commensurate with time spent providing the lectures, and also that spending time teaching has the potential to adversely affect compensation for those whose salary is based on relative value unit generation. Efforts were made to minimize these effects by limiting responsibility to deliver lectures to only once or twice per 4-week rotation. Also, physical therapists received permission from their leadership to use a "meeting block" on their schedule so they would not be scheduled for patient care during lecture time. None of the interprofessional staff in our study were required to give the lectures, nor was there any kind of compensation for doing so. Many described their own inherent motivation to teach, especially driven by being part of an academic teaching hospital. This motivation and buy-in from both sides is crucial to the long-term success of this type of curriculum.

Limitations

This study has notable limitations, including its single-center design, the limited number of resident focus group participants, lack of dedicated evaluations for the study itself, and lack of intern participation in the focus groups, all potentially affecting the generalizability of findings. There was no intermixing of residents and IPMs within the focus groups, which may have impacted the nature of the discussions. This separation was intentional, however, as we hoped to create an environment in which all parties felt comfortable to speak freely, and some of the comments do reflect that.

As discussion in the focus groups was prompted by standardized questions, and participation was strictly voluntary, it is possible that emergent themes are representative of feelings held by a more engaged and IPE-friendly group of residents. We further acknowledge the absence of participation of respiratory therapists and nurses as IPMs. Finally, we are unable to comment on the sustainability of this model of education, as our study period was limited to 14 months. As elucidated above, IPMs are not generally externally incentivized to deliver education in this fashion, so there is no way of guaranteeing longitudinal commitment from them. Despite these limitations, this model of curriculum delivery is ongoing in our MICU, with continued strong engagement and commitment from our IPMs, despite personnel turnover in some disciplines since study conception and lecture implementation.

There are many potential avenues for future research and innovation in this space. The effectiveness of IPE in the long term, particularly as it relates to clinician behavior and practice patterns, remains unknown, and studies exploring the effects of various types of IPE on learner knowledge acquisition would be beneficial. Brashers and colleagues present an extensive review of the literature on measuring the impact of IPE, and they have made helpful suggestions regarding long-term implementation of IPE and how to measure success (16). Their suggestions include making observations of learner behavior at baseline for future comparison and collection of pre-and postimplementation data at time points over many years. Next, as the acceptance and use of virtual learning platforms continues to explode, studies exploring how to successfully integrate IPE into asynchronous learning would be welcome. Not only could this augment other existing curricula but also it would minimize the pressure of time constraints felt by both learners and interprofessional educators. Finally, future research should focus on elucidating strategies about how best to translate the success observed using IPE in the ICU to other clinical settings.

Conclusions

Teaching by IPMs can be integrated into a lecture-based curriculum in an academic ICU. After implementation, learners described improved understanding of roles and responsibilities and mutual respect, whereas IPMs cited sharing of specialized knowledge and return on investment as motivations for teaching.

Author disclosures are available with the text of this article at www.atsjournals.org.

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