Enhancing Implementation of Complex Critical Care Interventions through Interprofessional Education

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ABSTRACT

Background: Many critical care interventions that require teamwork are adopted slowly and variably despite strong evidence supporting their use. We hypothesize that educational interventions that target the entire interprofessional team (rather than professions in isolation) are one effective way to enhance implementation of complex interventions in the intensive care unit (ICU).

Objective: As a first step toward testing this hypothesis, we sought to qualitatively solicit opinions about team dynamics, evidence translation, and interprofessional education as well as current knowledge, attitudes, and practices surrounding the use of one example of a team-based practice in the ICU—preventive postextubation noninvasive ventilation (NIV).

Methods: We conducted a qualitative evaluation using semistructured interviews and focus groups with nurses, respiratory therapists, and physicians working in four ICUs in four hospitals within an integrated health system. ICUs were selected based on variation in academic versus community status. We iteratively analyzed transcripts using a thematic content analysis approach.

Results: From December 2018 to January 2019, we conducted 32 interviews (34 people) and 3 focus groups (20 people). Participants included 31 nurses, 15 respiratory therapists, and 8 physicians. Participants had favorable views of how their teams work together but discussed ways team dynamics (e.g., leader inclusiveness) impact care coordination. Participants viewed interprofessional education favorably and shared suggestions

regarding preferred content and delivery (e.g., include both profession-specific and team-oriented content). Though participants reported frequently using NIV as a treatment, they described rarely using NIV as a preventive strategy, and nurses and respiratory therapists described challenges to use such as perceived patient discomfort. There were ICU-specific differences in management of patients at a high risk for respiratory failure after extubation, with some preferring to delay extubation.

Conclusion: Participants reported optimism that interprofessional education can be an acceptable and effective way to improve translation of evidence into practice. Participants also detailed patient-specific and ICU-wide barriers to the implementation of preventive postextubation NIV. This information about teamwork in the ICU, suggestions for interprofessional education, and barriers and facilitators to use of a target evidence-based practice can inform the development of novel educational strategies in ways that increase acceptability, appropriateness, and feasibility of the intervention.

Keywords:
implementation science; critical care; interprofessional education; evidence-based practice

Approximately six million patients are admitted to an intensive care unit (ICU) each year in the United States, with up to a million requiring invasive mechanical ventilation (1). The implementation of new evidence-based practices in this environment is challenging, with many mechanically ventilated ICU patients not consistently receiving evidence-based care (2, 3). One hypothesis regarding slow adoption of new evidence in ICUs is that traditional implementation strategies fail to account for the complex, interprofessional, team-based approach to care delivery routinely employed (3). For many evidence-based practices in the ICU, including those focused on liberation from mechanical ventilation, at least three members of the ICU team—the nurse, respiratory therapist, and physician—must communicate and coordinate their efforts (4). The inherent role of teamwork in the ICU, however, is neglected when an implementation strategy targets providers in isolation rather than as a team.

One implementation strategy that may overcome this problem is interprofessional

education (5). In healthcare contexts, interprofessional education is defined as learners from two or more healthcare professions learning together with the goal of simultaneously promoting shared knowledge and collaborative practice (6). Interprofessional education can promote shared mental models—which can facilitate evidence uptake by ensuring that different provider types think about implementation problems in the same way (7)—and effective specialization, communication, and trust, which together comprise "transactive memory," a collective memory system that improves team function (8).

Despite its potential value, little is known about how to effectively incorporate interprofessional education into implementation efforts in the ICU. To address this knowledge gap, we qualitatively explored dynamics of interprofessional ICU teams, such as team hierarchy, that may impact the use of evidence-based practices, and we solicited opinions and suggestions for two potential interprofessional education strategies—classroom-based and just-in-time interprofessional education—to inform future development and evaluation of these strategies in ICUs. Lastly, we evaluated current knowledge, attitudes, and practices surrounding the use of an archetypal team-based practice in the ICU—preventive post-extubation noninvasive ventilation (NIV)—that could be one ideal focus of interprofessional education in the ICU.

METHODS

We conducted a qualitative study that used both interviews and focus groups to identify interprofessional dynamics in the ICU; solicit input about the design of interprofessional education strategies; and understand current knowledge, attitudes, and practices regarding the target evidence-based practice. We used two complementary data collection methods to increase the

trustworthiness of our results (9). We used interviews to solicit individual opinions and focus groups to explore group norms and practices around the same issues. The use of both methods not only facilitated data collection regarding individual and group norms and practices but also allowed for triangulation in data collection as a way to confirm findings and increase credibility. This project was granted exempt status by the University of Pittsburgh Human Research Protection Office. Participants participated voluntarily and confidentially, consented verbally, and received $25 compensation.

Selection of the Evidence-based Practice

We focused on preventive postextubation NIV—which is used immediately after a planned extubation to prevent recurrent respiratory failure in a patient who is recovering but is at high risk for decline—because *1*) there is considerable evidence from randomized trials that preventive postextubation NIV improves outcomes for patients at high risk of respiratory failure after extubation (10–15), *2*) it is recommended in recent evidence-based clinical practice guidelines (16, 17), *3*) it is rarely used despite evidence of its efficacy (18), and *4*) this practice requires the input and coordination of multiple members of the interprofessional ICU care team (19).

Setting and Sample

We purposefully sampled ICUs within an integrated health system in both community ($n = 2$) and large academic hospitals ($n = 2$). In each participating ICU, we recruited a purposive sample that included nurses, respiratory therapists, and physicians, as these professions are primarily involved in implementing preventative postextubation NIV (19). As is typical with qualitative research, we did not

predetermine the number of interviews but rather recruited participants until data saturation was reached (20, 21). We considered data saturation to be reached when additional data collection did not lead to novel information within each of the participating ICUs.

Selection of Interprofessional Educational Strategies

We included questions about two specific strategies for continuing interprofessional education—classroom-based and just-in-time education—to solicit perceived benefits and drawbacks of each. The term classroom-based interprofessional education is used to describe a group of interprofessional learners gathering at a specified time and place to receive education before the moment of need, whereas just-in-time interprofessional education describes education delivered to a care team at the moment of need.

Data Collection Instruments and Piloting

We developed interview and focus group guides that were informed by input from clinical experts (T.D.G. and J.M.K.) and results of a survey study of current knowledge and attitudes toward preventative postextubation NIV (22). In a single adult ICU over the course of 2 days, we pilot tested the interview guide with three nurses, a respiratory therapist, an advanced practice provider, and a physician. We piloted the focus group guide with a group of nurses, respiratory therapists, and an advanced practice provider. Based on these pilots, we revised and refined questions. Interview and focus group guides are available in the data supplement.

Data Collection

During December 2018 and January 2019, a female, doctoral-level–trained medical anthropologist researcher (K.J.R.) and a

female, master's-level–trained public health researcher (E.A.C.) visited participating ICUs several afternoons per week over a 2-week time period. Study participants did not know the research team before the research. The researchers informed participants that they were qualitative researchers working with the principal investigator (T.D.G.) to learn more about promoting the adoption of evidence-based practices. As potential interview participants were caring for patients, we informed all eligible members of the team about our interest in conducting interviews should they have availability and be willing to participate. We did not, therefore, track "nonparticipation" but rather focused on continuing interviews until data saturation was achieved. Interviews were one time, in person, and conducted in or around the ICUs in a private location. We worked with nursing and respiratory therapy leadership to disseminate information about the focus groups together with details about how to participate. Focus groups were conducted on site at each hospital.

Data Management and Analysis

We audio recorded and took written notes during interviews and focus groups and transcribed them verbatim. We used NVivo qualitative software for data management (QSR International). We recorded demographic data in Excel (Microsoft). Using a constant comparative approach, we reviewed transcripts (which were not returned to participants) with clinical investigators (T.D.G. and J.M.K.) to inductively develop a codebook for thematic content analysis. Once the codebook was developed (*see* data supplement), two researchers (K.J.R. and E.A.C.) cocoded transcripts, resolving by consensus any coding that fell below 90% agreement, until percent coding agreement reached 98% (kappa = 0.81). Following

acceptable intercoder agreement, coding proceeded independently. The codebook consisted of themes, subthemes, and definitions (e.g., theme of risk-management strategies with subthemes of extubate, not extubate, and rationale). The results are presented as themes and subthemes with supporting quotes. As outlined in the data supplement, we used the Consolidated Criteria for Reporting Qualitative Studies (23).

RESULTS

We achieved data saturation with 32 interviews (representing 34 participants; average length, 30 min) and 3 focus groups (representing 20 participants; average length, 46 min) in four ICUs. Of the four ICUs, two were in academic and two were in community hospitals. The ICUs also varied by type (one medical, two medical and surgical, and one medical and cardiac), mechanical ventilation days per total patient days (range, 30–53%), and bed size (range, 10–22). Participation by ICU and participant characteristics are described in Table 1.

Our thematic content analysis identified four main themes related to interprofessional education for postextubation preventive NIV: *1)* interprofessional dynamics, *2)* opinions of interprofessional education strategies, *3)* current use of the NIV, and *4)* ICU extubation culture. The first two themes broadly relate to how interprofessional education can impact interprofessional care and provider knowledge, whereas the second two themes specifically relate to the interprofessional education in this clinical context.

Themes
Theme 1: Interprofessional dynamics
Participants consistently described their ICUs' communication and collaboration as positive, with a general view that team members are comfortable bringing ideas forward. However, there was some recognition that there are varying degrees to which teams function in an interprofessional fashion and that actual team collaboration means more than gathering together as a group.

Participants highlighted several specific aspects of interprofessional dynamics that illustrate how interprofessional education may act as a lever to improve uptake of evidence in the ICU. First, participants described beliefs that they would benefit from increasedknowledge and understandingof other team members' roles, which they view as interdependent and necessary, but that professional boundaries should be preserved. During a focus group, a participant noted, "I also think it's important that we know each other's roles well and the barriers on each other's roles so that way we can work together better." Second, participants discussed benefits of coordinating distributed expertise in the setting of quality-improvement projects, during which nurses and respiratory therapists came together to solve problems, such as skin breakdowns fromNIV masks. Third, a well-established hierarchy among the care team was described; although most nurses and respiratory therapists said they bring differing opinions forward, they acknowledge that physicians make the final decisions. This is relevant to the use of preventive postextubation NIV, as the ICUs do not have a protocol guiding the use outside of a physician order. Nurses and respiratory therapists stated they appreciate when physicians take the time to explain to the team why they made the decisions they did to form a shared understanding. Fourth, participants noted that physicians, as team leaders, demonstrate varying levels

Table 1. Interview and focus group participant characteristics

Characteristic	Interviews ($N = 34$)*	Focus Groups ($N = 20$)[†]
Site, n (%)		
Site 01	10 (29)	0 (0)
Site 02	8 (24)	6 (30)
Site 03	6 (18)	7 (35)
Site 04	10 (29)	7 (35)
Profession, n (%)		
Physician	8 (24)	0 (0)
Registered Nurse	16 (47)	15 (75)
Respiratory therapy	10 (29)	5 (35)
Age, median (IQR)	35 (32–49) ($n = 34$)	34 (28–53) ($n = 19$)
Year graduated from primary clinical program, median (IQR)	2007 (1,995–2,014) ($n = 32$)	2010 (2,001–2,015) ($n = 18$)
Years worked in current ICU, median (IQR)	6 (1.25–12.5) ($n = 33$)	3 (1.5–13.0) ($n = 19$)
Sex, n (%)		
Male	12 (38)	4 (20)
Female	22 (65)	15 (75)
Missing	0 (0)	1 (5)
Race, n (%)		
White	32 (94)	19 (95)
Multiracial	0 (0)	1 (5)
Other	1 (3)	0 (0)
Prefer not to answer	1 (3)	0 (0)
Missing	0 (0)	1 (5)
Ethnicity, n (%)		
Hispanic	1 (3)	1 (5)
Non–Hispanic	30 (88)	18 (90)
Prefer not to answer	2 (6)	0 (0)
Missing	1 (3)	1 (5)

Definition of abbreviations: ICU = intensive care unit; IQR = interquartile range.
*The 32 interviews involved 34 participants.
[†]The three focus groups involved 20 participants.

of leader inclusiveness (a term not explicitly used by participants), such as soliciting and valuing input from other members of the team. One example given in a focus group that was specific to extubation is when doctors ask, "what do you think [about extubation]? Do you think Optiflow? BiPAP?" Lastly, participants stated that team coordination occurs during rounds and through continued updates during the shift, and they valued teamwork and coordination within their ICUs.

There was also some discussion of the role of inter- and intraprofessional dynamics in relation to how knowledge is translated in the ICU. Nurses and respiratory therapists typically described top-down (pushed) diffusion, with implementation occurring because of a new policy or protocol and/or after demonstration by a physician, whereas physicians tended to describe diffusion via peer partnerships, indicating that physicians in their groups have different interests and bring new practices to the group to consider. Illustrative quotes of interprofessional dynamics are presented in Table 2.

Theme 2: Interprofessional educational strategies

Participants described a general belief that interprofessional education would benefit the ICU team by allowing team members to be on the "same page," to all hear the same information, and to understand the rationale behind decisions. As stated in a focus group, "Just like any team practices, you have your specialties, but you should [have] education as a team because we work as a team." In this way, interprofessional education would directly support the development of cultures that promote specific care practices. Example quotes for this theme and corresponding subthemes are provided in Table 3.

Interprofessional Classroom Education

When considering interprofessional classroom education, several participants suggested that profession-specific content be included (in addition to profession-neutral content), as a new practice has role-specific implications. Participants indicated that profession-specific content would also help other members of the ICU team to better understand each other's roles. One participant noted, however, concern that becoming too familiar with the professional role of others may result in overstepping professional boundaries. Participants also stated that interprofessional classroom education needs to be convenient to attend and to the point. Participants do not want to be lectured during interprofessional education, as they see the benefit of this type of education coming from interacting with others to see things from their perspective. Participants perceived that the benefit comes from learners getting on the same page (i.e., developing a shared mental model). They also described the belief that having multiple perspectives allows for consideration of a wider range of options and generates greater buy-in for whatever course of action is selected. Many participants stated that they already participate in unstructured interprofessional education, most often pointing to discussions that take place during morning rounds as an example. The biggest concern was how to schedule interprofessional continuing education so that everyone can attend, thereby representing a mix of professions. Several participants noted the need to pay special attention so that information is conveyed in a way that is accessible, and engaging, across the different audiences.

Interprofessional Just–in–Time Education

Participants noted that in-the-moment case-based learning is better able to "stick"

Table 2. Interprofessional dynamics quotes

Theme	Quote
Interprofessional dynamics	I think teamwork is … interprofessionalism is talked about a lot. I think a lot of times we pay more lip service to it than we actually manage to improve care delivery. Just because three of you are walking around together doesn't mean you're actually engaging in a functional team. And so I think it takes some work and it takes more work and attention than merely putting the team together. 01_MD
	I also think it's important that we know each other's roles well and the barriers on each other's roles so that way we can work together better. Like I know that [female name]has todo this, this, and this to be able to get the patient ready for their spontaneous breathing trial before I can even put them on there.Sothe more understanding we have of each other's roles, the better we can work together to understand how we can manage everything. Like the whole unit does better … 02_Focus Group
	And we had like some breakdown on a couple patients. And you know, I thought we did a pretty good job working with respiratory therapy. They kind of looked at it. We looked at it. They looked at the different things that they could do. 02_RN
	It's more of a physician decision. We don't have protocols for any of that stuff. 02_RT
	I think it's pretty good when I'm there and when one or two of the other … we have I think seven attending physicians. I think with three of us it's quite good because I think the three of us sincerely believe that this isa really importantpart of the care team; our respiratory therapists are really important parts of the care team. I know there are a few of our other attendings however who if they believe that, don't seem to demonstrate it. Andsonurses are not as comfortable going to them with issues or problems. 01_MD
	We discuss it during rounds and then like if somebody's not weaning, ready forextubationduring rounds, we kind of touch base throughout the day. They'll come let me know, "hey she's a lot more awake" and "maybe drop some pressure support here," and "do you think she's ready to extubate?" 03_RT
	So working in a team can influence it by like a physician saying, "Hey, I've read this study. This is evidence based. We need to look into this and we need to figure out how we can adjust to this." 02_RT

Definition of abbreviations: MD = physician; RN = nurse; RT = respiratory therapist.

because there is an actual practical application in front of you. They also described a preference for learning in a "hands-on" manner. As a result, participants believed that just-in-time education would facilitate a greater ability to apply the information to the next similar case. Participants described the timing of just-in-time education as a major concern, as the ICU environment is highly unpredictable. They also expressed

Table 3. Interprofessional education quotes

Theme	Quote
Opinions of interprofessional education	I think that'd be helpful. You know, you'd be learning like the same things and everybody'd be on the same page in a way with certain stuff. I'd think it be good too because you could learn from like the physician standpoint, what they're thinking or what they're learning. And then they get to see from our side too like what our goals … and what we do. 03_RN
	I think that would be awesome because I feel like sometimes, you'll have, (and it could be in any given day at any given time), you'll have a respiratory therapist that is at a level one experience, maybe they just graduated, you can have a nurse that's been here for a dozen years, pass off this experience. Then you can have a doctor that, he can understand it but he can't explain it, or any version of all three. Or they could all be extremely experienced and extremely skilled but all have different mindsets because of the different types of education we all get. 02_RT
	I think it's a great thing because every month we get a new group of doctors that round through here so we spend the month teaching them like the ways of CCU, and then last week when they finally like feel comfortable, then it's time for a whole new group to come in. So I think it's awesome to have … speaking together as a team, with the nurses involved as well, so we all are hearing the same things and it's not just the nurse going to the doctor and saying, "well they told us this." And then the doctor doesn't really believe us, and they want to hear it first hand. So I think it would be a good thing. 01_RN
Interprofessional classroom sessions	I think it's particularly good when we're looking at things like this. When do you extubate? When don't you extubate? What can we do to prevent their reintubation? Because all those people you just mentioned play major roles in that. The bedside nurse plays a major role, the respiratory therapist. So to bring them all together and say, "okay this is our problem. This is what we think the issues are. This is how we think we want to address is. These are your jobs, these are your jobs, these are all our jobs." I think that's very useful and to say it all together and have everybody sitting in the same room looking at each other and commenting on whatever it is they choose to comment on … 01_MD

Table 3. *Continued.*

Theme	Quote
	What would make it work is that everybody feels that they're benefiting from it. Not just one profession is getting the benefit and the other is just "okay, we knew all that. There's nothing interesting in this." So you have to have something for everybody to keep them all engaged … 01_MD
	It's hard to get everybody through mostly because you have different times and different days. And with a large number of say, nurses compared to respiratory therapists, there's going to be five to six nurses for every one respiratory therapist. And there can be trouble getting everybody through the education and hearing the same things, and understanding. 02_RT
Interprofessional just–in–time sessions	It sticks that way, right? I mean, you've got a case you have a patient and you're doing it for real, not on a dummy and not watching someone do it on TV. So I find if you have a patient case, that you actually do it, and you're hands-on and you're invested in it, it will stick better. So I think that's a great idea. 04_MD
	Well it sounds like it's not going to be a real long lengthy one. That I guess, could be done in rounds because that wouldn't be a real lengthy thing … 03_RT
	I would say yeah. I could think of the drawbacks would be, one I'm just not, I just don't want to hear it right now because I have other stuff to do. And two, I feel like the person giving the information can reach more eyes and ears if they're doing just in time and telling me about a face mask adjustment I could sit ten people down and tell them all at one time versus telling them ten different times. You know what I mean? 02_RN

Definition of abbreviations: CCU = cardiac care unit; MD = physician; RN = nurse; RT = respiratory therapist.

concern that they would be easily distracted, not really listening to what was being presented. At the same time, many participants indicated that they already participate in a type of just-in-time education, which they view as valuable. Examples of ongoing just-in-time education included discussions during rounds and on-the-job education provided by the unit clinician and/or "super-users." Respondents suggested that just-in-time education may not be the most efficient way to disseminate information because it only incrementally diffuses to other members of the team.

Theme 3: Current use of NIV
Participants indicated that their ICUs are familiar with NIV (which they often

referred to by the brand name "BiPAP"), particularly as a treatment for obstructive sleep apnea or for acute exacerbation of chronic obstructive pulmonary disease (COPD). Some nurses and respiratory therapists alluded to a disconnect between the straightforward act of a doctor placing the order for NIV and what it actually entails for the nurse and respiratory therapist to carry out the order. As a respiratory therapist described it, "And you put it on; even though it's helping them, they have the perception that it's making things worse. So, we have to really educate the patient. And then while they're on it, we need to continue to make sure that they're tolerating it well."

For nurses and respiratory therapists, patients' difficulty communicating and their discomfort during NIV are drawbacks to use, as is patients' nonadherence. However, physicians described the benefits of general NIV use, particularly in preventing more drastic efforts such as intubation. Quotes illustrating current use of NIV are given in Table 4.

Theme 4: Extubation cultures

Participants described norms surrounding the decision of whether or not to extubate a patient—what we label an extubation culture, though participants did not use this label—and revealed ways in which these norms differed across participating ICUs. When faced with a patient considered at high risk for respiratory failure after extubation (e.g., one with a marginal spontaneous breathing trial result), participants from two ICUs described a tendency to delay extubation in the hopes of more fully optimizing the patient or until they feel more confident the extubation will be successful. A respiratory therapist described the decision: "But normally, most of the time, we're expecting them to do

well. We tend to not extubate people who have a high chance of being reintubated."

Though participants (particularly physicians) from all four ICUs acknowledged that they sometimes use preventative postextubation NIV, especially for patients with COPD, most participants stated that postextubation NIV is rarely used preventively. At least one participant in all four ICUs described the use of preventative postextubation NIV as a bridge. In an interview, a physician noted, "Well I think it's a temporizing measure. I've often said BIPAP for instance, is not … . It's a bridge. It's not a destination." However, when NIV is used after extubation, they stated it is used more often as a rescue treatment for postextubation respiratory failure. One ICU was described as being "anti-BiPAP," with a preference to use postextubation high-flow oxygen instead of NIV for higher risk patients. Representative quotes are also given in Table 4.

DISCUSSION

Educating providers in isolation neglects the inherent role of coordination in evidence-based critical care (24). We therefore probed participants regarding the different ways members of the ICU team interact and opinions on interprofessional learning. In this qualitative study, we found that ICU team members, including nurses, respiratory therapists, and physicians, are optimistic that interprofessional education, which can occur in a classroom or at the bedside, can be an acceptable and effective strategy by which to advance the implementation of complex, evidence-based practices in the ICU. They view interprofessional education as beneficial when the content addresses professional roles and the sessions are interactive. Interaction with the other members of the team was the biggest

Table 4. Use of noninvasive ventilation and extubation culture quotes

Themes	Quote
Use of noninvasive ventilation	All of a sudden, a patient's not breathing well. We come at them with this mask that's blowing like a ShopVac. In fact, it's in your face. It scares people. And you put it on; even though it's helping them, they have the perception that it's making things worse. So we have to really educate the patient. And then while they're on it, we need to continue to make sure that they're tolerating it well. Be aware of skin breakdown. Change masks periodically, and make sure that we're getting therapeutic … 02_RT
	You can't understand [patients on NIV]. They want to talk to you and they get frustrated because we can't hear them because they're muffled. And then they get anxious. And then they get more short of breath, and their sats drop even lower. Their mouth is super dry because of the air flow. They're constantly asking for water and the majority of families don't understand that you can't take the mask off every five minutes to swab their mouth. They're hungry. They want to eat. They don't understand why they can't. Communication's the biggest thing though … 01_RN
	Well if you don't have to intubate the patient, then you don't have to get into difficulties with sedation, hypotension related to sedation. You know, [NIV] decreases the length of stay in the intensive care unit, decreases morbidity, mortality … 02_MD
Extubation culture	So my usual practice is that if somebody has a borderline spontaneous breathing trial, I might wait another day to try to reassess the risk to see if they can optimize the medical therapy and try to being a little more grounded into the establishment of the patient before extubation. 03_MD
	I just feel that if you go to that, you're going to use that, like I said before, I feel like they're not ready to be extubated if you're going to use the BIPAP. That's my perspective on that. I'm not the doctor. I just feel like they're not ready to be extubated so why extubate them and throw them on that BiPAP … 02_RT
	Mostly BiPAP, especially if they're COPD or something at baseline. Not for airway disease at baseline. Most of the time that would be the plan. We extubate them to BiPAP for a while trying to kind of non-invasively ventilate them for a while and transition to just oxygen. 01_MD
	COPD patients. Stuff like that, sometimes we would … or if … it's kind of borderline iffy. "Should we pull the tube? Should we not pull the tube?" sometimes they would pull it and perform BiPAP, too. Q: How often is that? A: I feel not that often. Most of the time, we're pretty sure [on extubating]. 04_RT
	So let's just extubate to bipap, not as often here, because they are not real pro-BiPAP … 04_RT

Table 4. *Continued.*

Themes	Quote
	The BiPAP, while it does a great job giving oxygen and talking away the work of breathing, easing the work of breathing, it dries out secretions and it pushing secretions deeper. Patients can't cough. I think it causes more trouble than it's worth. Patients with bad chronic lung disease, COPD, pulmonary fibrosis, BiPAP's great. We use it a lot, very successfully, but I've used a lot of Optiflow. It's heated. It's humidified. People feel much more comfortable with it on. 04_MD
	and usually I will try Airvo before I try BiPAP. But I would like to try the Airvo first since we're not putting the mask back on somebody and make them more uncomfortable than they really need to be. 04_RT

Definition of abbreviations: BiPAP = bilevel positive airway pressure; COPD = chronic obstructive pulmonary disease; MD = physician; NIV = noninvasive ventilation; RN = nurse; RT = respiratory therapist.

value ascribed to interprofessional education, as ICU team members indicated that they value developing a better appreciation of the perspectives of others in the team as well as shared mental models of when and how to use a practice. The proposed just-in-time education, for example, is intended to generate interprofessional discussion and would be similar to (though more targeted than) discussions that occur organically during rounds, a setting that participants indicated facilitates learning.

We asked ICU nurses, respiratory therapists, and physicians about the current use of NIV and management of patients at risk for respiratory failure after extubation to explore ways that teams interact around these activities and to identify tractable areas that might be targeted by interprofessional educational activities designed to increase the use of preventive postextubation NIV. Our findings reveal ways that interprofessional education could target specific barriers and leverage opportunities for improving the use of this specific team-based intervention, which is strongly supported by current evidence but is used infrequently in routine clinical practice (18, 25). An important barrier to

preventive postextubation NIV identified in this study was a tendency to delay extubation when it comes to patients at high risk for respiratory failure after extubation. This barrier could be addressed with an interprofessional education strategy that not only presents the evidence supporting preventive postextubation NIV but also creates a shared understanding of the risk inherent in delaying extubation in the hopes that a patient will be become more optimized for extubation. Furthermore, interprofessional education could help to change current extubation cultures by emphasizing the practice as a "bridge" to liberation from mechanical ventilation, thereby empowering the team to incorporate the practice as a routine step in the process and to communicate the role of preventive postextubation NIV to patients and families.

Another barrier to implementation of preventive postextubation NIV—the disconnect between the straightforward act of ordering NIV and the complex process of using it—likely impedes the implementation of other complex, team-based interventions in the ICU. Any intervention that requires communication and coordination of the ICU team will be

difficult to implement if members of the team are fractured rather than unified regarding the benefits and challenges that come with implementation. Traditional continuing medical education may be ineffective as an implementation strategy in the ICU, in part because it fails to account for the team-based nature of critical care. Like preventive postextubation NIV, most evidence-based practices in critical care are complex and multifaceted, requiring ongoing coordination within a dynamic interprofessional care team (26).

The ICU is a particularly challenging environment within which to translate new evidence into practice care (2, 3). In this setting, multifaceted implementation strategies may have greater success than educational strategies alone. One large cluster randomized trial, for example, found that a multicomponent strategy consisting of audit and feedback, dissemination of algorithms, and expert-led educational sessions improved adoption of targeted care practices in ICUs compared with control quality-improvement strategies. The educational component studied, however, consisted of traditional videoconference sessions that did not engage learners as an interprofessional team. Indeed, to date, very few studies (and, to our knowledge, no randomized trials) have examined the effects of interprofessional education in the ICU. High-quality trials are now needed to determine the effectiveness of interprofessional education. Ideally, these studies should examine interprofessional combined with other adult learning and implementation strategies (e.g., audit and feedback, protocols, etc.). Our work informs such efforts by revealing how interprofessional continuing education might provide advantages to traditional siloed education in the ICU.

One strength of our study was the inclusion of participants from ICUs that varied based on several characteristics (academic vs. community, volume of mechanical ventilation, and number of beds), which allowed for identification of variation in knowledge, attitudes, and practices as well as a broader range of factors that may impact acceptability, appropriateness, and feasibility of an interprofessional educational intervention. Another strength was that, in all but one ICU, we were able to triangulate findings across methods by exploring perceptions through both interviews and focus groups. One limitation of our study is that we did not include participants from all types of ICUs, so our findings may not be transferable to all ICUs. Also, although all nurses, respiratory therapists, and physicians who were working in participating ICUs on the days that we conducted interviews were eligible to participate, we allowed participants to self-select to be interviewed. In addition, we did not take a comprehensive approach to including ICU leadership. Thus, our findings may express the viewpoints of the bedside clinicians but not the leadership.

CONCLUSION

We found optimism among ICU team members that interprofessional education in a classroom and just-in-time setting can be acceptable and effective strategies by which to translate evidence into practice. Our findings can inform the design of interprofessional education that is acceptable, appropriate, and feasible for ICU team members. Interprofessional ICU team members reported patient-specific and ICU-wide barriers to the implementation of preventive postextubation NIV, a complex, evidence-based intervention that must be implemented by multiple members of the ICU team. Knowledge of learners'

current beliefs and practices, for example, can be used to tailor educational content to address barriers and leverage facilitators of uptake, and opinions and suggestions regarding interprofessional classroom and just-in-time education can inform the design, content, and delivery of the education.

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