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REPORTS OF ORIGINAL INVESTIGATIONS

Factors influencing the implementation of a ventilation weaning protocol in an adult intensive care unit: a qualitative multidisciplinary evaluation

Facteurs influençant la mise en œuvre d'un protocole de sevrage de la ventilation dans une unité de soins intensifs pour adultes : une évaluation qualitative multidisciplinaire

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Abstract

Purpose *Development of protocolized care in the intensive care unit (ICU) improves patient outcomes, but presents multiple challenges. A mechanical ventilation weaning protocol (WP) was adopted in our institution but was underused. This study aimed to determine the factors that influenced the implementation of this protocol locally.*

Methods *We performed a qualitative descriptive study using semidirected interviews in small profession-specific focus groups. The interviews were based on a standardized guide covering the major domains found in the Consolidated Framework for Implementation Research. A total of 32 participants across four key professions were recruited. The interviews were transcribed and codified sequentially, followed by categorization and analysis.*

Results *Three broad factors emerged that negatively impacted the implementation of the WP. First, the goals of the WP differed between professional groups. This difference led to significant frustration and breaches in collaboration. Second, there was a lack of a continuous quality improvement process. Third, the WP was incompatible with the routine and procedures already in place at the time of implementation. Time-of-day of WP application and patient safety concerns were specifically identified issues.*

Conclusions *Implementation of a continuous improvement process with regular and specific follow-up may help identify potential challenges and thus help ensure a more consistent use of the WP.*

Résumé

Objectif *La mise au point de soins protocolisés à l'unité de soins intensifs (USI) améliore les issues pour les patients, mais présente de nombreux défis. Un protocole de sevrage de la ventilation mécanique a été adopté dans notre établissement mais a été sous-utilisé. Cette étude visait à déterminer les facteurs qui ont influencé la mise en œuvre de ce protocole au niveau local.*

Méthode *Nous avons réalisé une étude descriptive qualitative en nous fondant sur des entrevues semi-dirigées dans de petits groupes de discussion alloués par profession. Les entrevues étaient fondées sur un guide normalisé couvrant les principaux domaines du cadre CFIR (Consolidated Framework for Implementation Research). Au total, 32 participants de quatre professions*

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clés ont été recrutés. Les entrevues ont été transcrites et codifiées séquentiellement, suivies d'une catégorisation et d'une analyse.

Résultats *Trois grands facteurs ayant un impact négatif sur la mise en œuvre du protocole de sevrage sont apparus. Premièrement, les objectifs du protocole de sevrage différaient d'un groupe professionnel à l'autre. Cette différence a entraîné une frustration importante et des bris de collaboration. Deuxièmement, il n'y avait pas de processus d'amélioration continue de la qualité. Troisièmement, le protocole de sevrage était incompatible avec la routine et les procédures déjà en place au moment de sa mise en œuvre. Le moment de la journée de l'application du protocole de sevrage et les préoccupations en matière de sécurité des patients ont été spécifiquement identifiés.*

Conclusion *La mise en œuvre d'un processus d'amélioration continue avec un suivi régulier et spécifique pourrait aider à identifier les défis potentiels, et ainsi assurer une utilisation plus cohérente du protocole de sevrage de la ventilation mécanique.*

Keywords ICU · mechanical ventilation · multidisciplinary team · quality improvement · weaning protocol

Often an essential and supportive modality in critical illness, mechanical ventilation (MV) is associated with several adverse effects such as increased mortality and hospital readmission.[1,2]

Several studies have shown that weaning protocols (WP) integrating a daily interruption of sedation (DIS) and a spontaneous breathing trial (SBT) can reduce the duration of MV and its associated complications, including mortality.[3–10] Despite these benefits, many institutions report noncompliance with WP.[11–13] While several contributing factors have been identified in the pediatric intensive care unit (ICU) literature, very little data exist about factors influencing the implementation of a WP that combines DIS and SBT in the adult ICU.[14]

Our local WP was implemented in 2017, requiring mandatory multidisciplinary screening of all MV patients for inclusion every 24 hr. The patients that meet inclusion criteria for the WP first undergo a DIS if no exclusion criteria (which include, for example, seizures, agitation, neuromuscular blockade) are met. If the DIS is deemed successful, a SBT is then trialed after again ensuring that the patient does not meet the exclusion criteria, such as positive end-expiratory pressure > 8 cm H_2O or fraction of inspired oxygen $> 50\%$. If the patient passes the SBT, the information is passed on to the physician, suggesting that the patient may be a candidate for extubation. If any of the criteria required to move on to the next step are not fulfilled, sedation is restarted according to the protocol. The protocol used at the time of the study (eFigure) can be found in the Electronic Supplementary Material (ESM). Nevertheless, despite specific training of nurses, respiratory therapists (RTs), and ICU attending physicians, as well as regular meetings with nurse and RT leaders to foster a collaborative effort to implement the WP, it remains infrequently used. The goal of this study was to describe the factors influencing the implementation of a WP that combines DIS and SBT in the adult ICU.

Methods

Study design

We conducted a qualitative descriptive study using focus groups to explore the perspectives of allied health professionals and physicians regarding a WP. This design is relevant to generate a straightforward, detailed description of participants' perspectives to provide an in-depth understanding of their experience using the WP.[15]

Setting, population, and sample

We recruited four categories of professionals (nurses, RTs, residents, and ICU attending physicians) through convenience sampling from three adult ICUs in a university hospital center where the WP was implemented. These ICUs had a total of 44 beds (14 medical ICU beds, 16 surgical ICU beds, and 14 mixed ICU beds). An average of 3,500 patients are admitted to these ICUs yearly, of which around 450 undergo MV. The nurse-to-patient ratio in the ICUs is 1:2. To be included, nurses and RTs needed to work on the night and/or day shift (therefore excluding the evening eight-hour shift, which is less relevant to the WP) and work at least five shifts per month in the ICU. Residents needed to have at least two years of experience working in the ICU and needed to work in internal medicine, general internal medicine, respirology, or anesthesia. We invited all ICU attending physicians to participate. There were no exclusion criteria for any of these four categories of professionals. Each focus group was conducted by category of professionals and included a minimum of three and a maximum of ten participants to create a maximum of interactions and ensure representativeness.[16]

Data collection and measures

Following managers' approval, the research team invited professionals to participate in one specific focus group for each category through verbal invitations and promotional posters. Focus groups took place in the ICU where the participants work between September 2019 and March 2020. After obtaining informed consent, participants completed a sociodemographic questionnaire verbally, and took part in a focus group interview. These were conducted in French by a member of the research team based on a validated interview guide, which can be found in the ESM eAppendix. The interview guide was developed by the multidisciplinary research teams based on the major domains found in the Consolidated Framework for Implementation Research (CFIR). The CFIR provided a menu of constructs organized in five domains that have been associated with effective implementation: intervention characteristics, outer setting, inner setting, characteristics of individuals, and implementation process.[17,18] Each domain was addressed within the focus groups through a few open-ended questions. The meetings lasted 45–60 min and were audio recorded to facilitate verbatim transcription and data analysis.

Ethical consideration

The study protocol was approved by the *CIUSSS de l'Estrie-CHUS* research ethics committee (#2020-3268; Sherbrooke, QC, Canada). Participation in the study was voluntary and participants could withdraw at any time. We ensured data confidentiality by removing all names from the transcripts and no links were established between the participants and the data collected.

Analysis

The recordings were first transcribed and uploaded to Dedoose© software (SocioCultural Research Consultants, Manhattan Beach, CA, USA) for further analysis.[19] A first level of coding was done by one of two members of the research team (M. L. and F. L.-B.). We categorized the results according to the domains of the CFIR and by category of professional. Emerging themes that were not identified initially were added to the code tree. Then, a third member of the research team (É. G.) carried out open cocoding of all transcripts (i.e., reviewing and building on the initial coding) to ensure homogeneous coding and thus credibility and reliability of the results. We resolved disagreements through discussions between the three members involved in coding. Then, we condensed the data and summarized the results using tables, based on prearranged categories related to the five domains of the CFIR.[17,20,21] The analysis involved iterative discussions between the research team members to examine the relationship and patterns in the data until a consensus was reached.[22] Transcripts quoted in this paper were translated from French into English by the research team.

Results

Thirty-two individuals participated in one of the seven semidirected focus groups, three of which were with nurses, one of which was with RTs, two of which were with residents, and one of which was with intensivists. Table 1 summarizes the sample characteristics. The results are summarized in Table 2 according to the five domains of the CFIR.

Intervention characteristics

The characteristics of the WP were discussed in terms of design quality, intervention rationale, implementation support, and associated risks. The latter construct was added to this domain by the authors to reflect the concept of risks inherent to the intervention. The WP design appeared satisfactory to most participants. Nevertheless, the time of day at which the protocol called for sedation interruption was the source of major challenges according to most participants. All participants agreed that the WP was important for patients as it aimed to reduce ventilation time and its associated risks.

While most nurses and RTs felt satisfied with the initial training, all agreed that there was no ongoing training or support. Importantly, nursing staff felt unsupported by their resident colleagues as they did not receive the same kind of formal training. Residents reported feeling underprepared to assume leadership of this task, even recognizing very little to no knowledge of the protocol's existence.

While intensivists and RTs viewed the sedation interruption as relatively safe, nurses feared for the safety and comfort of patients as they awakened. Nurses mostly feared that agitation and accidental self-extubation may occur. Residents also feared this as they felt ill-prepared to deal with emergent reintubation.

Outer setting

The outer setting refers to patient needs and resources as well as peer pressure and competition. One key item voiced by most participants across all professions was the lack of patient individualization associated with protocolized MV weaning. Nursing staff highlighted the variable sedation needs according to patient types and underlying disease. Intensivists also emphasized this concern, while also citing

Table 1 Participant characteristics

	Nurses	Respiratory therapists	Residents	Intensivists	Total
Number of professionals accessible, *n*	120	30	90	10	250
Number of participants, *n*/total *N* (%)	17/32 (53%)	5/32 (16%)	7/32 (22%)	3/32 (9%)	32/32 (100%)
Years of experience, median (range)	9 (1–22)	10 (2–16)	2 (1–3)	7 (3–14)	
Female, *n*/total *N* (%)	15/32 (88%)	3/32 (60%)	4/32 (57%)	0/32 (0%)	22/32 (69%)

Table 2 Participants' perceptions about the CFIR's five domains

CFIR's domains	Positive	Negative
Intervention characteristics	Design quality (Int)	Implementation support (RN)
	Intervention rational (RN, RT, Res, Int)	Risks (RN)
	Implementation support (RT, Int)	
	Risks (RT, Int)	
Outer setting	Peer pressure and competition (Int)	Patient-specific needs (RN, Int)
		Peer pressure and competition (RN, Res)
Inner setting		Culture (Res, Int)
		Compatibility with other procedures and values (RN)
		Tension for change (RN, Res)
		Goals, incentives, and feedback (RN, RT, Res)
		Relative priority (RN, RT, Res)
Characteristics of individuals	Competence (Int)	Competence (Res)
	Attitude (RT, Int)	Attitude (RN, Res)
Implementation process	Staff engagement (Int)	Planning (RN)
		Staff engagement (RN, Res)
		Execution (RN, RT, Res)
		Evaluation and quality improvement (RN, RT, Int)

CFIR = Consolidated Framework for Implementation Research; Int = intensivists; Res = resident; RN = nurses; RT = respiratory therapists

the need for multidisciplinary availability at the bedside when sedation weaning begins in the morning. This was difficult to achieve because of staffing constraints.

The concept of peer competitive pressure affected implementation negatively according to most nursing staff and residents. Interdisciplinary dynamics were a source of occasional frustration to participants. While nurses expressed frustration when immediate extubation did not occur, residents felt this pressure and were hesitant to call their attending staff in the early morning hours, especially given the assumption that extubation was frowned upon when attending staff were not physically present. They reiterated their discomfort with emergent airway management if extubation were to fail.

Inner setting

This domain refers to constructs that include culture and implementation climate (including its subconstructs).

Culture

The pre-existing values and norms, reflecting the general ICU culture at the time of implementation, were characterized by mixed emotions and perception. In the years preceding implementation of the WP, nursing staff reported feeling a culture change specifically relating to less sedative use. Mechanical ventilation in patients who were awake represented a paradigm shift compared with earlier decades, but resulted in significant anxiety related to patient comfort and staff workload. Intensivists shared this vision of the evolution of sedation practices but saw it as an improvement instead of an increased workload. Nursing

staff also deplored a lack of proximity and support between themselves and their superiors in decision-making positions.

Compatibility with other procedures and values

No professional group found that the WP fit seamlessly into the collective routine. The issue of timing was of particular concern to both nurses and RTs. The WP called for sedation interruption to begin at 6:30 am. As shift change occurs at 8:00 am, they felt that such a labor-intensive maneuver was not appropriate as there was already a long list of tasks to accomplish at this time. No suitable alternative timing was proposed by either group.

> "[…] the protocol must be performed at the time when we have the most work. It's at that moment that we need to finish our notes, send in bloodwork, breakfast arrives, electrolyte repletion, lab results …"–Nurse

Goals, incentives, and feedback

A very clear difference of opinion existed between nursing staff, RTs, and intensivists as to what the goals of the WP should be. Intensivists, who were the instigators of this initiative, only wanted to appropriately identify the patients who could be safely liberated from MV, whereas RTs and nurses wanted the protocol to lead to immediate extubation.

> "Nurses were more skeptical than us. We saw it in a positive light as we were finally going to be able to extubate. We saw it as an opportunity."–RT
> "The protocol was built to identify patients who are ready to be liberated from the ventilator. [Nurses and RTs] must therefore inform the medical team of the results which will inform whether to extubate the patient. The protocol was not built to automatically extubate patients when they pass their protocol. This is a misunderstanding on their part." –Intensivist

The residents' main objective was to address urgent clinical problems only. A lack of specific instructions from attendings pertaining to next steps following successful awakening and spontaneous breathing led residents to opt for the perceived safer option, which was to sedate patients once again and defer further decision regarding extubation to the daytime staff.

Relative priority

Mirroring the above findings is the concept of relative priority of this intervention. Nurses, RTs, and residents all felt that implementation of the WP was not being prioritized by leadership even if all agreed on its benefits to patients. Residents felt that other tasks were viewed as more important during the last hours of a night shift and therefore did not prioritize this protocol in their to-do lists.

Characteristics of individuals

The results are reported here in subcategories that are not specific to the CFIR and can be included in the construct of "Other Personal Attributes." We report here our findings for the constructs of competence and attitude as they relate to staff relevant to our study.

Competence

When asked about a variety of indicators ranging from protocol knowledge to clinical judgment and aptitude to care for ventilated patients, both nurses and RTs reported ease and experience. For reasons mentioned previously, residents felt the opposite.

> "We don't know this protocol enough to tell if it is well made or not. No such thing was in place in other centres I've been to. [Other intensivists] went with their gut feeling…" –Resident

Attitude

Residents were less compelled to show initiative in the realm of MV, instead displaying disengagement and passivity. Motivation to learn about MV and weaning, and the sense of professional obligation that accompanied this task, was strongly diminished. This contrasted with the attitude of intensivists and RTs who felt a profound sense of professional obligation relating to MV weaning. Nevertheless, as is reported by residents, intensivists did not display consistent leadership in instructing the night resident team as to what their expectations were toward MV weaning and the WP.

Implementation process

Planning

Nursing staff had the most grievances regarding planning of implementation of the WP. Staff directly involved in patient care felt uninvolved in decision-making regarding the timing of sedation interruption, even though nursing leaders had been involved in protocol development.

Execution

Despite some doubts, the rollout of the WP was reported by all, except residents, to have been met with a positive and open-minded attitude. Nevertheless, it became apparent soon after the launch of the initiative that fatigue with the WP ensued, leading to disuse. When sedation interruption was attempted, nurses reported a high degree of intraprofessional variability in the way this was achieved even though the protocol was clear in that regard. If sedation interruption was successful, RTs were not always readily available for SBTs for a variety of reasons. Finally, if a protocol result was communicated to residents, the communicated information was perceived as unimportant to them.

Evaluation and quality improvement

Participants did not see evidence of a quality improvement process. The reason given by intensivists for not seeking data showing efficacy was that the protocol was simply not applied appropriately. They acknowledged that more follow-up studies of new protocols should take place. RTs mentioned they would have liked to see data showing its effectiveness as a motivational tool. Nursing staff particularly appreciated the focus group discussion that took place for the present study citing rarity of such opportunities.

> "I've been in this hospital a long time. It's the first time we have a meeting to see what the experience is on the ward. First time." –Nurse

Discussion

Three main factors appeared to have negatively influenced the WP's implementation and should be further considered to inform future initiatives. These are 1) a shared understanding of the protocol's goals and objectives, 2) the lack of a quality improvement process, and 3) compatibility with existing routines, values, and procedures.

First, there was divergence among professional groups regarding the protocol's goals and objectives. At its inception, it was clear to intensivists that the WP existed only to identify readiness for MV liberation. This was contrary to the goals of nursing staff and RTs who wanted to expedite the extubation process. This difference led to significant frustration and breaches in collaboration. This variation in the understanding of the protocol could be due to cultural differences associated with each profession. Traditionally, nurses and RTs make decisions relating to patient care that take place in a relatively short time horizon (hours to days), at least in the ICU context. Physicians, however, plan care over days and weeks. This undoubtably affects how some aspects of direct patient care are felt, perceived, and valued. The impact of waiting before extubation was felt more strongly by nurses and RTs who are at the patient's bedside. Finally, training on the protocol was offered by different actors for each profession. It is possible that this variation in culture influenced the presentation of the protocol.

A second factor that emerged is the lack of a continuous quality improvement process. At the genesis of this study was the assumption that the protocol was not being appropriately used despite significant resources having been deployed originally for staff training and coordination. Nevertheless, no process existed to confirm this assumption.

The third factor identified is compatibility with the routine, values, and procedures already in place at the time of implementation. As was very clearly highlighted by nursing staff, the time at which the protocol calls for daily sedation interruption is not appropriate from their perspective. Nevertheless, no alternative time of day was proposed. When it comes to patient safety, nurses believed that daily sedation interruption was not worth the risk of self-extubation, self-harm, or harm to staff if immediate extubation was not a possibility.

Some implementation facilitators were also identified. All participants were aligned in their understanding of potential benefits for patients. This helped staff to rationalize their work and motivated them to apply the protocol, especially in the weeks following implementation. There is also a significant culture of research and improvement within the center.

Our findings align with those in the current literature. Implementation of the *awakening and breathing coordination, delirium monitoring/management, and early exercise/mobility (ABCDE) bundle* was facilitated by a greater sense of stakeholder autonomy and empowerment.[23] Barriers to implementation were similar to the ones reported here, including reluctance to follow both new and existing protocols, numerous care coordination and communication barriers, and workload-related concerns. Similarly, and pertaining specifically to DIS in the ICU, it was reported that stakeholder alignment on goals may be vital to implementation.[24]

In our study, there was significant interest across all professional groups in the benefits of WP. Nevertheless, despite a good understanding of the rationale behind this intervention, the results of our study align with those of previous studies that implementation will suffer when crucial elements are lacking.[23] It can be hypothesized that, in order for protocols such as WP to be properly

implemented and for their expected benefits to take place, significantly more resources are needed to alleviate the barriers that are consistently highlighted in the literature.

A strength of our study was that we used the CFIR framework, which is a standardization tool to assess implementation research. This allows for transferability of findings and serves as a model for evaluating quality improvement initiatives in other centers. Moreover, our rigorous qualitative data analysis allowed for robust conclusions. Verbatim coding followed by cocoding by a different investigator built consensus and strengthened the credibility of our findings. In addition, the interviews were conducted in groups composed of only one profession. This helped to reduce, but not eliminate, an inhibition bias.

There are several limitations to this study. This single-center study may not represent the reality of other centers and its conclusions should serve only as guidance to other centers. Specific biases may have affected our results, such as selection bias. The candidates were invited to participate out of their own free will and this may have selected individuals who had more grievances than their colleagues. Although only a small number of participants were recruited from each profession, efforts were made to ensure representativeness of each category regarding experience and work shifts by having focus groups at different time in the day. Staff working the nighttime shifts may be overrepresented because of their direct involvement in the application of the protocol, hence their eagerness to express opinions on it. Residents interviewed are also not a completely representative sample as only internal medicine residents were interviewed, leaving out those enrolled in programs such as anesthesiology. Based on the focus group interviews, it is not possible to discriminate if the professionals' opinions were based on hypothetical perceptions or practical experience. Nonetheless, their opinion is likely to influence their uptake of the WP. Bias linked to social desirability needs to be considered since the investigators are all colleagues of their participant peers and have specific knowledge of the ICUs involved. One coauthor (M. M.) is the author of the WP and participated in its implementation. He was not involved in any of the semidirected interviews.

Conclusion

This single-centre study sought to identify factors that affected implementation of a WP at a single center. To improve adherence to the WP, three broad issues need to be addressed. First, the goals and objectives of the protocol must be clear to all involved personnel. Interdisciplinary collaboration should be the object of particular emphasis. Second, a quality improvement process must be put in place at the time of implementation to document its use and address any unforeseen issues. Lastly, all efforts must be made to facilitate compatibility with existing routines, values, and procedures. If there are compatibility challenges, these must be addressed in a collaborative way with all stakeholders.

Author contributions *Émilie Gosselin* was the main content and methodology expert. Her background of qualitative research enabled her to lead the research team through all phases of the study. She contributed to and approved the final manuscript. *Mathieu Labossière* was a general internal medicine resident at the time of the study and contributed to all phases of the study, including data gathering (conducting interviews) and verbatim coding. He is responsible for the main writing and revision of the manuscript. *Frédéric Lussier-Baillargeon* was a general internal medicine resident at the time of the study and contributed to all phases of the study, particularly to the protocol elaboration and data collection (conducting interviews). *Michaël Mayette* was the main academic supervisor of the study in the context of postgraduate research. He was the only intensivist physician on the research team and was therefore a content expert. He was the main instigator of the mechanical ventilation weaning protocol discussed in the study.

Disclosures Émilie Gosselin was a nursing PhD candidate at the time of the study and is a colleague of some of the participants in the study. Drs Mathieu Labossière and Frédéric Lussier-Baillargeon were residents in the local General Internal Medicine program and occasionally were under the supervision of some of the intensivists that participated in the study. Dr Michaël Mayette is an internist-intensivist and is the main developer of the local mechanical ventilation weaning protocol discussed in the study. We declare no further potential conflict of interest, financial, commercial, or otherwise.

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