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Research article

Exploring the learning needs of clinicians in Belgium and Sweden regarding prone positioning and skin damage prevention: A qualitative study

Anika Fourie^{a,*}, Malin Karlberg-Traav^{b,2}, Karuna Dahlberg^{b,3}, Valerie Hanssens^c, Steven Smet^{a,d}, Maria Jaensson^{b,4}, Dimitri Beeckman^{a,b,5}

^a Skin Integrity Research Group (SKINT), University Centre for Nursing and Midwifery (UCVV), Department of Public Health and Primary Care, Ghent University, Ghent, Belgium

^b Swedish Centre for Skin and Wound Research (SCENTR), School of Health Sciences, Örebro University, Örebro, Sweden

^c Wound Care Centre, Brussels University hospital, Belgium

^d Wound Care Centre, Ghent University Hospital, Belgium



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ABSTRACT

Introduction: During the coronavirus pandemic (COVID -19), the use of prone positioning in critically ill patients with acute respiratory distress syndrome (ARDS) increased substantially. As a result, clinicians had to (re)learn how to treat the patient in the prone position while preventing adverse events such as pressure ulcers, skin tears and moisture-associated skin damage.

Aim: The purpose of the study was to determine participants' learning needs related to patients in the prone position and the prevention of skin damage, such as pressure ulcers, and what they perceived as a positive or negative learning experience.

Design: This study used a qualitative methodological framework and employed an exploratory design.

Participants: A purposive sample of clinicians ($n = 20$) with direct or indirect work experience with prone ventilated patients was recruited in Belgium and Sweden.

Methods: Individual semi-structured interviews were conducted in Belgium and Sweden between February and August 2022. Data were analysed thematically using an inductive approach. The COREQ guideline was utilised to comprehensively report on the study.

Findings: Two themes were identified: 'Adapting to a crisis' and 'How to learn', with the latter having two subthemes: 'balancing theory and practice' and 'co-creating knowledge'. Unexpected circumstances necessitated a personal adaption, a change in learning methods and a pragmatic adaptation of protocols, equipment and working procedures. Participants recognised a multifaceted educational approach which would contribute to a positive learning experience regarding prone positioning and skin damage prevention. The importance of poising theoretical teaching with practical hands-on training was highlighted with an emphasis on interaction, discussion, and networking between peers.

Conclusions: The study findings highlight learning approaches which may help inform the development of befitting educational resources for clinicians. Prone therapy for ARDS patients is not limited to the pandemic. Therefore, educational efforts should continue to ensure patient safety in this important area.

* Corresponding author at: Ghent University, Corneel Heymanslaan 10, 9000 Ghent, Belgium.

E-mail addresses: Anika.Fourie@UGent.be (A. Fourie), Malin.Karlberg-Traav@oru.se (M. Karlberg-Traav), Karuna.Dahlberg@oru.se (K. Dahlberg), Valerie.Hanssens@uzbrussel.be (V. Hanssens), Steven.Smet@UGent.be (S. Smet), Maria.Jaensson@oru.se (M. Jaensson), Dimitri.Beeckman@UGent.be (D. Beeckman).

¹ First author

² Joint first author

³ 2nd author

⁴ Joint last author

⁵ Last author

1. Introduction

Prone positioning is a lifesaving strategy for critically ill patients with moderate to severe acute respiratory distress syndrome (ARDS). The clinical practice guideline of the American Thoracic Society, European Society of Intensive Care Medicine, and Society of Critical Care Medicine (Fan et al., 2017) provided a strong recommendation for severe ARDS patients to be prone ventilated for >12 h/day. Placing the mechanically ventilated patient in the prone position elicits benefits such as decreased lung compression, improved gaseous exchange, reduced ventilator-induced lung injury and mobilisation of respiratory secretions (Hadaya and Benharash, 2020).

Since patients with coronavirus disease (COVID-19) may develop ARDS-like symptoms (Meyer et al., 2021), there was an unexpected and amplified utilisation of prone ventilation during the pandemic (WHO, 2020). The intensive care units (ICUs) did not necessarily have updated protocols in place (Fourie et al., 2021), specifically with the avoidance of one of the most prevalent adverse events - pressure ulcers (Sud et al., 2014). The pandemic has further exacerbated the nursing shortage (McGahan et al., 2012), which also appears to be chronic and has little prospect of improvement in the short and medium term. Due to the shortage of ICU trained nurses, there was a redeployment of nurses from the operating room and surgical wards to assist with the high patient demands (Gamberini et al., 2021). Consequently, auxiliary staff were required to work in ICUs and outside of their area of expertise (Grasselli et al., 2020; Monesi et al., 2022). These staff did not necessarily have the training to perform complex procedures such as prone positioning or mitigate the risk of adverse events such as pressure ulcers (Aiken et al., 2022; Bambi et al., 2020).

Pressure ulcers profoundly and negatively impact the patient's health-related quality of life (Gorecki et al., 2009). Patton et al. (2022) synthesised data from 10 systematic reviews which included 15,979 prone ventilated adult patients and reported the cumulative incidence of pressure ulcers to be between 25.7 % and 48.5 %. Pressure ulcers can result in substantial healthcare expenditures of up to €470.49 per day for wound treatment (Demarré et al., 2015). In addition, patients with pressure ulcers require longer hospital stays, extra clinician time for treatment, could get infection, or even succumb due to the pressure ulcers (Nghiem et al., 2022). The high incidence of pressure ulcers, the high costs and the detrimental consequences thereof, necessitate a focus on prevention strategies (Binda et al., 2021; Padula and Delarmente, 2019).

Clinical practice guidelines emphasise and recommend *education* as one of the pillars of the prevention of complications. The 'Intensive Care Society' and the 'Faculty of Intensive Care Medicine' developed safety standards highlighting *education* as a critical element to prevent potential complications with prone positioning (FICM and ICS, 2019). The European Pressure Ulcer Advisory Panel/ National Pressure Injury Advisory Panel and the Pan Pacific Pressure Injury Alliance (EPUAP/NPIAP/PPPIA, 2019) dedicated an entire chapter in their guideline to 'Health Professional Education', reiterating the importance of education for improved outcomes. In a comprehensive review (Fourie et al., 2021) the authors analysed the gaps pertaining to skin damage prevention of the prone ventilated patient, recognised a lack of accessible, evidence-based educational resources, and recommended a training needs analysis.

Prone ventilation has become a standard of care for patients with moderate to severe ARDS due to robust evidence and efficacy seen in clinical practice (Fan et al., 2017; Venus et al., 2021). This resulted in the need for clinicians to be equipped with the necessary training and skills to safely manage the prone ventilated patient. Gaining clinicians' insights into their specific learning needs might facilitate a better understanding to provide appropriate education.

2. Aim

The purpose of the study was to determine participants' learning needs related to patients in the prone position and the prevention of skin damage, such as pressure ulcers, and what they perceived as a positive or negative learning experience.

3. Methods

3.1. Design

This study used a qualitative methodological framework and employed an exploratory design where data were collected through individual semi-structured interviews. The utilisation of this design was deemed appropriate for this study to explore the educational experiences and learning needs of clinicians, given the need to gain a rich, in-depth understanding of the participants' views. The consolidated criteria for reporting qualitative research (COREQ) (Tong et al., 2007) were followed for transparency and comprehensive reporting (Appendix 1).

3.2. Participants and sampling

Participants were recruited using the purposive sampling technique. Recruitment occurred in Belgium and Sweden, where the research teams were based, where educational needs were anecdotally identified, and where the researchers could prospectively obtain in-depth information. The inclusion criteria were clinicians who a) work in critical care units (nurses, allied health professionals and physicians) or are b) wound care specialists and c) had (in)direct working experience with prone ventilated patients. In Belgium, the potential participants (all proficient in English), were contacted via email or telephone and if they were interested in participating, written information was sent to them before the appointment for the interview. In Sweden, the invitation to participate was via the head of the nursing/critical care department whereafter those interested, contacted the researchers or the head of the department.

3.3. Data collection

The interviews were conducted between February and August 2022 either online or face-to-face at the participants' workplace (hospital) with the interviewer and participant present. The researchers who conducted the data collection (a PhD candidate and PhD-qualified researchers within the nursing domain) were all employed at their respective universities during this period. To ensure dependability (Lincoln and Guba, 1985), a semi-structured interview guide was developed by both research teams. From a cultural interpretational aspect, all questions were thoroughly discussed between the researchers. The interview guide (Appendix 2) was pilot tested in Belgium with no change to the guide; therefore, that interview was included in the analysis. Open-ended questions were used to obtain rich in-depth information from the participants and semi-structured interviews allowed for probing and clarification (Barriball and While, 1994). Data collection concluded when no new information/themes emerged (Belgium) (Polit and Beck, 2021), or when the planned number of participants were interviewed (Sweden). The mean interview duration was 31 min (19–48 min). The interviews were audio-recorded and were then transcribed verbatim.

3.4. Data analysis

An inductive approach was applied using Braun and Clarke's (2006) six phases of thematic analysis. Given the dearth of research on this topic, we elected to utilise an inductive approach.

The researchers familiarised and immersed themselves in their respective parts of the full dataset with close readings of text, re-reading,

and listening to the audio recordings of the interviews. Initial codes were assigned by AF (Belgian interviews) and MKT, KD, and MJ (Swedish interviews) to start identifying “text segments that contain meaning units” within interviews (Thomas, 2006 p.4.). Identified patterns in the data extracts were collated into potential themes. The researchers then discussed and agreed upon the themes and verified a correlation with the coded extracts. The recursive approach of discussion and refinement between all four researchers assisted in the confidence that accurate reflections were reported without losing the nuances in language between English and Swedish.

3.5. Ethical considerations

This study followed the principles of Helsinki (World Medical Association, 2013). It was approved by the Ethics Committee of Ghent University, Ghent University Hospital (BC-11011) and Universitaire Brussel's Ethics Committee (22051 Pronetec). The Swedish Ethical Review Authority (Dnr 2022-01041-01) provided an advisory statement that ethics approval was not necessary. Confidentiality and privacy were ensured by the pseudonymisation of personal details. All participants voluntarily signed the consent form indicating their willingness to participate in this study.

4. Findings

4.1. Participant characteristics

Twenty participants were interviewed: seven from Belgium (in English) and 13 from Sweden (in Swedish). All the potential participants who signed the informed consent partook in the study; there were no refusals to participate. The characteristics of the participants are presented in Table 1.

4.2. Themes

The analysis identified two themes: 1) *Adapt to a crisis*, and 2) *How to learn* - with the latter having two subthemes: *Balancing theory and practice* and *co-creating knowledge*. A representation of the emergent

Table 1
Description of participants (n = 20).

Female/male, n	15/5
Belgium/Sweden, n	7/13
Characteristic	n (%)
Job function (frequency/(%))	
ICU ^a nurse (management)	3 (15)
ICU nurse (non-managerial)	5 (25)
ICU nurse assistant ^b	6 (30)
Physiotherapist	2 (10)
Wound care specialist	2 (10)
Registered nurse anaesthetist who worked in COVID-ICUs	2 (10)
Years of clinical experience	
Mean	18
Median	15
Min-max	2-40
Years of ICU experience	
Mean	14
Median	10
Min-max	2-36
Education	n (%)
PhD	1 (5)
Master's Degree	8 (40)
Bachelor after Bachelor (additional postgraduate degree in wound care)	1 (5)
Bachelor's degree	4 (20)
Upper secondary school	6 (30)

^a ICU = Intensive Care Unit.

^b ICU nurse assistant = upper secondary qualification, licensed to provide routine patient care under the supervision of a registered nurse or physician (Sweden).

themes is provided in Table 2.

Participants described their experiences of education and education needs in light of the COVID-19 pandemic. The pandemic had a great influence on their experiences since for many of them it was during the pandemic that they first worked with prone positioning. Within this process, participants described growing in confidence, albeit an unknown need. This was expressed in different ways, but the feeling of having changed positively after the pandemic was common to all. The fact that participants were able to use a difficult, undesirable situation to their professional advantage demonstrates a degree of acceptance of their circumstances. In addition, participants described how the mutual support of team members strengthened the team and provided a sense of security. There was tacit agreement on what to do, even though opinions differed on how to act.

4.3. Theme 1: “Adapt to a crisis”

During the pandemic there was no time to prepare, no time for the usual adaption to new knowledge; the staff had to accept, adapt, and respond to the crisis. The participants described that the need for prone positioning was minimal before the COVID-19 pandemic and that they rarely used it in their ICUs. As their knowledge increased, their clinical processes improved, and they could make independent decisions. With that, the participants experienced a sense of accomplishment and pride in knowing they were curious to learn and wanted to do the best for the patients. This was reflected in how the participants described their feeling of growth in confidence as they gained mastery over the prone position and realised that they could safely care for the patients and manage this situation. The participants were no longer reliant on referring their patients to university hospitals as they adapted, learned together, and supported each other.

... we have only worked with this (prone position) for a while; before when the patient needed prone position, they were transported to another hospital... but now it has shown that there are [is] absolutely no problem with that (Interview 2, Sweden).

With increased confidence, participants described how their knowledge empowered them to address errors and improve patient care.

...I dare to go into situations and tell in a good way that “this-maybe you should do it in this way instead”, and try to turn it in a way, not aggressively but...”this is also a good way”, yes before maybe I didn't go in and do that, but I dare to do it today, to help...(Interview 5, Sweden).

The pandemic left no room for learning in the way the participants were used to: assimilating knowledge, practising, and then applying it in practice. Given the crisis, the participants expressed how they had to adapt their learning methods. New procedures (prone positioning) suddenly became a part of daily routine which they had to (re)learn, accept, and adopt. Their learning was a process; at first from noticing patients in the prone position with adverse events (skin damage e.g., pressure ulcers), to adapting their working procedures, protocols, and equipment, re-evaluating, learning, and improving patient outcomes.

...it was a disaster in [at] the beginning of the COVID, there was no training because it was just to throw yourself in it [the pandemic] and we were so happy when we got the protocol ready, or the routine of care and got hold of [...] the prone positioning kit... ..and yes, we weren't so proud over how it got in the beginning because it was just, there was no chance to practice at all. We tried as good as we could... (Interview 1, Sweden).

Participants had to personally adapt to the crisis, adjust their learning methods, and optimise their equipment (support surfaces/beds/mattresses). They needed the right equipment not only for the

Table 2
Representation of the emergent themes.

Theme	Subtheme	Data extract examples
Adapt to a crisis		...before Covid we do it not often, the prone position, but during Covid we have to do the prone positioning a lot of times and that is why we were not aware of the details uh about positioning and we saw some problems while turning the patients ... (Interview 1, Belgium). ... we have only worked with this [prone position] for a while; before when the patient needed prone position[ing], they were transported to another hospital... but now it has shown that there are [is] absolutely no problem with that [managing prone positioning] (Interview 2, Sweden).
How to learn	Balancing theory and practice	Being a nurse, it's not only the paper and $2 + 2 = 4$ [...]. You have a patient who is bigger, a patient who is smaller, so it is, it is very difficult to just have the theoretical achtergrond [background] (Interview 4, Belgium). You have, you need to have a little theoretical background but it's more the practical stuff. That's very important (Interview 5, Belgium).
	Co-creating knowledge	... but then together ...we changed the protocol and the staff got educated and trained in the new protocol and it worked, it works very well (Interview 5, Belgium). yes yes it is fantastic this, that you can [...] share experiences and share the knowledge you bring [...] that is valuable in a situation like this [the pandemic] (Interview. 3, Sweden). ... it's important that you maybe have a link to someone or to contact, that you can contact someone to adjust maybe at your situation or to ask some questions (Interview 2, Belgium).

safety of the patient, but also for the safety of the clinical staff (avoiding injuries) when performing the prone manoeuvre.

...we changed our beds, and the mattresses because we had a lot of difficulties with them, and then we were checking together ... "What do we do wrong?" Because we saw a lot of patients with wounds which we didn't have before. So, we were looking for causes and how to manage it, how to give [do] it better (Interview 5, Belgium).

4.4. Theme 2: "How to learn"

The in-depth interviews prompted participants to reflect on positive and negative educational experiences, funnelling down to what educational strategies they felt were still needed specific to prone positioning. To reach the person who is "about to learn," participants were asked to reflect on the learning situation. The unique pandemic context could not accommodate all of the participants' learning methods, but the need for knowledge prompted them to take action. In terms of learning, they all expressed that they would have liked more time to practice.

"...but we were right in the pandemic, so we had no choice – let's do this!" (Interview 5, Sweden).

"Balancing practice and theory".

Participants described positive educational experiences in terms of the content of the educational material and the teacher should follow a "common thread," meaning that education should be presented with a unified thought or path through the learning process. There should be a balance between the theoretical component and the practical application. Education should not be a passive experience ... "that the lecture demands something from you, something [activity] from you, otherwise it [knowledge] is harder to use I think" (Interview. 6, Sweden).

Participants noted that the educator should be well-prepared, skilled, and knowledgeable about the subject. The participants described positive attributes of a good educator as the ability to adjust to and answer questions from the audience and being flexible, interesting, engaging and motivating. The educator's attitude (i.e., not being arrogant) played a significant role in constructive learning outcomes. Participants expressed that learning should be stimulating, without too many slides and texts with detailed statistics or information that does not match the educational level of the audience.

"You got the explanation from doctors for doctors but there it's very important to have the explanation for nurses" (Interview 5, Belgium).

The participants emphasized that they wanted to 'act versus to listen'

when skills training was necessary "...I am a strong believer of simulation education..." (Interview 1, Belgium). The prone manoeuvre warrants a stronger component of skills training (versus theory). Participants indicated a preference for practice, such as positioning each other, with colleagues serving as patient dummies, to feel and understand what it is like to be prone.

The participants described how different people acquire knowledge and skills; how they prefer to learn according to their own character, style, and personality. Some participants noted how some individuals prefer a "keep it simple" approach; straightforward instructions that they will follow without questioning the rationale behind the action. Some participants, however, have an enquiring mind seeking the answers as to 'the why'.

The participants noted that a valuable tool for keeping updated or to refresh their knowledge is short videos, especially useful for new nurses. They find themselves regularly referring to, for example, YouTube® videos for revision on new or irregularly utilised procedures. Participants reflected on both the benefits and negative aspects of e-learning. A participant shared that "We have so many e-learning, and it can be interesting, but you really need to be then focused on it and having the time for it" (Interview 7, Belgium), whilst other participants found e-learning beneficial in terms of accessibility and keeping abreast with new information. A summary was created to reflect the participants' views on "how to learn" (Table 3).

4.5. "Co-creating knowledge"

Participants described how much they valued the 'team approach' and shared learning with multidisciplinary members. Learning did not occur individually or only within the 'nursing field' or the 'medical field'. For example, physical therapists, physicians, surgical staff, wound care specialists, and nurses worked together to manage prone positioning and minimise harm.

yes yes it is fantastic this, that you can [...] share experiences and share the knowledge you bring [...] that is valuable in a situation like this [the pandemic] (Interview. 3, Sweden).

Participants provided examples of multidisciplinary collaboration and communication: how a wound care specialist assisted with prone protocol development, how the physiotherapists played a pivotal role in giving guidance and training to correct patient positioning and how the materials/equipment managers assisted in bringing the right supplies to the staff members. When they co-created knowledge, there was an attitude and feeling of equality.

The participants expressed that small workshops or round table discussions add value to their learning, especially "where you can have

Table 3
Participants' views on "how to learn".

Methods of learning	Reflections from participants
Workshops / focused in-class education	Small groups invite open discussions Participants are not afraid to ask questions Encourage an exchange of clinical experiences Small groups encourage discussion and interaction Needs a balance between what is necessary and what is feasible for the participants. A duration of one day was suggested High cost Requires time of the speakers and participants Small groups encourage interaction and participation in the actions Participants observe an action/procedure Participants provide feedback, exchange ideas Allows for sufficient time to practice Big groups – many distractions, often difficult to hear Agenda and specific topics available prior to the conference Receive the latest information Quality of speaker engagement important Added benefit of networking and sharing best practices Restricted during the pandemic Beneficial for learning Accessible at own time Technical difficulties (poor internet connection) Easily distracted
Theory with practical examples and case studies Specialised workshops (also called Master Classes) In-depth theoretical information with practical sessions on one specific domain e.g., pressure ulcers	Should be of short duration: not always having time to watch it Very important to show certain skills Beneficial for new staff Beneficial for refresher training Beneficial to practice skills Safe environment: the ability to make mistakes Learn from feedback Master the skill only by doing it at the bedside with a patient (real-life action) Requires action/participation Different personality types; might find it difficult to come out of their comfort zone Available in ICU cubicle or central area Easily get essential information on key focus areas Easy referral for procedures (in)frequently used Should also be available on a digital platform (intranet) Must be short Posters on a wall are ineffective (often too many posters and staff do not pay attention to them) Easily distributed internally Teaching aid Adapted to the local environment and available equipment Add visuals to the protocol (i.e., correct use of off-loading devices, pillows, positioning) Essential to get buy-in from colleagues when creating the protocol Training before or after the shift Distractions (need to attend to patients or tiredness after the shift) Keeping attention Easily share internal protocols, new procedures, and medicine alerts Restricted inter-hospital sharing Essential Duration <30 min with repeat sessions Beneficial for new employees Someone to trust – to discuss challenges with Receive alerts when adverse events increase Can target a specific area/unit with tailor-made educational programs Staff motivation (show the results of education)
Practical workshops (observe, discuss, practice) Practical hands-on training. Demonstrations using colleagues (e.g., repositioning) Could be used for training on how to use specialised equipment/devices (support surfaces, head positioners, eye care, foam dressings) Conferences	
Webinars and e-learning	
Live or recorded presentations, online courses	
Videos	
Demonstration of new procedures (prone manoeuvre) Applying equipment/devices correctly Simulation education	
Skills training Team training (non-technical) i.e., communication, teamwork, leadership	
Practice guidance document	
Step-by-step guide and a checklist	
Laminated pictures/photos Tips, key focus areas, "need-to-knows"	
Internal protocols	
Team meetings	
Centralised digital platform	
Company training Training on new equipment/devices Mentors	
Statistics i.e., incidences of pressure ulcers, medicine errors	

interaction, for me personally, that works the best" (Interview 7, Belgium).

Participants described how important it was to learn from each other and to share knowledge freely. Face-to-face networking at conferences was restricted during the pandemic, however, they could network and share evidence online between hospitals or use their professional group mailing lists...

"So you really need that network, with small [questions] but also about [with] the bigger issues, I think it is really, really nice to be a part of this national network also" (Interview 5, Sweden).

Participants shared how they contacted their colleagues at other hospitals during the crisis enquiring about the equipment/devices (e.g., special mattresses) they were using; to care for the prone ventilated

patients and to prevent pressure ulcers "it's important that you maybe have a link to someone or [...] that you can contact someone to adjust maybe at your situation or to ask some questions" (Interview 2, Belgium).

Participants noted the openness between colleagues; they shared their challenges, discussed their pressure ulcer incidences, and collaborated to find the best solution for patients. While cross-hospital networking can occur between individuals, it also emerged from the interviews that there was also a barrier to "knowledge co-creation" in terms of sharing protocols and educational materials. Hospitals had their centralised educational resources on their internal systems and were not allowed to share them with other hospitals or external individuals due to restrictive hospital policies. When asked if it was a problem that hospitals do not share ... "No, it would be lots easier if all the hospitals did the same [shared their protocols], but I think that's an utopy [utopia]...

(Interview 6, Belgium).

Overall, participants expressed that they value and appreciate interpersonal exchange and networking with colleagues.

5. Discussion

The purpose of this study was to determine participants' learning needs related to patients in the prone position and the prevention of skin damage, such as pressure ulcers, and what they perceived as a positive or negative learning experience. Unexpected circumstances necessitated a personal adaptation, a change in how they assimilate new knowledge, and pragmatically adapting their policies, equipment and working procedures. The participants highlighted the importance of balancing theoretical teaching with practical hands-on training emphasising interaction, discussion, and networking between peers.

Several studies recognise that education is an essential contributor to the safe management of the prone ventilated patient (Binda et al., 2021; McEvoy et al., 2022; Montanaro, 2021). However, to our knowledge, there are no studies to date to explore the specific learning needs clinicians have regarding this topic.

Our interpretation of the interviews was that participants described themselves within the Kolb learning styles (Kolb, 2014), dominant in the 'accommodator' approach to learning. The well-researched work of Kolb (1984) describes how individuals have a unique preference for a combination of different learning styles. The four approaches to learning are the 1) diverger ('reflectors' who prefer to observe versus to do), as opposed to the 2) converger (pragmatists who prefer solving problems via ideas and theory, the 3) assimilator (theorists preferring abstract ideas versus practical application) and the 4) accommodator (activists; having the preference to learn from practical hands-on experiences and ability to adapt to changing environments). Knowledge of these learning styles is essential in informing educators or managers on how to effectively provide training that meets the needs of their ICU staff. Influences such as an individual's personality, culture, educational specialisation, career choice, and "adaptive competencies" result in different preferences for how individuals use the learning cycle of 'experience,' reflection, thought, and action. When looking at educational specialisation, our findings confirmed the previous research of Kolb (2013, p. 12), stating that "individuals with the Accommodating styles, often have educational backgrounds in education, communication and nursing...". Similar to the present study, Smith (2010) found that the majority of participants were 'accommodators' (31 %) when investigating a group of registered nurses ($n = 217$) enrolled in an online post-graduate course. In contrast, D'Amore et al. (2012) found that in a cohort ($n = 345$) of new undergraduate nursing and midwifery students that most identified with the 'diverger and assimilating' learning styles. This is not surprising, as Kolb (1984) described that individuals go through different stages of growth and development and can ultimately draw on all four learning style approaches.

Our findings that participants prefer hands-on training and clinician interaction echo those of Hochberg et al. (2023) in their qualitative study. Similarly, their participants expressed their personal adoption of new procedures (prone positioning), the modification in their local protocols, and the optimisation of equipment and devices for pressure ulcer prevention.

Our findings also corresponded with some of the facilitators (determinants) for implementing prone positioning, identified in the work of Klaiman et al. (2021). Three of the five recommendations the authors identified as implementation strategies - "knowledge" (providing education), "resources" (available/accessible, evidence-based protocols and equipment) and "interdisciplinary communication" were similarly expressed by our participants. In contrast to these studies investigating the enablers or influences for implementing prone positioning (Hochberg et al., 2023; Klaiman et al., 2021), this study explored the clinicians' views on their personal learning needs regarding this topic.

The participants recognised a multifaceted educational approach

(Table 3) which would contribute to a positive learning experience for them. Overall, an emphasis on pragmatic, hands-on, bedside training was preferred, yet the importance of the theoretical component was recognised *provided* it is at the right educational level of the attendees and by a presenter with the right skills. In addition, participants felt that they learned most through interaction and discussion, in small groups, workshops or during networking meetings.

While it is not within the scope of this study to appraise the various educational strategies highlighted by participants, a large body of literature has evaluated the different learning methods or educational strategies: The benefits of clinical simulation education (Khan et al., 2018), active learning (Ghezzi et al., 2021), classroom teaching and comparative studies between different teaching modalities (Bloomfield et al., 2010), to name a few, are well established (Culha, 2019). The value of this study lies in the collective insights of the participants and the suggested learning strategies specifically related to prone positioning and avoidance of skin damage.

The educational / clinical implications emanating from this study could be perceived on different levels. At an international level, conferences and specialised workshops can be valuable in balancing the theoretical and practical application of knowledge. On the country/regional/institutional level, practical workshops and team discussions can offer a cost-effective, beneficial way to teach correct patient positioning and prevention of pressure ulcers. Knowledge can be co-created at the hospital/ICU level through interdisciplinary communication and customising internal prone position protocols according to available equipment and materials and suitability to the context. Online e-learning and webinars can be seen as supplementary educational resources to practical on-the-job training. Participation and interaction can be invited through games, quizzes, or creative group discussions (breakout rooms) to avoid distractions (Ahmad et al., 2020). These digital resources could be advantageous when there is restricted access to simulation laboratories, especially in developing countries or resource-constrained settings (Agu et al., 2021). In addition, digital material and virtual meetings could bridge the gap when there are time or financial constraints to attending academic conferences abroad (Remmel, 2021).

During the pandemic, prone position ventilation became the standard of practice for critically ill patients. Since the effectiveness of prone positioning is well proven (Guerin et al., 2020) and not isolated to COVID-19-infected patients but to all patients with moderate to severe ARDS (Fan et al., 2017; Venus et al., 2021), it should remain a standard procedure. For this reason, it will be important to have refresher training on the prone manoeuvre and have evidence-based, short videos available that demonstrate various aspects of positioning and management of the patient. Accessible, recorded material could benefit new ICU staff and serve as refresher training for others. Practice guidelines and checklists should be kept up to date and available to staff through centralised hospital digital systems. An exemplary project on interdisciplinary co-creation was published by Montanaro (2021). As a team they developed a prone positioning protocol, checklist, training program and video which had a positive effect on team cohesion, communication, and increased staff confidence in performing the prone manoeuvre without any consequent adverse events.

Overall, clinicians and educators should continue to share evidence-based best practices - whether at team meetings, conferences, through open-access publications, or through the creation of publicly available educational materials.

5.1. Study strengths and limitations

We explored the views of participants in multi-centres both in Belgium and Sweden. Their diversity in professions, years of clinical experience and cultures provided in-depth insights regarding their learning needs. In addition, three members of the research team are highly skilled and experienced in the domain of qualitative research

which presented as another strength of this study.

The Belgian participants were interviewed in English, and, while all were fluent, participants were also informed that they could switch to Dutch if they had difficulty expressing themselves. To avoid losing the nuances of the language the Swedish transcripts were not translated into English, yet all three members of the research team cross-checked the transcripts to avoid any misinterpretation. The appropriate Swedish extracts were ultimately translated into English after verification by all three Swedish researchers and the supporting quotes were added. Additionally, one Swedish researcher read all of the English transcripts. During several interim meetings and theme discussions of the full dataset, we are confident that the interpretations of the findings were presented in a transparent and trustworthy manner. A balanced representation of appropriate quotes from both countries was provided to support the findings and provide transferability, confirmability, and trustworthiness (Polit and Beck, 2021). Credibility was achieved throughout the transparent process, both in the collection of the data and by the research groups' experience of the studied context (Cope, 2014).

The limitations of the study centre on *the time lapse from study conception to findings*, due to the high relevance of the topic. A broad database search using Medline on the PubMed platform (19.02.2023), using MeSH terms ("prone position" and acute respiratory distress syndrome") showed a rapid increase in publications from 24 in 2019, 80 in 2020, to 105 in 2021 after which publications declined. However, after refining the search on "education" only two qualitative studies (Hochberg et al., 2023; Klaiman et al., 2021) were published, though with different study aims. The authors from both these important studies, explored the enablers for successful implementation of prone positioning opposed to the present study that explored individual learning needs.

Future research should examine the knowledge and confidence of future critical care nurses (e.g., in postgraduate critical care courses) regarding safe prone positioning. Suboptimal results may indicate that appropriate educational resources need to be developed to train future clinicians.

6. Conclusion

Education is an essential component for the prevention of complications. Learning needs are based on learning style and perceived positive and negative learning experiences. The pandemic required personal adaptation, a change in the way new knowledge is assimilated, and pragmatic adaptation of strategies, equipment, and work practices. It is important to balance theoretical teaching with practical training that emphasises interaction, discussion, and networking among colleagues. The management of ARDS patients in the prone position is not limited to the pandemic. Therefore, training efforts should continue to ensure safe prone positioning and prevention of complications such as pressure ulcers. The results of the study highlight learning approaches that may help in the development of appropriate training materials for current and new ICU clinicians.

CRedit authorship contribution statement

AF: Conceptualization, Methodology, Validation, Formal analysis, Investigation, Writing- Original, visualization, Project administration. **MKT:** Conceptualization, Methodology, Validation, Formal analysis, Investigation, Writing- review. **KD:** Conceptualization, Methodology, Validation, Formal analysis, Investigation, Writing- review. **VH:** Validation, Writing- review, project administration. **SS:** Validation, Writing- review, project administration. **MJ:** Conceptualization, Methodology, Validation, Formal analysis, Writing- review. **DB:** Conceptualization, Methodology, Validation, Writing- review, Supervision, Funding.

Declaration of competing interest

None.

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Appendix A. Supplementary data

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