

Impact of interprofessional education on noninvasive ventilation in a tertiary neonatal intensive care unit

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OBJECTIVE: To evaluate the impact and effectiveness of an experiential interprofessional education workshop on noninvasive ventilation (NIV) in the setting of a neonatal intensive care unit.

METHODS: In the present cross-sectional study, a full-day workshop, consisting of didactic and hands-on components, was developed to assess knowledge and perceptions, and to disseminate the latest evidence and practical aspects of NIV use. All health care professionals (HCPs) were asked to participate. Pre- and post-participation questionnaires and knowledge tests were used to assess the effectiveness of knowledge transfer, and to seek participants' reflections on the utility of the workshop.

RESULTS: Among 214 participants, 206 (96%) and 195 (91%) completed the pre- and post-participation questionnaires, respectively. The majority agreed (14%) or strongly agreed (75%) that NIV education was important for their role. Participants scored their perceived comfort with NIV following the workshop highly (median 5 [interquartile range (IQR) 1]) on a five-point Likert scale and 96% would recommend it to a colleague. Median knowledge scores on NIV, assessed as percent correct responses, increased from 74% (IQR 16) to 86% (IQR 11) ($P < 0.05$).

CONCLUSIONS: A focused, context-specific workshop helped improve understanding and comfort among HCPs while reducing misconceptions about NIV. Further research to assess optimal delivery of NIV education and impact on patient outcomes is required.

Key words: *Health care professional; Interprofessional care; Hands-on workshop*

Use of noninvasive ventilation (NIV) has increased in neonatal intensive care units (NICUs) in an effort to reduce ventilation-induced lung injury (1-3). With the advent of new technology, various modes of NIV, such as biphasic continuous positive airway pressure (CPAP), nasal intermittent positive pressure ventilation, noninvasive high-frequency ventilation and high-flow nasal cannula, are now available, along with the traditional mode of nasal CPAP (4). In addition, a variety of different interfaces are also available, resulting in numerous permutations of NIV-interface combinations that a patient can receive at any given time (5-8).

This increased availability of various NIV modes and interfaces necessitates proper education about the mechanics, advantages, indications and limitations of each, based on available evidence. In addition to physicians, there is also the need to educate front-line health care professionals (HCPs) about NIV. In the NICU, registered nurses and/or respiratory therapists play a vital role in the implementation and trouble-shooting of NIV and, as such, their education on the topic is imperative. In addition, in a busy environment such as the NICU, despite provision of health care as a multidisciplinary team, the

Les effets d'une formation interprofessionnelle sur la ventilation non invasive dans une unité de soins intensifs néonataux de niveau tertiaire

OBJECTIF : Évaluer les effets et l'efficacité d'un atelier expérimental de formation interprofessionnelle sur la ventilation non invasive (VNI) dans une unité de soins intensifs néonataux.

MÉTHODOLOGIE : Dans la présente étude transversale, les chercheurs ont créé un atelier d'une journée comportant des volets magistraux et pratiques pour évaluer les connaissances et les perceptions et pour faire connaître les données probantes les plus récentes et les aspects pratiques de la VNI. Ils ont invité tous les professionnels de la santé (PdS) à y participer. Ils ont utilisé des questionnaires avant et après la participation et des tests de connaissances pour évaluer l'efficacité de l'application du savoir et pour obtenir les réflexions des participants sur l'utilité de l'atelier.

RÉSULTATS : Parmi les 214 participants, 206 (96 %) et 195 (91 %) ont rempli le questionnaire avant et après la participation, respectivement. La majorité étaient d'accord (14 %) ou tout à fait d'accord (75 %) pour affirmer que la formation sur la VNI était importante dans leur rôle. Les participants avaient une perception élevée de leur aisance à l'égard de la VNI après la formation (médiane 5 [plage interquartile (PIQ) 1]) sur une échelle de Likert de cinq points, et 96 % l'auraient recommandée à un collègue. Les indices de connaissances médians sur la VNI, évalués selon le pourcentage de bonnes réponses, sont passés de 74 % (PIQ 16) à 86 % (PIQ 11) ($P < 0,05$).

CONCLUSIONS : Un atelier ciblé et adapté au milieu a contribué à accroître la compréhension et l'aisance des PdS tout en réduisant les idées fausses quant à la VNI. D'autres recherches s'imposent pour évaluer la prestation optimale de la formation sur la VNI et les effets sur les résultats cliniques des patients.

detailed roles and responsibilities of any one HCP discipline may not be apparent to others. Interprofessional education (IPE) has been shown to improve collegiality and communication among various team members, as well as lead to improved patient outcomes in various other fields (9-11). In fact, the WHO and Institute of Medicine have both endorsed IPE as a key initiative toward improving patient outcomes (12,13). Recognizing this importance of IPE on the relatively new intervention, a hands-on educational workshop for all HCP disciplines was organized at our centre based on the principles of IPE – to learn with, from and one another (14). The objective of the present study was to assess the impact of this workshop in improving caregivers' knowledge and comfort with NIV.

METHODS

In the present cross-sectional study performed at a tertiary level neonatal intensive care unit in Canada, all HCPs (including registered respiratory therapists, registered nurses, advanced care nurse practitioners and their respective trainees) were invited to participate in an NIV-focused full-day IPE workshop. The workshop was

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TABLE 1
Participant feedback regarding pre- and post-participation surveys

HCP category (n1, n2)*	Pre-participation		Post-participation	
	NIV education importance	Desire to learn more about NIV	Increased comfort with NIV	Recommend to peers
Acute care nurse practitioners (6, 6)	5 (0)	5 (0)	4.5 (1)	5 (0.75)
Respiratory therapists (17, 16)	5 (1)	5 (1)	5 (0)	5 (0)
Registered nurses (139, 134)	5 (0)	5 (1)	5 (1)	5 (1)
Other HCPs (20, 20)	5 (1)	5 (0.5)	4 (1)	4 (1)
HCP trainees (24, 19)	5 (1)	5 (0)	4 (1)	5 (1)
Overall (206, 195)	5 (0)	5 (0)	5 (1)	5 (1)

Data presented as median (interquartile range). *n1 = Number of pre-participation respondents, n2 = number of post-participation respondents. HCP health care provider; NIV noninvasive ventilation

developed by a multidisciplinary group of HCPs consisting of physicians, registered respiratory therapists, acute care nurse practitioners and registered nurses, with the overarching intent of optimizing the local practice of NIV use. The workshops were conducted weekly for three months to enable all HCPs the opportunity to attend as well as limit the number of participants in each workshop to 20 to facilitate opportunity for interdisciplinary discussions and collaborative learning in small groups.

Based on principles of the Kirkpatrick educational framework (15), this experiential workshop consisted of a didactic component led by the respiratory therapist educator that covered basic pulmonary development and physiology, the rationale for increased NIV use, the strengths and weaknesses of each modality, as well as a review of available evidence. Furthermore, the role of registered respiratory therapists in providing and maintaining adequate NIV was covered. This included the indications to call them to the patient's bedside, imparting knowledge on basic trouble-shooting that they do to ensure proper functioning of the equipment and interface, and their thought process leading to decision making regarding escalation and/or weaning from a particular mode of NIV, with a view to increase awareness of the roles of registered respiratory therapists to other HCP disciplines.

In addition to the didactic component, there was a hands-on simulation that included the opportunity to practice placing interfaces correctly on a newborn mannequin, discuss strategies to maintain the desired set NIV pressure and basic trouble shooting. The hands on session with the interfaces were based on IPE principles whereby HCPs of varying backgrounds (as listed in Tables 1 and 2) had the opportunity to discuss their respective roles and expertise while learning from each other. These sessions allowed time for spontaneous discussions among representatives from varying HCP disciplines in small groups, moderated by the lead respiratory therapist educator (DP) as needed, that were designed to allow for increased awareness and mutual understanding of one another's roles and responsibilities.

A pre- and post-participation questionnaire was given to all participants (Supplementary Files 1 and 2 [go to www.pulsus.com]) on the day of the workshop. The pre-participation questionnaire consisted of a knowledge assessment component (consisting of 20 questions and scored as a percentage of correct responses) on basic respiratory physiology and non-invasive ventilation. The second component consisted

TABLE 2
Comparison of knowledge and pre- and post-participation

HCP category*	Participation score		
	Pre	Post	P
Acute care nurse practitioners (n=6)	82 (9)	89 (0)	NS
Respiratory therapists (n=16)	79 (17)	89 (11)	<0.05
Registered nurses (n=134)	68 (15)	84 (10)	<0.05
Other HCPs (n=20)	71 (28)	89 (12)	<0.05
HCP trainees (n=19)	74 (10)	89 (8)	<0.05
Overall (n=195)	74 (16)	84 (11)	<0.05

All results expressed as median % (IQR) unless otherwise indicated. *Participants who completed both pre- and post-participation knowledge questionnaires. HCP Health care provider; NS Not significant

of participants' opinion, on a modified Likert scale of 1 (strongly disagree) to 5 (strongly agree), regarding importance of understanding principles of NIV and desire to learn more about it. In addition, we inquired about barriers to adequate knowledge and understanding on NIV in free form.

A post-participation survey consisted of the same knowledge assessment questions to assess effectiveness of the workshop on knowledge acquisition, as well as a reflection component (assessed on the same Likert scale) regarding post-participation comfort with NIV, and whether they would recommend this workshop to a colleague. Suggestions to improve practice of NIV at the bedside were also ascertained in free form. All ordinal Likert scale results and quantitative knowledge scores were reported as median (interquartile range). Pre- and post-participation knowledge scores were reported only for participants who completed both and compared using Wilcoxon signed-rank test; P<0.05 was considered to be statistically significant.

The present project was approved by the Hamilton Integrated Research Ethics Board (Hamilton, Ontario), and all data (completed survey questionnaires) were stored in a locked cabinet in the office of one of the authors (AM).

RESULTS

The 214 participants (of 250 eligible HCPs) of the workshop consisted of a variety of HCPs including registered nurses (139 of 180 eligible [77% participation rate]), acute care nurse practitioners (six of 11 eligible [55% participation rate]), respiratory therapists (17 of 22 eligible [77% participation rate]) and HCP trainees. Among the participants, 206 (96%) completed the pre-participation, among whom 195 (91%) also completed the post-participation surveys.

Before participating in the workshop, 88% (n=182) of respondents agreed or strongly agreed that NIV education was important to their profession. Similarly, 93% (n=191) of respondents agreed or strongly agreed that they would like to learn more about NIV, while 2% (n=4) did not answer the question. Details of these results from the Likert scale, subcategorized according to profession, are as shown in Table 1. When asked regarding the best form of education to learn more about NIV, 86% (n=178) favoured a combination of didactic and hands-on-learning. Lack of educational materials/sessions, lack of in-servicing and lack of recognition of roles and responsibilities were identified as the top three barriers to adequate knowledge and understanding of NIV.

In the post-participation survey, 90% (n=175) of respondents agreed or strongly agreed that they felt more comfortable in caring for a patient on NIV after participation in the workshop, with 1% (n=2) not responding. Similarly, 96% (n=188) said they would recommend the workshop to a colleague. Details of responses in modified Likert scale are as shown in Table 1. A comparison of pre- and post-participation knowledge assessments showed improvement in knowledge across

all professions, as shown in Table 2. Suggestions to improve NIV practice were categorized into the following three themes: enhanced team collaboration; education; and minimize excessive patient load. Other comments from the participants are listed in Table 3.

DISCUSSION

In the present study, we found that participation in an interprofessional experiential workshop focused on NIV was useful in increasing HCPs' comfort with the use of this modality as well as increasing their knowledge significantly. It also filled an important knowledge-gap as identified by HCPs themselves, and the vast majority of participants indicated they would recommend such a workshop to their peers. Finally, although not measured as a tangible outcome, this workshop allowed for various HCPs to gain a deeper appreciation of the roles and responsibilities of their colleagues from other disciplines, albeit with a heavy focus on the role of registered respiratory therapists. To our knowledge, the present study was the first to investigate the effectiveness of an IPE-based hands-on workshop on NIV in an NICU.

Interprofessional care models have become increasingly common in various medical fields due to the complexity of patients seen, many of whom require the skills and knowledge of professionals with a wide range of expertise (9,11,16). Such an interprofessional care model is particularly relevant in the intensive care unit setting where some of the most complex and chronic patients with multisystem issues are cared for (17). An effective interprofessional care model requires knowledge, collegiality, mutual respect, open communication and understanding of the roles of all team members, and IPE is an important tool to this end (10,18). However, recent reviews have suggested the need for more research in the field of IPE (19,20) and the current study adds to this growing body of literature in a unique patient care setting.

While there have been no studies investigating the efficacy of ventilation education specifically in the NICU, there are studies evaluating multiprofessional education in adult intensive care units. Guilhermino et al (21) conducted a qualitative survey of 160 nurses in an Australian intensive care unit and found that interactive, practical teaching was perceived to improve transfer of knowledge of ventilation to the everyday work environment. In a separate study, the same group of authors also noted that 63% of respondents reported in a structured survey not having received education about mechanical ventilation before working in intensive care. When asked regarding forms of education, hands-on-practice was perceived to be most effective (22). These results are consistent with our findings whereby the vast majority of participants indicated a desire to learn more about NIV. In addition, a practical and hands-on interactive workshop was the preferred education format according to the majority of our respondents. Results from our study lend support to the efficacy of hands-on workshops in the neonatal setting.

There is a large and continually evolving body of literature on theoretical frameworks of IPE. Recently, the WHO published the "Framework for Action on Interprofessional Education and Collaborative Practice", in which IPE was deemed to be most effective when principles of adult learning are used, learning methods reflect real world practice and interaction occurs between students (14). Grapczynski et al (11) recently introduced the 'Integrated Model for Interprofessional Education', combining concepts of holism, participation and practical education. However, no single IPE model is considered the 'gold standard' and profession-specific IPE models need further development and evaluation (19). In addition, the evaluative component of IPE varies widely as reported in a review by Remington et al (9); however, most studies have used a pre- and post-test comparative model that we used in our study. Controlled evaluations using a comparison group may be challenging because the comparison group would need to have similar experience and training for the same duration as participants in IPE.

One of the main strengths of the present study was the large number of participants, and the high rate of participation in the workshop

TABLE 3
Participant comments

What they liked	Looking at the different interfaces Discussion periods, questions, hands on Review of NIV modes Video and interaction Examples discussed in applying knowledge Speaker and presentation style Open forum Casual atmosphere Discussions regarding team effort Before and after tests Playing with the CPAP equipment Opportunity to brainstorm and develop strategies Putting together the whole picture Case scenarios
Suggestions to improve the session	More detail Change the room setup Activity wasn't needed More case scenarios More trouble shooting Transitional physiology More case studies
Suggestions to improve NIV practice	Increased collaboration among team members More bedside discussions about plans More hands on sessions like this Continued education More education Yearly review of therapies

CPAP Continuous positive airway pressure; NIV Noninvasive ventilation

among eligible HCPs. This high rate of participation in the workshop limits selection bias whereby only those HCPs interested in the topic (or those with knowledge of the field) may have participated. In addition, there was a high rate of survey completion among the workshop participants. Finally, the knowledge transfer as a result of the workshop was assessed by participants' self-reflection in their comfort with the topic, as well as an objective knowledge-based set of questions, which limits measurement bias. However, a number of limitations also warrant acknowledgement. First, this IPE workshop was a one-time intervention and, as such, long-term knowledge retention cannot be evaluated. From the published literature, it remains unclear whether a single IPE session can lead to long-term knowledge retention (9). Second, no patient-centred outcomes were assessed. Objective measures of improvement in patient care and outcomes are difficult to ascertain in relation to a single intervention, particularly in a setting as complex as the NICU. Audits of practice patterns and assessment of consistency could have been one measure of outcomes, but was outside the scope of the present intervention. Finally, there were no attending physicians who participated and, hence, the interprofessional composition of the NICU was not fully represented.

The success of this single IPE educational workshop on NIV needs to be followed by the development of an ongoing curriculum of educational program that may enhance knowledge retention and sustainability, while ensuring consistency of practice. Such a program needs to be founded on evidence-based theoretical frameworks that have been proven in other fields (11,19) as well as evidence-based evaluation tools as recently proposed by Reeves et al (23). The development of such a curriculum could not only be part of ongoing IPE for HCPs already working in the NICU, but incorporated into the training of prospective HCPs. Furthermore, the educational framework need not only include NIV, but could incorporate other aspects of neonatal care such as sedation/analgesia, weaning of invasive mechanical ventilation and nutritional guidelines, just to name a few. Finally, further research is required to determine the effectiveness of such educational programs on interprofessional collaboration and, ultimately, their effect on effi-

ciency and quality of care as well as patient outcomes in the NICU.

The focused IPE workshop on NIV described in the present study showed improvement in HCPs knowledge and increased their self-perceived comfort. An evidence-based curriculum on IPE – on NIV and other aspects of neonatal care – may be required as a next step to ensure sustainability and enhance quality of care in an

interprofessional care model. Further work is also required in the NICU setting to assess the effectiveness of IPE on HCP collaboration, communication and, ultimately, patient outcomes.

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