

An electronic Delphi study to establish pediatric intensive care nursing research priorities in 20 European countries

Lyvonne N. Tume RN, PhD^{1,2}, Agnes van den Hoogen RN, PhD³, Joke M. Wielenga RN, PhD⁴, Jos M. Latour RN, PhD^{5,6,7}

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¹ PICU and Children's Nursing Research Unit, Alder Hey Children's NHS, Liverpool, United Kingdom.

² University of Central Lancashire, School of Health, Preston, United Kingdom.

³ Intensive Care Neonatology, Wilhelmina Children's Hospital, University Medical Centre, Utrecht, The Netherlands.

⁴ Intensive Care Neonatology, Emma Children's Hospital, Academic Medical Center, Amsterdam, The Netherlands.

⁵ School of Nursing and Midwifery, Faculty of Health, Education and Society, Plymouth University, Plymouth, United Kingdom.

⁶ School of Nursing and Midwifery, Faculty of Health Science, Curtin University, Perth, WA, Australia.

⁷ Department of Pediatrics, Intensive Care Neonatology, Erasmus MC–Sophia Children's Hospital, Rotterdam, The Netherlands.

Corresponding author:

Lyvonne Tume RN, PhD

Senior Research Fellow; Alder Hey Children's Hospital Liverpool; Paediatric Intensive Care Unit and the Children's Nursing Research Unit; Alder Hey Children's NHS FT, Eaton Rd, Liverpool UK and University of Central Lancashire, Preston UK

Phone: +44 151 282 4588 Fax +44 151 252 5771

E-mail: Lyvonne.Tume@alderhey.nhs.uk or lyvonnetume@gmail.com

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ABSTRACT

Objective: To identify and to establish research priorities for pediatric intensive care (PIC) nursing science across Europe.

Design: A modified three round electronic Delphi technique was applied. Questionnaires were translated into seven different languages.

Setting: European PIC units.

Participants: The participants included PIC clinical nurses, managers, educators and researchers. In round one the qualitative responses were analysed by content analysis and a list of research statements and domains was generated. In round two and three the statements were ranked on a scale of one to six (not important to most important). Mean scores and standard deviations were calculated for round two and three.

Interventions: None

Main results: Round one started with 90 participants, with round three completed by 64 [71%]. The seven highest ranking statements (≥ 5.0 mean score) were related to end of life care, decision-making around forgoing and sustaining treatment, prevention of pain, education and competencies for PIC nurses, reducing healthcare associated infections, identifying appropriate nurse staffing levels and implementing evidence into nursing practice. Nine research domains were prioritised, these were: 1. clinical nursing care practices, 2. pain and sedation, 3. quality and safety, 4. respiratory and mechanical ventilation, 5. child and family centred care, 6. ethics, 7. professional issues in nursing, 8. haemodynamics and resuscitation, and 9. trauma and neurocritical care.

Conclusions: The results of this study inform the European Society of Pediatric and Neonatal Intensive Care's (ESPNIC) nursing research agenda in the future. The results allow nurse researchers within Europe to encourage collaborative initiatives for nursing research.

INTRODUCTION

Despite an increasing number of studies to establish critical care research priorities internationally no studies have explored research priorities in PIC nursing within Europe [1-3]. Research priorities are not static, but change according to cultural ideologies, local challenges, and political and economic resources of individual communities. The European Society of Pediatric and Neonatal Intensive Care (ESPNIC) aims to promote the art and science of pediatric and neonatal intensive care and to develop evidence based clinical practice [4]. In view of expanding its scientific activities, the society established sections to support these activities in 2012. The nursing science section was established and one of its aims was to establish the nursing research agenda within Europe. The current problem within European PIC nursing is that although there are a number of active research groups [5-7], there are no formal collaborative links or any known consensus of research priorities to allow further development of PIC nursing science across Europe. Therefore it is imperative that the PIC nursing research priorities within Europe are defined. Without understanding the most important problems affecting pediatric critical care nursing, research efforts may be uncoordinated and directed in areas that are not of highest priority. Therefore it is imperative to establish the PIC nursing research priorities within Europe.

To increase the likelihood that research impacts on nursing practice, the importance of involving key stakeholders in the identification process is crucial. The aim of this study was to identify and to prioritise nursing research topics of importance as defined by European pediatric intensive care nurses.

MATERIALS AND METHODS

A modified three round e-Delphi technique was undertaken. An e-Delphi approach is defined as the use of the modified Delphi technique via an electronic/web based medium [8]. Within healthcare research the Delphi technique is often used to set priorities or to gain consensus

about important issues [9-10]. It is a multi-staged survey allowing consulting a large number of experts without bringing them physically together. Using consecutive surveys, it is possible to collect, evaluate, and tabulate the experts' opinions. The characteristics of the Delphi technique are based on anonymity, iteration, controlled feedback, and statistical group response [11]. The surveys protect the anonymity and iteration takes place by presenting the discussed issues over a certain number of rounds. Controlled feedback and statistical group response take place in between rounds by informing individual experts about the opinions of the total expert group. The e-Delphi technique is performed via email or online web surveys [8]. The e-Delphi process used in this study is outlined in Figure 1. The three rounds were completed within 5 months, from the first of July to the first of December 2012. Institutional review board approval was received from University Medical Centre Utrecht (protocol number 12/147), signed consent forms from participants were not required.

Participants

The participants were clinical pediatric intensive care nurses, managers, educators and researchers from all European countries. The aim was to generate a mixture of nursing roles and to have eight nurses per country (two clinical nurses, two education nurses, two nurse managers and two research nurses). The inclusion criteria included being a nurse currently working in pediatric intensive care unit or in an intensive care unit that cared for children, who identified themselves as being primarily a pediatric intensive care nurse and having an email address. Exclusion criteria were nurses who indicated they were neonatal or adult intensive care nurses exclusively. There are no universally agreed criteria for minimum or maximum number of experts in a Delphi method, but other similar Delphi studies [1] used eight per country, thus we took a pragmatic decision to include two nurses (if possible) from four different PIC nursing roles (clinical, education, management and research) in each country to achieve our aim. Contact details for participants were obtained through the ESPNIC registry and through personal contacts. Individuals were informed about the voluntary nature of the study and the

need for participation in all three electronic survey rounds. Informed consent was assumed by completing the surveys. Personal data (email addresses, name, age and job title) was kept on a secure password protected database (Excel) accessible only to LNT and JML and identifiable data on this database was deleted after study completion. Participants were informed about the need for their name for each round to determine response rates and link findings to nursing roles and countries. To maximise response rates and reduce attrition between rounds, the 90 nurses who agreed to participate received the questionnaire of all three rounds and three reminders were sent for each round. If we received more than 8 responses per country, we agreed we would use all the respondents, as we did not want to exclude motivated participants who had already been contacted by the country lead.

Questionnaires

The questionnaires for the e-Delphi rounds were developed in a three step process (Fig 1). The first e-Delphi round was an electronic questionnaire inviting participants to list a minimum of three and maximum of five important topics for PIC nursing research. Based on the results of round one, a structured electronic questionnaire was developed with statements and domains. In round two, participants ranked these statements and domains on a 6-point scale (1 is not important to 6 is extremely important). The same questionnaire was used for round three but included mean scores of the group response of round two per statement and domain. All surveys were forward translated only by a lead person in all countries.

SurveyMonkey™ Gold version was used to administer the questionnaires to the study participants.

Analysis

Results of round one were content analysed by two researchers independently (LNT and JML). Statements were categorised into thematic areas (termed domains) according to the content but also the number of suggestions using an analysis framework [12] Creswell 2003] JML and LNT undertook the content analysis separately, and then met to discuss and agree these domains.

We reached agreement over these domains by discussion and these were then checked for validity by two researchers independently (AvdH and JMW) [13]. Any disagreement was discussed and agreement reached through discussion. In terms of any conflict of interest, although both authors' (LNT and JML) research fits within these broad domains, these domains were established from the responses of participants and neither researcher's specific research is represented within the research statements. Furthermore, these domains and statements, along with the quantitative data responses were sent to the two independent researchers (AvH and JW) of this to ensure validity of these generated items.

This analysis generated a list of research statements and domains for round two. The mean and standard deviations (SD) were calculated of the round two responses and the total mean scores were added to the round three questionnaire. Participants were asked re-rate the statements again taking the group scores into account. In the round three analyses, the importance of the statements was ranked by means and SD with effect size examined by Cohen's d (standardised mean difference) between round two and three. For Cohen's d, the effect size interpretation is as follows: 0.2 small effect, 0.5 medium effect and >0.8 large effect [14]. The paired t test was applied to calculate difference between round two and round three (significance level set at ≤ 0.05 and two tailed tests were used). The ranking of importance of the statements was defined by the highest mean and the smallest standard deviation. Normally distributed variables are presented using the mean and SD. Differences between the five different nursing roles (clinical, education, research, management, advanced practice) multiple groups were tested using one way ANOVA as the data were normally distributed . The data analysis was undertaken both in Microsoft Excel and IBM SPSS version 20 by LNT and JML. Respondents were categorised for analysis by European region using the definition in the ETHICUS study [15].

RESULTS

The e-Delphi study started by inviting 169 PIC nurses across Europe. Of these, 90 nurses agreed to participate and completed round one. The response rates of consecutive rounds were: round two 69/90 (77%) and round three: 64/90 (71%). The respondents were pediatric intensive care clinical nurses, managers, educators and researchers from 20 European countries (Table 1). A variance was observed in the number of nurses and roles per country as some countries had no education or research nurses. In two countries, Italy and UK, more than eight nurses started in round one. The national lead contact often provided names of more than 8 nurses per country. Although we did randomly select 8 nurses (by role/unit variation) we did over recruit to 10-12, as we found that in most countries this only generated 8 responses, however in two countries (UK and Italy) we got more than 8 responses. The characteristics of the respondents remained similar over the three rounds (Table 2). There were a small percentage of nurses who worked within adult intensive care units, but whom cared for children and identified themselves as primarily pediatric intensive care nurses. This reflects the way the PIC services are delivered across some European countries and thus we included these nurses.

There were 357 suggestions for research topics provided by 90 nurses in round one and content analysis produced 47 research statements in nine research domains. Some research statements did fit into different domains, however if there were a large number of statements related to one topic area (eg pain and sedation) then we agreed this was important to make this a domain of its own. Of the 47 statements, they ranged from the lowest mean score of 3.91 (SD 1.70) to 5.40 (SD 1.01) in both rounds (Table 3). The nine priority research domains identified were: 1. clinical nursing care practices (mean 5.17 SD 1.05), 2. pain and sedation (mean 5.11 SD 1.04), 3. quality and safety (mean 4.85 SD 1.06), 4. respiratory and mechanical ventilation (mean 4.79 SD 1.07), 5. child and family centred care (mean 4.68 SD 1.16), 6. ethics (mean 4.57 SD 1.02), 7. professional issues in nursing (mean 4.54 SD 1.11), 8. haemodynamics and resuscitation (mean 4.37 SD 1.13) and 9. trauma and neurocritical care (mean 4.09 SD 1.27).

The mean scores did not change significantly between round two and three (Table 3 supplemental digital content), the effect size (Cohen's d) was not greater than 0.32. In round three, seven statements achieved a mean score of ≥ 5.0 . These related to end of life care, communication and decision making around forgoing and sustaining treatment, interventions to reduce pain, education and competencies, reducing healthcare associated infections, nurse staffing levels and implementing evidence based practice (Table 4). The top 20 research statements are presented in Table 4. There was little difference in the ranking of round 3 domains between different nursing roles, except the domain pain and sedation. In this domain advanced practice nurses (n=3) rated this lowest, mean score 3.0, and research nurses (n=9) rated it highest, mean score 5.8 ($p=0.008$). When each of the research statements within this domain were examined, the three statements related to sedation (sedation assessment, sedation strategies and delirium scales) were the statements ranked highly by the research nurses (respectively $p=0.001$; $p=0.006$, $p=0.000$). There were no statistically significant differences between the three European regions in the ranking of the research domains (Table 5).

DISCUSSION

This the first study to identify PIC nursing research priorities within Europe. European PIC nurses have prioritised fundamental clinical nursing care issues for critically ill children and in supporting their families within and beyond the PICU. Organisational and professional issues were also identified as priority research areas. These priorities are not dissimilar to many of the research priorities previously identified in intensive care nursing [1-2, 16-19]. Studies on research priorities in intensive care have been conducted by several critical care nursing organisations around the world.

Most studies have used a form of expert consensus method to identify and generate the research priorities. Most recently, a study in adult critical care across Europe, identified research

priorities relating to organisational aspects of clinical practice and organ-system support [1]. In 2011, the Australian College of Critical Care Nurses conducted a Delphi study on research PIC nursing priorities in Australia and New Zealand [18]. They found the top priorities included patient issues related to neurological care, pain/sedation/comfort, best practice at the end of life, and ventilation strategies, as well as two priorities related to professional issues about nurses' stress/burnout and professional development needs. In a Delphi study undertaken with nurses from the Hong Kong Critical Care Nursing Association in 2003, priorities were mostly related to patient and family issues such as the use of therapeutic touch to relieve pain and anxiety, reducing fatigue in weaning, reducing family stress and family participation in patient care [17].

The top research priorities as identified in our study are related to end-of-life practices, pain management, nursing education and competencies, reducing health care associated infections, staffing levels and improving evidence-based nursing practice. Most of these areas have already been under investigation by several PIC nurses researchers. These researchers operate in a PIC research group or even work on international level with other PICUs. A multi-centre study on end-of-life practices has been active previously by the support of ESPNIC and identified the decision-making practices to forgo life sustaining treatments [20-22]. Another group of nurse researchers is active in pain and sedation management. They developed several scales to assess pain and sedation [23-25]. Other nurse researchers have started to work on staffing levels and education [26-27]. The detailed statements and their priority listing of our study might motivate these nurse researchers to continue their work and provide in-depth information for future research. Our findings with regard to the significantly higher ranking of pain and sedation (specifically sedation) by the research/science nurses may in fact reflect a just small number of the participant's interests in this field. To maximise the efficiency and effectiveness of the PIC nursing research, it might be advocated to establish more links with other PIC centres and collaboratively work on several areas of PIC nursing to increase the body of knowledge on a scientific level. Therefore, the development of European PIC nursing

research priorities may facilitate the process of clinical research and assist in developing an agenda for PIC nursing research. Some, however, have argued that Delphi studies identifying research priorities have had little or no impact on actual outputs in these areas, thus need to only be undertaken within the context of their intended use [28]. The setting of research priorities is however widely advocated for assisting researchers and aligning funding with European evidence needs [8]. Our study was undertaken in conjunction with the society of ESPNIC and within this, the nurse science section. The results of this study are intended to drive the nursing research agenda of this society, producing a future roadmap for this section [29]. As with all research priority studies however, these results reflect the social, political and economic culture of the European healthcare environment in 2012 and may change. Future research should examine patient and parent's perspectives on research priorities.

This study has limitations that warrant acknowledgement. There were a variable number of nurses per country and some European countries were not represented, whereas others were over-represented. Every effort was made to have a convenience sample representing all European countries. In comparison, an adult critical care Delphi study only managed to cover 20 European countries [1]. This was, despite the involvement of the European federation of Critical Care Nursing association (EfCCNa), a network of 25 national critical care societies. In our study, we had to rely on individual members as ESPNIC does not yet have established a network of societies. A bias within this study is also that, given the variation in how pediatric and neonatal intensive care is delivered within Europe, some PICUs are combined with neonatal intensive care. Therefore there may be some 'contamination' of the PIC nursing study participants with that of neonatal intensive care nurses. However, where possible, nurses identifying themselves as only 'neonatal' nurses were excluded in this survey. A further limitation was that this study only consulted PIC nurses about their research priorities and did not consult services users (parents or older children who had experience of PIC). The strength of the study lies in the electronic nature of the study. This enabled rapid responses and faster data analysis and

reduced the costs. Others have recently reported the benefits of e-Delphi studies [8]. Additionally, the local translations of the survey meant that it did not restrict it to only English-speaking nurses, which has been a limitation of other studies [1]. Our lack of back translation for round one may also be a limitation, however any unclear statements were sent back to the country lead for clarification. A final limitation was that when comparing differences between nursing roles, the groups were not equal in number and many countries did not have research/science nurses and this may have introduced bias into the findings.

CONCLUSIONS

Delphi studies focussing on establishing research priorities are a useful way to initiate research programs. This was a key driver for the ESPNIC nurse science section. Nine PIC nursing priority research domains were identified. The results of this study allow nurse researchers within Europe to establish and review their PIC nursing research agenda. This will encourage collaborative initiatives for nursing research, as well defining the research topics that should be financially supported. With the increasing importance of empowering children and parents in healthcare decisions, further research should investigate the perspectives of children and parents in research priorities.

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REFERENCES

1. Blackwood B, Albarran JW, Latour JM (2011) Research priorities of adult intensive care nurses in 20 European countries: a Delphi study. *J Adv Nurs* 67:550-562
2. Daly J, Chang EM, Bell PF (1996) Clinical nursing research priorities in Australian critical care: a pilot study. *J Adv Nurs* 23:145-151
3. Funk M (1989) Research priorities in critical care nursing. *Focus Crit Care* 16:135-138.
4. European Society of Pediatric and Neonatal Intensive Care. www.espnice-online.org accessed 30 June 2013
5. Ista E, van Dijk M, van Achterberg T (2013) Do implementation strategies increase adherence to pain assessment in hospitals? A systematic review. *Int J Nurs Stud* 50:552-568
6. Latour JM, van Goudoever JB, Duivenvoorden HJ, Albers MJ, van Dam NA, Dullaart E, van Heerde M, de Neef M, Verlaat CW, van Vught EM, Hazelzet JA (2011) Construction and psychometric testing of the EMPATHIC questionnaire measuring parent satisfaction in the pediatric intensive care unit. *Intensive Care Med* 37:310-318
7. Tume L, Carter B, Latten L (2013) A UK and Irish survey of enteral nutrition practices in pediatric intensive care units. *Br J Nutr* 109:1304-1322
8. Gill FJ, Leslie GD, Grech C, Latour JM (2013) Using a web-based survey tool to undertake a Delphi study: Application for nurse education research. *Nurse Educ Today* doi: 10.1016/j.nedt.2013.02.016
9. Keeney S, Hasson F, McKenna H (2006) Consulting the oracle: ten lessons from using the Delphi technique in nursing research. *J Adv Nurs* 53:205-212
10. Keeney S, Hasson F, McKenna H (2011) *The Delphi Technique in Nursing and Health Research*. Wiley-Blackwell, Chichester, UK
11. Dalkey NC (1969) *The Delphi method: An experimental study of group opinion*. RAND Corporation, Santa Monica, USA
12. Creswell J (2003) *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*. 2nd Edn. Sage Publications, Thousand Oaks, USA
13. Pope C, Ziebland S, Mays N (2000) Qualitative research in health care. Analysing qualitative data. *BMJ* 320:114-116
14. Cohen J (1988) *Statistical Power Analysis for the Behavioral Sciences*. Lawrence Erlbaum Associates, New York
15. Sprung CL, Cohen SL, Sjøkvist P et al (2003) End-of-life practices in European intensive care units: the Ethicus Study. *JAMA* 290:790-797

16. Goldfrad C, Vella k, Bion JF, Rowan KM, Black NA (2000) Research priorities in critical care medicine in the UK. *Intensive Care Med* 26:1480-1488
17. Lopez V (2008) Critical care nursing research priorities in Hong Kong. *J Adv Nurs* 43:578-587
18. Ramelet AS, Gill F (2012) A Delphi study on National PICU nursing research priorities in Australia and New Zealand. *Aust Crit Care* 25:41-57
19. Imhof L, Abderhalden C, Cignacco E, Eicher M, Mahrer-Imhof R, Schubert M, Shaha M (2008) [Swiss Research Agenda for Nursing (SRAN): the development of an agenda for clinical nursing research in Switzerland]. *Pflege* 21:252-261
20. Devictor DJ, Latour JM, EURYDICE II study group (2011) Forgoing life support: how the decision is made in European pediatric intensive care units. *Intensive Care Med* 37:1881-1887
21. Devictor D, Latour JM, Tissieres P (2008) Forgoing life-sustaining or death-prolonging therapy in the pediatric ICU. *Pediatr Clin North Am* 55:791-804
22. Latour JM, van Goudoever JB, Schuurman BE, Albers MJ, van Dam NA, Dullaart E, van Heerde M, Verlaat CW, van Vught EM, Hazelzet JA (2011) A qualitative study exploring the experiences of parents of children admitted to seven Dutch pediatric intensive care units. *Intensive Care Med* 37:319-325
23. Ista E, van Dijk M, de Hoog M, Tibboel D, Duivenvoorden HJ (2009) Construction of the Sophia Observation withdrawal Symptoms-scale (SOS) for critically ill children. *Intensive Care Med* 35:1075-1081
24. van Dijk M, Knoester H, van Beusekom BS, Ista E (2012) Screening pediatric delirium with an adapted version of the Sophia Observation withdrawal Symptoms scale (SOS). *Intensive Care Med* 38:531-532
25. van Dijk M, de Boer JB, Koot HM, Tibboel D, Passchier J, Duivenvoorden HJ (2000) The reliability and validity of the COMFORT scale as a postoperative pain instrument in 0 to 3-year-old infants. *Pain* 84:367-77
26. Gill FJ, Leslie GD, Grech C, Latour JM (2012) A review of critical care nursing staffing, education and practice standards. *Aust Crit Care* 25:224-237
27. Tume L (2010) Remodelling the pediatric ICU workforce: there is a case for implementing advance nurse practitioner roles into all pediatric intensive care units. *Nurs Crit Care* 15:165-167
28. Marshall A (2004) Research priorities for Australian critical care nurses: do we need them? *Aust Crit Care* 17:142-4, 146, 148-150

29. Wielenga J, Tume L, van den Hoogen A, Latour JM (2013) Research Priorities of PICU and NICU nurses across Europe: A Delphi Study. *Intensive Care Med* 39(S1):S194

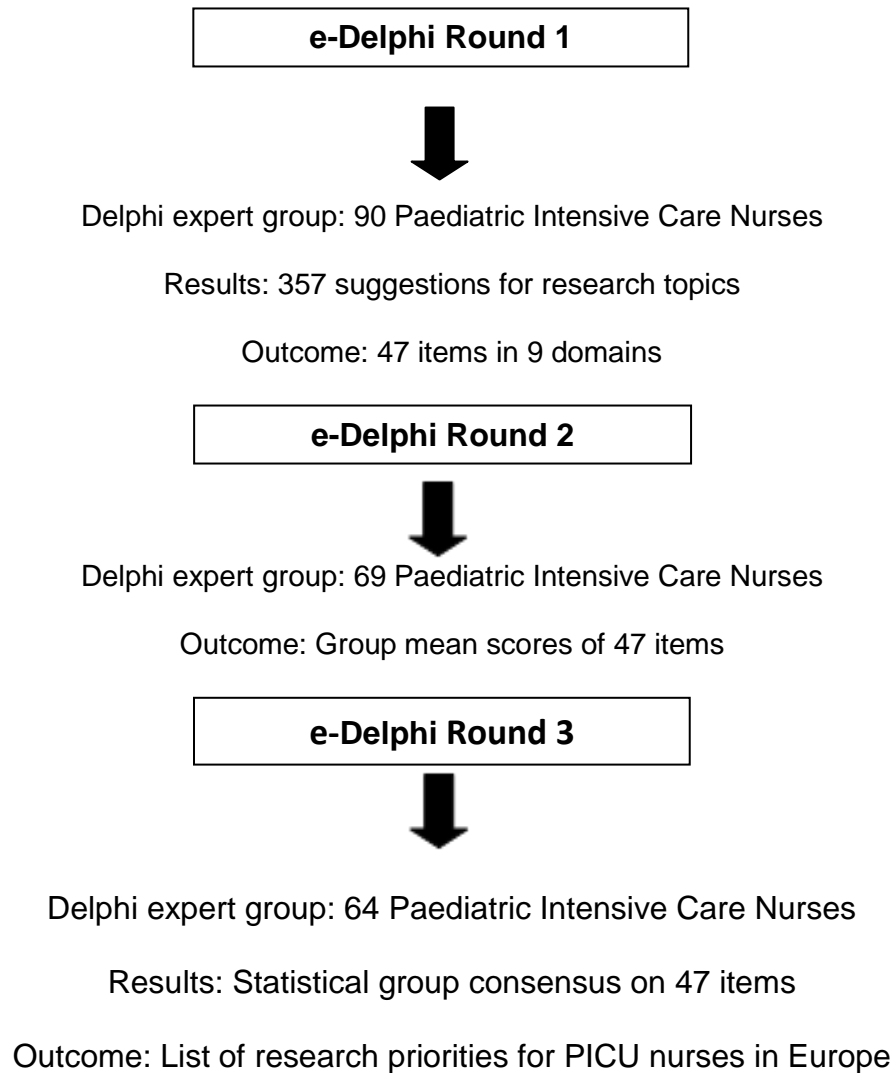


Figure 1 PICU e-Delphi study Flowchart

Table 1 Dispersion of pediatric intensive care nursing respondents from 20 European countries

Country	European region	Round 1 <i>n</i> =90	Round 2 <i>n</i> =69	Round 3 <i>n</i> =64
Belgium	Central	3	3	2
Cyprus	Southern	4	2	3
Denmark	Northern	2	1	1
Finland	Northern	3	3	2
France	Central	3	2	2
Germany	Central	8	6	7
Greece	Southern	4	4	2
Iceland	Northern	3	0	1
Ireland	Northern	6	6	5
Italy	Southern	11	7	7
Netherlands	Northern	8	6	4
Norway	Northern	1	1	0
Portugal	Southern	6	5	6
Romania	Central	1	0	0
Serbia	Central	4	3	4
Slovenia	Central	2	2	1
Sweden	Northern	4	3	3
Switzerland	Central	4	4	4
Turkey	Southern	3	2	2
UK	Northern	10	9	8

Table 2 Respondent demographics

	Round 1 <i>n</i> =90	Round 2 <i>n</i> =69	Round 3 <i>n</i> =64
Female (%)	74	75	71
Age in years; mean (SD)	41 (9)	41 (9)	41 (9)
PICU experience; years (SD)	14 (8)	13.5 (8)	13.5 (8)
Main nursing role			
Clinical (%)	43	45	42
Education (%)	14	21	17
Research (%)	10	9	10
Management (%)	20	22	19
Advanced practice (%)	3	3	3
Missing (%)	10	0	9
Unit type			
PICU (%)	74	65	59
PICU-NICU combined (%)	17	32	29
AICU (%)	4	3	4
Missing (%)	5	0	8

SD Standard deviation; PICU Pediatric Intensive Care Unit;
NICU Neonatal Intensive Care Unit; AICU Adult Intensive Care Unit

Table 3 Results of domains and statements of Round 2 and Round 3

Domains and Statements	Round 2 mean (SD)	Round 3 mean (SD)	Cohen's <i>d</i>	<i>P</i> value
1. Clinical Nursing Care Practices	4.98 (1.20)	5.17 (1.05)	-0.16	0.25
Identifying and implementing strategies to improve evidence based nursing practice	5.05 (1.15)	5.03 (1.07)	0.01	0.36
Evaluating the impact of noise and light on the critically ill child	4.77 (1.05)	4.61 (1.13)	0.14	0.44
Interventions to improve skin and wound care	4.40 (1.03)	4.25 (0.93)	0.15	0.68
Interventions to prevent pressure ulcers	4.30 (1.08)	4.18 (0.92)	0.11	0.57
Interventions to optimise the developmental care of neonates	4.16 (1.34)	4.16 (1.20)	0.00	0.53
Interventions to improve oral care in PICU	4.20 (1.18)	4.06 (1.15)	0.12	0.65
Optimising nutritional and metabolic requirements in critically ill children	4.13 (1.14)	4.06 (1.12)	0.06	0.08
Identifying best practices in enteral feeding	4.13 (1.16)	3.96 (1.24)	0.14	0.21
Nursing management of the post-operative patient	4.17 (1.14)	3.91 (1.70)	0.17	0.93
2. Pain & Sedation	5.05 (1.10)	5.11 (1.04)	-0.05	0.81
Effective interventions to prevent or reduce pain	5.29 (0.84)	5.15 (1.04)	0.14	0.45
Identifying best practices for preventing analgesia and sedation withdrawal	5.07 (0.99)	4.96 (1.18)	0.10	0.48
Identifying best practices for sedation assessment	5.13 (1.02)	4.95 (1.04)	0.17	0.26
Effectiveness of sedation strategies	4.88 (1.08)	4.82 (1.01)	0.05	0.50
Identifying best practices for pain assessment	4.95 (1.37)	4.53 (1.24)	0.32	0.10
Assessment scales for delirium	4.63 (1.47)	4.23 (1.33)	0.28	0.05
3. Quality & Safety	4.88 (1.03)	4.85 (1.06)	0.02	0.92
Interventions to reduce healthcare associated infections	5.02 (1.10)	5.11 (1.04)	-0.08	0.58
Improving healthcare team communication and collaboration	5.02 (1.11)	4.96 (1.02)	0.05	0.87
Identifying and improving the quality indicators for PICU nursing	5.05 (1.05)	4.95 (1.07)	0.09	0.80
Improving safety, preventing harm and managing adverse events	4.85 (1.06)	4.62 (1.11)	0.21	0.14
4. Respiratory & Mechanical Ventilation	4.85 (1.01)	4.79 (1.07)	0.05	0.56
Identifying best practices in weaning from mechanical ventilation	4.88 (1.16)	4.91 (1.04)	-0.02	0.75

Identifying best practices in delivering NIV	4.89 (1.22)	4.77 (0.98)	0.10	0.28
Interventions to improve mechanical ventilation	4.64 (1.09)	4.64 (1.02)	0.00	0.55
5. Child & Family Centred Care	4.72 (1.18)	4.68 (1.16)	0.03	1.00
Strategies to support parents and siblings of critically ill children	5.19 (0.85)	4.90 (0.92)	0.32	0.10
The role and involvement of parents in the care of their child on PICU	4.85 (1.22)	4.85 (1.04)	0.00	0.81
Psychosocial outcome and quality of life of the child & family after PICU admission	4.77 (1.17)	4.79 (1.06)	-0.01	0.87
Therapeutic communication between PICU nurses & PICU children	4.93 (1.02)	4.71 (1.08)	0.20	0.39
Identifying best practices to improve family centred care	4.61 (1.27)	4.61 (1.19)	0.00	0.82
Improving the physical outcomes of the child after PICU admission	4.56 (1.25)	4.58 (1.19)	-0.01	0.90
Improving parental presence and visitation on the PICU	4.59 (1.23)	4.58 (1.23)	0.01	1.00
Identifying the needs and experiences of the child, parents and family	4.73 (1.13)	4.53 (0.99)	0.18	0.15
Identifying the needs of the chronically ill child on PICU	4.80 (1.18)	4.52 (1.14)	0.24	0.11
6. Ethics	4.53 (1.29)	4.57 (1.02)	-0.03	0.62
Improving end-of-life and palliative care for children and their family	5.23 (0.93)	5.26 (1.01)	-0.03	0.93
Communication and decision-making in forgoing or sustaining treatment	5.17 (0.96)	5.20 (0.98)	-0.03	0.85
Ethical dilemmas related to cost and quality of life issues	4.74 (1.25)	4.56 (1.19)	0.14	0.68
7. Professional Issues in PICU Nursing	4.62 (1.28)	4.54 (1.11)	0.06	0.89
The effect of continuous education and training methods on nursing competence & knowledge	5.40 (1.00)	5.12 (0.96)	0.02	0.61
Identifying appropriate nurse staffing levels and recruitment strategies	4.98 (1.13)	5.03 (0.90)	-0.04	0.71
Education and training to prepare new nurses to work in PICU	4.91 (1.22)	4.91 (1.12)	0.00	0.08
Reducing stress and burnout in PIC nurses	4.85 (1.25)	4.88 (1.14)	-0.02	0.26
Identifying the scope of the PICU nursing role & responsibilities	4.80 (1.14)	4.59 (1.15)	0.18	0.81
The impact of the changing workforce (e.g. ANP roles) on patient outcomes	4.71 (1.11)	4.54 (0.96)	0.16	0.32

8. Haemodynamics & Resuscitation	4.60 (1.26)	4.37 (1.13)	0.19	0.15
Advanced life support practices to improve patient outcomes	4.91 (1.08)	4.77 (1.12)	0.12	0.33
The effect of nurse-driven protocols to wean inotropes	4.46 (1.44)	4.62 (1.05)	-0.12	0.65
Interventions to optimise the care of invasive lines	4.52 (1.21)	4.54 (0.89)	-0.01	0.73
Improving the nursing care of the child on ECLS	4.37 (1.36)	4.30 (1.33)	0.05	0.36
9. Trauma & Neurocritical Care	4.24 (1.20)	4.09 (1.27)	0.12	0.34
Interventions to optimise the nursing care of the child with traumatic brain injury	4.78 (1.01)	4.60 (1.08)	0.17	0.22
Nursing care to ensure effective therapeutic hypothermia to improve patient outcomes	4.76 (1.12)	4.51 (0.95)	0.24	0.14
Preparing for major incidents and optimising trauma care	4.32 (1.33)	4.29 (1.17)	0.02	0.40

SD Standard deviation; ECLS Extracorporeal life support; ANP Advanced Nurse Practitioner; NIV Non-invasive ventilation

Table 4 Top 20 ranking pediatric intensive care nursing research statements

Research statement	Mean (SD)
1 Improving end-of-life and palliative care for children and their families	5.26 (1.01)
2 Communicating and decision-making around forgoing and sustaining treatment	5.20 (0.98)
3 Effective interventions to reduce and prevent pain	5.15 (1.04)
4 The effect of continuous education and training methods on nursing competence and knowledge	5.12 (0.96)
5 Interventions to reduce health care associated infections	5.11 (1.04)
6 Identifying appropriate nurse staffing levels and recruitment strategies	5.03 (0.90)
7 Identifying and implementing strategies to improve evidence-based nursing practice	5.03 (1.07)
8 Improving healthcare team communication	4.96 (1.04)
9 Identifying best practices for preventing analgesia and sedation withdrawal	4.96 (1.18)
10 Identifying best practices in sedation assessment	4.95 (1.04)
11 Identifying and improving quality indicators for PICU nursing	4.95 (1.07)
12 Identifying best practices in weaning mechanical ventilation	4.91 (1.04)
13 Education and training to prepare new nurses to work in PICU	4.91 (1.12)
14 Strategies to support parents and siblings of critically ill children	4.90 (0.92)
15 Reducing stress and burnout in PICU nurses	4.88 (1.14)
16 The role and involvement of parents in the care of the critically ill child	4.85 (1.04)
17 Identifying effective sedation strategies	4.82 (1.01)
18 Psychosocial outcome and quality of life of the child and family after PICU	4.79 (1.06)
19 Identifying best practices in non-invasive ventilation	4.77 (0.98)
20 Advanced life support practices to improve patient outcomes	4.77 (1.12)

SD Standard deviation; PICU Pediatric Intensive Care Unit

Table 5 Comparison of research domains per European region, Round 3

Research Domain	Overall mean (SD) <i>n</i> =64	Northern Europe mean (SD) <i>n</i> =25	Central Europe mean (SD) <i>n</i> =19	Southern Europe mean (SD) <i>n</i> =20
Clinical Nursing Care Practices	5.17 (1.05)	5.00 (1.25)	5.12 (1.02)	5.44 (0.85)
Pain & Sedation	5.11 (1.04)	4.84 (1.40)	5.37 (0.62)	5.16 (0.78)
Quality & Safety	4.85 (1.06)	5.00 (1.22)	4.93 (1.06)	4.61 (0.84)
Respiratory & Mechanical Ventilation	4.79 (1.07)	4.72 (1.10)	4.93 (1.10)	5.05 (0.93)
Child & Family Centred Care	4.68 (1.16)	4.24 (1.20)	4.68 (1.35)	5.05 (0.80)
Ethics	4.57 (1.02)	4.60 (1.22)	4.68 (1.01)	4.61 (0.77)
Professional Issues in PICU Nursing	4.54 (1.11)	4.44 (1.04)	4.43 (1.03)	4.94 (0.99)
Haemodynamics & Resuscitation	4.37 (1.13)	4.44 (1.15)	4.68 (1.07)	4.33 (1.08)
Trauma & Neurocritical Care	4.09 (1.27)	4.04 (1.30)	4.12 (1.20)	4.27 (1.36)

SD Standard deviation; PICU Pediatric Intensive Care Unit