



Review

The competence of neonatal intensive care nurses: A systematic review

Eeva Talus^{*}, Hanna Seppänen, Kristina Mikkonen, Anna-Kaija Palomaa, Tarja Pölkki

Research Unit of Health Sciences and Technology, University of Oulu, Finland Medical Research Center Oulu, Oulu University Hospital and University of Oulu, Oulu, Finland

The Finnish Centre for Evidence-Based Health Care: A Joanna Briggs Institute, The Finnish Centre of Excellence, Helsinki, Finland

ARTICLE INFO

Keywords:

Systematic review
Nurses
Competence
Neonatal
Intensive care

ABSTRACT

Objective: The objective was to conduct a systematic review describing the competencies required from nurses working in neonatal intensive care settings.

Design: Systematic review.

Data sources: A total of eight databases, including PubMed, Scopus, CINAHL, MEDLINE, Mednar, Web of Science, ProQuest and Medic, were screened for relevant literature during February and September 2022.

Review methods: The systematic review process followed Joanna Briggs Institute guidelines. The inclusion criteria were: 1) (P = population) registered nurses; 2) (C = concept) the competence; 3) (C = context) nursing in neonatal intensive care units; and 4) cross-sectional study as study method. A critical appraisal tool for cross-sectional studies from Joanna Briggs Institute was used by two independent reviewers. After data extraction, thematic analysis was performed.

Results: The database searches yielded a total of 8887 studies and after two independent evaluations, a total of 50 eligible studies were identified comprising of 7536 registered nurses working in neonatal intensive care units across 19 countries. The studies described four main competence themes: 1) neonatal care interventions; 2) caring for a dying infant; 3) family-centered care; and 4) neonatal intensive care interventions.

Conclusion: Previous research has focused on evaluating specific competencies that are necessary in the neonatal intensive care setting. There is a need for research concerning the overall competence of nurses working in neonatal intensive care units. There was a lot of variety within the quality of the eligible studies and within the used instruments.

Protocol registration: This systematic review was registered in Prospero (PROSPERO 2022 CRD42022308028).

1. Introduction

Registered nurses working in neonatal intensive care units (NICUs) need to have special competencies because this setting focuses on sick infants and preterm infants who are still developing. Decisions about treatment can affect a child's survival and quality of life. On a global level, 8–10 million infants need intensive care each year (WHO, 2019). Efficient, high-quality neonatal intensive care has dramatically decreased the mortality rate of infants and made the care of infants more cost-effective (Cheah, 2019). The competence of registered nurses greatly impacts the planning, delivery, and evaluation of care. This is particularly relevant to the intensive care unit, where the condition of an infant can change rapidly (Bromley, 2019). As such, the competence of registered nurses influences neonatal outcomes (Jones, 2019).

There is a need for comprehensive knowledge on the different

competencies required in NICUs. This is important in developing the education and competence of registered nurses working in NICUs. The measurement – and subsequent mapping – of a competence offers the possibility to develop nursing career paths and affect the retention of registered nurses. Reliable information from competence measurements can ensure high-quality nursing care (Greig et al., 2006).

2. Background

Professional competence encompasses the attitudes, values, knowledge, and skills of a registered nurse that are needed to provide high-quality care which ensures patient safety (Al-Jabri et al., 2021). To acquire nursing competence, a registered nurse needs to possess both specific skills and traits to perform their duties as well as the ability to integrate multiple elements (techniques, knowledge, thinking, values,

^{*} Corresponding author at: Aapistie 5, 90220 Oulu, Finland.

E-mail address: eeva.talus@oulu.fi (E. Talus).

<https://doi.org/10.1016/j.nedt.2023.105892>

Received 23 March 2023; Received in revised form 4 June 2023; Accepted 22 June 2023

Available online 24 June 2023

0260-6917/© 2023 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

and attitudes) that are needed in specific contexts (Fukada, 2018). Professional competence is a fundamental part of the registered nurse role due to its relationship to both nursing quality and patient care (Karami et al., 2017). Professional development enhances the standard of neonatal intensive nursing when the education focuses on competencies relevant to the neonatal context (Maree et al., 2020).

There are no systematic reviews about the competence needed in neonatal intensive care units, however, the nursing standards made by Korean experts for neonatal intensive care include the domains of nursing practice standards and professional performance standards. Nursing practice standards involve data collection, diagnosis, planning, and performance, whereas professional practice standards comprise ethics, evaluation, education, evidence-based practice and research, consultation and cooperation, use of resources, and quality management (Lee et al., 2020). Alfieri et al. (2017) have previously qualitatively mapped the nursing competencies required in neonatology. They identified 42 different competence areas in neonatal nursing, including planning, observing, and evaluating nursing interventions, along with monitoring vital parameters, administering medication, and blood sampling, among others.

NICUs treat premature infants (born before 37 gestational weeks) and critically ill newborns. Under the most demanding intensive care, infants born during gestational weeks 22–23 can survive. Depending on the unit, infants up to one year of age requiring intensive care may be admitted to the NICU. Reasons for intensive care can include breathing problems, premature birth, circulatory problems, neurological issues, metabolic issues, and infections (Mandy, 2021).

Measuring the competence of registered nurses makes it possible to develop the professional competence of nurses and ensure a certain level of care (Fukada, 2018). Multiple instruments are used to measure the competence of registered nurses. These instruments have been developed for various reasons, namely, to measure the universal competence which is required from all nurses (Flinkman et al., 2017). For example, the Nurse Competence Scale (NCS) (Flinkman et al., 2017), the Nurse Professional Competence Scale (NPC) (Nilsson et al., 2018), and the European Healthcare Training and Accreditation Network Questionnaire Tool (EQT) (Cowan et al., 2007) are all validated instruments for measuring the competence of registered nurses. Specific instruments have been developed to measure the required competence for special areas of nursing. The Intensive and Critical Care Nursing Competence Scale (ICCN-CS-1) was developed to measure the basic competencies needed in intensive care units where adult patients are receiving care (Lakanmaa et al., 2013). The Palliative Care Nursing Self-competence Scale was developed to measure the competence required for providing palliative care (Desbiens and Fillion, 2011), while NICU-BKAT3 was created to test the basic knowledge required in NICUs. The items of this instrument are related to cardiovascular, gastrointestinal, pulmonary, neurological, renal, and family care, along with monitoring lines (Toth, 2007).

The competence of registered nurses working in NICUs affects the quality of care which the families of patients receive. Competence also influences a registered nurse's wellbeing, with lower competence levels previously linked to an increased risk of work-related burnout (Sorush et al., 2016). Competence related to specific competence areas such as palliative care (Kyc et al., 2020) and pain management (Sarkaria and Gruszfeld, 2022) have previously been studied in the NICU setting, however, no studies have comprehensively investigated the competence of registered nurses working in NICUs. Multiple studies have focused on interventions which affect the competence of registered nurses working in NICUs (Bakhshi et al., 2018; Monshizadeh et al., 2019; Zamani et al., 2019).

A preliminary search of PROSPERO, MEDLINE, the Cochrane Database of Systematic Reviews and JBI Synthesis of Evidence returned no previous, current, or underway systematic reviews on the topic.

The objective was to conduct a systematic review describing the competencies required from nurses working in NICU settings. The

review question was: what types of competencies have been previously described for nurses working in NICUs?

3. Methods

The review process was based on Joanna Briggs Institute (JBI) guidelines for systematic reviews (Stephenson et al., 2020). The PRISMA checklist was used while reporting the study (Page et al., 2021) (the filled checklist is available from the corresponding author). The database searches were conducted between February and September 2022 in the PubMed, Scopus, CINAHL, MEDLINE, Web of Science, ProQuest, and Medic databases. The grey literature was searched from Mednar database. Additionally, study registries from JBI, Cochrane, and Prospero were examined.

After the database search, the bibliographies of eligible studies were also manually screened. The keywords used in the searches are presented in Table 1. MESH-terms of the keywords were applied according to the requirements of each database. An information specialist from the library was consulted to check the search strategy for appropriateness before the database search. Covidence software was used for study selection. The full report of searches is presented in Supplementary File 1.

The inclusion and exclusion criteria were based on the PCC (Population/Concept/Context) format. The inclusion criteria were: (1) registered nurses (P = population); (2) the competence of registered nurses working in NICUs (C = concept); (3) nursing in NICUs (C = context); and (4) cross-sectional study as study method. In addition, we included research published in the Finnish, Swedish or English language. There were no limitations due to the publication year. The exclusion criteria were: (1) the study considers intensive care provided after the neonatal period; (2) the study considers health care professionals other than registered nurses; (3) the study considers the competence of nursing students; (4) the original article is not available; (5) the study design is systematic review and meta-analysis, randomized controlled trial (RCT), intervention, experimental, qualitative, or quasi-experimental. The limitations regarding the used methodology were due to the objective of describing competence and not for example measuring the competence.

3.1. Quality appraisal

A critical appraisal tool for cross-sectional studies from JBI was used in this review (Moola et al., 2020). Quality appraisal was independently done by two reviewers (ET and HS). None of the studies were excluded based on quality. In the case that the applied methodology was unclear, the corresponding authors of the publications were contacted; however, no responses were documented. There was a lot of variety within the quality of the eligible studies. Many of the studies did not present sufficient information about the inclusion and exclusion criteria, the validity of the employed questionnaire, or which statistical analyses were used during data analysis. More details of the quality appraisal process are presented in Supplementary File 2.

Table 1
The keywords used in the database searches.

Bibliographic databases	Keywords
Pubmed, Scopus, CINAHL, Medline, Mednar, Science Direct, ProQuest	nurs* OR health personel AND competen* OR skills OR knowledge OR attitude OR attribute OR expertise OR knowhow OR capability OR qualification OR values OR belief* AND neonatal intensive care OR NICU OR newborn intensive care OR baby unit
Medic (Finnish database)	sairaanhoitaja* OR hoitaja* AND osaami* OR ammatittai* OR ammattiosaam* OR arvo* OR tiedot OR tieto* OR taidot OR taito* OR taido* OR tietämy* OR asen* AND vasyteho OR vastasyntyneiden teho-osasto

3.2. Data extraction and synthesis

The extracted data included bibliographic information about the article (author, title, journal, year), information about the participants (number, occupation, sex, education, age and NICU experience) and the measured competence. One reviewer (ET) extracted data from the eligible studies. Another reviewer (HS) extracted data from 20 % of the eligible studies to ensure that the data extraction was trustworthy. There were no disagreements between reviewers, but a third member of the research team would have commented on the situation if such disagreement had happened. More details about the data extraction are presented in Supplementary File 3.

Thematic analysis was used to analyze which competencies were measured in the eligible studies. This analysis allows findings from diverse studies to be organized and categorized (Popay et al., 2006). After data extraction, all identified competencies were coded with descriptive codes. In the next step, similar codes were combined to identify themes of competencies, and then grouped into main themes of competencies (Castleberry and Nolen, 2018).

4. Results

The database searches yielded a total of 8887 studies. The JBI, Cochrane and Prospero databases only included studies that did not meet the inclusion criteria of this study; therefore, no eligible studies were found from the registries. A total of 50 studies were eligible for the systematic review after two independent (ET and HS) evaluations of the

inclusion and exclusion criteria based on title, abstract and full text (Fig. 1).

The eligible studies were conducted in 19 different countries. The methodology used in all studies was cross-sectional, which also included studies with descriptive designs using instruments to measure competence. The eligible studies were conducted between the years 2003 and 2022 (88 % of the included studies were published between years 2012 and 2022). The full details of the included studies are presented in Table 2. In the included studies, 53 different instruments were used. The identified instruments included Likert-type, multiple choice, or true-false items, and the instruments included between 10 (Mahmoodi et al., 2015) and 133 (Bellini and Damato, 2009) items. The instruments used to measure competencies relevant to nursing in NICUs, along with the validity and reliability are presented in Table 3.

4.1. Demographic information about the participants

Participants in the eligible studies were registered nurses (n = 7536) working in NICUs. The studies included between 9 (Martins et al., 2013) to 861 (Zhang et al., 2018) participants. Most of the participants were female (95,8 %). The sex of the participants was presented in 32 studies. There was considerable variety in the educational background of the participants; more specifically: 26 % had a nursing diploma or had completed lower education; 65 % had a bachelor's degree; and 9 % held a master's degree or had completed some type of higher education. The educational background of participants was presented in 31 studies.

The participants had a mean age of 32 years. The mean age was

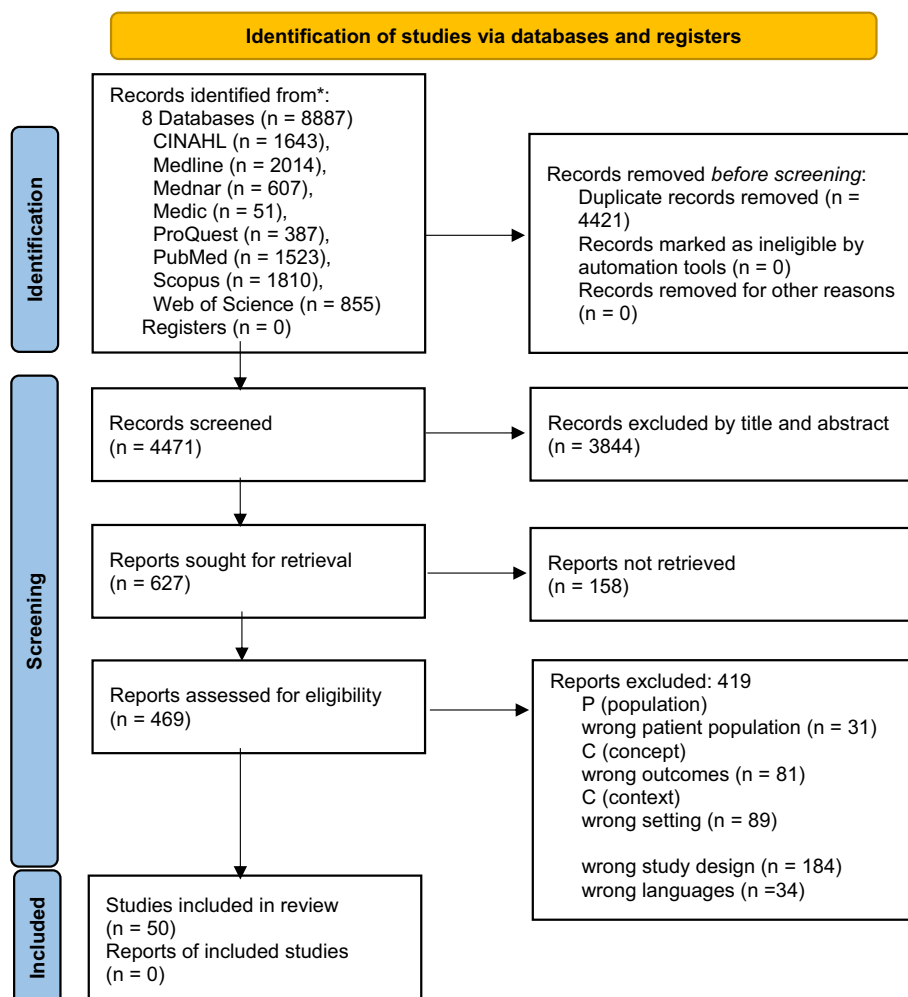


Fig. 1. PRISMA chart describing the study selection process (Page et al., 2021).

Table 2
The table of eligible studies.

Authors, study title, journal, year of publication and origin country	Participants	The aim of the study	Study design and methods	The main results	The quality of the study
1. Abdel Razeq, N.M.; Akuma, A.O.; Jordan, S. Status of neonatal pain assessment and management in Jordan Pain Management Nursing 2016;17(4):239–248 Jordan	Nurses working in the NICU ($N = 184$).	To report neonatal nurses' knowledge, existing pain assessment practice, and pharmacological pain management of neonates in Jordan.	A cross-sectional descriptive study, questionnaire, descriptive and inferential statistics	Nurses' knowledge concerning neonates' neurological development and need for neonatal pain management was suboptimal. The highest pain scores were assigned to circumcision, lumbar punctures, and chest tube insertion. In private hospitals pain assessment scales were more likely to be used and pain during procedures was more likely to be treated than in public hospitals.	JB1 4/6
2. Abed, N.T.; Eldesouky, R.Sh. Infection control: hand hygiene practices among nurses in the neonatal intensive care unit at Benha University hospital Egyptian Journal of Hospital Medicine 2020;80(1):619–626 Egypt	Nurses working in the NICU ($N = 28$).	To investigate the availability of hand-hygiene equipment and supplies at the neonatal intensive care unit (NICU) at Benha University Hospital, to assess the hand-washing practices among nurses working on this unit, and to determine the factors underlying improper hand-hygiene practices.	An observational cross-sectional study, questionnaire, Fisher's exact test, Shapiro–Wilks test, the Kruskal–Wallis test.	7.1 % of the nurses followed hand-hygiene practices accurately. 75 % of the nurses followed practices usually. 17.9 % of the nurses followed poorly the practices and training, close observation, and follow-up were recommended. Education has a significant association to proper hand-hygiene practices.	JB1 7/8
3. Aita, M; Goulet, C Assessment of neonatal nurses' behaviors that prevent overstimulation in preterm infants Intensive and Critical Care Nursing 2003;19 (2):109–118 Canada	Nurses working in the NICU ($N = 54$).	To assess the adoption by neonatal nurses of behaviors that prevent visual, auditory, and tactile overstimulations in preterm infants, as well as the intentions, attitudes, and subjective norms related to the adoption of these behaviors.	A cross-sectional study, questionnaire, descriptive statistics	The nurses often prevented tactile overstimulation and their intentions, attitudes and norms favored overstimulation prevention. More than 50 % of the nurses did not frequently prevent visual and auditory overstimulation.	JB1 3/6
4. Al-Shehri H; Binmanee A Kangaroo mother care practice, knowledge, and perception among NICU nurses in Riyadh, Saudi Arabia. Int J Pediatr Adolesc Med Mar 2021;8(1):29–34 Saudi-Arabia	Nurses working in the NICU ($N = 209$).	To assess the levels of knowledge and competency of kangaroo mother care (KMC) among nurses and to identify the potential barriers to practice.	A descriptive cross-sectional study, questionnaire, descriptive statistics	The nurses perceived kangaroo care to promote maternal-infant bonding (4.47 ± 1.3) and breastfeeding (4.44 ± 0.9). 92,8 % of the nurses encouraged to perform kangaroo care. Barriers to kangaroo care were fear of accidental extubation, lack of time due to workload, familial reluctance to initiate KMC, and lack of privacy during KMC practice.	JB1 5/6
5. Aris, C., Stevens, T.P., LeMura, C., Lipke, B., McMullen, S., Côté-Arsenault, D., & Consenstein, L. (2006). NICU nurses' knowledge and discharge teaching related to infant sleep position and risk of SIDS. Advances in Neonatal Care, 6, 281–293. Unites States of America	Nurses working in the NICU ($N = 252$).	To explore and describe neonatal intensive care unit (NICU) nurses' knowledge and practice in the NICU, and to determine the content of parent instruction regarding infant sleep position at discharge.	Cross-sectional study, questionnaire, content analysis	Most of the nurses (65 %) identified prone position to be the best sleep position for prematurely born infants. The nurses responded following according to the readiness of sleeping in supine positioning: anytime (29 %), close to discharge (13 %), between 34 and 36 weeks postmenstrual age (15 %), when maintaining body temperature in an open crib (25 %), when the infant's respiratory status was stable (6 %), and after 37 weeks (13 %). At discharge, 52 % of nurses instructed to use the supine position at home.	JB1 4/8
6. Arslan, Gunay; Ekici, Behice Nonpharmacological Interventions practiced by neonatal nurses: the example of two hospitals in Turkey. International Journal of Caring Sciences 05//May-Aug2020 2020;13(2):1333–1338 Turkey	Nurses working in the NICU ($N = 68$).	To determine which NPI's NICU nurses use and the impact of these interventions.	A qualitative descriptive design (seems to be more like a cross-sectional study), questionnaire, numbers, percentages and the chi-squared test.	Most of the nurses (98.5 %) had performed one or more nonpharmacological intervention. The most common interventions were positioning (86.8 %), reducing environmental stimuli (79.4 %), picking up the neonate (75 %), initiating non-nutritive sucking (73.5 %), offering breast milk (73.5 %) and massaging (58.8 %). These interventions reduced crying and pain and also regulated saturation.	JB1 5/8

(continued on next page)

Table 2 (continued)

Authors, study title, journal, year of publication and origin country	Participants	The aim of the study	Study design and methods	The main results	The quality of the study
7. Asadi-Noghabi, F.; Tavassoli-Farahi, M.; Yousefi, H.; Sadeghi, T. Neonate pain management: what do nurses really know? <i>Global journal of health science</i> 2014;6(5):284–293 Iran	Nurses working in the NICU ($N = 40$).	To determine knowledge, attitude, and performance pain management in neonates by nurses working in neonatal units in Bandar Abbas University hospitals.	A descriptive and analytical study, questionnaire, descriptive statistical tests	The mean knowledge scores were 13.51/28 (48.2 %). The mean score of attitude was 54.22/60 and the mean score for the nurses' level of practices was found to be 4.22/10. Nurses with more education had higher scores.	JB1 4/6
8. Asadollahi M; Arshadi Bostanabad M; Jebrailli M; Mahallei M; Seyyed Rasooli A; Abdolalipour M Nurses' knowledge regarding hand hygiene and its individual and organizational predictors. <i>J Caring Sci Mar</i> 2015;4(1):45–53 Iran	Nurses working in the NICU ($N = 150$).	To determine the knowledge of hand hygiene and its individual and organizational predictors among nurses in neonatal units.	A descriptive and cross-sectional study, questionnaire, descriptive statistics, Pearson correlation test, independent samples t-test, One-way ANOVA, multiple linear regressions	Most of the nurses had an acceptable level of knowledge regarding hand hygiene. The highest score was for infection control and the lowest score was for definition of hand hygiene. Training and work experience had impact on the nurses' knowledge about hand hygiene.	JB1 8/8
9. Aykanat Girgin, B.; Gözen, D. Turkish Neonatal nurses' knowledge and practices regarding the transition to oral feeding in preterm infants: a descriptive, cross-sectional study <i>Journal of Pediatric Nursing</i> 2020;53(0):e179-e185 Turkey	Nurses working in the NICU ($N = 275$).	To determine neonatal nurses' knowledge levels and clinical practices related to the process of transitioning preterm infants to oral feeding.	A descriptive cross-sectional study, questionnaire, descriptive analysis	The mean knowledge score of the nurses was 64.7/100 ($SD = \pm 8.7$; range = 40–87.5). Rates of correct responses were low for items related to cue-based feeding, interventions to promote oral–motor development, non-nutritive sucking, and infant positioning for oral feeding.	JB1 7/8
10. Bellini, S.; Damato, E.G. Nurses' knowledge, attitudes/beliefs, and care practices concerning do not resuscitate status for hospitalized neonates JOGNN - <i>Journal of Obstetric, Gynecologic, and Neonatal Nursing</i> 2009;38(2):195–205 United States of America	Nurses working in the NICU ($N = 66$).	To describe the knowledge, attitudes/beliefs, and care practices of neonatal intensive care unit nurses concerning do not resuscitate status for hospitalized neonates and to assess differences based on years of neonatal intensive care unit experience and educational background.	Comparative descriptive design, questionnaire, descriptive statistics	¼ of nurses did not recognize do not resuscitate by its legal definition. Nurses with more work experience were less supportive of initiating certain aggressive care modalities for do not resuscitate patients. Responses regarding The educational background did not appear to be influencing on knowledge, attitudes/beliefs, and care practices related to do not resuscitate designation for neonates.	JB1 4/8
11. Bisgin B., Taplak A., Polat S. Determination of neonatal unit nurses' practices for newborn skin care: a cross-sectional study. <i>Journal of Neonatal Nursing</i> 28 (2022) 182–187 Turkey	Nurses working in the NICU ($N = 124$).	To determine the practices of neonatal nurses for newborn skin care.	Cross-sectional study, questionnaire, descriptive statistics	The most (83.9 %) preferred skin antiseptic was alcohol. The first bath of the newborn was 41.9 % of babies delayed until the umbilical cord falls off. The natural drying method was found to be the most (81.5 %) preferred umbilical care method. 1/3 of the nurses made a daily assessment of newborn skin and hardly none used an assessment scale.	JB1 2/6
12. Cerratti, F.; Tomietto, M.; Della Pelle, C.; Kain, V.; Di Giovanni, P.; Rasero, L.; Cicolini, G. Italian Nurses' attitudes towards neonatal palliative care: a cross-sectional survey <i>Journal of Nursing Scholarship</i> 2020;52(6):661–670 Italy	Nurses working in the NICU ($N = 347$).	To describe nurses' attitudes toward neonatal palliative care and to identify the barriers and facilitators associated with nurses' attitudes toward neonatal palliative care.	A cross-sectional survey, questionnaire, descriptive statistics, a chi-square test, independent t-test and one-way analysis of variance	The main barriers to and facilitators of implementing palliative nursing care were organization, resources and clinicians.	JB1 8/8
13. Chin, S.D.N.; Paraszczuk, A.M.; Eckardt, P.; Bressler, T. Neonatal nurses' perceptions of palliative care in the neonatal intensive care unit MCN. <i>The American Journal of Maternal Child Nursing</i> 2021;46(5):250–257 the United States of America	Nurses working in the NICU ($N = 200$).	To examine neonatal nurses' perceptions of barriers and facilitators to palliative care in their NICU setting.	A cross-sectional design, questionnaire, parametric statistical analyses	A positive correlation was noted for NiPCASTM© scores and unit culture support, unit neonatal palliative care policy and neonatal palliative care education.	JB1 5/6
14. Cong, X.; Delaney, C.; Vazquez, V. Neonatal nurses' perceptions of pain assessment and management in NICUs: a national survey <i>Advances in Neonatal Care</i> 2013;13(5):353–360 the United States of America	Nurses working in the NICU ($N = 237$).	To investigate neonatal nurses' perceptions of knowledge and practice in pain assessment and management.	A cross-sectional descriptive survey design, questionnaire, descriptive and correlational statistical methods	The nurses reported the use of pain assessment tools (81 %) and felt confident in uses of pharmacologic (83 %) and nonpharmacologic interventions (79 %). The most felt that the pain tool they used was appropriate for neonates (65 %) and was an accurate measure (60	JB1 3/8

(continued on next page)

Table 2 (continued)

Authors, study title, journal, year of publication and origin country	Participants	The aim of the study	Study design and methods	The main results	The quality of the study
15. Cong, X.; McGrath, J.M.; Delaney, C.; Chen, H.; Liang, S.; Vazquez, V.; Keating, L.; Chang, K.; Dejong, A. Neonatal nurses' perceptions of pain management: survey of the United States and China Pain Management Nursing 2014;15(4):834–844 China and the United States of America	Nurses working in the NICU from China and the USA (N = 343).	To investigate neonatal nurses' perceptions, knowledge, and practice of infant pain in the United States and China	A cross-sectional survey study, questionnaire, descriptive and correlational statistical methods	Only 44 % reported that pain was well managed and 43 % stated that their pain protocols were research evidence based. Nurses had adequate knowledge in general pain concepts, but knowledge deficits were found regarding e.g., preterm infants are more sensitive to pain and long-term consequences of pain. The perception of pain management was related to education, accurate tools and use of research-based protocols. Barriers to pain management included resistance to change, lack of knowledge, lack of time, fear of side effects of pain medication, and lack of trust in the tools.	JB1 7/8
16. Costa T; Rossato LM; Bueno M; Secco IL; Sposito NP; Harrison D; Freitas JS Nurses' knowledge and practices regarding pain management in newborns. Rev. Esc Enferm USP Apr 2017;51(): e03210 Brazil	Nurses working in the NICU (N = 51).	To analyze nurses' knowledge and practices regarding pain management of newborns admitted to Neonatal Intensive Care Units	A descriptive and cross-sectional study, questionnaire, descriptive analysis	Most nurses (86.0 %) thought that neonates can feel pain. 34.7 % of the nurses reported never using pain assessment scales. Administered pharmacological measures were Paracetamol and Fentanyl (47.1 %) and Morphine (17.6 %); non-pharmacological measures adopted were sweetened solution (68.6 %), non-nutritive sucking (58.8 %) and positioning (56.9 %).	JB1 2/6
17. Craig, A.; James, C.; Bainter, J.; Lucas, F.L.; Evans, S.; Glazer, J. Survey of neonatal intensive care unit nurse attitudes toward therapeutic hypothermia treatment. Advances in Neonatal Care 2017;17(2):123–130 the United States of America	Nurses working in the NICU (N = 83).	To assess NICU nurse attitudes to the provision of TH with respect to perceptions about baby pain/sedation, need for nurse and parent education, decision making about initiation of TH, and barriers to best care	A cross-sectional study, descriptive analyses, questionnaire, thematic analysis	Nurses at the urban institution more frequently expressed concerns on inadequate treatment of baby pain/sedation, and nurses at both institutions strongly felt the need for more education about therapeutic hypothermia and improved timeliness of decision making for initiation of therapeutic hypothermia.	JB1 5/8
18. De Clifford Faugère G., Aita M., Feeley N., Colson S. Nurses' perception of preterm infants' pain and the factors of their pain assessment and management. J Perinat Neonat Nurs 2022 Volume 36 Number 3, 312–326. Canada and France	Nurses working in the NICU (N = 202).	To evaluate nurses' perceptions of preterm infants' pain, to evaluate nurses' pain assessment and management practices, as well as to identify the individual and contextual factors that influence nurses' assessments and interventions for pain management.	A cross-sectional study, questionnaire, descriptive analyses	Nurses stated that they used sucrose, non-nutritive sucking, and positioning as pain management interventions. Skin-to-skin contact was rarely practiced. Country, level of care, and work shift and also age, level of education, being parent to a preterm infant, perceptions of family-centered care, and skin-to-skin contact predicted nurses' pain assessment and management practices.	JB1 7/8
19. Deng, Q.; Zhang, Y.; Li, Q.; Wang, H.; Xu, X. Factors that have an impact on knowledge, attitude and practice related to kangaroo care: national survey study among neonatal nurses Journal of Clinical Nursing 2018;27 (21–22):4100–4111 China	Nurses working in the NICU (N = 830).	To explore factors that impact nurses' knowledge, perceptions and practice related to kangaroo care in neonatal intensive care units in China.	A descriptive cross-sectional survey, questionnaire, central tendency, dispersion, ANOVA, t-tests and the general linear model a descriptive study	Range of score for each scale was knowledge 0–16 (M = 9.62), perceptions 28–103 (M = 79.99), barriers 17–85 (M = 65.40) and practice 11–55 (M = 34.44). Nurses with more work experience had higher level of knowledge and perceived less barriers. Nurses' highest education and neonatal intensive care unit level also influenced the knowledge and practice score. A major barrier to practice kangaroo care was the reluctance of physicians, nurses and parents.	JB1 7/8
20. Elsayed, L.A.; El-Nagger, N.S.; Aly, S.M. Nursing care provided for neonates with respiratory distress syndrome in the neonatal	Nurses working in the NICU (N = 50).	To assess the nurses' knowledge and performance regarding their care provided for neonates with respiratory distress syndrome in	A descriptive study, questionnaire and observation, descriptive measures	The most of nurses had unsatisfactory knowledge regarding the neonatal respiratory distress syndrome.	JB1 5/8

(continued on next page)

Table 2 (continued)

Authors, study title, journal, year of publication and origin country	Participants	The aim of the study	Study design and methods	The main results	The quality of the study
intensive care units at Makkah Al-Mukarramah in Saudi Arabia Life Science Journal 2013;10 (1):4403–4412 Saudi-Arabia		the Neonatal Intensive Care Units (NICUs).			
21. Foote, J.M.; Hanrahan, K.; Mulder, P.J.; Nielsen, A.K.; Perkhounkova, Y.; Hein, M.; Saeidzadeh, S.; McCarthy, A.M. Growth measurement practices from a national survey of neonatal nurses Journal of Pediatric Nursing 2020;52(10):10–17 the United States of America	Nurses working in the NICU (N = 301).	To describe neonatal nurses' growth measurement practices, attitudes, knowledge, bases of practice knowledge, and barriers and facilitators for changing practice; and to identify differences in practices and knowledge by nursing organization, unit type, education, and experience.	A cross-sectional online survey, questionnaire, descriptive statistics	Some evidence-based practices (EBPs) were infrequently re-reported including recording frontal-occipital head circumference (FOC) and length using 0.1 cm increments, measuring FOC, weight, and length more than once before recording and for length, using a length board instead of tape measure. Most nurses perceived their measurements as accurate or highly accurate (96.7 % for FOC, 99.3 % for weight, and 87.1 % for length). The mean percentage correct on knowledge items was 68.1 %. Team culture (33.3 %) and insufficient resources (32.6 %) were the most common barriers to EBP of growth measure.	JB1 7/8
22. Froh, E.; Dahlmeier, K.; Spatz, D. L. NICU nurses and lactation-based support and care Advances in Neonatal Care 2017;17 (3):203–208 the United States of America	Nurses working in the NICU (N = 140).	To describe how NICU bedside nurses are providing lactation-based support and care during their shifts and the frequency of that support and to gain an understanding of the NICU nurses' attitudes toward human milk and breastfeeding.	A prospective descriptive cohort design (seems more like a cross-sectional study), questionnaire, descriptive analysis	50.7 %- 72.9 % of nurses reported to provide lactation-based support and care during the previous shift worked and during the previous week worked. The participants' responses to the IIFAS resulted having a positive attitude to breastfeeding (an overall score of 69.1).	JB1 3/6
23. Gulia S, Kaur K, Devi S, Singh S, Rohilla KK. Nurses in NICUs' views on nosocomial infection prevention. J Edu Health Promot 2022;11:158. India	Nurses working in the NICU (N = 60).	To assess practices followed by nurses of NICUs for nosocomial infection prevention.	A cross-sectional study, questionnaire, descriptive statistics	55 % of nurses had never attended a session on nosocomial infection prevention. Nurses (70 %) had a moderate degree of understanding on nosocomial infection prevention. Nurses' practices showed good practise for nosocomial infection prevention. The staff of NICU do recognize infant cue signs. The staff possess knowledge of different cue signs. Some of the time parents are taught and supported in providing cue-based care.	JB1 3/6
24. Hannah LA Awareness of preterm infants' behavioural cues: a survey of neonatal nurses in three Scottish neonatal units. Infant 05/2010;6(3):78–82 the United Kingdom	Nurses working in the NICU (N = 43).	To explore caregivers' awareness of infant cues, whether their awareness affected the care the infant received, or whether staff taught parents about infant cues.	Quantitative approach, questionnaire, manual content analysis	The staff of NICU do recognize infant cue signs. The staff possess knowledge of different cue signs. Some of the time parents are taught and supported in providing cue-based care.	JB1 2/6
25. Huizing MJ; Villamor-Martínez E; Meus S; de Jonge FM; Villamor E Dutch Neonatal intensive care nurses' perceptions of pulse oximeter saturation target limits for preterm infants. J Pediatr Nurs Nov-Dec 2019;49(10):e36–e41 the Netherlands	Nurses working in the NICU (N = 328).	To conduct a national survey to assess practice, knowledge, barriers, and perceptions regarding oxygen saturation (SpO2) target limits among Dutch neonatal intensive care unit (NICU) nurses.	A cross-sectional, web-based survey, descriptive statistics	85.7 % reported to know the local policy of SpO2 target limits, 29.6 % and 74.4 % rightly identified the lower and upper limit. For most of the nurses, the baby would spend 10 % of the time out-side the lower or upper SpO2 limits. Automated oxygen control systems were considered a good idea by 59.2 % of the nurses. 53.9 % of the nurses considered allowing parents to participate in FiO2 titration a bad or very bad idea.	JB1 3/8
26. Jeong IS; Park SM; Lee JM; Choi YJ; Lee J Perceptions on pain management among Korean nurses in neonatal intensive care units. Asian Nurs Res (Korean Soc Nurs Sci) Dec 2014;8(4):261–6 Korea	Nurses working in the NICU (N = 141).	To investigate the perceptions among nurses of neonatal pain and the associated use of pharmacologic measures (PMs) and nonpharmacologic comfort measures (CMs) in neonatal intensive care units (NICUs).	A cross-sectional, descriptive survey study, means and standard deviations, Pearson's correlation coefficient, t-tests.	The mean scores of perceived pain and the necessity of pharmacological measures and nonpharmacological comfort measures were 3.68, 2.96, and 3.79 points. Keeping or reading guidelines, or receiving education on pain management resulted higher perception of the necessity of pharmacological measures.	JB1 7/8
27. Kadivar, M.; Mardani-Hamoolleh, M.; Kouhnavard, M.; Sayarifard, A. Nurses' attitudes toward caring for terminally ill neonates and their	Nurses working in the NICU (N = 138).	To determine nurses' attitudes toward providing care for terminally ill neonates and their families.	A cross-sectional study, questionnaire, descriptive statistics and inferential statistics	The nurses had the most positive attitudes toward the items "nursing care should include the family of the terminally ill patient, too" and	JB1 7/8

(continued on next page)

Table 2 (continued)

Authors, study title, journal, year of publication and origin country	Participants	The aim of the study	Study design and methods	The main results	The quality of the study
families in Iran: a cross-sectional study <i>Journal of Medical Ethics and History of Medicine</i> 2021;14(1):1–10 Iran				“the care provider can prepare the patient or his/her family for death”. The least positive attitude was toward the item “the time spent on caring for terminally ill patients creates a sense of frustration in me”.	
28. Latimer MA; Johnston CC; Ritchie JA; Clarke SP; Gilin D Factors affecting delivery of evidence-based procedural pain care in hospitalized neonates. <i>J Obstet Gynecol Neonatal Nurs</i> Mar-Apr 2009;38(2):182–94 Canada	Nurses working in the NICU (N = 93).	To examine the effects of nurse, infant, and organizational factors on delivery of collaborative and evidence-based pain care by nurses.	A cross-sectional study, questionnaire, descriptive analyses and multinomial logistic regression analyses	Higher nurse-physician collaboration, caring for higher care intensity infants and experienced unexpected increases in work assignments had effect on procedural pain care, making it more likely to meet evidence-based criteria.	JBI 5/6
29. Mahmoodi, N.; Arbabisarjou, A.; Rezaeipoor, M.; Pishkar Mofrad, Z. Nurses' awareness of preterm neonates' sleep in the NICU <i>Global Journal of Health Science</i> 2015;8(6):226–233 Iran	Nurses working in the NICU (N = 30).	To investigate NICU nurses about neonates' sleep state.	A descriptive study, questionnaire, descriptive statistics methods	Of the nurses 16 % had a very good awareness, 24 % had a good awareness, 28 % had a moderate awareness and 28 % had a weak awareness about neonates sleep state. Most of the nurses gave a correct answer to questions about sleep-inducing factors in the NICU, ideal noise level in the NICU, decreased light and KMC and standard methods for sleep description. Most of the incorrect answers regarded questions about sleep cycles, AS specifications, sleep differentiation in fetus and the role of sleep-in neural detoxification.	JBI 4/6
30. Martins S., Dias F., Enumo S., Pereira de Paula K. Pain assessment and control by nurses of a neonatal intensive care unit. <i>Rev. Dor. São Paulo</i> , 2013 Jan-Mar;14(1):21–6 Brazil	Nurses working in the NICU (N = 9).	To identify and analyze pain conceptions and management by nurses during nine routine invasive procedures in a NICU of a teaching hospital.	Descriptive study, descriptive and content statistical analysis	Nurses acknowledged the importance of pain control to minimize children's development risks. Pain was primarily evaluated weeping, facial mimics and motor activity. Routine procedures were considered from moderate to extremely painful and the nurses stated that they used to be carried out without adequate relief measures.	JBI 2/6
31. Mehrmoush, N.; Ashktorab, T.; Heidarzadeh, M.; Momenzadeh, S.; Khalafi, J. Pain management perceptions of the neonatal nurses in NICUs and neonatal units in Ardebil, Iran <i>Iranian Journal of Neonatology</i> 2016;7(4):23–29 Iran	Nurses (N = 120) working in the NICU.	To determine the knowledge and practice of the neonatal nurses in pain assessment and management.	A cross-sectional descriptive study, questionnaire, descriptive statistics and qualitative content analysis method.	The nurses had adequate level of knowledge about the neonatal pain. Most of the nurses reported that they did not use any pain assessment tools (65 %). Less than half of the nurses reported that pain was well managed in their institution (28.3 %). 71,6 % of the nurses reported that parents should be involved with the care and comfort of their infants during the painful procedures.	JBI 4/6
32. Mirlashari J; Qommi R; Nariman S; Bahrani N; Begjani J Clinical competence and its related factors of nurses in neonatal intensive care units. <i>J Caring Sci Dec</i> 2016;5(4):317–324 Iran	Nurses working in the NICU (N = 117).	To evaluate the clinical competence of nurses in the neonatal intensive care units.	A cross-sectional study, questionnaire, Pearson correlation coefficient, t-test and Chi-square test.	The highest levels of competence were regarding to critical thinking and research attitude and interpersonal relationships. The lowest level was related to training and mentoring. There was a relationship between marital status, employment status, level of interest in working in the neonatal intensive-care units and the clinical competence of nurses.	JBI 8/8
33. Mohamed, Z.; Newton, J.M.; Lau, R. Malaysian nurses' skin care practices of preterm infants: experience vs. knowledge <i>International Journal of Nursing Practice</i> 2014;20(2):187–193 Malaysia	Nurses working in the NICU (N = 41).	To explore the impact of Malaysian nurses' perceptions, knowledge and experiences in preterm infant skin care practices using a descriptive approach	A descriptive approach, questionnaire, descriptive analyses	A knowledge gap was revealed in theoretical and practical knowledge of preterm infant skin.	JBI 8/8

(continued on next page)

Table 2 (continued)

Authors, study title, journal, year of publication and origin country	Participants	The aim of the study	Study design and methods	The main results	The quality of the study
34. Park, J.; Kim, J.-S. Factors influencing developmental care practice among neonatal intensive care unit nurses. <i>Journal of Pediatric Nursing</i> 2019;47(0):e10-e15 Korea	Nurses working in the NICU; staff nurses ($N = 125$), charge nurses ($N = 16$).	To examine factors that influence developmental care practice among neonatal intensive care unit nurses.	A descriptive, cross-sectional study, questionnaire, multiple linear regression analysis	The professional efficacy had the largest influence on developmental care practice. Other factors influencing the developmental care were perception of developmental care and a task-oriented organizational culture.	JB1 8/8
35. Park, J.-Y.; Oh, J. Influence of perceptions of death, end-of-life care stress, and emotional intelligence on attitudes towards end-of-life care among nurses in the neonatal intensive care unit. <i>Child Health Nursing Research</i> 2019;25(1):38–47 Korea	Nurses working in the NICU ($N = 111$).	To investigate the influence of perceptions of death, end-of-life (EOL) care stress, and emotional intelligence on attitudes toward EOL care among nurses in the neonatal intensive care unit (NICU)	A descriptive study, questionnaire, the t -test, Pearson correlation coefficient, and stepwise multiple regression analysis	The mean score for perceptions of death was 3.16/5, the mean score for EOL care stress was 3.61/5, the mean emotional intelligence score was 4.66/7, and the average score for EOL care attitudes was 2.77/4. Academic degree, anxiety regarding death, negativity toward death, experiences of patient death, and emotional intelligence were the factors affecting attitudes toward EOL care.	JB1 7/8
36. Sefatbaqa S., Jafarian Amiri J., Roqayeh S., Ali Z., Parisa P., Arzani, Afsaneh A. Performance of nurses in neonatal intensive care unit regarding transfusion of blood and blood products. <i>Journal of Evidence-based Care</i> 10//2020;10 (3):7–14 Iran	Nurses working in the NICU ($N = 35$).	To assess the performance of nurses in a neonatal intensive care unit (NICU) regarding the transfusion of blood and blood products.	A descriptive cross-sectional study, questionnaire, descriptive statistics	The highest frequency (66.2 %) of transfusions was observed for fresh frozen plasma. In the pre-transfusion phase, none ensured the openness of the vein with normal saline injections run. In the transfusion phase, the guidelines were not followed: slow shaking the blood bag during injection (68.6 %) and venous line washing with saline solution (45 %). After the transfusion phase, in all cases, the volume of infused products, blood types, post-transfusion reactions and vital signs, and status of product labeling were recorded.	JB1 8/8
37. Shakerkovar, P.; Mussavi, M.; Valizadeh, S.; Alizadeh, M.; Bostanabad, M.A. Performance of neonatal intensive care unit nurses in blood culture procedure in Tabriz hospitals in 2016 Iranian. <i>Journal of Neonatology</i> 2019;10 (1):58–62 Iran	Nurses working in the NICU ($N = 90$).	To compare the performance of nurses in the NICUs of Tabriz University of Medical Sciences using a standard sampling method.	A descriptive cross-sectional study, questionnaire, descriptive and analytical statistics	The total performance scores before and during blood culture sampling were 13.20 ± 2.57 and 12.48 ± 2.14 .	JB1 5/6
38. Shattnawi, K.K.; Al-Ali, N.; Alnuaimi, K. Neonatal nurses' knowledge and beliefs about kangaroo mother care in neonatal intensive care units: a descriptive, cross-sectional study. <i>Nursing and Health Sciences</i> 2019;21 (3):352–358 Jordan	Nurses working in the NICU ($N = 229$).	To assess Jordanian neonatal nurses' knowledge and beliefs toward the application of kangaroo mother care in the neonatal intensive care unit.	A cross-sectional, descriptive survey, questionnaire, statistical analysis, including descriptive statistics	Most of the nurses agreed that kangaroo mother care was beneficial to both mothers and infants. Many nurses believed that kangaroo mother care should be restricted to infants on intravenous treatment, intubated, or with an umbilical catheter. Most of the nurses correctly answered questions regarding kangaroo mother care. A relationship was found between the nurses' knowledge and their beliefs toward kangaroo mother care.	JB1 7/8
39. Shoghi, Mahnaz; Nazarshodeh, Shiva; Borimnejad, Leili. Knowledge and attitude of nurses working in a neonatal intensive care unit on the use of human donor milk. <i>Journal of Client Centered Nursing Care</i> 02//2020;6(1):55–64 Iran	Nurses working in the NICU ($N = 100$).	To determine the knowledge and attitude of nurses working in Neonatal Intensive Care Units (NICUs) regarding the use of human donor milk and its advantages and disadvantages.	A descriptive cross-sectional study, questionnaire, independent t -test and analysis of variance	Most nurses had appropriate knowledge about donor milk. About 68 % of nurses believed that human donor milk would reduce the growth rate of the baby, but 33 % of nurses said that the formula milk was easier to find and less stressful than donor milk. Approximately 48 % of nurses were opposed to receiving human donor milk. 45 % of the nurses blamed its costs and investment as the strongest barriers toward consuming donor milk in their cities. The results showed the knowledge ($P = 0.031$), and	JB1 7/8

(continued on next page)

Table 2 (continued)

Authors, study title, journal, year of publication and origin country	Participants	The aim of the study	Study design and methods	The main results	The quality of the study
40. Simkoi, Fateme Amiri; Masoumpoor, Anahita; Shirinabadi-Farahani, Azam; Pahlevanzadeh, Bagher Evaluation of the clinical performance of nurses employed in the neonatal intensive care units. <i>Advances in Nursing & Midwifery</i> //Summer2019 Iran	Nurses working in the NICU ($n = 96$).	To determine the status of clinical performance of neonatal nurses in the NICU	A descriptive study, questionnaire, descriptive statistics	attitude ($P < 0.00$) of the nurses were associated with nurses' marital status. The neonatal nurses' clinical performances were acceptable (69.74 %) in all the areas measured: vital signs control, daily cares, respiratory cares, infants feed, vessels' access, medicine prescription, phototherapy and using required equipment for neonates. The highest practices were assessed in the field of infant nutrition (84.11 %) and lowest practices were assessed in the field of equipment utilized (51.93 %).	JB1 4/6
41. Smith, A.R.; Hanson-Abromeit, D.; Heaton, A.; Salley, B. A survey of neonatal nurses perspectives on voice use and auditory needs with premature infants in the NICU <i>International Journal of Environmental Research and Public Health</i> 2021;18(16): the United States of America	Nurses working in the NICU ($N = 82$).	To examine voice use behaviors of NICU nurses in the United States and their current knowledge of early auditory development.	A cross-sectional study, questionnaire, descriptive statistics	Nurses reported speaking to infants was the most common type of voice use. Nurses did believe that premature infants are exposed to adequate voice sounds but did not believe the NICU auditory environment to be sufficient to meet early auditory needs of premature infants.	JB1 5/8
42. Solberg, MT; Hansen, TWR; Bjork, IT Nursing assessment during oxygen administration in ventilated preterm infants <i>Acta Paediatrica</i> 2011;100(2):193–197 Norway	Nurses working in the NICU ($N = 111$).	To document nurses' opinions about their assessments of oxygen requirements in ventilated preterm infants receiving oxygen supplementation.	A survey design with descriptive statistic, questionnaire	The nurses stated that they used oxygen saturation to assess the infants' oxygen requirements when adjusting oxygen supplementation. Only few (17 %) of the nurses used the oxygen-haemoglobin dissociation curve in their assessments and those nurses who responded that they used the curve did not use it correctly.	JB1 1/6
43. Soti, H.; Gautam, S.; Paudel, S.; Bhattarai, M. Knowledge regarding resuscitation of newborn among nurses. <i>Current Pediatric Research</i> 2021;25 (3):452–456 Nepal	Nurses working in the NICU ($N = 130$).	To assess the knowledge regarding neonatal resuscitation among nurses working in inpatient department of selected wards in Gandaki Medical College Teaching Hospital and Research Center (GMCTHRC)	A descriptive, cross sectional study design, questionnaire, descriptive and inferential statistics	64.6 % of nurses had inadequate knowledge. There was association between knowledge level and working unit ($p = 0.013$).	JB1 4/8
44. Tarjoman, A.; Vasigh, A.; Pouy, S.; Safari, S.; Borji, M. Pain management in neonatal intensive care units: a cross sectional study of neonatal nurses in Ilam City <i>Journal of Neonatal Nursing</i> 2019;25(3):136–138 Iran	Nurses working in the NICU ($N = 58$).	To investigate the assessment and management of pain by nursing staff in neonatal intensive care units (NICU).	A descriptive cross-sectional study, questionnaire, descriptive statistics, and independent t -test	The results showed that only 7.1 % of the nurses answered "always" to setting up measures for reducing pain or discomfort of neonatal. In the "parents were allowed to relieve pain" item, 31.0 % of the nurses used this strategy occasionally. Regarding non-pharmacological methods to reduce pain, only 13.8 % used this item "always".	JB1 4/6
45. Thuileiphy, T.; Joshi, P.; Dolma, Y.; Paul, J.; Joshi, M.; Gudiya; Murry, L.L. A descriptive survey on knowledge gap related to retinopathy of prematurity and its prevention and management among nurses in a tertiary care hospital <i>Indian Journal of Ophthalmology</i> 2021;69 (8):2122–2125 India	Nurses working in the NICU ($N = 53$).	To assess the knowledge gap among nurses related to ROP and its prevention and management working in NICU in a tertiary care hospital	A cross-sectional descriptive survey, questionnaire, descriptive and inferential statistics	38, 68 % of the nurses had overall poor knowledge, followed by fair knowledge (21 %). An association between the overall knowledge scores and age, total professional experience in NICU, designation, and educational qualification of the nurses could be found ($P \geq 0.05$).	JB1 7/8
46. Wari, G.; Wordofa, B.; Alemu, W.; Habte, T. Knowledge and practice of nurses and associated factors in managing neonatal pain at selected public hospitals in Addis Ababa, Ethiopia, 2020 <i>Journal of Multidisciplinary Healthcare</i> 2021;14(0):2275–2286 Ethiopia	Nurses working in the NICU ($N = 115$).	To assess the neonatal ICU nurses' knowledge and practice and factors associated with neonatal pain management at selected public hospital of Addis Ababa, Ethiopia	A cross-sectional study design, questionnaire, logistic regression model and odds ratio	68.7 % of nurses had adequate knowledge and 32.2 % of them had good practice of neonatal pain management. There was a relationship between nurses' knowledge scores and receiving in-service training on neonatal pain management. Factors associated with practice of nurses in neonatal pain management were having an	JB1 8/8

(continued on next page)

Table 2 (continued)

Authors, study title, journal, year of publication and origin country	Participants	The aim of the study	Study design and methods	The main results	The quality of the study
47. Williamson, S.; McGrath, J.M. Neonatal Nurses' self-reported practices, knowledge, and attitudes toward use of maternal voice for preterm infants <i>Advances in Neonatal Care</i> 2020;20 (5):415–422 the Unites States of America	Nurses working in the NICU (N = 117).	To explore nurses' knowledge, attitude, and use of maternal voice as a therapeutic intervention for preterm infants in the NICU	A descriptive study, questionnaire, descriptive and frequency statistics	infant pain management policy in place, getting training on neonatal pain management and knowledge category. 73.3 % of nurses agreed that they were willing to incorporate maternal recordings into caregiving.	JB1 2/6
48. Yousef, S.A.; Ridah Hasan, A.M. A. Assessment of nurses knowledge toward neonate with birth asphyxia at neonatal intensive care unit in pediatric hospitals at Babylon governorate <i>Medico-Legal Update</i> 2020;20 (3):1099–1104 Iraq	Nurses working in the NICU (N = 62).	To identify knowledge of nurses in caring of neonate with birth asphyxia at NICU at pediatric hospitals in Babylon governorate, determine the relationship between nurses' knowledge with birth asphyxia at NICU with certain of socio-demographic characteristics of sample Babylon, Iraq.	A comprehensive research, questionnaire, statistical analysis method and Inferential statistical data analysis	Nurses with excellent awareness served (66.1 %), whereas those with bad information (33.9 %) reflected nurses in the Neonatal Intensive Care Unit at the Babylon Governorate Pediatric Hospitals. Relationships exist between education and awareness engagement ($p = 0.015$).	JB1 2/6
49. Zhang Y; Deng Q; Zhu B; Li Q; Wang F; Wang H; Xu X; Johnston L Neonatal intensive care nurses' knowledge and beliefs regarding kangaroo care in China: a national survey. <i>BMJ Open</i> Aug 2018;8(8): e021740 China	Nurses working in the NICU (N = 861).	To investigate the current knowledge, beliefs and practices regarding KC among NICU nurses in China using the 'Kangaroo Care Questionnaire'.	A quantitative descriptive survey, questionnaire, statistical and content analysis	47.7 % of the nurses had participated in the implementation of kangaroo care. Nurses in the 'experienced in KC' group showed better understanding of KC and its benefits with a higher 'correct response' rate than those in the 'not experienced in KC' group.	JB1 7/8
50. Özçelik, Çağrı Çövençer; Aktaş, Eda The evaluation of nurses' knowledge and practice about the temperature of milk fed to infants: a descriptive study. <i>Journal of Education & Research in Nursing/Hemsirelikte Egitim ve Arastirma Dergisi</i> 07//2019;16(3):176–182 Turkey	Nurses working in the NICU (N = 116).	To evaluate the practices and knowledge of nurses in the neonatal intensive care unit regarding temperature of breastmilk/formula given to infants during feeding	A descriptive study, questionnaire, definitive statistical methods	52.6 % of the nurses stated that the milk given to infants should be beneath 35 °C. 47.4 % of the nurses stated that it should be above 35 °C. 76.4 % of the nurses stated that the temperature of the breastmilk/formula given to infants may cause nutrient loss. 78.4 % of the nurses heated the milk in a warming bath, 6 % heated the milk by keeping it at room temperature, and 15.6 % preheated the milk with a heater and thermostat. 91.4 % of the nurses were found to test the temperature of the breastmilk/formula by placing some on the inner segment of the forearm, 5.2 % by using a liquid thermometer, and 3.6 % by placing some on the palm.	JB1 5/8

calculated from the 22 studies that provided this information. According to the 13 studies that specified work experience, the participants had a mean NICU experience of seven years. The studies conducted in units that presented all NICU levels ranging from one to four.

4.2. Competencies involved in neonatal intensive care nursing

A total of 14 competence themes were identified from the studies included in this review. These themes were further organized into four main competence areas (see Fig. 2). The competence of neonatal care interventions involves management of skin care (Bisgin et al., 2022; Mohamed et al., 2014), clinical performance (Mirlashari et al., 2016; Simkoi et al., 2019), enteral feeding (Aykanat Girgin and Gözen, 2020; Froh et al., 2017; Shoghi et al., 2020; Özçelik and Aktas, 2019), infection prevention (Abed and Eldesouky, 2020; Asadollahi et al., 2015; Gulia et al., 2022), developmental care (Aita and Goulet, 2003; Aris et al., 2006; Foote et al., 2020; Hannah, 2010; Mahmoodi et al., 2015; Park and Kim, 2019), and neonatal pain evaluation and management (Abdel

Razeq et al., 2016; Arslan and Ekici, 2020; Asadi-Noghabi et al., 2014; Cong et al., 2013; Cong et al., 2014; Costa et al., 2017; De Clifford Faugère et al., 2022; Jeong et al., 2014; Latimer et al., 2009; Martins et al., 2013; Mehrmouh et al., 2016; Tarjoman et al., 2019; Wari et al., 2021). The competence of enteral feeding was included in studies that concerned the provision of breast milk in NICUs (Froh et al., 2017; Shoghi et al., 2020; Özçelik and Aktas, 2019) and transitioning to oral feeding (Aykanat Girgin and Gözen, 2020). The theme of infection prevention involved both hand hygiene practices (Abed and Eldesouky, 2020; Asadollahi et al., 2015) and infection prevention practices (Gulia et al., 2022) in NICUs. Developmental care was included in studies that described the prevention of overstimulation (Aita and Goulet, 2003), infant cues (Hannah, 2010), growth measurement (Foote et al., 2020), neonatal sleep (Aris et al., 2006; Mahmoodi et al., 2015), and overall developmental care (Park and Kim, 2019).

The competence of caring for a dying infant consisted of neonatal palliative care (Cerratti et al., 2020; Chin et al., 2021; Kadivar et al., 2021) and end-of-life care (Park and Oh, 2019). The competence of

Table 3

The instruments used to measure competencies relevant to nursing in NICUs, along with the validity and reliability.

The competence that the used instruments measure	The used instruments	The validity and the reliability of the used instruments
The competence of neonatal care interventions	Infection control assessment tool (ICAT 2009) Competency Inventory for Registered Nurses questionnaire (CIRN) Knowledge of nurses about donor milk pros and cons and Attitudes of nurses about donor milk questionnaires Akuma's and Jordan's scale questionnaire Questionnaire of Capellini et al. Nurses' attitudes and perceptions of pain assessment questionnaire (NAPPAQ-FIPM) Questionnaire by Porter et al. The questionnaire of Nurses' perceptions of Neonatal Pain Questionnaire made by Rahimi et al. Neonatal growth measurement survey The Developmental Supportive Competency Scale for Nurses caring for preterm infants The instrument developed by researchers in 15 studies No information on one study	Cronbach's alpha ranged from 0.58 to 0.97. Content validity index ranged from 0.88 to 0.97.
The competence of caring for a dying infant	The Neonatal Palliative Care Attitude Scale (NiPCAS) Questionnaire of Frommelt Questionnaire developed by Cha and modified by Yoshiyuki Questionnaire developed by Jang the Wong and Law Emotional Intelligence Scale (WLEIS) Attitudes toward Nursing Care of the Dying Scale (FATCOD)	The Cronbach's alpha ranged from 0.77 to 0.94. No data available for the Content Validity Index
The competence of family-centered care	Kangaroo Care Questionnaire (KCQ) The instrument developed by researchers in three studies	The Cronbach's alpha ranged from 0.80 to 0.89 No data available for the Content Validity Index
The competence of neonatal intensive care interventions	The instrument developed by researchers in ten studies	The only Cronbach's alpha in this competence was 0.88 and the only Content Validity Index was 0.91

family-centered care involved support for skin-to-skin contact (kangaroo care) (Al-Shehri and Binmanee, 2021; Deng et al., 2018; Shattnawi et al., 2019; Zhang et al., 2018) and knowledge regarding the use of parental voice (Smith et al., 2021; Williamson and McGrath, 2020).

The competence of neonatal intensive care interventions included management of respiratory support, knowledge of neonatal illnesses, blood transfusions (Sefatbaqa et al., 2020; Shakerkovar et al., 2019), and resuscitation (Bellini and Damato, 2009; Soti et al., 2021). Oxygen saturation targets (Huizing et al., 2019) and oxygen requirements (Solberg et al., 2011) were included in the theme of management of respiratory support. Knowledge of neonatal illnesses was mentioned in studies that covered respiratory distress syndrome (RDS) (Elsayed et al., 2013), asphyxia (Yousef and Ridah Hasan, 2020), therapeutic hypothermia (Craig et al., 2017), and retinopathy of prematurity (ROP)

(Thuileiphy et al., 2021).

5. Discussion

Measuring, and – if necessary – improving, the competence of registered nurses is vital for safe, high-quality, and ethical care (Flinkman et al., 2017). This systematic review identified four main themes under which neonatal intensive nursing competencies were categorized, namely, 1) neonatal care interventions, 2) caring for a dying infant, 3) family-centered care, and 4) neonatal intensive care interventions. These findings show that previous research has focused on evaluating specific competencies that are necessary in the NICU setting. This does not mean that the four main themes of nursing competencies discussed in this review completely cover the field of neonatal intensive nursing competence. At present, there are several examples of frameworks for neonatal nursing competence; notably, both the Council of International Neonatal Nurse (Jones, 2019) and The Royal College of Nursing (2016) have attempted to outline which competencies are needed in the NICU setting. A comparison of the presented results with the International Neonatal Nursing Competency Framework, published by the Council of International Neonatal Nurses (Jones, 2019), and the career, education, and competence framework for neonatal nursing in the UK (The Royal College of Nursing, 2016) highlight that numerous competence areas have not been studied and, therefore, are not included in this review. For example, none of the eligible studies concerned medication, parental nutrition, monitoring the well-being of an infant, or reporting. This demonstrates a lack of high-quality information and means that the topic of neonatal intensive nursing competence needs to be more comprehensively studied.

The Nurse Competence Scale (NCS) includes the competencies of helping role, teaching-coaching, diagnostic functions, managing situations, therapeutic interventions, and ensuring quality and work role (Meretoja et al., 2004). These general nursing competencies differ from the four main themes of neonatal intensive nursing competence reported in this review. In other words, none of the four main themes are clearly related to the competencies measured in the NCS. The closest relationship is between competence in neonatal care interventions and managing situations and therapeutic interventions (included in the NCS).

Registered nurses working in NICUs are at high risk of developing burnout (Vitorino et al., 2018). The extensive and complex workload at NICUs is one factor that strongly influences NICU nurses' stress (Bry and Wigert, 2022). Therefore, it is important to increase job satisfaction in this field, which will be preceded by reliably evaluating nurses' competence, and – if necessary – providing additional education. This type of knowledge would provide a blueprint from which to develop effective educational programs for nurses, teachers, and managers related to work in NICUs. Considering this objective, the current review offers insight into which competence areas have been measured among NICU nurses, and which types of instruments were used to gather data.

Each registered nurse who works in a NICU has a great impact on the lives of neonatal patients and their families (Bromley, 2019). However, it has proven difficult to comprehensively describe the competence of nurses working in NICUs, as shown by the heterogeneity of studies measuring these competencies. To provide high-quality care for neonatal patients and their families, there is a need for better understanding of the overall competence that is required in the neonatal intensive care units and an instrument to measure that competence.

5.1. Strengths and limitations of the review

A strength of the review was that the database search was conducted across multiple databases and redone again before publishing the results; this meant that a wide variety of eligible studies were identified. The study selection and quality appraisal were completed by two independent reviewers (Bin Ali and Usman, 2018). The eligible studies were conducted in 19 different countries and across all available NICU levels;

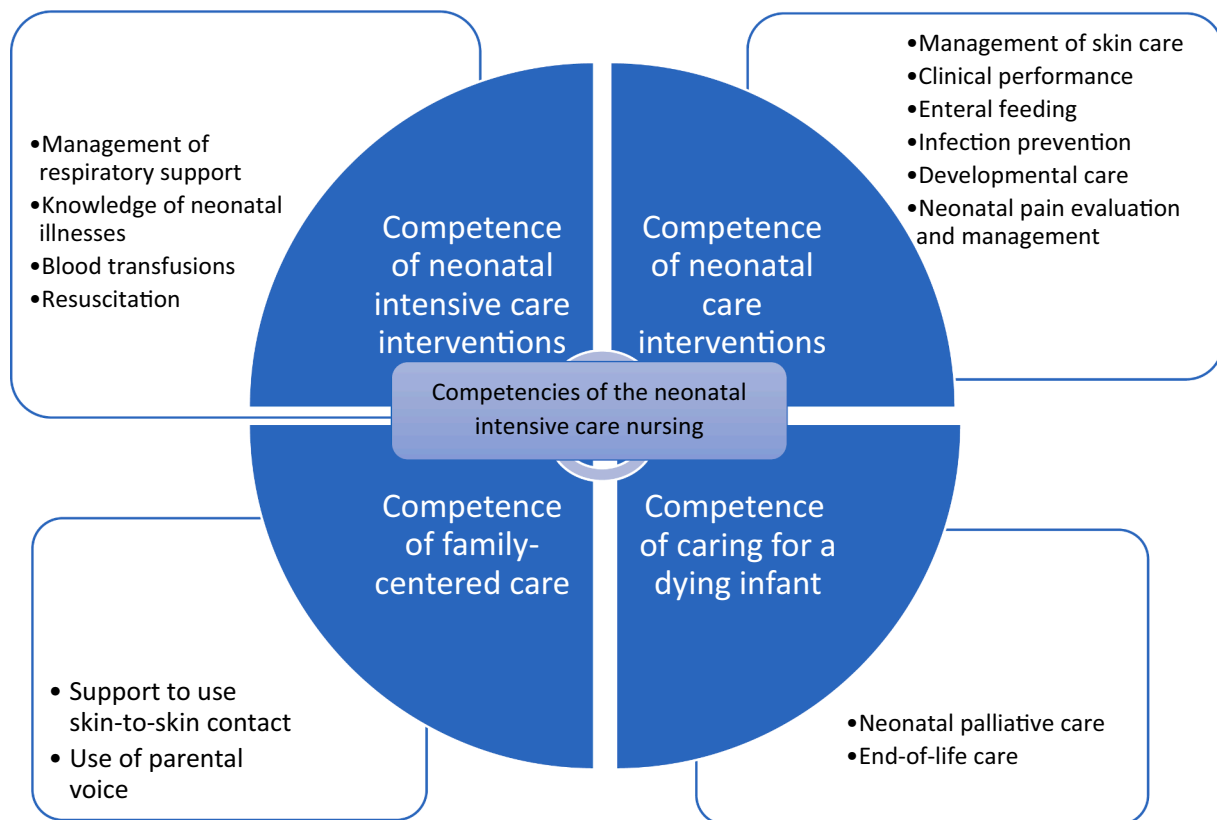


Fig. 2. Competencies involved in neonatal intensive care nursing.

therefore, the results demonstrate sufficient generalizability. The codes and themes were checked by three reviewers and a neonatal nursing specialist to ensure that appropriate concepts had been described. Furthermore, transparent reporting of the study protocol enables the reader to evaluate the transferability of the presented results.

A total of 158 articles were not retrievable due to a publishing date between 1970 and 1990. The search was limited to the Finnish, Swedish and English languages, which means that additional relevant studies may have been overlooked. Several studies also detailed the competence of health care professionals other than registered nurses; although these studies had to be excluded based on the exclusion criteria, they may have contained relevant information about certain competence areas related to the NICU setting. No unpublished grey literature was searched.

6. Conclusions

Previous research has described competencies that can be grouped under the main themes of neonatal care interventions, caring for a dying infant, family-centered care, and neonatal intensive care interventions. The presented results highlight that the competence of registered nurses working in NICUs needs to be investigated in a more robust, comprehensive manner. For example, there is a particular need for research concerning the overall competence of nurses working in NICUs, as this type of knowledge will be critical to ensuring a high standard of care for neonatal patients in intensive care units.

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.nedt.2023.105892>.

Funding statement

This study was funded by the Finnish Nursing Education Foundation sr. through a grant awarded to Eeva Talus.

CRediT authorship contribution statement

Eeva Talus: Conceptualization, Methodology, Investigation, Data curation, Writing – original draft, Visualization, Project administration, Funding acquisition. **Hanna Seppänen:** Investigation, Data curation, Writing – review & editing. **Kristina Mikkonen:** Conceptualization, Methodology, Data curation, Writing – review & editing. **Anna-Kaija Palomaa:** Data curation, Writing – review & editing. **Tarja Pölkki:** Conceptualization, Methodology, Data curation, Writing – review & editing.

Declaration of competing interest

Given their role as Editor on this journal, Professor Kristina Mikkonen had no involvement in the peer-review of this article and has no access to information regarding its peer-review. Full responsibility for the editorial process for this article was delegated to an independent Editor.

Acknowledgments

Sirpa Grekula, information specialist, University of Oulu.

References

- Abdel Razeq, N., Akuma, A., Jordan, S., 2016. Status of neonatal pain assessment and management in Jordan. *Pain Manag. Nurs.* 17 (4), 239–248.
- Abed, N., Eldesouky, R., 2020. Infection control: hand hygiene practices among nurses in the neonatal intensive care unit at Benha university hospital. *Egypt. J. Hosp. Med.* 80 (1), 619–626.
- Aita, M., Goulet, C., 2003. Assessment of neonatal nurses' behaviors that prevent overstimulation in preterm infants. *Intensive Crit. Care Nurs.* 19 (2), 109–118.
- Alfieri, E., Alebbi, A., Bedini, G., Boni, L., Foa, C., 2017. Mapping the nursing competences in neonatology: a qualitative research. *Acta Biomed* 88 (3), 51–58.
- Al-Jabri, F., Kvist, T., Azimirad, M., Turunen, H., 2021. A systematic review of healthcare professionals' core competency instruments. *Nurs. Health Sci.* 23 (1), 87–102.

- Al-Shehri, H., Binmanee, A., 2021. Kangaroo mother care practice, knowledge, and perception among NICU nurses in Riyadh, Saudi Arabia. *Int. J. Pediatr. Adolesc. Med.* 8 (1), 29–34.
- Aris, C., Stevens, T., LeMura, C., Lipke, B., McMullen, S., Côté-Arsenault, D., Consenstein, L., 2006. NICU nurses' knowledge and discharge teaching related to infant sleep position and risk of SIDS. *Adv. Neonatal Care* 6, 281–293.
- Arslan, G., Ekici, B., 2020. Nonpharmacological interventions practiced by neonatal nurses: the example of two hospitals in Turkey. *Int. J. Caring Sci.* 13 (2), 1333–1338.
- Asadi-Noghabi, F., Tavassoli-Farahi, M., Yousefi, H., Sadeghi, T., 2014. Neonate pain management: what do nurses really know? *Global J. Health Sci.* 6 (5), 284–293.
- Asadollahi, M., Arshadi Bostanabad, M., Jebraili, M., Mahallei, M., Seyyed Rasooli, A., Abdolalipour, M., 2015. Nurses' knowledge regarding hand hygiene and its individual and organizational predictors. *J. Caring Sci.* 4 (1), 45–53.
- Aykanat Girgin, B., Gözen, D., 2020. Turkish neonatal nurses' knowledge and practices regarding the transition to oral feeding in preterm infants: a descriptive, cross-sectional study. *J. Pediatr. Nurs.* 53, e179–e185.
- Bakhshi, F., Montaseri, S., Edraki, M., Razavi Nejad, M., Haghpanah, S., 2018. Impact of instructions on the developmental status of premature infants on the clinical practice of neonatal intensive care unit (NICU) nurses. *Iran. J. Neonatol.* 9 (2), 2–7.
- Bellini, S., Damato, E., 2009. Nurses' knowledge, attitudes/beliefs, and care practices concerning do not resuscitate status for hospitalized neonates. *J. Obstet. Gynecol. Neonatal. Nurs.* 38 (2), 195–205.
- Bin Ali, N., Usman, M., 2018. Reliability of search in systematic reviews: towards a quality assessment framework for the automated-search strategy. *Inf. Softw. Technol.* 99, 133–147.
- Bisgin, B., Taplak, A., Polat, S., 2022. Determination of neonatal unit nurses' practices for newborn skin care: a cross-sectional study. *J. Neonatal Nurs.* 28, 182–187.
- Bromley, P., 2019. A paradigm shift from competence to capability in neonatal nursing. *J. Neonatal Nurs.* 25, 268–271.
- Bry, A., Wigert, H., 2022. Stress and social support among registered nurses in a level II NICU. *J. Neonatal Nurs.* 28 (1), 37–41.
- Castleberry, A., Nolen, A., 2018. Thematic analysis of qualitative research data: is it as easy as it sounds? *Curr. Pharm. Teach. Learn.* 10 (6), 807–815.
- Cerratti, F., Tomietto, M., Della Pelle, C., Kain, V., Di Giovanni, P., Rasero, L., Cicolini, G., 2020. Italian nurses' attitudes towards neonatal palliative care: a cross-sectional survey. *J. Nurs. Scholarsh.* 52 (6), 661–670.
- Cheah, I., 2019. Economic assessment of neonatal intensive care. *Transl. Pediatr.* 8 (3), 246–256.
- Chin, S., Paraszczuk, A., Eckardt, P., Bressler, T., 2021. Neonatal nurses' perceptions of palliative care in the neonatal intensive care unit MCN. *Am. J. Matern. Child Nurs.* 46 (5), 250–257.
- Cong, X., Delaney, C., Vazquez, V., 2013. Neonatal nurses' perceptions of pain assessment and management in NICUs: a national survey. *Adv. Neonatal Care* 13 (5), 353–360.
- Cong, X., McGrath, J., Delaney, C., Chen, H., Liang, S., Vazquez, V., Keating, L., Chang, K., Dejong, A., 2014. Neonatal nurses' perceptions of pain management: survey of the United States and China. *Pain Manag. Nurs.* 15 (4), 834–844.
- Costa, T., Rossato, L., Bueno, M., Secco, I., Sposito, N., Harrison, D., Freitas, J., 2017. Nurses' knowledge and practices regarding pain management in newborns. *Rev. Esc. Enferm. USP* 51.
- Cowan, D., Wilson-Barnett, D., Norman, I., Murrells, T., 2007. Measuring nursing competence: development of a self-assessment tool for general nurses across Europe. *Int. J. Nurs. Stud.* 45, 902–913.
- Craig, A., James, C., Bainter, J., Lucas, F., Evans, S., Glazer, J., 2017. Survey of neonatal intensive care unit nurse attitudes toward therapeutic hypothermia treatment. *Adv. Neonatal Care* 17 (2), 123–130.
- De Clifford Faugère, G., Aita, M., Feeley, N., Colson, S., 2022. Nurses' perception of preterm infants' pain and the factors of their pain assessment and management. *J. Perinat. Neonatal Nurs.* 3 (3), 312–326.
- Deng, Q., Zhang, Y., Li, Q., Wang, H., Xu, X., 2018. Factors that have an impact on knowledge, attitude and practice related to kangaroo care: national survey study among neonatal nurses. *J. Clin. Nurs.* 27 (21–22), 4100–4111.
- Desbiens, J.-F., Fillion, L., 2011. Development of the palliative care nursing self-competence scale. *J. Hosp. Palliat. Nurs.* 13 (4), 230–241.
- Elsayed, L., El-Naggar, N., Aly, S., 2013. Nursing care provided for neonates with respiratory distress syndrome in the neonatal intensive care units at Makkah Al-Mukarramah in Saudi Arabia. *Life Sci. J.* 10 (1), 4403–4412.
- Flinkman, M., Leino-Kilpi, H., Numminen, O., Jeon, Y., Kuokkanen, L., Meretoja, R., 2017. Nurse competence scale: a systematic and psychometric review. *J. Adv. Nurs.* 73 (5), 1035–1050.
- Footo, J., Hanrahan, K., Mulder, P., Nielsen, A., Perkhounkova, Y., Hein, M., Saeidzadeh, S., McCarthy, A., 2020. Growth measurement practices from a national survey of neonatal nurses. *J. Pediatr. Nurs.* 52, 10–17.
- Froh, E., Dahlmeier, K., Spatz, D., 2017. NICU nurses and lactation-based support and care. *Adv. Neonatal Care* 17 (3), 203–208.
- Fukada, M., 2018. Nursing competency: definition, structure and development. *Yonago Acta Med.* 61, 001–007.
- Greig, C., Gray, M., Kerr, L., Wright, A., 2006. Developing a competency framework and core clinical skills for neonatal nurses in Scotland. *Infant* 2 (4), 152–155.
- Gulia, S., Kaur, K., Devi, S., Singh, S., Rohilla, K., 2022. Nurses in NICUs' views on nosocomial infection prevention. *J. Educ. Health Promot.* 11, 158.
- Hannah, L., 2010. Awareness of preterm infants' behavioural cues: a survey of neonatal nurses in three Scottish neonatal units. *Infant* 6 (3), 78–82.
- Huizing, M., Villamor-Martínez, E., Meus, S., de Jonge, F., Villamor, E., 2019. Dutch neonatal intensive care nurses' perceptions of pulse oximeter saturation target limits for preterm infants. *J. Pediatr. Nurs.* 49, e36–e41.
- Jeong, I., Park, S., Lee, J., Choi, Y., Lee, J., 2014. Perceptions on pain management among Korean nurses in neonatal intensive care units. *Asian Nurs. Res.* 8 (4), 226–266.
- Jones, T., 2019. International neonatal nursing competency framework. *J. Neonatal Nurs.* 25, 258–264.
- Kadivar, M., Mardani-Hamoooleh, M., Kouhnavard, M., Sayarifard, A., 2021. Nurses' attitudes toward caring for terminally ill neonates and their families in Iran: a cross-sectional study. *J. Med. Ethics Hist. Med.* 14, 1–10.
- Karami, A., Farokhzadian, J., Foroughameri, G., 2017. Nurses' professional competency and organizational commitment: is it important for human resource management? *PLoS One* 12, 11.
- Kyc, S., Bruno, C., Shabanova, V., Montgomery, A., 2020. Perceptions of neonatal palliative care: similarities and differences between medical and nursing staff in a level IV neonatal intensive care unit. *J. Palliat. Med.* 23 (5), 662–669.
- Lakamäa, R.-L., Suominen, T., Pertilä, J., Ritmala-Castrén, M., Vahlberg, T., Leino-Kilpi, H., 2013. Basic competence in intensive and critical care nursing: development and psychometric testing of a competence scale. *J. Clin. Nurs.* 23, 799–810.
- Latimer, M., Johnston, C., Ritchie, J., Clarke, S., Gilin, D., 2009. Factors affecting delivery of evidence-based procedural pain care in hospitalized neonates. *J. Obstet. Gynecol. Neonatal. Nurs.* 38 (2), 182–194.
- Lee, H., Kim, D., Han, J., 2020. Developing nursing standard guidelines for nurses in a neonatal intensive care unit: a Delphi study. *Healthcare* 8, 1–21.
- Mahmoodi, N., Arbabisarjou, A., Rezaeipoor, M., Pishkar Mofrad, Z., 2015. Nurses' awareness of preterm neonates' sleep in the NICU. *Global J. Health Sci.* 8 (6), 226–233.
- Mandy, G., 2021. Short-term complications of the preterm infant. Retrieved October 10, 2022, from UpToDate. <https://www.uptodate.com/contents/short-term-complications-of-the-preterm-infant>.
- Maree, C., Scheepers, M., Janse van Rensburg, E., 2020. Competencies for structured professional development of neonatal nurses in South Africa. *Afr. J. Health Prof. Educ.* 12 (3), 154–160.
- Martins, S., Silva Dias, F., Fiorim Enumo, S., Pereira de Paula, K., 2013. Pain assessment and control by nurses of a neonatal intensive care unit. *Rev. Dor* 14 (1), 21–26.
- Mehrnoush, N., Ashktorab, T., Heidarzadeh, M., Momenzadeh, S., Khalafi, J., 2016. Pain management perceptions of the neonatal nurses in NICUs and neonatal units in Ardebil, Iran. *Iran. J. Neonatol.* 7 (4), 23–29.
- Meretoja, R., Isoaho, H., Leino-Kilpi, H., 2004. Nurse competence scale: development and psychometric testing. *J. Adv. Nurs.* 47 (2), 124–133.
- Mirlashari, J., Qommi, R., Nariman, S., Bahrman, N., Begjani, J., 2016. Clinical competence and its related factors of nurses in neonatal intensive care units. *J. Caring Sci.* 5 (4), 317–324.
- Mohamed, Z., Newton, J., Lau, R., 2014. Malaysian nurses' skin care practices of preterm infants: experience vs. knowledge. *Int. J. Nurs. Pract.* 20 (2), 187–193.
- Monshizadeh, A., Nasiriani, K., Khodayarian, M., Shakerfar, H., 2019. The effect of nursing residency program on the clinical competence of novice nurses working in the ICU & NICU from the viewpoint of head nurses. *World J. Peri Neonatol.* 2 (1), 28–36.
- Moola, S., Munn, Z., Tufanaru, C., Aromataris, E., Sears, K., Sfetcu, R., Currie, M., Qureshi, R., Mattis, P., Lisy, K., Mu, P.-F., 2020. Chapter 7: systematic reviews of etiology and risk. In: Aromataris, E., Munn, Z. (Eds.), *JBI Manual for Evidence Synthesis*. JBI. Retrieved October 10, 2022, from <https://synthesismanual.jbi.global>. Retrieved October 10, 2022, from.
- Nilsson, J., Engström, M., Florin, J., Gardulf, A., Carlsson, M., 2018. A short version of the nurse professional competence scale for measuring nurses' self-reported competence. *Nurse Educ. Today* 71, 233–239.
- Özcelik, C., Aktas, E., 2019. The evaluation of nurses' knowledge and practice about the temperature of milk fed to infants: a descriptive study. *J. Educ. Res. Nurs.* 16 (3), 176–182.
- Page, M., McKenzie, J., Bossuyt, P., Boutron, I., Hoffmann, T., Mulrow, C., 2021. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ* 372, 71.
- Park, J., Kim, J., 2019. Factors influencing developmental care practice among neonatal intensive care unit nurses. *J. Pediatr. Nurs.* 47, e10–e15.
- Park, J.-Y., Oh, J., 2019. Influence of perceptions of death, end-of-life care stress, and emotional intelligence on attitudes towards end-of-life care among nurses in the neonatal intensive care unit. *Child Health Nurs. Res.* 25 (1), 38–47.
- Popay, J., Roberts, H., Sowden, A., Petticrew, M., Arai, L., Rodgers, M., Britten, N., Roen, K., Duffy, S., 2006. Guidance on the Conduct of Narrative Synthesis in Systematic Reviews. <https://www.lancaster.ac.uk/media/lancaster-university/content-assets/documents/fhm/dhr/chir/NssynthesisguidanceVersion1-April2006.pdf>.
- Sarkaria, E., Gruszfeld, D., 2022. Assessing neonatal pain with NIPS and COMFORT-B: evaluation of NICU's staff competences. *Pain Res. Manag.* Retrieved November 2, 2022 from <https://www.hindawi.com/journals/prm/2022/8545372/>. Retrieved November 2, 2022 from.
- Sefatbaqa, S., Jafarian, A., Seyedeh, R., Zabihi, A., Pouredad, P., Arzani, A., 2020. Performance of nurses in neonatal intensive care unit regarding transfusion of blood and blood products. *J. Evid. Based Care* 10 (3), 7–14.
- Shakerkavar, P., Mussavi, M., Valizadeh, S., Alizadeh, M., Bostanabad, M., 2019. Performance of neonatal intensive care unit nurses in blood culture procedure in Tabriz hospitals in 2016. *Iran. J. Neonatol.* 10 (1), 58–62.
- Shattnawi, K., Al-Ali, N., Alnuaimi, K., 2019. Neonatal nurses' knowledge and beliefs about kangaroo mother care in neonatal intensive care units: a descriptive, cross-sectional study. *Nurse Health Sci.* 21 (3), 352–358.

- Shoghi, M., Nazarshodeh, S., Borimnejad, L., 2020. Knowledge and attitude of nurses working in a neonatal intensive care unit on the use of human donor milk. *J. Client Cent. Nurs. Care* 6 (1), 55–64.
- Simkooi, F., Masoumpoor, A., Shirinabadi-Farahani, A., Pahlevanzadeh, B., 2019. Evaluation of the clinical performance of nurses employed in the neonatal intensive care units. *Adv. Nurs.* 28, 1–8.
- Smith, A., Hanson-Abromeit, D., Heaton, A., Salley, B., 2021. Survey of neonatal nurses perspectives on voice use and auditory needs with premature infants in the NICU. *Int. J. Environ. Res. Public Health* 18 (16).
- Solberg, M., Hansen, T., Bjork, I., 2011. Nursing assessment during oxygen administration in ventilated preterm infant. *Acta Paediatr.* 100 (2), 193–197.
- Soroush, F., Zargham-Boroujeni, A., Namnabati, M., 2016. The relationship between nurses' clinical competence and burnout in neonatal intensive care units. *Iran. J. Nurs. Midwifery Res.* 21, 424–429.
- Soti, H., Gautam, S., Paudel, S., Bhattarai, M., 2021. Knowledge regarding resuscitation of newborn among nurses. *Curr. Pediatr. Res.* 25 (3), 452–456.
- Stephenson, M., Riitano, D., Wilson, S., Leonardi-Bee, J., Mabire, C., Cooper, K., Monteiro da Cruz, D., Moreno-Casbas, M., Lapkin, S., 2020. Chapter 12: systematic reviews of measurement properties. In: Aromataris, E., Munn, Z. (Eds.), *JBI Manual for Evidence Synthesis*. JBI. <https://doi.org/10.46658/JBIMES-20-13>. Retrieved October 10, 2022, from <https://synthesismanual.jbi.global>.
- Tarjoman, A., Vasigh, A., Pouy, S., Safari, S., Borji, M., 2019. Pain management in neonatal intensive care units: a cross sectional study of neonatal nurses in Ilam City. *J. Neonatal Nurs.* 25 (3), 136–138.
- The Royal College of Nursing, 2016. *Career, Education and Competence Framework for Neonatal Nursing in the UK*. NHS.
- Thuileiphy, T., Joshi, P., Dolma, Y., Paul, J., Joshi, M., Gudiya, M., 2021. A descriptive survey on knowledge gap related to retinopathy of prematurity and its prevention and management among nurses in a tertiary care hospital. *Indian J. Ophthalmol.* 69 (8), 2122–2125.
- Toth, J., 2007. Development of the basic knowledge assessment tool (BKAT) for the neonatal intensive care unit. *J. Perinatal Neonatal Nurs.* 21 (4), 342–348.
- Vitorino, M., Rodrigues, M., Evangelista, C., Guimarães, K., Batista, J., FONSECA, A., Araújo, A., Melo, F., 2018. Burnout syndrome: knowledge of neonatal nursing team. *J. Nurs.* 12 (9), 2308–2314.
- Wari, G., Wordofa, B., Alemu, W., Habte, T., 2021. Knowledge and practice of nurses and associated factors in managing neonatal pain at selected public hospitals in Addis Ababa, Ethiopia. *J. Multidiscip. Healthc.* 14, 2275–2286.
- Williamson, S., McGrath, J., 2020. Neonatal nurses' self-reported practices, knowledge, and attitudes toward use of maternal voice for preterm infants. *Adv. Neonatal Care* 20 (5), 415–422.
- World Health Organization, 2019. *SURVIVE AND THRIVE: transforming care for every small and sick newborn*. <https://data.unicef.org/resources/survive-and-thrive-transforming-care-for-every-small-and-sick-newborn/>.
- Yousef, S., Ridah Hasan, A., 2020. Assessment of nurses knowledge toward neonate with birth asphyxia at neonatal intensive care unit in pediatric hospitals at Babylon governorate. *Medico-Legal Update* 20 (3), 1099–1104.
- Zamani, P., Dehnad, A., Haghani, H., Borimnejad, L., 2019. Effect of web-based education on knowledge, attitude, and practice of nurses in neonatal intensive care unit. *Interdiscip. J. Virtual Learn. Med. Sci.* 2019.
- Zhang, Y., Deng, Q., Zhu, B., Li, Q., Wang, F., Wang, H., Xu, X., Johnston, L., 2018. Neonatal intensive care nurses' knowledge and beliefs regarding kangaroo care in China: a national survey. *BMJ Open* 8 (8).