








## SYSTEMATIC REVIEW

# Interventions for supporting parents of infants requiring neonatal inter-hospital transport: A systematic review

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## Abstract

**Background:** Neonatal inter-hospital transport is associated with heightened stress for parents whose needs may remain unmet around this time.

**Aim:** To identify interventions which are used to support parents whose infants require neonatal inter-hospital transport.

**Study Design:** A systematic literature review approach was used. Six online databases (CINAHL, EMBASE, EMCARE, Medline, PsycINFO, Web of Science) were searched up to February 2022. The eligibility criteria included interventional studies published in the English language. Methodological quality was assessed by the Critical Appraisal Skills Programme checklists. Data were extracted using a predefined framework and synthesized narratively because of heterogeneity of reported outcomes.

**Results:** A total of 671 articles were screened, with five meeting the eligibility criteria. Three interventions were reported within the five studies: a communication-based intervention before transport represented by 223 parents in one study, Kangaroo Care during transport, which was carried out with 136 infants in three studies,

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and video calls after transport evaluated by one study in seven parents versus a control group. The effectiveness of the interventions could not be reliably determined. Neonatal nurses were the main providers of all the interventions pre-, peri-, and post-transport.

**Conclusion:** Limited evidence of mixed quality and inconsistent outcome measurements is available. Future research should focus on developing a contemporary intervention, determining the optimum timing for its implementation, and evaluating it using a robust study design.

**Relevance to Clinical Practice:** Neonatal nurses need to be aware of the importance of their role in supporting parents through the distressing time of neonatal transport.

#### KEYWORDS

infant, high risk; intensive care, neonatal; neonatal intensive care nursing; parent-infant bonding; patient transport

## 1 | INTRODUCTION

Parents of infants hospitalized on neonatal units (NNU's) experience multiple stressful events which impact their attachment and future relationship with their infant.<sup>1,2</sup> A major exacerbation of parental stress is caused by inter-hospital transport<sup>3,4</sup> which affects approximately 10% of infants admitted in NNU's in the United Kingdom (UK).<sup>5</sup> Neonatal transport exacerbates the separation of parents from their infants which is traumatic for both.<sup>6</sup>

Regionalisation of neonatal care occurred during the last two decades to centralize specialized resources and staff expertise, thus necessitating neonatal transport in the UK<sup>7,8</sup> and other countries.<sup>9</sup> Three levels of neonatal care are provided in the UK, comparably with international literature, and are defined by the British Association of Perinatal Medicine<sup>10</sup> as intensive care, high dependency care, and special care. Infants in any of these categories may require transportation for a variety of reasons.

The context of neonatal transport varies to a large extent, depending on the clinical condition of the infant, the mode of transport and the distance travelled. Sick and unstable infants require urgent uplift of care to Neonatal Intensive Care Units (NICU's) which may be unexpected and may be undertaken by any vehicle available to any hospital that accepts the infant for ongoing care.<sup>9</sup> This may be a long distance from the parents' home. However, in the UK, neonatal transport teams strive to keep infants in the same geographical area, termed neonatal network, which is a group of NNU's with a lead NICU, thus minimizing parents' travelling.<sup>7</sup>

The other major reason for neonatal transfer is called "back-transfer", which occurs frequently from NICU to a hospital closer to the parents' home, once the infant's condition is stable.<sup>9</sup> Back-transfers tend to be planned, including the mode of transfer, as the urgency for transfer is no longer present. Infants may also be transferred from NICU's for resource reasons to provide capacity for sicker infants. Occasionally, infants are also transferred for other reasons, such as for specialist appointments or for palliative care, the latter may be to the parents' home or a hospice.

### What is known about the topic

- Parents on neonatal units experience stress which increases around the time of neonatal inter-hospital transport.
- Various interventions have been tested to reduce parental stress on neonatal units.

### What this paper adds

- Few interventions have been studied in relation to parental support and neonatal transport.
- Interventions pre-, peri-, and post-transport are predominantly implemented by neonatal nurses.
- Neonatal staff should focus on effectively communicating with parents when neonatal transport is required, optimize the use of existing video calling platforms, and promote and facilitate KC in NNU and during transport whenever clinically appropriate.
- Because of the complexity of the phenomena, a combination of interventions would be beneficial to be evaluated and implemented in the future, such as a care bundle for supporting parents in relation to their infant's neonatal transport.

Regardless of the reason, neonatal transport may be processed by parents as a crisis.<sup>11,12</sup> Their worries, intuitive or based on actual experience, are substantiated, as infants have been shown to be exposed to excessive levels of noise and vibration<sup>13</sup> and show more discomfort during transport compared with their physiological parameters when in NNU.<sup>14</sup> In addition, parental needs may remain unmet when their infant requires neonatal transport,<sup>4,15</sup> such as their physical comfort and emotional needs. Moreover, when parents leave the familiar unit behind, they move towards the unknown,<sup>11,12,16</sup> which stimulates

apprehension about the new staff and routines. Inconsistencies in information and routines are often quoted as the main source of stress associated with transitions between health care facilities.<sup>17,18</sup>

Support for parents through a transition to another hospital is therefore required.<sup>7</sup> Although current neonatal research priorities include support for parents,<sup>19,20</sup> parental support specifically in relation to neonatal transport has been identified only recently as a research priority.<sup>21</sup> Hence, literature on this topic is sparse, with only two evidence syntheses identified.<sup>22,23</sup> Whyte et al.<sup>22</sup> reviewed substantial amounts of evidence regarding neonatal transport with the aim of recommending improvements for uplifts, however, parental support was underrepresented and consisted of one brief paragraph. Conversely, Schwartz and Raines<sup>23</sup> focus on parent-infant bonding after neonatal transport; however, their synthesis fails to demonstrate comprehensiveness of their literature search. To date, there are no systematic reviews regarding this phenomenon that synthesize all available evidence and thus accelerate its appropriate use in practice.

## 1.1 | Aims and objectives

This systematic literature review aimed to establish what interventions are used to support parents whose infants require neonatal inter-hospital transport. Specific objectives were to: (a) assess the effectiveness of the interventions, (b) identify when the interventions were implemented on the care pathway (pre-, peri-, or post-transport), and (c) identify which groups of staff implemented them.

## 2 | METHODS

The protocol was registered on PROSPERO The International Prospective Register of Systematic Reviews (ID: CRD42022309243) prior to the review commencing. This article was structured using the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) reporting guidelines 2020.<sup>24</sup>

### 2.1 | Eligibility criteria

Eligible were any primary research studies and literature reviews containing an intervention concerned with parental support strategies used when their infant required neonatal inter-hospital transport. No geographical or date limits were set, thus any articles published up to February 2022 were considered for inclusion. Only articles with full text available in English were included, because of lack of funding for translation.

### 2.2 | Search strategy

Six electronic databases (Cumulative Index to Nursing and Allied Health Literature [CINAHL], EMBASE, EMCARE, Medline, PsycINFO,

and Web of Science) were searched in February 2022 using a predefined search strategy. The searches were completed by EH and LM. Scopus was initially included in the protocol; however, after discussion with co-authors, Scopus was deemed not relevant for this specialized area. Scopus was substituted with EMCARE which was identified as indexing more relevant literature aligned to this topic. The searches were carried out by combining terms related to three key areas: (1) “parents of infants requiring neonatal inter-hospital transport”, (2) “parental support strategies” and (3) “parental results and satisfaction with peri-transport care”. The search strategy was developed using “Population, Intervention, Comparison, Outcome” (PICO) framework by LM with input from all the collaborators and is detailed in Appendix A, Tables A1–A4. Subsequently, reference lists of included articles were also searched.

### 2.3 | Study selection

Articles were initially screened by title and abstract against the eligibility criteria by the primary reviewer (LM) using software Rayyan<sup>25</sup> which is useful for importing references, screening, and organizing them. A sample of 20% underwent a blind assessment which identified no discrepancies. This was accomplished by three reviewers (DN, SC, DL) re-screening a randomly assigned sample in Rayyan software (with the “blind on”). The next stage involved full text screening by LM. Subsequently, a second blind assessment was performed by two reviewers (IW, JCM). One article,<sup>26</sup> which was identified from reference lists of the included studies, did not achieve consensus in the double-blind assessment. This was discussed with a third reviewer (TM) who identified it as eligible for inclusion, hence it was included.

### 2.4 | Data extraction

Data extraction was performed by LM and subsequently cross-checked for accuracy by other reviewers (DN, SC, DL). A pre-piloted spreadsheet was used to extract the following information: author, publication year, country, study design, sample characteristics, reason for transport, intervention modalities, outcome measures, and results. Authors of three studies were contacted for missing information via email.

### 2.5 | Methodological quality assessments

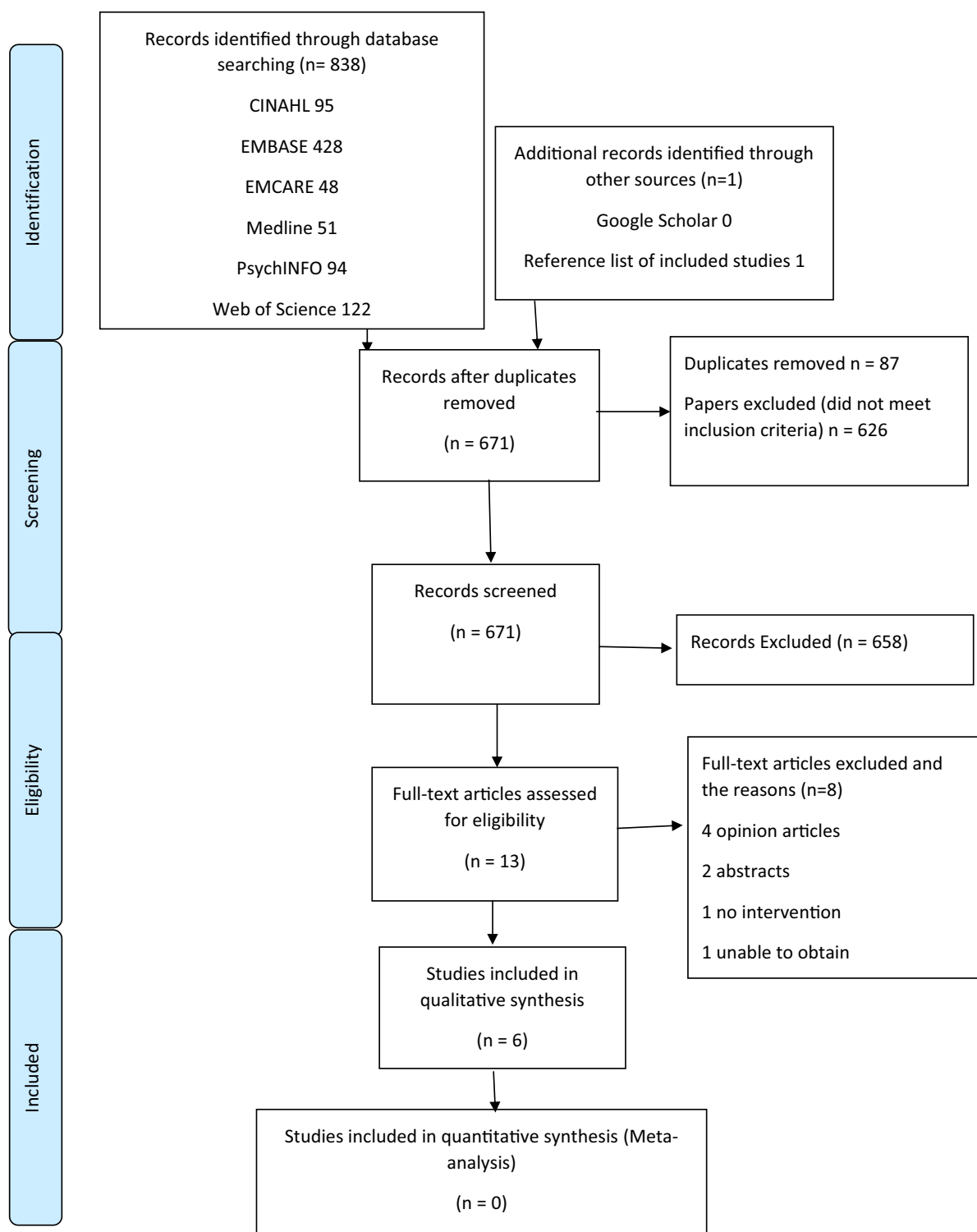
The methodological quality of the included studies was independently evaluated by two reviewers using standardized critical appraisal instruments from the Critical Appraisal Skills Programme (CASP), selected according to the type of study.<sup>27–29</sup> Minor discrepancies were identified, discussed, and agreement reached. No studies were rejected based on quality assessment to synthesize all available studies, thus capturing the breadth of research in this area.

## 2.6 | Data synthesis

A narrative synthesis is presented as heterogeneity of the included studies precluded meta-analysis. Articles were grouped according to the type and timing of intervention. However, the included studies varied in their research questions and set objectives.

## 3 | RESULTS

Database searches returned 838 records. As shown in the PRISMA flow chart (Figure 1), once duplicates were removed, manually and using Rayyan software,<sup>25</sup> there were 670 articles, which were screened by title and abstract. Subsequently, another article was identified by searching



**FIGURE 1** Flow diagram of included and excluded studies.

the reference lists of the included studies. Six-hundred and fifty-eight articles were excluded during title and abstract screening; the vast majority were discussing other topics than neonatal transport and consequently were not relevant. Other reasons for exclusion were because of opinion articles, not including an intervention, or outcomes not focussing on parents. Thirteen articles were taken forward to full text review. Eight were excluded with the following reasons: opinion article ( $n = 4$ ),<sup>30–33</sup> abstract only ( $n = 2$ ),<sup>34,35</sup> no intervention ( $n = 1$ ),<sup>36</sup> unable to obtain ( $n = 1$ ).<sup>37</sup> The remaining five articles were included in the review.

### 3.1 | Characteristics of included studies

The included studies were published between 1983 and 2021 in the following countries: Sweden ( $n = 2$ ),<sup>38,39</sup> Belgium ( $n = 1$ ),<sup>40</sup> Germany ( $n = 1$ ),<sup>26</sup> and USA ( $n = 1$ ).<sup>41</sup> (Table 1). The study designs varied: observational ( $n = 2$ ),<sup>26,40</sup> qualitative study with an inductive approach ( $n = 1$ ),<sup>38</sup> quasi-experimental quantitative study ( $n = 1$ ),<sup>39</sup> and case-control ( $n = 1$ ).<sup>41</sup> No randomized controlled trials or literature reviews were identified. The total number of parental participants is unclear, approximately 370, as one study specifies infant, rather than parent, participants.<sup>40</sup> Clarification was attempted to be obtained from the authors; however, this was unsuccessful.

The representation of parental participants varied with sample sizes ranging from 11<sup>38</sup> to 223.<sup>39</sup> Two studies included only mothers,<sup>40,41</sup> one reported primarily mothers and one father,<sup>26</sup> and two studies did not specify which parents (mothers or fathers) were represented.<sup>38,39</sup> Other parental characteristics, such as ethnicity, religion, socio-economic status, number of previous children or occupation, were also underreported and completely missing in three studies.<sup>26,39,40</sup> Van den Berg and Lindh<sup>39</sup> justified this by protecting participants' anonymity. Parental ethnicity and number of previous children were reported in two studies.<sup>38,41</sup> Piecuch et al.<sup>41</sup> documented an ethnically diverse sample that included four ethnicities, whereas Lundqvist et al.<sup>38</sup> acknowledged the lack of diversity as a limitation to the generalisability of their findings. Lundqvist et al.<sup>38</sup> also specified that all parents were cohabiting with the other parent and had no previous neonatal experience; however, they differed in their level of education and came from urban and rural areas. In contrast, Piecuch et al.<sup>41</sup> lacked diversity in the participants' marital status, because all the participants were married, and their age, which was reported as mean age of 30 years with a standard deviation of 1.4 and 1.8 for the intervention and control group, respectively.

Regarding the characteristics of the transported infants, mostly stable infants receiving special care were represented. Two studies considered only these infants<sup>38,40</sup> and one reported most infants in this category with no critically sick infants present.<sup>26</sup> Clarification was sought from the corresponding author,<sup>26</sup> albeit unsuccessfully, regarding the care level of some infants. Van den Berg and Lindh<sup>39</sup> concentrated on back-transport to a lower level of care unit; however, no further specifications were provided. Only one study explored uplifting sick infants for intensive care<sup>41</sup> and no studies investigated transport to other destinations than hospitals, such as home or hospice. Furthermore, parental

presence during transport was only reported when the infant was transferred in a Kangaroo Care (KC) position with their parent.<sup>26,38,40</sup>

The mode of transport was by ambulance transport,<sup>26,38,40</sup> with one study also including two helicopter transfers.<sup>26</sup> The distance of travel ranged from 2 to 400 km where reported; two studies did not define the mode of transport used or the distance.<sup>39,41</sup> Therefore, the broadest spectrum of transfers was studied by Sontheimer et al.<sup>26</sup> with two transport modes and the largest distance range.

### 3.2 | Quality of studies

Three types of CASP checklists<sup>27–29</sup> were used according to the study designs. They are detailed in Table 2 with the following colouring of the answers: green for “yes”, amber for “cannot tell” and red for “no”. Only one study achieved all green answers and is therefore of high quality.<sup>38</sup> The remaining studies were of mixed quality, with two studies including two to three concerning (red) areas<sup>39,41</sup> and one study that conveyed minimal detail because it was published as a brief report.<sup>40</sup> There were no strong patterns identified in respect of methodological or reporting issues across the studies. All studies addressed a clearly focused issue, while the most concerning were questions regarding the accounting of confounders and participants' duration and completeness of follow-up. Furthermore, there was also a risk of bias during the data collection phase in some studies with regard to who collected the data and when. Therefore, the validity and reliability of the results and their synthesis must be carefully considered before any use in practice.

### 3.3 | Types of interventions

Three types of parental support interventions were identified: van den Berg and Lindh<sup>39</sup> developed and evaluated a communication-based intervention, Piecuch et al.<sup>41</sup> studied the use of video calls for maternal emotional well-being, whereas the remaining three studies were concerned with the transfer of the infant together with their parent in a KC position.<sup>26,38,40</sup> It was unclear from the papers who developed the interventions and how; only one study provided an outline of the process.<sup>39</sup>

Consequently, there is a wide variability of the reported study outcomes. Piecuch et al.<sup>41</sup> evaluated an intervention to reduce maternal anxiety and increase maternal attachment to her sick newborn after the infant had been transported to a NICU. The intervention consisted of video calls from the cot side in the NICU to show the infant and provide updates on the infant's progress to the mother, who remained hospitalized in the hospital where the infant was transferred from. Whereas Piecuch et al.<sup>41</sup> focused on uplift to NICU, van den Berg and Lindh<sup>39</sup> evaluated an intervention for the psychological preparation of parents of NICU infants before their back-transport to the community hospital. Despite the remaining three studies investigating the same intervention, KC position during transport, they focused on various aspects including the feasibility of the

TABLE 1 Characteristics of the included studies in relation to parental outcomes.

Authors (year)	Country	Study design	Aim of the study	Sample characteristics	Intervention type	Intervention timing	Staff groups implementing the intervention (a specific role described)	Data collection method	Summary of results
Lundqvist et al (2021)	Sweden	Qualitative	To illuminate parents' experiences of holding their infant in a kangaroo position during neonatal ground ambulance transport	Parents (proportion of mothers and fathers not specified). $n = 11$	Kangaroo Care during transport	During transport	Transport team (neonatal nurse and ambulance staff)	Unstructured interviews	The overarching theme was "uninterrupted closeness chain." Parents' experiences were allocated into three categories: "Strengthen the feeling of being important as a parent," "promote security and create a positive environment for the baby" and "the professionals' attitude promotes security".
Hennequin et al. (2018)	Belgium	Observational	To present the authors' experience with regards to the physiological stability of the infants, the mothers' stress and an evaluation by the medical professionals involved	Mothers of infants (the exact number of mothers is unclear; four sets of twins were included). $n = 94$	Kangaroo Care during transport	During transport	Transport team (neonatal nurse)	Verbal rating on a Likert scale 0–10 (0 = worst, 10 = best)	The mothers said that the skin-to-skin transfer helped to decrease their stress and gave the experience a mean score of 9.2.
Van den Berg and Lindh (2011)	Sweden	Quasi-experimental	To evaluate an intervention created in collaboration with one NICU Department and one CH for the psychological preparation of families before back-transport of their infant from NICU to CH	Parents (proportion of mothers and fathers not specified). $n = 223$	Communication-based intervention aimed at improving the psychological preparation of parents before their back-transfer from NICU to their CH, consisting of three parts: (a) communication routine with CH staff while still at NICU, (b) brochure with information about the CH, and (c)	Pre-transport	NICU and CH staff (primary nurse at CH)	Survey: semi-structured questionnaire	This study showed that parents need up-to-date information and personal communication with staff at the CH before back-transport of the baby from NICU. Families rated how prepared they felt for transition from NICU to CH on a 0–10 VAS: Those with prior CH contact scored 8.6, compared

TABLE 1 (Continued)

Authors (year)	Country	Study design	Aim of the study	Sample characteristics	Intervention type	Intervention timing	Staff groups implementing the intervention (a specific role described)	Data collection method	Summary of results
					additional offers to families to become acquainted with the CH				with 6.6 for those with no prior CH contact, which was statistically significant ( $p < .001$ ). Families who had at least one previous contact with the CH also rated their CH reception significantly higher ( $p < .001$ ) than those who had no prior contact. Furthermore, families with at least one prior contact with the CH rated the continuity between feeding routines significantly higher ( $p < .05$ ) than those who had no prior contact. However, the significant difference for the latter two results was not found in the long-term follow-up group
Sonthaimer et al. (2004)	Germany	Observational	To describe the authors' procedure of back-transfer in Kangaroo position and present results of their kangaroo transports of stable preterm and term	The infants who were transported in the Kangaroo position were paired with one adult each: 27 mothers, 1 father, 2 female nurses, and 1 male neonatologist. Total: $n = 31$	Kangaroo Care during transport	During transport	Transport team (neonatal nurse and a neonatologist)	Not stated for parental data	All parents appreciated being able to stay with their infants during transport, reporting that they felt comfortable, safe, and happy to be able to provide

(Continues)

TABLE 1 (Continued)

Authors (year)	Country	Study design	Aim of the study	Sample characteristics	Intervention type	Intervention timing	Staff groups implementing the intervention (a specific role described)	Data collection method	Summary of results
Piecuch et al. (1983)	USA	Case-control	To evaluate effectiveness of videophone calls, compared with voice calls, on the attachment of mothers to their sick transported infants	Fourteen mothers (intervention group ( $n = 7$ ), control group ( $n = 7$ ))	The use of a videophone to support emotional well-being of hospitalized mothers whose infant had been transferred to a higher level of neonatal care unit. The control group used voice calls (comparison: video calls and voice calls).	Post-transport	NICU staff (nurses)	A telephone call log in nursing records	personal transport for their infants During the mothers' hospitalization, the mean number of telephone calls to the intensive care unit made per day by the videophone mothers was significantly greater than the number made by the control mothers. Furthermore, after leaving the hospital and no longer had use of the videophone, the study mothers continued to call the intensive care unit more frequently each day to ask about their infants.

Abbreviations: CH: Community Hospital; NICU: Neonatal Intensive Care Unit; VAS: Visual Analog Scale.

**TABLE 2** Quality assessment (CASP) chart for the included studies.

CASP checklist item no. → Study and CASP checklist type used ↓	1	2	3	4	5 (a + b)	6 (a + b)	7	8	9	10	11	12
Lundqvist et al. (2021) <i>Qualitative Study</i>											N/A	N/A
Hennequin et al. (2018) <i>Cohort study</i>												
Van den Berg and Lindh (2011) <i>Cohort study</i>												
Sontheimer et al. (2004) <i>Cohort Study</i>												
Piecuch et al. (1983) <i>Case-Control Study</i>												N/A

Note: Key: green = “yes”, amber = “cannot tell”, red = “no”.

intervention,<sup>26,40</sup> the effect on mothers' stress levels,<sup>40</sup> and the acceptability of the intervention with themes from the experiences of parents.<sup>38</sup>

### 3.4 | Modalities of interventions

The timing of the interventions corresponds with the whole care pathway: one intervention was implemented pre-transport,<sup>39</sup> one during,<sup>26,38,40</sup> and one post-transport.<sup>41</sup> There was no evidence of application of other interventions throughout the care pathway for the continuity of support for parents around the time of their infant's transport.

The common feature among the interventions was that neonatal nurses predominantly implemented them. The communication-based intervention was implemented by both NICU and community hospital nurses with a specific role of a primary nurse at the community hospital.<sup>39</sup> Video calls were also facilitated and documented by bedside NICU nurses.<sup>41</sup> The decision to implement KC during transport and the actual implementation was shared by the NICU and transport teams whose composition varied, and generally included a neonatologist and transport crew. However, they always included a neonatal transport nurse who accompanied the transfer (please see Table 1).

### 3.5 | Outcomes of interventions

It was not possible to definitively assess the effectiveness of the interventions. Because of the encountered heterogeneity of the studies and their design, each outcome relies upon the report of each individual study. Video calls were favourable compared with voice calls with a significant difference of calls made by the mother to NICU to enquire about her sick infant.<sup>41</sup> This difference was sustained in the long term, after the mothers had been discharged home, and suggested an improved early bonding between the mother and her infant.<sup>41</sup> In contrast, the communication-based intervention showed significantly better parental preparedness for their back-transfer in

the short-term, compared with the long-term.<sup>39</sup> However, the authors report difficulties in sustaining the long-term implementation of the intervention which influenced the results.<sup>39</sup>

Regarding KC transport, all studies revealed positive effects and reported no adverse outcomes.<sup>26,38,40</sup> Parents appreciated being able to stay with their infants throughout the journey<sup>26</sup> and reported alleviation of their stress by providing a score of 9.2 on a scale of 0 to 10, from lowest to highest.<sup>40</sup> Furthermore, when narrating their KC transport experience, parents elucidated their positive feelings related to being close to their infants, having their parental role affirmed, and positive relationship with the transport nurses.<sup>38</sup>

## 4 | DISCUSSION

This review has synthesized evidence for supporting parents whose infants require neonatal inter-hospital transport. A paucity of research was identified with five studies of mixed methodological quality, reporting three types of interventions. Despite this research spanning four decades and various countries, no randomized controlled trials or previous literature reviews have been conducted. Therefore, no definite conclusions could be drawn and, consequently, further research in this area is warranted.

The intervention supported by most studies, and of better quality based on the CASP checklists, is KC during transport. The other two interventions were examined by one study each, both of which were determined to be of lower quality. Furthermore, the number of participants could be considered small, apart from one study,<sup>39</sup> and homogeneous.

The lack of diversity of the included study samples impacts its generalisability to various practice settings. Fathers were underrepresented which is congruent with other neonatal literature.<sup>42,43</sup> In addition, no data are available regarding certain groups, such as single, same-sex, teenage, foster, or adoptive parents. A wider representation of ethnicities would also be beneficial to reflect the composition of today's society. Moreover, health care settings, such as NNU's and transport teams, vary in their service provision and availability of

resources. Therefore, implementing some interventions would potentially involve considerable efforts and reorganization of resources on multiple levels. For instance, if KC transport were used for eligible parents and their infants, it could be expected that the receiving NNU would accommodate the parent, particularly if distant from their home, congruently with latest recommendations in the UK.<sup>7,44</sup> However, this may not be currently possible for some NNU's.

When considering reasons for transfer, uplifts are associated with less stable infant conditions and greater urgency, compared with back-transport. However, paradoxically, most of the identified interventions focused on back-transport. No justifications were identified, except that KC transport was reported as inappropriate for infants requiring repeated handling and therapeutic interventions during transport.<sup>26</sup> Nevertheless, it is proposed that ventilated infants, hence intensive care level, could be considered for KC transport as KC is successfully practised with ventilated infants on NNU's.<sup>26</sup> Implementing KC in NNU is, however, still fraught with challenges,<sup>45</sup> which may also apply in the transport environment. This particularly relates to keeping the endotracheal tube and ventilator tube secure in the presence of vibrations during transfer.

Mode of transport or distance travelled were not discussed with respect to their effects on parental outcomes, as this was not an objective of any of the included studies. These variables were reported only by the studies investigating KC transport<sup>26,38,40</sup> as there might be direct associations with parental outcomes. Overall, KC transport is acceptable for and appreciated by parents, regardless of distance, or if an ambulance or helicopter was used. Congruently, parental presence during transport was identified as desirable<sup>4</sup> and as one of the quality indicators of a transport service.<sup>46</sup> In addition, KC transport was used coincidentally elsewhere during a flight, with positive effects<sup>47</sup> and is also recommended by the Resuscitation Council UK for newborns requiring unplanned transfer to a hospital.<sup>48</sup> Consequently, its cautious implementation in practice appears justifiable while considering each institution's health and safety regulations.

Regarding the timing of interventions, although all stages were represented among the studies, each study focused only on one stage. No evidence of attempts to support parents continually and consistently before, during, and after the transport episode was found. It is noteworthy that a communication-based intervention, for example, lends itself to multiple modification possibilities for all the stages. However, challenges to its successful implementation persist.

Another potentially universally applied intervention is KC. KC has been extensively studied on NNU<sup>49</sup> and therefore is suitable for the pre- and post-transport phases. Furthermore, the use of KC during transport brought feelings of "uninterrupted chain of closeness" for parents in Sweden<sup>38</sup> where zero separation of the mother-infant dyad in neonatal care is strongly encouraged.<sup>6,50</sup> Nevertheless, KC undertaken on NNU's pre- or post-transport may not provide any specific support for parents in relation to neonatal transport.

Conversely, video calls can be directly used on NNU's to support parents of transferred infants when the parents cannot be with their infant. Alternatively, they can also be used for parents to view the NNU where their infant requires transportation to, to assist them with

the transition. Video calling and messaging is a growing trend nowadays with various electronic platforms being developed and used on NNU's.<sup>51-54</sup> This is also being implemented around the time of neonatal transport for various purposes.<sup>23,31,55,56</sup> Furthermore, since the study by Piecuch et al.<sup>41</sup> technology has rapidly advanced and is now ubiquitous in the form of various mobile devices. Not surprisingly, the effectiveness of modern technology-based interventions related to neonatal transport and parental support is yet to be determined.

Finally, the common theme among the included studies is that neonatal nurses participated in implementing all interventions before, during and after transport. Neonatal nurses, including neonatal transport nurses, are the professional group who spend their time with the infants and their parents, and therefore are ideally placed to support parents throughout their neonatal journey.

## 4.1 | Strengths and limitations

The main limitation of this review is that only articles published in English were sought which potentially limited the diversity of study samples and interventions. Nevertheless, no English abstracts with full text articles in another language were identified and the included studies were from various countries. Furthermore, the search strategy was co-developed with literature review and subject experts and had an adequate balance of specificity and sensitivity. Rigour was also demonstrated by a double-blind review at the screening stage, following the protocol, and adhering to reporting guidelines. Another strength is the composition of the review team which included experts on the topic, as well as on the systematic review methods.

The main limitation of the findings was a lack of commonalities of the study outcomes which precluded meta-analysis. Moreover, the quality of reporting was affected by the brevity of report in two studies.<sup>40,41</sup> The descriptions of the utilized research methods were mostly lacking sufficient detail and any underpinning theoretical framework behind the intervention was mostly absent. There was also a risk of bias during the data collection phase in some studies regarding who collected the data and when. In addition, the context around the parents was missing, and their characteristics were provided only partially, which limits the generalisability of the findings. Nevertheless, the strength is that several types of studies published at various times were identified and interventions spanning from pre- to post-transport were included in the synthesis.

## 5 | CONCLUSION

This systematic review identified five articles reporting three interventions used to support parents around the time of their infant's neonatal inter-hospital transport: a communication-based intervention pre-transport, KC during transport, and video calls post-transport. Their effectiveness could not be established. Meta-analysis was not possible because of the heterogeneity of outcome measurements of the

included studies. Therefore, generalisable recommendations on the implementation of interventions cannot be made. Nevertheless, neonatal nurses were the primary providers of all the interventions, which confirms that they are ideally placed to support parents around the time of their infant's neonatal transport.

## 5.1 | Implications for future practice

Neonatal staff should focus on effectively communicating with parents when neonatal transport is required, optimize the use of existing video calling platforms, and promote and facilitate KC in NNU and during transport whenever clinically appropriate. Neonatal nurses should be aware of the importance of their role in supporting parents through the distressing time of neonatal transport.

Future research needs to consistently address outcomes which parents consider important. In addition, in view of the age of some of the interventions, a contemporary intervention needs to be developed. Furthermore, because of the complexity of the phenomenon, a care bundle approach with several intervention components might be advantageous. Future feasibility testing would determine the optimum time for implementing the new intervention, pre-, peri-, post-transport, or a combination of these. Finally, the intervention needs to be evaluated by a study with a robust design, such as a randomized controlled trial, to provide valid data for its implementation in practice.

## AUTHOR CONTRIBUTIONS

Systematic Review Study conceptualisation and design: LM; TM; JCM. Data collection/extraction/checking/quality assessments: LM; DN; SC; DL; IW; TM; JCM. Data Synthesis: LM; JCM. Manuscript writing: All authors were involved and contributed to the critical review and revision of the manuscript. All authors have approved the final manuscript.

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## CONFLICT OF INTEREST STATEMENT

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## DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available in [repository name] at [DOI/URL], reference number [reference number]. These data were derived from the following resources available in the

public domain: [list resources and URLs] via internet based search databases listed within the paper.

## ETHICS STATEMENT

Not required for a literature review.

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## APPENDIX A

## SEARCH STRATEGY IN DETAIL

An iterative search process was conducted: EH conducted preliminary and LM more comprehensive searches. These were combined and duplicates removed. The following four tables (A1, A2, A3, and A4) detail the search process.

**TABLE A1** Search terms used, shown as PICO (population, intervention, comparison, outcome).

Column terms combined with	Population	AND Population	AND Population	AND Intervention	AND Outcome
OR	Mother*	Infant*	Transfer*	Support*	Bonding
OR	Father*	Baby	Transport*	Arrangement	Attachment
OR	Mum*	Babies	Retrieval*	Approach*	Psycholog*
OR	Dad*	New*born	Inter*facilit*	Strateg*	Stress*
OR	Parent*	Neonat*	Inter*hospital	Need*	Distress*
OR	Carer*		Ambulance*		Experienc*
OR	Famil*		Fly*		Perception*
OR					Satisf*

**TABLE A2** The complete search strategy used by EH.

#	Database	Search term	Results
1	CINAHL	((((mother* OR father* OR mum* OR dad* OR parent* OR carer* OR famil*) AND (infant* OR baby OR babies OR new*born OR neonat*)) AND (bonding OR attachment OR psycholog* OR stress* OR distress* OR experienc* OR perception*)) AND ("patient transfer*" OR "inter*hospital transfer*" OR "patient transport*")).ti,ab	3
2	CINAHL	((((mother* OR father* OR mum* OR dad* OR parent* OR carer* OR famil*) AND (infant* OR baby OR babies OR new*born OR neonat*)) AND (bonding OR attachment OR psycholog* OR stress* OR distress* OR experienc* OR perception*)))).ti,ab	16 521
3	CINAHL	"TRANSFER, INTRAHOSPITAL"/	1284
4	CINAHL	exp "TRANSPORTATION OF PATIENTS"/	12 271
5	CINAHL	(3 OR 4)	13 473
6	CINAHL	(2 AND 5)	42
7	CINAHL	6 [Languages eng]	41
8	PsycINFO	((((mother* OR father* OR mum* OR dad* OR parent* OR carer* OR famil*) AND (infant* OR baby OR babies OR new*born OR neonat*)) AND (bonding OR attachment OR psycholog* OR stress* OR distress* OR experienc* OR perception*)) AND ("patient transfer*" OR "inter*hospital transfer*" OR "patient transport*")).ti,ab	0
9	PsycINFO	((((mother* OR father* OR mum* OR dad* OR parent* OR carer* OR famil*) AND (infant* OR baby OR babies OR new*born OR neonat*)) AND (bonding OR attachment OR psycholog* OR stress* OR distress* OR experienc* OR perception*)))).ti,ab	21 450
10	PsycINFO	"TRANSFER, INTRAHOSPITAL"/	0
11	PsycINFO	exp "TRANSPORTATION OF PATIENTS"/	0
12	PsycINFO	"CLIENT TRANSFER"/	282
13	PsycINFO	(9 AND 12)	1
14	Medline	((((mother* OR father* OR mum* OR dad* OR parent* OR carer* OR famil*) AND (infant* OR baby OR babies OR new*born OR neonat*)) AND (bonding OR attachment OR psycholog* OR stress* OR distress* OR experienc* OR perception*)) AND ("patient transfer*" OR "inter*hospital transfer*" OR "patient transport*")).ti,ab	4
15	Medline	"PATIENT TRANSFER"/	9307
16	Medline	"TRANSPORTATION OF PATIENTS"/	9574
17	Medline	(15 OR 16)	18 422

(Continues)

**TABLE A2** (Continued)

#	Database	Search term	Results
18	Medline	(14 AND 17)	1
19	EMBASE	(((((mother* OR father* OR mum* OR dad* OR parent* OR carer* OR famil*) AND (infant* OR baby OR babies OR new*born OR neonat*)) AND (bonding OR attachment OR psycholog* OR stress* OR distress* OR experienc* OR perception*)) AND ("patient transfer*" OR "inter*hospital transfer*" OR "patient transport*")).ti,ab	8
20	EMBASE	"TRANSPORTATION OF PATIENTS"/	28 256
21	EMBASE	exp "PATIENT TRANSPORT"/	30 438
22	EMBASE	(((((mother* OR father* OR mum* OR dad* OR parent* OR carer* OR famil*) AND (infant* OR baby OR babies OR new*born OR neonat*)) AND (bonding OR attachment OR psycholog* OR stress* OR distress* OR experienc* OR perception*))).ti,ab	45 797
23	EMBASE	(20 OR 21)	30 439
24	EMBASE	(22 AND 23)	134
25	EMBASE	24 [Exclude medline journals]	14
26	EMBASE	24 [Exclude medline journals] [Publication types Journal] [English language]	13
27	EMCARE	(((((mother* OR father* OR mum* OR dad* OR parent* OR carer* OR famil*) AND (infant* OR baby OR babies OR new*born OR neonat*)) AND (bonding OR attachment OR psycholog* OR stress* OR distress* OR experienc* OR perception*)) AND ("patient transfer*" OR "inter*hospital transfer*" OR "patient transport*")).ti,ab	3
28	EMCARE	exp "PATIENT TRANSPORT"/	13 186
29	EMCARE	(((((mother* OR father* OR mum* OR dad* OR parent* OR carer* OR famil*) AND (infant* OR baby OR babies OR new*born OR neonat*)) AND (bonding OR attachment OR psycholog* OR stress* OR distress* OR experienc* OR perception*))).ti,ab	18 471
30	EMCARE	(28 AND 29)	54
31	EMCARE	30 [Publication types Article] [English language]	48

**TABLE A3** Additional alternative search terms (*italics*) and MeSH terms (CAPITALS) used by LM in various combinations.

Database	"Parents"	"Neonate"	"Transport"	"Intervention/support"
CINAHL	PARENTS	<i>neonat*</i>	TRANSPORTATION OF PATIENTS	SUPPORT, PSYCHOSOCIAL, <i>intervention*</i>
EMBASE			PATIENT TRANSPORT	
Medline	PARENTS	<i>neonat*</i>	TRANSPORTATION OF PATIENTS	PSYCHOSOCIAL SUPPORT SYSTEMS, <i>intervention*</i>
PsycINFO	PARENTS		AIR TRANSPORTATION, GROUND TRANSPORTATION	EMOTIONAL SUPPORT, SOCIAL SUPPORT

**TABLE A4** Number of records identified by EH and LM per database.

Database	EH search	LM search	Total (EH + LM before deduplication)
CINAHL	41	54	95
EMBASE	13	415	428
EMCARE	48	Not searched (searched Scopus instead which was found not to index relevant literature)	48
Medline	1	50	51
PsycINFO	1	93	94
Web of Science	Not searched	122	122
Total	104	734	838