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The effectiveness of neonatal early supported transfer to home interventions for parents and preterm infants in neonatal intensive care units: A systematic review and meta-analysis

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ABSTRACT

Background: Preterm infants often need admission to a neonatal unit causing prolonged stress for parents. Evidence has shown that neonatal early supported transfer to home interventions may reduce stress levels. This systematic review investigates effectiveness of neonatal early supported transfer to home interventions for parents and preterm infants in neonatal intensive care units.
Methods: Six databases and two trials registries were searched from inception to February 2022. Risk of bias was assessed using the RoB2 and ROBINS I tool.
Results: Ten studies were included. Neonatal early supported transfer to home interventions reduced duration of hospital stay by up to 11 days compared to usual care, without significantly increasing hospital re-admission rates (p= >0.05). Studies were judged to have moderate to serious risk of bias.
Conclusions: The findings indicate that early supported transfer to home interventions may reduce hospital stay with no evidence of difference in hospital admission rates, infants weight gain or breastfeeding rates (compared to standard care). However, due to the dearth of high-quality evidence it is not possible to make recommendations for implementation.

1. Background

In the United Kingdom, over 38,000 preterm infants (less than 37 weeks' gestation age) are cared for in Neonatal Intensive Care Units (NICU) each year (NDAU, 2017). The average length of hospital stays for preterm infants ranges from 13 to 88 days, dependant on gestational age and individual care needs (Zainal et al., 2019, Seaton et al., 2019). Preterm infants in NICU are often high risk and need careful monitoring, causing prolonged stress for parents (Williams et al., 2018). Parental stress linked with stays in NICU is associated with factors such as the perceived vulnerability of the infant, the medical status of the infant, the medicalised and overwhelming experience of the NICU environment, and the increase in responsibility associated with transitioning into parenthood (Shandra Bos et al., 2018; Enke et al., 2017). Parental stress is intensified by prolonged separation from their infants, which also leads to frequent misunderstandings of behavioural cues, adversely affecting the long-term parent-infant relationship (Craig et al., 2015; Mehler et al., 2011).

Evidence has shown that early educational, behavioural, and psychological support interventions for parents of preterm infants admitted to NICU, may reduce stress levels, and promote healthier parent-infant relationships (Gooding et al., 2011; Melnyk et al., 2006). Neonatal early supported transfer to home interventions allows parents and preterm infants to be discharged home at an earlier date than standard care would permit, allowing them to continue their progress at home (Whittaker et al., 2020). This is key given that earlier discharge from

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NICU to home has frequently been highlighted as a principal desire of many parents (Melnyk et al., 2006; Treherne et al., 2017). Previously, these interventions have typically involved early discharge support for parents including pre-discharge planning, education, equipment at home, and home visits from clinicians (Whittaker et al., 2020).

To facilitate early supported transfer to home interventions, a family centred care approach has been recommended which incorporates confidence and competence building with parents, empowering them to be more involved as the carers for their infant (Waddington et al., 2021). In England, there is some exploratory evidence that a strategic family centred approach has gone some way to reducing harm (e.g., nosocomial infection rates, re-hospitalisation rates) for early preterm infants (<31 weeks gestation). However, a greater focus is now needed for late or moderately preterm infants (>32 week gestation) to keep the mother-infant dyad together (Waddington et al., 2021).

Family integrated care strategies recognise that whilst they may keep babies with their carer, they are still in hospital which may increase anxiety on parents, and cost to healthcare services (O'brien, 2021). The implementation of early supported transfer to home interventions is particularly challenging within existing NHS Trusts in the UK as there are no funding arrangements for continuation of care in the community or home-based setting (once discharge from hospital), which is where most parents of late preterm babies would wish to be (Aagaard and Hall, 2008). In most National Health Service Trusts in the UK, there is reduced funding for continuation of care once pre-term infants have transferred from acute services (NICU) into the community outreach services (neonatal outreach teams) (Boykova and Kenner, 2012). There is a need for a paradigm shift to recognise these funding challenges, understanding that a transition of care setting may be as feasible when compared to early discharge with continuation of care in the community (Bembich et al., 2021). This concept of a transition of care setting is the basis of a recent neonatal early supported transfer to home (NEST@Home) approach (Richards et al., 2021). This approach to the implementation of early supported transfer (or discharge) to home interventions has yet to be extensively evaluated for its effectiveness in clinical practise (Patel et al., 2018; Mazur et al., 2021).

Although there is some exploratory literature, it is not yet known if early supported transfer to home interventions are clinically effective or cost efficient for health services. Specifically, research has yet to synthesise the clinical effectiveness for these interventions, balanced against less desirable outcomes such as post-discharge parental stress, parental well-being, and hospital re-admissions (Ingram et al., 2018). This review will focus on assessing the evidence of neonatal early supported transfer to home interventions or what has previously been termed as 'early supported discharge' for parents with preterm infants in NICU (Ingram et al., 2018).

2. Methods

2.1. Study design

The study followed a systematic review design (Ranganathan and Aggarwal, 2020). The study has been reported in accordance with the preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews guidelines (PRISMA-ScR). A protocol was registered on PROSPERO (registration number: CRD42022309797), the International prospective register of systematic reviews (Booth et al., 2011).

2.2. Study selection

Six databases were searched to identify relevant articles: Cochrane Central Register of Controlled Trials (CENTRAL), World Health Organization International Clinical Trials Registry Platform, EMBASE, Medline, CINAHL and PsychInfo (see Table 1 for example search strategy). We searched all databases and trials registries from inception to February 2022. A search of clinical trials was also conducted through the Cochrane Airways Trials Register and the CENTRAL database. We checked the reference lists of all primary studies and review articles for additional studies.

Table 1
Ovid MEDLINE® search strategy.

Database: Ovid MEDLINE(R) and Epub Ahead of Print, In-Process, In-Data-Review & Other Non-Indexed Citations and Daily <1946 to January 14, 2022>
1 family/or exp parents/(204203)
2 (Parent* or family or families or mother* or father* or mum* or dad* or maternal or paternal).tw. (1992855)
3. 1 or 2 (2036720)
4. Exp Infant, Premature/(60862)
5. Intensive Care, Neonatal/(6009)
6. Intensive Care Units, Neonatal/(16714)
7. ((Prematur* or pre-matur* or preterm or pre-term) adj1 (infant* or baby or babies or newborn* or neonate* or child*)).tw. (60728)
8. (Neonatal adj3 (care or unit* or ward* or hospital*)).tw. (31842)
9. (prematuritas or very low birth weight or vlbw).tw. (8868)
10. (Neonatal intensive care or nicu).tw. (26598)
11. or/4–10 (118224)
12. Health Education/(62577)
13. Patient Education as Topic/(87797)
14. (Educat* or train* or taught or teach* or support* or program* or resource* or package or bundle or intervention* or psychoeducation* or psychosocial).tw. (4578477)
15. Education.fs. (292897)
16. or/12–15 (4736581)
17. Patient Discharge/or Transitional Care/(35875)
18. (discharge or transition*).ti,ab,kw,kf. (672694)
19. 17 or 18 (682529)
20. 3 and 11 and 16 and 19 (1895)

Two reviewers independently screened the titles and abstracts of the search results for relevant studies. Following the initial screening, two reviewers screened the full texts of all potentially eligible studies.

2.3. Data extraction

Three reviewers independently extracted data from the included studies after pre-planning and piloting the data extract form. A fourth reviewer checked the data extractions. Any disagreements were resolved through discussion with a fifth reviewer.

Randomised controlled trials (RCT's), non-randomised intervention studies and observational studies (comparative and prospective) were included. We included studies reported in full text and those published only as an abstract. We included studies of parents or primary caregivers of preterm infants (as described by study authors or less than 37 weeks' gestation) who had been involved in early supported transfer interventions involving early discharge planning, education or training (of any form as defined below). We excluded studies that were not available in English, and those without a comparator/control group.

Neonatal Early Supported Transfer in the context of this review referred to any intervention (education, training, planning etc.) which allowed a parent and preterm infants to be discharged home at an earlier date than standard care would permit, allowing them to continue their progress at home (Whittaker et al., 2020). Neonatal Early Supported Transfer differs from usual care in supporting babies to achieve recognised stages in their development (e.g., feeding without the help of a nasogastric tube) at home rather than hospital, allowing early discharge (Whittaker et al., 2020). Neonatal Early Supported Transfer is often supported by a neonatal multidisciplinary team and typically involves written, verbal, multi-media, technological (e.g., mobile applications) or active demonstration components delivered face-to-face or remotely (Whittaker et al., 2020).

We included studies of parental support interventions for parents of preterm infants in NICU's with control groups of usual care and comparisons between different types of early discharge support, education and training (e.g., printed instructions only versus printed instructions plus face-to-face training; physical demonstrations virtually versus physical demonstrations face to face) or comparisons between different methods of delivering education and training (e.g., group versus individual education or training). Usual, standard, or routine care referred to the support parents would normally receive from their NICU and healthcare provider which may include advice on parenting in accordance with the national or international guidelines, medication adherence and support (e.g., breastfeeding), but not specifically about the early supported transfer to home intervention.

We analysed seven outcomes in this review. The primary outcomes were duration of NICU (hospital) stay and hospital re-admission. The secondary outcomes were parental stress, parental well-being, parental confidence, infant weight gain and breastfeeding. A selection of clinician rated, and patient rated outcomes were chosen through consultation with a team of neonatal clinicians and parents of preterm infants who had experienced NICU care.

2.4. Data synthesis and analysis

We summarised the included studies narratively and, where data was available, we synthesised data with meta-analysis using a random effects model (Jamovi software, version 2.3.13). Where meta-analysis was not feasible or appropriate, we synthesised, prioritised, and ordered data by employing the guidelines of the Synthesis WIthout Meta-analysis in systematic reviews (SWiM) (Campbell et al., 2020).

2.5. Risk of bias of included studies

Two reviewers independently assessed the risk of bias for the included studies. A third reviewer verified the assessments. The risk of bias of included RCTs was appraised at study level using the Cochrane risk-of-bias 2 tool for randomized trials (RoB2). The risk of bias in non-randomised studies was assessed using the Risk Of Bias In Non-randomized Studies of Interventions (ROBINS-I) tool (Sterne et al., 2016). We reached overall judgement for each specific outcome for the included studies according to the individual tools criteria (e.g., low/-poor risk of bias, some concerns/moderate/fair, high/serious risk of bias) (see Table 2 for risk of bias assessments) (Higgins et al., 2011; Sterne et al., 2016) (see Tables 3 and 4).

3. Results

After removal of duplicates, 4227 citations were identified. Of these, 42 full texts were retrieved and assessed for inclusion. Following screening, 31 articles were excluded: 11 with incorrect study design, eight focused on the wrong intervention, four were protocols, six included the wrong population and two did not report any outcomes of interest. In total, 12 papers reporting 10 studies were included in the analysis of this review. Fig. 1 shows the Prisma flow diagram (see Figs. 2, 3 and 4).

3.1. Characteristics of included studies

The total number of participants across all 10 studies was 12821 (see study characteristics in Table 2). There were substantially higher numbers of participants receiving the control (routine care) compared to those receiving the intervention. The mean age of preterm infants in the studies ranges from 24 to 36 weeks (Esque Ruiz et al., 2012; Ingram et al., 2018). The year of publication ranged from 1995 to 2019, with seven studies published on, or after 2008 (Mannix et al., 2019; Kotagal et al., 1995; Van Kampen et al., 2019; Alvarez Miro et al., 2013; Esque Ruiz et al., 2012; Ortenstrand et al., 2001; Gunn et al., 2000; Saenz, 2007; Toral-Lopez et al., 2016). Studies were conducted in seven countries: four in Spain (Alvarez Miro et al., 2013; Esque Ruiz et al., 2012; Saenz, 2007; Toral-Lopez et al., 2016), one in New Zealand (Gunn et al., 2000), one in Australia (Mannix et al., 2019), one in the Netherlands (Mannix et al., 2019), one in England (Ingram et al., 2018), one in Sweden (Ortenstrand et al., 2001), and one in the United States of America (Kotagal et al., 1995). All studies were conducted in hospital settings and ranged in duration from 12 months to 12 years (Alvarez Miro et al., 2013; Saenz, 2007). Across the studies, follow up ranges from 8 days to 12 months (Ortenstrand et al., 2001, Alvarez Miro et al., 2013). Of the 10 studies, five were non-randomised observational studies (Kotagal et al., 1995; Alvarez Miro et al., 2013; Esque Ruiz et al., 2012; Mannix et al., 2019; Ingram et al., 2018), three were non-randomised intervention studies (Ortenstrand et al., 2001; Toral-Lopez et al., 2016, Van Kampen et al., 2019) and two were randomised controlled trials interventions (Gunn et al., 2000; Saenz, 2007).

3.2. Intervention components

Early supported transfer to home interventions of pre-term infants varied across all studies but typically aimed to reduce the length of hospital stay, improve parents' preparedness to take their infant home and teach parents about caretaking of their child (whilst providing adequate out of hours home support). Interventions were delivered by specialist neonatology nurses (Alvarez Miro et al., 2013; Ortenstrand et al., 2001), home-care nurses (Ortenstrand et al., 2001; Ingram et al., 2018; Kotagal et al., 1995), research nurses (Gunn et al., 2000), primary care paediatricians (Alvarez Miro et al., 2013), nursing specialist programme managers (Alvarez Miro et al., 2013; Esque Ruiz et al., 2012; Gunn et al., 2000; Kotagal et al., 1995) or members of the outreach team (Alvarez Miro et al., 2013; Esque Ruiz et al., 2012; Toral-Lopez et al., 2016; Saenz, 2007, Van Kampen et al., 2019).

Across the studies, interventions had several components such as home visits, educational sessions and support which varied in frequency/intensity (see Supplementary Table 1). The most common component within the interventions were home visits which featured in seven studies (Van Kampen et al., 2019, Toral-Lopez et al., 2016; Ortenstrand et al., 2001; Kotagal et al., 1995; Gunn et al., 2000, Esque Ruiz et al., 2012, Alvarez Miro et al., 2013). Home visits were conducted at least weekly in all seven studies and in addition, conducted daily (for the first week) following discharge in two studies (Gunn et al., 2000; Kotagal et al., 1995). The mean number of home visits was reported in three studies ranging between 3.35 and 5.9 per infant (Esque Ruiz et al., 2012; Ortenstrand et al., 2001, Van Kampen et al., 2019). Two studies indicated that home visits lasted on average between 28 and 47 min in length (Esque Ruiz et al., 2012; Van Kampen et al., 2019). Six of the 10 interventions studies included parental educational sessions that provided information and training on breastfeeding, kangaroo care (method of holding an infant involving skin-to-skin contact), preparation for discharge and arrival at home (Alvarez Miro et al., 2013, Esque Ruiz et al., 2012, Ortenstrand et al., 2001, Toral-Lopez et al., 2016, Van Kampen et al., 2019, Ingram et al., 2018). It was unclear how many education sessions parents received but the emphasis of the sessions was largely on pre-discharge planning and preparedness for the transfer home (Van Kampen et al., 2019). Two studies also provided parents with takeaway information (i.e. leaflets) on feeding, growth, temperature and sleeping (Alvarez Miro et al., 2013; Ingram et al., 2018). Of the 10 intervention studies, six included 24-h telephone support where parents had a direct line to a healthcare professional (13, 15, 25, 27, 29, 30). One study increased parental visits to the NICU prior to discharge (Kotagal et al., 1995).

Five intervention studies provided guidance as part of the interventions which recommended that infants not be discharged until they reached a body weight of at least 750g (Alvarez Miro et al., 2013). Most studies recommended a body weight discharge range between 1.6 and 2.5 kg (Alvarez Miro et al., 2013; Mannix et al., 2019; Saenz, 2007). That said, weight was not always used as a criterion for discharge but instead an infant was judged to be eligible by a senior clinician (Kotagal et al., 1995).

Most studies did not provide details relating to the duration of the

Table 2
Study characteristics.

Study	Study design	Study setting	Participants (*n*)		Age (mean/median) *(GA weeks)*		With-drawals	Outcomes reported	Follow-up	Overall risk of bias
Author			Intervention	Control	Intervention (weeks)	Control (weeks)	n%			
Alvarez-Miro 2013/ Carbonell-Estrany, 2015	Non-randomised comparative case—control (1:1) study	Hospital to home	Infants –65	Infants - 65	Infants median - 32 (31–33)	Infants median - 32 (30–33)	NR	➢ Duration of hospital stay ➢ Corticosteroid therapy ➢ Ruptured membrane (hours) ➢ Caesarean section ➢ Apgar 1 min ➢ Umbilical artery pH ➢ Intrauterine growth restriction (weight) ➢ Breastfeeding ➢ % Gavage feeding ➢ % Baby formula (Eoprotin®) ➢ % Breastfeeding ➢ General appearance (poor, bad) ➢ Sleep (poor, bad) ➢ Little or absent urination ➢ Few or absent bowel movements ➢ Hypothermia ➢ Infections: Diarrhoea ➢ Rhinitis ➢ Conjunctivitis ➢ Regurgitation or vomiting ➢ Choking or cyanotic spell ➢ Medications ➢ Emergency room and/or paediatrician visits ➢ Total number of children with infections	Day 9 in cases and day 8 in controls (weight)	Serious
Esque et al., 2012	Non randomised observational study	Hospital to home	Infants - 1034	Infants - 9092	Infants median 32.6 (2.34) (IQR:31–34)		NR	➢ Duration of hospital stay ➢ Hospital re-admission ➢ Weight gain ➢ Number of nurse visits at home ➢ Emergency visits ➢ Morbidity ➢ Days of iontotherapy ➢ Continuous positive airway pressure (days) ➢ Mechanical ventilation (days) ➢ Antibiotics (days) ➢ Parenteral nutrition ➢ Days of stay in NICU ➢ Total length of stay (days) ➢ Weeks of postmenstrual conceptional age	2 months (hospital re-admission)	Moderate
Gunn et al. (2000)	Randomised control trial	Hospital to home	Infants –148 Parents – N/R	Infants –160 Parents – N/R	Infants mean - 33.22		122 mothers declined the ED	➢ Duration of hospital stay ➢ Hospital re-admission ➢ Parental stress ➢ Breastfeeding %	6 weeks and 6 months	Some concerns

(*continued on next page*)

Table 2 (*continued*)

Study	Study design	Study setting	Participants (*n*)		Age (mean/median) *(GA weeks)*		With-drawals	Outcomes reported	Follow-up	Overall risk of bias
Author			Intervention	Control	Intervention (weeks)	Control (weeks)	n%			
								➢ Bottle feed % ➢ Breastfeeding “successful” (6 months) % ➢ Weight at discharge (g) ➢ Weight 6 week after discharge (g) ➢ Weight gain (g/kg/d) ➢ Suckle-feeding (hospital days)		
Ingram et al., 2018	Non-randomised before and after comparative study	Hospital to home	Infants – 117 Parents - 110	Infants – 128 Parents - 121	Infants Median 30.5 (5.7) Parents –N/R	Infants Median 29.7 (5.6) Parents – N/R	1 in intervention; 1 in control group	➢ Duration of hospital stay ➢ Hospital re-admission ➢ Parental stress ➢ Parental confidence ➢ Admission to NICU ➢ Cardiorespiratory conditions ➢ Infections ➢ Metabolic, endocrine, nutritional, gastroenterological ➢ Neurological ➢ Feeding at discharge ➢ Breastfeeding % ➢ Bottle feeding % ➢ Tube feeding % ➢ Feeding at 8 weeks ➢ Maternal Perceived Maternal Parenting Self-Efficacy (base-line, discharge, home)	6 weeks and 6 months	Moderate
Kotagal et al., 1995	Non randomised observational study	Hospital to home	Infants - 477	Infants - 257	Infants mean - 34.7 (4.1)	Infants mean - 34.7 (3.9)	NR	➢ Duration of hospital stay ➢ Hospital re-admission ➢ Total live discharges ➢ Discharges to all other nurseries (including term) ➢ Discharges to other level KI nurseries ➢ Discharges to other level II nurseries ➢ Discharges to home alive ➢ Special care markers Infants with mechanically ventilated lungs (No.) ➢ Ventilator days ➢ Patients receiving oxygen therapy ➢ Oxygen therapy days ➢ Patients with umbilical catheters ➢ Emergency department visits ➢ Cost of early-discharge program	14 days 30 days 7 months	Serious

(*continued on next page*)

Table 2 (*continued*)

Study	Study design	Study setting	Participants (*n*)		Age (mean/median) *(GA weeks)*		With-drawals	Outcomes reported	Follow-up	Overall risk of bias
Author			Intervention	Control	Intervention (weeks)	Control (weeks)	n%			
Mannix et al., 2019	Non-randomised observational study	Hospital to home	Infants - 31	Infants - 37	NR	NR	NR	➢ Duration of hospital stay ➢ Hospital re-admission ➢ Babies discharged to NED ➢ Cost of babies discharged (mean) ➢ Babies/per annum discharged to NED ➢ Inpatient's cost ➢ Total NED expenditure (years) ➢ Cost saving (per annum)	NR	Serious
Ortenstrand et al., 1999, 2001	Non-randomised intervention study	Hospital to home	Infants - 45 Parents – 74	Infants - 43 Parents - 65	Infants mean - 31.4 (2.9) Parents - NR	Infants mean - 32.0 (2.3) Parents –NR	8 families in intervention; 5 in control group	➢ Duration of hospital stay ➢ Hospital re-admission ➢ Parental well-being ➢ Visits to the neonatal ward (n) ➢ Telephone calls (n) ➢ In-hospital care (d) ➢ Domiciliary nursing program (d) ➢ Bronchopulmonary dysplasia ➢Morbus Down ➢Patent ductus arteriosus ➢ Perinatal asphyxia ➢ Peri- or intraventricular haemorrhage ➢ Reasons for hospital readmission ➢ Antibiotics, intravenous ➢ Antibiotics, peroral ➢ Antibiotics, topical ➢ Nose decongestant ➢ Surgery ➢ Cryotherapy of retinopathy of prematurity ➢ Inguinal hernia, operation ➢ Weight gain/d (g)	Depletion of domiciliary care post-conceptional 38.6 week 1 year	Serious
Saenz, 2007	Randomised control trial	Hospital to home	Infants - 84 Parents - 94	Infants - 72 Parents - 77	Infants mean - 33 (30–35) Parents 32.2 (years)	Infants mean - 32 (29–35) Parents - 30.6 (years	NR	➢ Duration of hospital stay ➢ Hospital re-admission ➢ Parental wellbeing ➢ Admission to the NICU (%) ➢ Neonatal length of stay (days)* ➢ Discharge weight (g) ➢ Discharge height (cm) ➢ Discharge head circumference (cm)	3 months	Some concerns
Toral-lopaz et al., 2016	Non-randomised control trial	Hospital to home	Infants - 46	Infants - 40	NR	NR	NR	➢ Duration of hospital stay ➢ Number of people involved in care ➢ Medical diagnosis ➢ Apgar test	NR (scores on admittance and on discharge)	Moderate

(*continued on next page*)

Table 2 (*continued*)

Study	Study design	Study setting	Participants (*n*)		Age (mean/median) *(GA weeks)*		With-drawals	Outcomes reported	Follow-up	Overall risk of bias
Author			Intervention	Control	Intervention (weeks)	Control (weeks)	n%			
								➢ Neonatal complications ➢ Maternal complications ➢ Number of days mother stays in hospital ➢ Number of days stay in breastfeeding mothers' Units ➢ Number of days stay in hospital of new-born ➢ Number of days stay of new-born in ICU ➢ Number of months fed with only breast milk ➢ NOC 1819 Knowledge: infant care score ➢ NOC 1800 Knowledge: breast-feeding score ➢ NOC 1806 Knowledge: health resources score ➢ NOC 1500 Parent-infant attachment score ➢ NOC 1504 Social support score ➢ NOC 1305 Psychosocial adjustment: life changes score		
Van Kampen et al., 2019	Non-randomised intervention study	Hospital to home	Infants - 113	Infants - 103	Infants mean - 32.6 (2.8)	Infants mean - 32.7 (2.5)	NR	➢ Duration of hospital stay ➢ Hospital re-admission ➢ Parental satisfaction with the procedure ➢ Breastfeeding	4 and 12 weeks	Moderate

Table 3
Risk of Bias In Non-randomized Studies of Interventions assessment.

	Domain 1 (Confounding)	Domain 2 (Selection)	Domain 3 (Classification)	Domain 4 (Deviation)	Domain 5 (Missing data)	Domain 6 (Outcomes)	Domain 7 (Reporting)	Overall risk of bias judgement
Alvarez-Miro/ Carbonell et al, 2013. (Alvarez Miro et al., 2013)	-	-	+	+	+	+	+	Serious
Esque et al, 2012. (Esque Ruiz et al., 2012)	-	+	+	?	+	+	+	Moderate
Ingram et al, 2018. (Ingram et al., 2018)	+	-	+	+	+	+	+	Moderate
Kotagal et al, 1995. (Kotagal et al., 1995)	-	-	+	+	+	+	+	Serious
Mannix et al, 2019. (Mannix et al., 2019)	?	-	-	+	-	+	+	Serious
Ortenstrand et al, 2001. (Ortenstrand et al., 2001)	-	+	-	?	-	+	+	Serious
Toral-lopaz et al, 2016. (Toral-Lopez et al., 2016)	-	+	+	+	+	+	+	Moderate
van Kampen et al, 2018. (van Kampen et al., 2019)	-	+	+	+	+	+	-	Moderate

*- moderate or serious risk, + low risk, ? unclear.

Table 4
Risk of Bias 2 for RCT's assessment (Ortenstrand et al., 2001).

	Domain 1 (Random sequence)	Domain 2 (Blinding)	Domain 3 (Outcome data)	Domain 4 (Outcome measures)	Domain 5 (Reporting)	Overall risk of bias judgement
Gunn et al, 2000. (Gunn et al., 2000)	+	-	+	+	+	Some concerns
Saenz et al, 2008. (Saenz, 2007)	-	-	+	+	+	Some concerns

* - Some concerns of risk, + low risk, ? unclear.

intervention, but three indicated a range from three to 11 months (Ingram et al., 2018; Kotagal et al., 1995; Saenz, 2007). The comparator (control) group of each study involved usual neonatal intensive care with standard discharge times (not described in detail by any study).

4. Methodological quality of included studies

The 10 studies included in this review were judged to have moderate to serious concerns of bias (Van Kampen et al., 2019, Toral-Lopez et al., 2016, Saenz, 2007, Ortenstrand et al., 2001, Mannix et al., 2019, Kotagal et al., 1995, Gunn et al., 2000, Esque Ruiz et al., 2012, Alvarez Miro et al., 2013, Ingram et al., 2018). The risk of bias in the two RCT's were judged to be of some concerns (Gunn et al., 2000; Saenz, 2007). The risk of bias in four non-RCT studies was judged to be moderate (Esque Ruiz et al., 2012; Ingram et al., 2018; Toral-Lopez et al., 2016, Van Kampen et al., 2019), whilst the other four non-RCT studies were judged to be serious (seen in table three and four) (Alvarez Miro et al., 2013, Mannix et al., 2019; Kotagal et al., 1995; Ortenstrand et al., 2001). Largely, less rigorous study designs (e.g., non-randomised observational study) were associated with a higher risk of bias (Mannix et al., 2019; Ortenstrand et al., 2001).

The methods of measuring the outcomes were appropriate in all studies with low risk of measurement or detection bias. The outcomes were reported according to those detailed in the protocol or methods in 90% of the included studies (Alvarez Miro et al., 2013, Esque Ruiz et al., 2012, Ingram et al., 2018; Kotagal et al., 1995; Mannix et al., 2019; Ortenstrand et al., 2001; Toral-Lopez et al., 2016; Gunn et al., 2000; Saenz, 2007). Eight studies had low risk of bias regarding missing data as they reported low attrition rates or used appropriate methods to impute missing data (Alvarez Miro et al., 2013, Esque Ruiz et al., 2012, Ingram et al., 2018, Kotagal et al., 1995, Toral-Lopez et al., 2016, Van Kampen et al., 2019, Gunn et al., 2000, Saenz, 2007). There was little to no reporting bias (outcomes), and the risk of bias in selection of the reported result was low in all but one study (Van Kampen et al., 2019). Blinding and selection bias was a risk in 60% of included studies as parents or staff were not blinded and confounding differences were observed between intervention and control groups (Alvarez Miro et al., 2013, Ingram et al., 2018; Kotagal et al., 1995; Mannix et al., 2019;

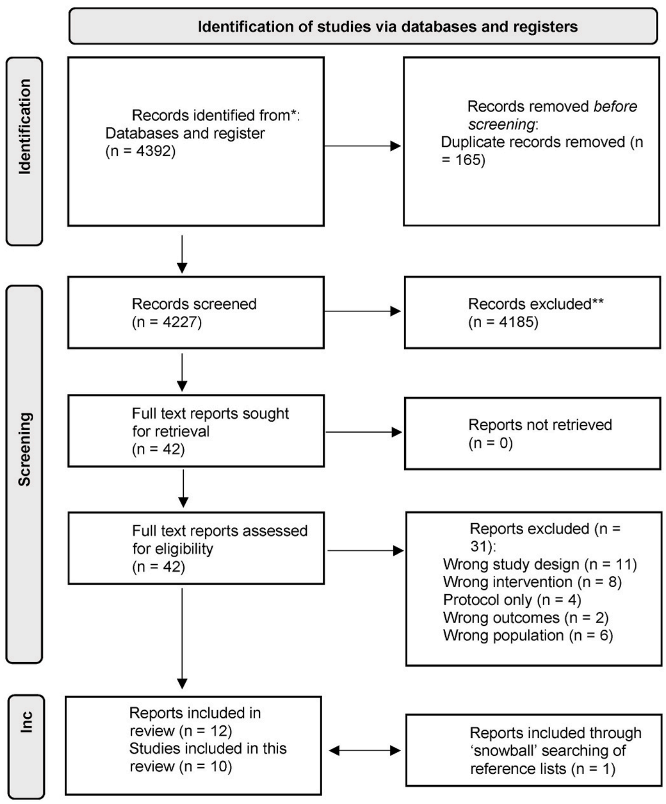

Fig. 1. Prisma Flow diagram.

Gunn et al., 2000; Saenz, 2007). Allocation bias was a risk in most studies due to a lack of randomisation and the absence of description relating to the concealment process of treatment allocation (Alvarez Miro et al., 2013, Ingram et al., 2018; Kotagal et al., 1995; Mannix et al., 2019; Gunn et al., 2000; Saenz, 2007).

4.1. *Primary outcome 1 – duration of hospital stay*

All 10 studies reported on duration of hospital stay (Van Kampen et al., 2019, Toral-Lopez et al., 2016, Saenz, 2007, Ortenstrand et al., 2001, Mannix et al., 2019, Kotagal et al., 1995, Gunn et al., 2000, Esque Ruiz et al., 2012, Alvarez Miro et al., 2013, Ingram et al., 2018). Nine of the 10 studies indicated that early supported transfer to home interventions reduced duration of hospital stay for pre-term infants under 37 weeks gestational age (Van Kampen et al., 2019, Toral-Lopez et al., 2016; Saenz, 2007; Ortenstrand et al., 2001; Mannix et al., 2019; Kotagal et al., 1995; Gunn et al., 2000, Esque Ruiz et al., 2012, Alvarez Miro et al., 2013). A meta-analysis of four studies (n = 1038) showed that early supported transfer home enabled pre-term infants to be discharged 10.4 days (95% CI -13.8; −7.1, P = < 0.001, RoB = Non-RCT: three serious & one moderate) earlier compared to those receiving standard care (Alvarez Miro et al., 2013, Kotagal et al., 1995; Ortenstrand et al., 2001; Toral-Lopez et al., 2016). There was no evidence of heterogeneity between the four studies (P = 0.602) (figure two).

Out of the six studies which could not be meta-analysed, four studies reported duration of hospital stay comparing median days between intervention and control groups and two described any differences narratively (Table 5) (Saenz, 2007; Van Kampen et al., 2019; Toral-Lopez et al., 2016; Ingram et al., 2018). Two of the four studies showed that early supported transfer to home enabled pre-term infants to be discharged 10.5 median days (p = <0.001) and 6 median days (p

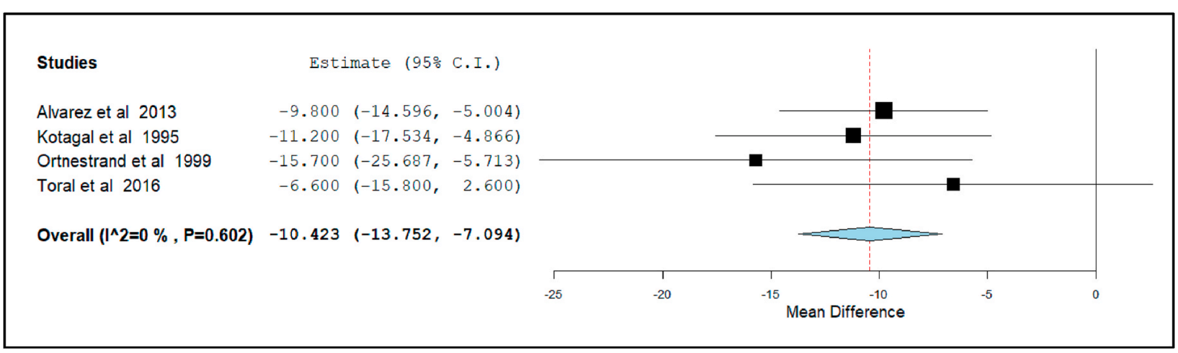

Fig. 2. Mean difference of duration of hospital stay of comparable studies.

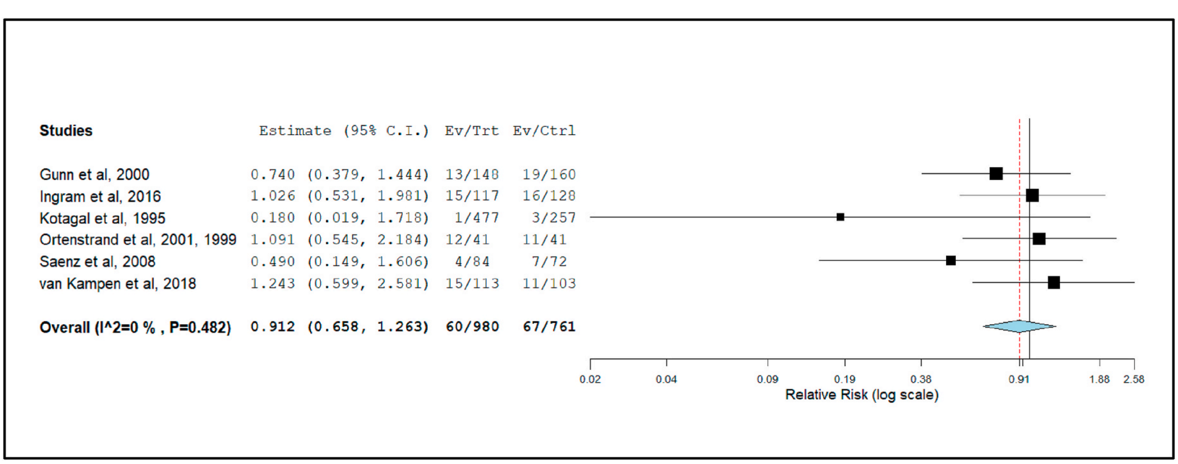

Fig. 3. Relative Risk of hospital re-admissions rates.

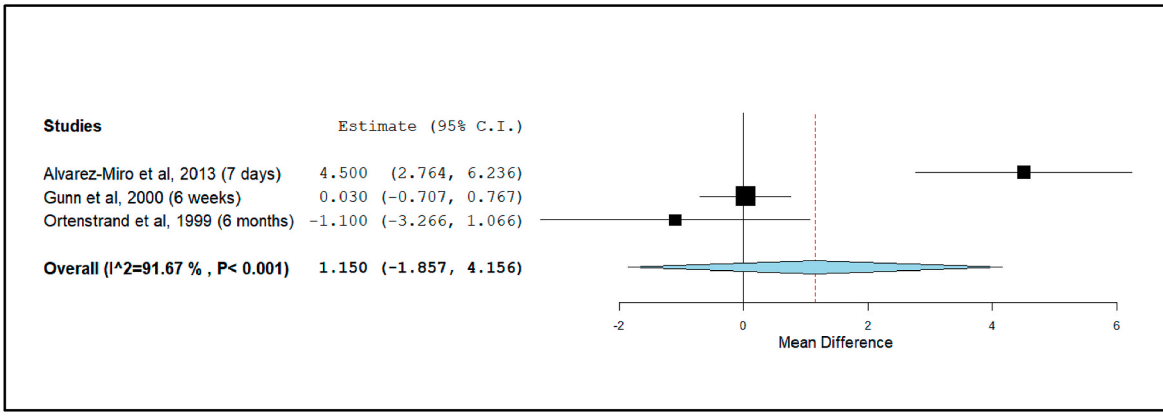

Fig. 4. Mean difference of infant weight gain of comparable studies.

Table 5
Primary outcome - Duration of hospital stay.

Study	Intervention		Control		p value
	Mean days (SD)/Median (IQR)	*n*	Mean days (SD)/Median (IQR)	*n*	
[a]Alvarez Miro et al., 2013; Carbonell-Estrany, 2015	Mean 23.5 (13.8)	65	Mean 33.3 (14.1)	65	0.001
Esque Ruiz et al., 2012	Total length of stay always shorter in ED group	1034	Total length of stay always shorter in ED group	9092	NR
Gunn et al., 2000 (After full oral feeding)	Mean 2.7	148	Mean 4.4	160	NR
Ingram et al., 2018	Median 32 (IQR 20–46)	128	Median 28 (IQR 19.5–43.5)	117	0.32
[a] Kotagal et al., 1995	Mean 40.6 (37.7)	477	Mean 51.8 (43.8)	257	NR
Mannix et al., 2019	Mean reduction in length of stay was 11 days	31	NR	37	NR
[a] Ortenstrand et al., 2001	Mean 30.6 (24.4)	45	Mean 46.3 (23.4)	43	<0.01.
Saenz, 2007	Median 15.5 (95% centiles, 6.0–47.5)	84	Median 26 (95% centiles, 11.6–57.2)	72	0.001
[a] Toral-lopaz et al., 2016	Mean 25.9 (21.1)	46	Mean 32.5 (22.23)	40	>0.05
Van Kampen et al., 2019					
24–29 weeks GA	Median 9 (range 3–27)	16	Median 15 (range 5–53)	20	<0.001
30–33 weeks GA	Median 33 (range 9–83)	49	Median 27 (range 15–67)	37	0.46
34-35 weeks GA	Median 93 (range 47–126)	48	Median 63 (range 47–142)	46	0.11

[a] Included in meta-analysis, IQR= Inter-Quartile Range, ED = Early Discharge, SD= Standard Deviation, n = frequency, NR= Not Reported.

= not reported) earlier than those receiving standard care, respectively (Saenz, 2007, Van Kampen et al., 2019) (RoB = RCT: one some concerns, Non-RCT: one serious).

One study (n = 245) indicated that standard care enabled pre-term infants to be discharged a median of 4 days earlier compared to intervention group (Ingram et al., 2018) (RoB = non-RCT: one serious). However, this difference was not statistically significant between groups (P = 0.32). One further study (n = 182) indicated that standard care enabled pre-term infants aged 30–33 and 34–35 weeks to be discharged earlier compared to early supported discharge, but this difference was not statistically significant (Van Kampen et al., 2019) (RoB = non-RCT: one moderate).

Two studies descriptively reported differences in duration of hospital stay between intervention and control groups (Esque Ruiz et al., 2012; Mannix et al., 2019) (RoB = non-RCT: one serious & one moderate). One study reported earlier discharge of 11 days, whilst another study stated that the total length of stay was always shorter in the early supported discharge group (Esque Ruiz et al., 2012; Mannix et al., 2019).

One study (n = 308) indicated that early supported discharge enabled pre-term infants to be discharged on average, 1.7 mean days earlier than those receiving standard care (P= <0.001) (Gunn et al., 2000) (RoB = RCT: one some concerns). This study was not included in the meta-analysis because duration of hospital stay was recorded at the point of full oral feeding and not from infant birth (therefore, not directly comparable with other studies included in this review) (Gunn et al., 2000).

4.2. *Primary outcome 2 – hospital re-admissions*

A total of six studies reported hospital re-admissions as an outcome (Gunn et al., 2000; Kotagal et al., 1995; Ortenstrand et al., 2001; Saenz, 2007; Van Kampen et al., 2019; Ingram et al., 2018). A pooled analysis of six studies (n = 1741) using a random effects model showed that there is no evidence of difference in risk between control and intervention groups related to hospital re-admissions (Table 6) (RR 0.91, 95% CI 0.65–1.26 P = 0.57) (Gunn et al., 2000; Kotagal et al., 1995; Ortenstrand et al., 2001; Saenz, 2007; Van Kampen et al., 2019; Ingram et al., 2018). There was no evidence of heterogeneity across the six studies within the meta-analysis (figure three) (P = 0.482).

4.3. *Secondary outcome 1 – parental stress*

The 10 included studies of this review did not report an outcome of parental stress.

4.4. *Secondary outcome 2 – parental wellbeing*

Two studies (one RCT and one non-randomised intervention study) reported parental wellbeing as an outcome (see Table 7) (Ortenstrand et al., 2001; Saenz, 2007).

Ortenstrand et al. measured trait and state anxiety in mothers and fathers of pre-term infants at the point of hospital discharge and after completion of the early supported discharge programme (RoB = non-RCT: serious). Changes in the severity of anxiety, and well-being were measured using the State-Trait Anxiety Inventory. No statistical

Table 6
Primary outcome - Hospital re-admissions.

Study	Intervention		Control		p value
	Percentage of infants (incidents)	n	Percentage of infants (incidents)	n	
[a] Gunn et al., 2000	8.8% (13)	148	11.9% (19)	160	0.37
6 weeks	20.2% (30)		20.3% (32)		0.96
6 months					
[a] Ingram et al., 2018	12.8% (15)	117	12.5% (16)	128	>0.05
[a] Kotagal et al., 1995	0.4% (1)	477	0.6% (3)	257	<0.01
[a] Ortenstrand et al., 2001	29.2% (12)	41	26.8% (11)	41	1.0
1 year					
[a] Saenz, 2007	4.2% (4)	84	10.3% (7)	72	>0.05
[a] van Kampen et al., 2018. (Van Kampen et al., 2019)	13.2% (15)	113	10.6% (11)	103	0.72

[a] Included in meta-analysis, NR= Not reported, N/A = Not applicable.

differences were observed in Trait anxiety between mothers in the intervention compared to standard care, at discharge or at follow up. However, mothers in the intervention group had significantly lower state anxiety at the time the infants were to be discharged from hospital to home (compared with mothers whose infants remained in standard care control, P= <0.01) (Ortenstrand et al., 2001). Fathers' trait anxiety was also lower in the early supported transfer group compared to standard care, both at discharge and follow up (P= <0.01). State anxiety was lower in fathers in the early transfer to home group but these differences were not significant (P= >0.05) (Ortenstrand et al., 2001). No significant difference in general anxiety, anxiety related to the care of the infant, or mental imbalance were reported between early supported discharge and the standard care groups (both parents at one year, P= >0.05) (Ortenstrand et al., 2001).

Saenz et al. measured anxiety and depression in mothers and fathers of pre-term infants at the point of hospital discharge, and well-being nine weeks following early supported discharge (Saenz, 2007) (RoB = RCT: one some concerns). Changes in the severity of anxiety, depression and well-being were measured using the Hospital Anxiety and Depression Scale (HADS) and the Well-Being Scale (Snaith, 2003). At hospital discharge, mothers' depression scores were significantly lower in the early supported discharge group compared to standard care (P= <0.05). There was no statistically significant difference between the early supported discharge group compared to standard care for depression for fathers, and anxiety for both mothers and fathers at discharge (P= >0.05) (Saenz, 2007). There was no statistically significant difference in well-being scores for combined parents (n = 156) between early supported discharge and the standard care groups at nine weeks post discharge (P= >0.05) (Saenz, 2007).

Table 7
Secondary outcome – Parental wellbeing.

Study	Intervention		Control		p value
	Parent scores	*n*	Parent scores	*n*	
Ortenstrand et al., 2001					
Parental anxiety hospital discharge					
Mother Trait	32.8 (5.9)	39	33.3 (7.8)	33	0.75
Father Trait	30.1 (5.8)	35	33.5 (7.7)	32	<0.05
Mother State	30.9 (6.2)	39	36.6 (8.4)	39	<0.01
Father State	29.5 (5.4)	35	32.8 (9.1)	35	0.08
After completion of the programme					
Mother Trait					
Father Trait	31.7 (7.1)	39	31.1 (7.8)	33	0.74
Mother State	29.0 (6.1)	35	32.3 (6.9)	32	<0.05
Father State	27.8 (5.9)	39	30.1 (7.6)	39	0.16
General anxiety	27.6 (6.3)	35	29.4 (5.4)	35	0.20
Mother					
Father	5.4 (2.2)				
0 = Maximally anxious	5.4 (2.4)	37	4.9 (2.1)	33	0.40
12 = Maximally calm		32	4.6 (2.0)	33	0.19
Anxiety related to infant					
Mother					
Father		37	5.9 (2.7)	33	0.58
0 = Maximally anxious	6.2 (1.8)	32	5.0 (1.4)	33	0.20
12 = Maximally calm	5.5 (1.6)				
mental imbalance					
Mother	35	37	24	33	0.46
Father	19	32	21	33	0.95
Saenz, 2007					
Well-being 9 weeks since discharge	9.3	84	8.9	72	>0.05
Anxiety at discharge					
Mother	5.5	84	6	72	>0.05
Father	5.5		5.5		>0.05
Depression at discharge					
Mother	2		3.3		<0.05
Father	2	84	3	72	>0.05

*NR= Not reported, N/A = Not applicable, n = frequency.

4.5. Secondary outcome 3 – parental confidence

Two studies reported parental confidence as an outcome (Ortenstrand et al., 2001; Ingram et al., 2018) (RoB = non-RCT: one serious & one moderate). In one study, changes in the parental confidence were measured using the Perceived Maternal Parenting Self-Efficacy (PMPS-E) (Ingram et al., 2018), and the Borg scale CR-10 was used in

Table 8
Secondary outcome – Parental confidence.

Study	Intervention		Control		p value
	Parents instrument scores	*n*	Parents instrument scores	*n*	
Ingram et al., 2018 (PMPS)					
Baseline	59 (IQR 54.0–67.0)	110	60 (IQR 54–69.5)	121	0.33
Discharge	69 (IQR 64.0–74.75)	92	70 (IQR 61.5–76.5)	101	0.77
Home	74 (IQR 70.25–78)	84	74 (IQR 66–79)	84	0.52
Ortenstrand et al., 2001					
Confidence in handling the baby					
Mother	6.1 (SD 2.1)	37	5.7 (SD 2.4)	33	0.46
Father	5.4 (SD 2.2)	32	4.8 (SD 2.1)	33	0.30
Feeling prepared to take care of the baby					
Mother	6.7 (SD 2.0)	37	5.8 (SD 1.9)	33	0.06
Father	5.5 (SD 2.3)	32	5.2 (SD 1.9)	33	0.62

*NR= Not reported, N/A = Not applicable, IQR= Inter-Quartile Range, SD= Standard Deviation, n = frequency.

Table 9
Other outcome – Post discharge weight gain.

Study	Intervention		Control		p value
	grams per day (SD)	*n*	grams per day (SD)	*n*	
Alvarez Miro et al., 2013 *7 days*	21.5g (SD 5.36)	65	17g (SD 4.72)	65	0.001
Gunn et al., 2000 *6 weeks*	12.18g (SD 2.98)	148	12.15g (SD 3.61)	160	>0.05
Ortenstrand et al., 1999, 2001 6 months	22.5g (SD 2.4)	74	23.6g (SD 9.2)	62	0.54

*NR= Not reported, N/A = Not applicable, SD= Standard Deviation, n = frequency.

the other study (Table 8) (Ortenstrand et al., 2001). In both studies (n = 302), no significant difference in parental confidence scores were observed between early supported discharge and the standard care groups (measurements at baseline, discharge, home or one year follow up) (P= >0.05) (Ortenstrand et al., 2001; Ingram et al., 2018).

4.6. Secondary outcomes 4 – infant weight gain

A pooled analysis of three studies (n = 574) using a random effects model indicated that there was no evidence of difference observed in weight gain of pre-term infants between early supported discharge intervention compared to those who received standard care (see Table 9) (Mean difference = 1.150 g per day. 95% CI: 1.85 - 4.15, Std. Error 1.53, P = 0.454) (Alvarez Miro et al., 2013; Gunn et al., 2000; Ortenstrand et al., 2001) (RoB = RCT: one Some concerns, Non-RCT: two serious). Values indicated that there was a statistically significant heterogeneity (I^2 = 91.67%, P= <0.001) (figure four).

4.7. Secondary outcomes 5 – breastfeeding

A total of five studies reported breastfeeding as an outcome (see Table 10) (Esque Ruiz et al., 2012, Gunn et al., 2000; Ortenstrand et al., 2001; Toral-Lopez et al., 2016, Van Kampen et al., 2019). In four studies, no significant difference in rates of exclusive infant breastfeeding, rates of partial infant breastfeeding or duration of breastfeeding were observed between early supported discharge and standard care groups (at three weeks, six weeks, or six-month follow-up; P= >0.05) (Gunn et al., 2000; Ortenstrand et al., 2001; Toral-Lopez et al., 2016, Van Kampen et al., 2019). One study indicated that breast-feeding was more frequent in the infants receiving early supported discharge support compared to control (statistical significance not reported) (Esque Ruiz et al., 2012).

5. Discussion

This systematic review aimed to assess the effectiveness of neonatal early supported transfer to home interventions for parents of preterm infants within NICU, compared with routine care. The studies included in this review examined key outcomes such as duration of hospital stay, hospital re-admission, parental wellbeing, parental confidence, breast-feeding, and weight gain following early supported transfer to home interventions (compared with usual NICU care) (Van Kampen et al., 2019, Toral-Lopez et al., 2016, Saenz, 2007, Ortenstrand et al., 2001, Mannix et al., 2019, Kotagal et al., 1995, Gunn et al., 2000, Esque Ruiz et al., 2012, Alvarez Miro et al., 2013, Ingram et al., 2018).

The synthesis of current evidence establishes that early supported transfer to home interventions for pre-term infants (<37 weeks GA) may reduce duration of hospital stay by up to 11 days (compared to standard NICU care), without significant increasing hospital re-admission rates (although the evidence is limited by methodological weaknesses) (Van Kampen et al., 2019; Saenz, 2007). These findings are substantiated by previous studies which have highlighted that early transfer to home interventions (involving education and pre-discharge planning) demonstrate no significant difference in hospital re-admissions compared to routine care (Coffey et al., 2019; Jones et al., 2021). The current review suggests that early supported transfer to home interventions may improve opportunities for parent-infant interaction and could have cost-saving implications for healthcare services given the reduction in hospital days (Saenz, 2007; Mannix et al., 2019; Kotagal et al., 1995). Previous studies have estimated that hospital services

Table 10
Other outcome - Breastfeeding.

Study	Intervention		Control		p value
	Rates (%)/Duration (months)	*n*	Rates (%)/Duration (months)	*n*	
Esque Ruiz et al., 2012	ED premature had better breast-feeding rates.	NR	NR	N/A	NR
Gunn et al., 2000		148		160	
Exclusive breastfeeding at 3 weeks	54.8%		64.7%		>0.05
Exclusive breastfeeding at 6 weeks	31.3%		40.5%		>0.05
Exclusive breastfeeding at 6 months)	0.8%		3.6%		>0.05
Ortenstrand et al., 2001 6 months	No differences were observed in the duration of exclusive or partial breastfeeding between the groups	74	"	62	0.06
Toral-Lopez et al., 2016 Time of exclusive breastfeeding	3.8 months	46	2.76 months	40	0.68
Van Kampen et al., 2019 Partial or exclusive at 3 months	23% (25/110)	113	30% (21/69)	103	0.25

*ED = Early discharge, NR = Not reported, n = frequency.

could potentially save £8495.69 ($10,609 USD) per infant by providing early support transfer to home interventions (Mannix et al., 2019; Kotagal et al., 1995). These saving may be re-invested to fund neonatal early supported transition to home services in the form of community outreach teams and specialist nurses. In addition, this study highlights that there is no evidence of difference in weight gain per day (g/day) and rates (and duration) of exclusive or partial breastfeeding for preterm infants receiving early supported transfer to home interventions, compared to routine care (Gunn et al., 2000; Ortenstrand et al., 2001; Toral-Lopez et al., 2016, Van Kampen et al., 2019). This is in line with previous studies and builds on the evidence base for implementation of these interventions (Meerlo-Habing et al., 2009).

As it relates to parental outcomes, the current review findings suggest there is no evidence of difference that parental confidence or parental wellbeing are enhanced as a result of early supported transfer to home interventions compared to standard care (Saenz, 2007; Ingram et al., 2018). This is contrary to literature that has suggests early discharge interventions enhance parents' autonomy and self-confidence (Schuetz Haemmerli et al., 2022). It is notable that the evidence that informs much of the current review findings was judged to be of moderate to serious risk of bias, had statistically significant substantial heterogeneity, and was based on non-randomised studies, and therefore should be interpreted with caution. Several studies had significant flaws that imply a range of biases which could invalidate the results. These concerns provide a rationale to suggest that the current evidence is not of sufficient quality to inform clinical practise.

The transition from hospital to home can often be challenging for parents because of the immediate learning and adaptation needed for caring for a pre-term infant (Dellenmark-Blom and Wigert, 2014). Neonatal early supported transfer to home may provide an opportunity to bridge the gap between traditional hospital NICU care and at home care (Dellenmark-Blom and Wigert, 2014). Although the evidence is limited, this review identifies several components that may facilitate the successful implementation of early supported transfer to home interventions for preterm infants (and their parents) (Alvarez Miro et al., 2013, Ortenstrand et al., 2001; Toral-Lopez et al., 2016, Van Kampen et al., 2019). According to the findings, early supported transfer to home interventions commonly incorporates three to four components: education, home visits and 24-h telephone support (Ortenstrand et al., 2001). Previous interventions recommend that parental education classes should be delivered during admission to NICU and in preparation for early supported transfer to home (Brodsgaard et al., 2015). Parental education classes frequently include information on breastfeeding, kangaroo care, nutrition, life at home, prevention of illness, preparation for discharge, signs of disease, infant signals, motor development and arrival at the home (Brodsgaard et al., 2015; Alvarez Miro et al., 2013; Toral-Lopez et al., 2016; Van Kampen et al., 2019; Ortenstrand et al., 2001; Ingram et al., 2018). Home visits also were a common feature in previous interventions, with studies proposing daily visits for the first seven days (dependant on the needs of the parents and infants) and weekly thereafter (Gunn et al., 2000; Kotagal et al., 1995; Brodsgaard et al., 2015; Van Kampen et al., 2019; Alvarez Miro et al., 2013; Esque Ruiz et al., 2012; Toral-Lopez et al., 2016). Home visits were typically conducted by an experienced nurse or midwife trained in neonatology (Toral-Lopez et al., 2016; Kotagal et al., 1995, Van Kampen et al., 2019). A third component of previous early supported transfer to home interventions has typically been 24-h telephone support (Van Kampen et al., 2019). Studies offered parents an unrestricted direct telephone line to a neonatologist when they required emergency medical support or advice (Van Kampen et al., 2019, Brodsgaard et al., 2015, Alvarez Miro et al., 2013, Esque Ruiz et al., 2012, Toral-Lopez et al., 2016, Gunn et al., 2000, Ortenstrand et al., 2001). Previous interventions have also included takeaway information, increased visits to the NICU prior to discharge and programme management support (dedicated nursing specialist) (Alvarez Miro et al., 2013, Gunn et al., 2000; Kotagal et al., 1995; Ingram et al., 2018). To optimise success, literature states that early supported transfer to home interventions be reviewed by a health visitor and paediatric nurse at two weekly intervals (up to six weeks post discharge) to evaluate infant weight, infant length, nutritional status, well-being of the family and the status of infant development (Brodsgaard et al., 2015). However, given the limitations of the studies included in this review, is not yet possible to make recommendations for any of these components to be implemented into clinical practice.

Future research should focus on developing a core outcome set which may reduce some heterogeneity of the interventions (Beltrán et al., 2021). Future studies should also attempt to mitigate methodological limitations of existing studies by designing high quality RCT's which establish the effectiveness of early supported transfer to home interventions on key clinical outcomes (e.g., parental mental wellbeing, confidence, stress etc.). However, there is an acknowledgement that conducting research with pre-term infants within NICU's poses several ethical and methodological challenges (Beltrán et al., 2021). In particular, inclusion rates are typically very low in individual settings which makes randomisation and blinding challenging (Beltrán et al., 2021).

It was noted in the current review that the mean gestation age of infants included in the studies was 33 weeks (Gunn et al., 2000; Ingram et al., 2018; Alvarez Miro et al., 2013; Saenz, 2007). Compared to those born before 32 weeks gestational age, preterm infants born between 33 and 37 weeks are typically at lower risk of medical complications which may have had an impact on the effectiveness of early supported transfer to home interventions in this population (Raju, 2013; Walker et al., 2011). Preterm infants older than 33 weeks are likely to be healthier and not need specific medical therapies other than a brief period of antibiotic treatment, or non-invasive respiratory support (Raju, 2013; Smyrni et al., 2021). Given that late or moderate preterm babies confer a higher burden on cot capacity in NICU's, the potential benefits to early planning of transfer home for these babies may not have been recognised in this review. Early preterm infants (GA of 27–32 weeks) would likely benefit from earlier supported transfer to home under continued support from specialist nursing with access to interventions such as nasogastric feeds and monitoring of weight. However, further research is needed to strengthen the evidence of effectiveness for these interventions in a population of early preterm infants under 32 weeks gestational age.

A limitation of this review was that it did not include articles that were published in other languages not in English. Due to the restrictions within the search strategy, it is possible that relevant studies were not included in the review (Hamer et al., 2021). That said, this is unlikely given that a search of reference lists of all included studies (conducted by two authors independently), did not identify articles published in non-English languages (that were not translated). A further limitation was that publication bias was not able to be assessed because there was insufficient number of studies to generate a funnel plot. Similarly, inconsistency in the reported units of relevant outcomes (e.g., breastfeeding) meant that several studies could not be included in the meta-analysis of each outcome. The dearth of data meant that this review was unable to synthesise an accurate estimate for the effect of early supported transfer to home interventions on several parental outcomes (i.e., parental stress, parental confidence, or wellbeing).

6. Conclusion

The systematic review findings indicate that early supported transfer to home interventions may reduce hospital stay with no evidence of negative effect on hospital readmission rates, parents' well-being, parental stress, weight gain or breastfeeding. However, it is not yet possible to make recommendations for implementation into clinical practice because of the dearth of high-quality evidence. Further research in the form of high quality RCT's assessing the effectiveness of early supported transfer to home interventions on key clinical and psychological outcomes are required. Future studies should plan to address the methodological limitations associated with the studies included in this review, so that the findings can provide evidence-based recommendations for clinical practice and policy.

Ethics statement

The study was granted an exemption by the institutional review board.

Data availability statement

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request: Dr Oliver Hamer, email: Ohamer@uclan.ac.uk.

Prospero registration number

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Declaration of interest

The authors declare that they have no competing interests.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jnn.2022.08.005.

List of abbreviations

CI – Confidence interval
ED – Early discharge
GA – Gestational age
HADS – Hospital anxiety and depression scale
IQR – Interquartile range
NEST Neonatal early supported transfer to home
NICU – Neonatal intensive care unit
NR – Not reported
PMPS-E – Perceived Maternal Parenting Self-Efficacy
RCT – Randomised control trial
RoB – Risk of bias
ROBIN-I Risk of bias tool to assess non-randomized studies of interventions
RR –Risk ratio

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