Developmental care: the carer's perspective

Developmental care provides a framework in which the neonatal environment and care processes are modified and structured to support the individual medical, psychosocial and developmental needs of the preterm infant and family. Although infant benefits have previously been reported, this literature review indicates that developmental care may also have significant benefits for parents and providers of neonatal care.

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Key points

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- Developmental care relates to a broad category of interventions designed to minimise the stress of the neonatal intensive care on the preterm infant's development.
- Early developmental care strategies are effective in ameliorating the negative effects of prematurity on parenting, mother-infant interactions, and parenting outcomes.
- 3. Individual developmental care approaches, such as kangaroo care, as well as combination approaches, are effective in reducing length of hospitalisation and hospital costs.

Despite increased efforts to prevent prematurity, each year in the UK approximately 6% of live births are preterm, while in the USA the incidence is as high as 12%¹. Demand for neonatal care has risen year on year, and currently premature infants account for >70% of neonatal intensive care unit (NICU) admissions². In 2007 in England alone, around 60,000 babies (one in ten births) were admitted to NICUs, at a cost to the NHS of £420 million³.

Financial costs of prematurity alone do not tell the whole story. Preterm infants have significantly more developmental impairment than their term counterparts⁴. The brain of preterm infants is still immature and rapidly developing in the neonatal period. However, neonates in the intensive care environment are exposed to an abnormal environmental milieu, repeated invasive procedures and prolonged illness. This intense sensory impact adversely affects maturation and organisation of vision, hearing, sleeping pattern, growth and consequently neuro-development and long-term outcomes of the child^{5,6}.

For parents of preterm infants, the neonatal experience exposes them to a multitude of stressors and negative emotions, such as anxiety, guilt, helplessness and depression⁷. The highly technical environment, as well as the appearance and behaviours of the premature infant, frequently lead to disruptions in assuming the parental role and a diminished quality of parent-infant interactions⁸. These early problems may contribute to prolonged difficulties with parenting and place premature infants at risk for further cognitive, emotional, behavioural, and developmental problems⁹.

Against this background, developmentally supportive care has been proposed as a means of optimising the infants' development and diminishing the deleterious effects of prematurity¹⁰. It relates to a broad category of interventions which include the control of external stimuli (vestibular, auditory, visual, tactile); clustering of nursery care activities as well as integration of parents; and specific supportive behavioural techniques such as non-nutritive sucking and kangaroo care. These individual strategies can be combined in a model of care such as the Newborn Individualized Developmental Care and Assessment Program (NIDCAP) which involves sequential, formalised and naturalistic observations of the infant's behaviour¹¹. In its broadest sense, developmental care provides a framework in which the care environment and processes are modified and structured to support the individual medical, psychosocial and developmental needs of the infant and family.

Although developmentally supportive care has been subject to several reviews from the perspective of infant outcomes and the variety of procedures involved widely documented, there is comparatively little evidence of its impact on parents or neonatal staff. This review seeks to redress this issue by reviewing the components of developmentally supportive care and their impact on parents and providers of neonatal care.

Methods

A broad, preliminary review of abstracts was conducted to define inclusion and

exclusion criteria.

The inclusion criteria were:

Types of studies – all studies exploring a developmental care intervention for premature infants, conducted in the setting of a NICU. Systematic review of developmental care is difficult primarily due to methodological issues, therefore a broader approach was adopted, and all types of studies were included¹².

Participants – infants <37 weeks' gestation.

Interventions – kangaroo care; positioning; modification of external stimuli; massage/touch; clustering of nursery care activities; combined approaches to individualised developmental care.

Outcome measures – Parent satisfaction and psychological status; parent-infant behaviours; staff satisfaction; length of hospital stay; and cost of care.

Exclusion criteria were studies relating to pain control and acute pain; related interventions for term babies and those outside of the NICU environment; and foreign language papers.

Literature search

The medical MeSH website was used to compile the following search terms: developmental disabilities; developmental disabilities/prevention and control; infant, newborn; infant, premature; environment; nursing care; noise; acoustic stimulation; touch; physical stimulation. The following text words were also used: developmental care, infant stimulation, lighting in the NICU. Computerised searches were conducted using the above MeSH headings and combinations thereof in July 2007 and February 2008 in the following electronic databases: PubMed; Psychlit; EMBASE; CINHAL; The Cochrane Central Register of Controlled Trials (CENTRAL); Web of Science; OVID. The following limits were applied: all infant, birth-23 months, published in the last 10 years (January 1997 to December 2007), humans.

Abstract review

All titles and abstracts were retrieved (n=458) and 198 duplicates removed, 260 citations were downloaded into Endnote. All abstracts were reviewed for inclusion suitability and 208 articles not relating directly to the inclusion criteria were excluded. Full text versions of the remaining 52 papers were obtained and reviewed.

Analysis of papers and assessment of methodological quality

A review proforma was developed to assess study details, information about the intervention and its impact¹³. As part of the proforma, methodological quality was assessed using the Centre for Reviews and Dissemination Quality Assessment Checklist¹⁴. Methodological appraisal scores were categorised as: adequate (>75%), partially adequate (51-75%), inadequate (≤50%) or not reported. Studies were ranked according to the following hierarchical order:

- Experimental studies (randomised control trials)
- Quasi-experimental studies (experimental study without randomisation)
- Controlled observational studies (cohort studies, case control studies)
- Observational studies without control (cross-sectional studies, case studies, pre and post intervention studies, qualitative studies).

Results

Methodological quality

In general, the research was of moderate methodological quality. Half the studies (n=24) had adequate or partially adequate methodological rigour, outlined in FIGURE 1. In comparison to studies involving different drug treatments, there are inherent difficulties in achieving an optimal experimental design for evaluations of developmental care interventions. The most frequently noted limitations in the randomised-controlled trials (RCTs) and quasi-experimental studies were lack of calibration of scales or inter-rater reliabilities, small sample sizes and related inability to do inferential statistics. The controlled observational

studies were largely single-centre studies, commonly with a lack of blinding in outcome assessments and a reliance on investigator-developed surveys or interview schedules which lacked empirical testing. The observational studies lacked controls and were limited in generalisability in that they relied heavily on self-report instruments. These were also all singlecentre studies.

Of the 52 studies, just over half (n=28) focused on parents. The majority of studies were on kangaroo care (n=28), followed by combined approaches to individualised care (n=14), five were on environmental modifications and four on parental interventions. The key findings are listed in relation to the developmental care intervention in **TABLE 1**. For the purpose of this publication, the remainder of the results are presented and discussed in relation to each developmental care intervention.

Kangaroo care

Kangaroo care was first suggested in 1978 by Dr Edgar Rey in Bogotá, Colombia as an alternative to conventional care in order to compensate for overcrowding and scarcity of resources⁶⁰. Currently, kangaroo care is an adjunct to standard care for stable low birthweight and premature infants. The core feature is early positioning of the infant, clad only in a nappy, prone and upright on the mother or father's chest to maximise skin-to-skin proximity³⁹. Associated features are kangaroo nutrition (exclusive breast feeding whenever possible) and early home discharge in the kangaroo position⁶¹.

Since kangaroo care was first introduced more than 260 studies have been published relating to its safety, efficacy, and feasibility.



FIGURE 1 Methodological quality of included studies.

DEVELOPMENTAL CARE

Outcome	Positive results	No difference	Negative results
Kangaroo care			
Maternal mental state	Tessier et al 1998 ^{*15} Feldman et al 2002 ^{*16} Dombrowski et al 2001 ¹⁷ de Macedo et al 2007 ^{*18}	Roberts et al 2000 ^{*19} Miles et al 2006 ^{*20}	
Parental satisfaction	Cattaneo et al 1998 ^{*21} Moran et al 1999 ²² Roller et al 1999 ²³ Dombrowski et al 2000 ²⁴ Swinth et al 2000 ²⁵ Dombrowski et al 2001 ¹⁷ Parker and Anderson, 2002 ²⁶ Kadam et al 2005 ^{*27} Nirmala et al 2006 ²⁸ Johnson, 2007a ²⁹		Neu, 1999 ³⁰ Swinth et al 2000 ²⁵ Miles et al 2006 ^{*20} Johnson, 2007a ²⁹
Parent-infant interaction and parenting	Tessier et al 1998 ^{*15} Neu, 1999 ³⁰ Roller et al 1999 ²³ Swinth et al 2000 ²⁵ Feldman et al 2002 ^{*16} Parker and Anderson, 2002 ²⁶ Feldman et al 2003 ^{*31} Roller, 2005 ²² Nirmala et al 2006 ²⁸ Johnson, 2007a ²⁹	Miles et al 2006 ^{*20}	
Nursing experience	Cattaneo et al 1998 ^{*21} Chia et al 2006 ³³ Nirmala et al 2006 ²⁸	Engler et al 2002 ³⁴ Johnson, 2007b ³⁵	
Duration of hospital stay	Charpak et al 1997 ^{*36} Cattaneo et al 1998 ^{*21} Kambarami et al 1998 ³⁷ Tessier et al 1998 ¹⁵ Ramanathan et al 2001 ³⁸ Charpak et al 2001 ^{*39}	Roberts et al 2000 ^{*19} Chwo et al 2002 ^{*40} Kadam et al 2005 ^{*27}	
Hospital costs	Cattaneo et al 1998 ^{*21}		
Modification of external stimuli			
Maternal mental state		Bvers et al 2003*41	
Parental satisfaction		Byers et al 2003*41	
Staff satisfaction			Byers et al 2003*41
Length of hospital stay	White et al 2002 ^{*42}	Brandon, Holditch-Davis and Belyea, 200243	
Hospital costs	Petryshen et al 1998 ^{*44}		
Parent-focused interventions			
Maternal mental state	Melnyk et al 2001* ⁸	Browne and Talmi, 2005 ⁴⁵ Glazebrook et al 2007 ^{*46}	
Parent-infant and interaction and parenting	Browne and Talmi, 2005 ⁴⁵ Lawhon, 2002 ⁴⁷ Melnyk et al 2001 ^{*8}	Glazebrook et al 2007*46	
Individualised developmental care			
Maternal mental state	Als et al 2003*48		Kleberg, Hellstrom-Westas and Widstrom, 2007 ⁴⁹
Parental satisfaction	Kleberg, Hellstrom-Westas and Widstrom, 2007 ⁴⁹ Wielenga, Smit et Unk, 2006 ^{*50}	Byers et al 2006⁵¹	
Parent-infant interaction and parenting	Als et al 2003*48 Kleberg, Hellstrom-Westas and Widstrom, 200749	Prentice and Stainton, 2003 ^{*52}	
Nursing experience	Als et al 2003 ^{*48} Heermann and Wilson, 2000 ⁵³ Premji and Chapman, 1997 ⁵⁴ van der Pal et al 2007 ⁵⁵		Premji and Chapman, 1997 ⁵⁴ van der Pal et al 2007 ⁵⁵
Length of hospital stay	Als et al 2003 ^{*50} Altimier et al 2004 ^{*56} Brown & Heermann, 1997 ^{*57} Hendricks-Munoz et al 2002 ^{*2}	Byers et al 2006 ⁵¹ Prentice and Stainton, 2003 ^{*52} Westrup et al 2000 ^{*58} Wielenga et al 2007 ^{*59}	
Hospital costs	Als et al 2003 ^{*48} Altimier et al 2004 ^{*56} Hendricks-Munoz et al 2002 ^{*2}	Byers et al 2006 ⁵¹	

* Indicates experimental, quasi-experimental and controlled observational studies with adequate methodological rigour

TABLE 1 Impact of developmental care interventions for parents and providers of care.

In premature infants, it has been associated with immediate and long-term positive effects such as improved infant state organisation, thermal regulation, respiratory patterns, and oxygen saturation^{27,62}; reduced apnoea and bradycardia⁶³; increased rate of weight gain and enhanced lactation⁶⁴; and functioning as an analgesic during painful procedures⁶⁵⁻⁶⁶.

Reviewed articles indicated that kangaroo care was associated with such immediate effects as enhanced coping, improved mental state, bonding and increased confidence^{15,18,23,25,26,28}. Mothers reported less depression, tended to perceive their infants as less abnormal and experienced less stress in relation to length of hospital stay as compared to traditional care mothers^{15,31}. Although three studies reported initial parental anxiety^{25,29,30}, a predominant theme was parental satisfaction^{17,21-29}. Mothers related feelings of being needed and having an important role in caring for their infant in the NICU^{28,29}. Longer term parenting effects were reported in relation to more sensitive parentinfant interactions^{16,30,31} and heightened maternal-infant acquaintance^{29,30,32}.

In general, the studies also reflect positive staff perceptions of kangaroo care^{21,28,33-35}. Staff from units practising kangaroo care had more positive perceptions than those who did not^{33,34}. Where reported, nurses found facilitating kangaroo care professionally satisfying³³. Primary benefits were parental relationship building, particularly maternal attachment and parental confidence^{28,33,35}.

Nine studies looked at the relationship between kangaroo care and duration of hospitalisation, of which six reported shorter length of hospital stay,^{21,37,38} particularly for those <1800g^{36,39} and <1500g¹⁵ birthweight. Three more recent randomised controlled trials found no decrease in duration of hospitalisation^{19,27,40}. One study included a cost analysis, reporting significant savings in relation to salaries (US\$ 11788 *vs* US\$ 29888) as well as other neonatal running costs (US\$ 7501 *vs* US\$ 9876)²¹.

Modification of external stimuli

Developmental care also refers to providing a structured environment with reduced light and noise levels, the coordination of clinical interventions to prevent frequent interruptions during infant sleep and positioning to prevent disorganisation, optimise postural development and promote selfregulation^{57,67}. Guidelines recommend reducing noise levels, using adjustable lighting alongside procedural lighting⁶⁸ as well as the implementation of light/dark cycles to aid the development of circadian rhythms^{12,69}. Infant massage has also been proposed as a means of decreasing infant stress and providing tactile stimulation⁷⁰.

One study looked at the impact of cobedding multiple-gestation infants and found no improvement in parental outcomes, although nurses reported more difficulty caring for co-bedded infants and increased nursing workload associated with more frequent temperature monitoring⁴¹.

Combined approaches to reducing the noxious stimuli of the NICU environment have previously been associated with beneficial effects such as reduced diastolic blood pressure and mean arterial pressure and a decrease in infant movements5. In our review, one study analysed length of stay in infants who received a combination of auditory, tactile, visual and vestibular intervention⁴². Study group infants were discharged at a mean of 1.6 weeks earlier than the control infants. Similarly, a Canadian project looked at the costs of a combined approach comprising clustering of care, positioning and reducing NICU light and noise44. Intervention infants spent less time in intensive care than control infants with subsequent average reduction in nursing and support costs of Canadian \$4,340 per infant.

Parent-focused interventions

Several parenting interventions have been developed with the premise that developmental care delivered by parents can improve neurodevelopmental outcomes by promoting more sensitive and responsive parenting⁷¹. Such interventions have been found to increase cognitive development⁷², enhance parents' knowledge of their infant⁷³, and improve maternal satisfaction and self-confidence in their role⁷⁴.

Four studies looked at parent-focused interventions, of which three reported enhanced parenting. In these interactive programmes parents evidenced greater knowledge and more contingent, sensitive interactions with their infants^{8,45,47}. In one, a small randomised controlled trial, intervention mothers were also less stressed by the NICU environment⁸. The components of developmental care can be combined into a model of care, individualised to each infant. Individualised developmental care has been reported in relation to a number of outcomes including increased physiological stability⁷⁵; fewer and less severe intraventricular haemorrhages⁵⁶; fewer days of ventilatory support^{56,57}; lessened use of exogenous surfactant and total parenteral nutrition⁵²; quicker progression to full enteral feeding⁵⁷ and improved weight gain⁵⁷.

One combined approach to individualised developmental care is NIDCAP, developed in the early 80s by Als and colleagues13. The premise of this approach is that it enhances outcomes in premature infants by supporting optimal brain development⁷⁶. As well as a combination of environmental modifications and clustering of care, the infant's efforts at self-regulation and interaction are observed through approach and avoidance behaviours; and recommendations for care-giving are discussed with parents and other caregivers77. Two systematic reviews have reported limited evidence for the benefits of NIDCAP. In one, a meta-analysis of 32 studies, some short-term gains were noted on growth, feeding outcomes, respiratory support, length of stay, and hospital costs67. Improved neurodevelopmental outcomes were sustained to 24 months of age. Another meta-analysis found decreased supplemental oxygenation requirements and improved neurodevelopmental outcomes at nine to 12 months, but this gain was not sustained to 24 months78.

Our review provides inconclusive evidence of parental benefits of individualised, developmentally-supportive care. A three-centre randomised controlled trial of NIDCAP reported reduced parenting stress⁴⁸, while in a single-site study, NIDCAP mothers expressed more anxiety, although they tended to rate the staff's ability to support them more highly⁴⁹. Similarly, one study noted increased satisfaction in NIDCAP parents⁵⁰, while another reported no differences between NIDCAP and conventional care parents⁵¹. In the three-centre trial, NIDCAP mothers perceived their own competence as parents as greater and their infants as better regulated, more gratifying and more autonomous than the control

DEVELOPMENTAL CARE

group mothers⁴⁸. The size of this effect was most noticeable in the unit with the lowest developmental care scores, the socioculturally most challenged families, and initially sickest infants.

Seven articles looked at the nursing experience of delivering developmentally supportive care, reporting both positive and negative outcomes for care and working relationships. Positive effects included enhanced caregiver sensitivity to infant cues48; increased parental involvement in care53 and a change in emphasis in putting infant needs first54. Nurses had a more positive attitude towards developmental care than physicians⁵⁵. Two studies indicated negative experiences in relation to tension between non-trained and trained developmental care nurses, feeling intimidated by knowledgeable parents and loss of control⁵⁴, and the timeconsuming nature of the intervention⁵⁵.

Five out of eight studies reported a reduction in length of stay and/or hospital costs. Of the five NIDCAP papers, two noted a reduction in hospitalisation. In one, study infants were discharged 2.8 weeks earlier than control infants, with an overall reduction of \$29.6K in hospital costs⁴⁸. Another reported an average decrease in NICU stay of eight days per infant57. Additionally, a small Australian study reported a non-significant reduction in hospitalisation of six days in NIDCAP infants⁵². In another, although infants receiving NIDCAP were not discharged earlier, they had diminished costs in relation to 8% less sedatives/narcotics and 15% less vasopressors⁵¹.

Two papers evaluated the WEE CARE programme - another individualised developmental care programme which includes environmental modifications as well as staff training. Both reported significant reductions in duration of hospitalisation and costs. For one, hospital stay was reduced by an average of 23 days and hospital costs, calculated according to room and nursing costs only, decreased by \$37,750 per infant². These reductions were most marked for infants <27 weeks' gestational age. Similarly, another study reported an average reduction of 15 days per infant in length of stay⁵⁶. Again the difference was most marked for the most immature infants (<27 weeks: 21 days, 28-30 weeks: 13 days, 31-34 weeks: 11 days). Using similar calculations for room and nursing costs only, this was estimated as an annual savings of \$13,114,000.

Conclusions

Early intervention strategies are critical to ameliorating the negative effects of prematurity on parenting, mother-infant interactions, and child outcomes. As such, developmental care has been proposed as an effective means of reducing the stress of neonatal intensive care and promoting infant stability and there is an increasing body of evidence to support its uptake in preterm infants in the neonatal environment. This review of published reports also indicates that specific strategies may also have important benefits for parents and providers of neonatal care. These primarily relate to reduced parental stress, enhanced parenting and reduced length of hospital stay and associated costs.

In an era of networked neonatal care which advocates parents as partners in care, effective implementation of developmental care supports not only the active involvement of parents, but may have significant cost-effective implications for service delivery. In view of the significant benefits to preterm infants and care providers, an essential initiative must now be to develop and foster a supportive developmental care culture by pursuing effective training strategies, and developing standardised guidelines throughout the neonatal care continuum.

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