



KANGAROO MOTHER CARE

**HEALTH TECHNOLOGY ASSESSMENT SECTION
MEDICAL DEVELOPMENT DIVISION
MINISTRY OF HEALTH MALAYSIA
017/2014**

DISCLAIMER

Technology review is a brief report, prepared on an urgent basis, which draws on restricted reviews from analysis of pertinent literature, on expert opinion and / or regulatory status where appropriate. It has been subjected to an external review process. While effort has been made to do so, this document may not fully reflect all scientific research available. Additionally, other relevant scientific findings may have been reported since completion of this review.

Please contact: htamalaysia@moh.gov.my, if you would like further information.

Health Technology Assessment Section (MaHTAS),
Medical Development Division
Ministry of Health Malaysia
Level 4, Block E1, Precinct 1
Government Office Complex
62590 Putrajaya

Tel: 603 88831246

Fax: 603 8883 1230

Available at the following website: <http://www.moh.gov.my>

Prepared by:

Dr Khadijah binti Abdul Rahim
Senior Assistant Director
Health Technology Assessment Section (MaHTAS)
Ministry of Health Malaysia

Reviewed by:

Datin Dr Rugayah Bakri
Deputy Director
Health Technology Assessment Section (MaHTAS)
Ministry of Health Malaysia

Dr Junainah Sabirin
Senior Principal Assistant Director
Health Technology Assessment Section (MaHTAS)
Ministry of Health Malaysia

External reviewers:

Dr Irene Cheah Guat Sim
Consultant Paediatrician & Neonatologist
Department of Paediatrics
Hospital Kuala Lumpur

Dr. Ravichandran a/l Jeganathan
Senior Consultant & Head of Obstetrics and Gynaecology Department
Hospital Sultanah Aminah, Johor Bahru
(Head of Obstetrics and Gynaecology Services, Ministry of Health)

DISCLOSURE

The author of this report has no competing interest in this subject and the preparation of this report is totally funded by the Ministry of Health, Malaysia.

EXECUTIVE SUMMARY

Background

Worldwide, an estimated 13 million babies are born prematurely each year, with 92% of them born in less developed countries. Premature infants are more likely to suffer from respiratory and sensory deficits and learning disabilities than infants carried to term. Meanwhile, low birth-weight (LBW), defined as weight at birth of less than 2500g irrespective of gestational age, is associated with an increased risk of neonatal morbidity and mortality, neurodevelopmental disabilities, and may even be an important risk factor for adult diseases. Every year, about 20 million LBW infants were born worldwide, with 95.6% of them in developing countries. LBW is a major contributor to infant mortality, accounting for 60 to 80% of neonatal deaths and about two thirds of infant deaths. Conventional neonatal care is proven to lower the burden of both neonatal morbidity and mortality. However, it is expensive and needs both trained personnel and permanent logistic support. In low- and middle- income countries, financial and human resources for this type of neonatal care are limited and hospital wards for LBW infants are often overcrowded. Thus, interventions for LBW infants that reduce the neonatal morbidity and mortality as well as costs would be an important advance in care.

In the past three decades, kangaroo mother care (KMC) has been established as a safe and effective method of infant care, with the potential of improving the survival of LBW newborns. The mothers are used as “incubators” to maintain the infants’ body temperature and as the main source of food and stimulation for LBW infants while they mature enough to face extra-uterine life in similar conditions as those born at term. The central component of KMC is skin-to-skin contact (SSC) in which infants are placed vertically between the mother’s breasts firmly attached to the chest and below her clothes. SSC is offered to infants as far as the mother-infant dyad can tolerate it. The other two components of KMC are nutrition based on exclusive breastfeeding whenever possible and attempt of early discharge from hospital regardless of weight or gestational age with strict follow-up. In Malaysia, the KMC method is relatively new and has not been widely practised. Its implementation is limited to very few tertiary hospitals and not being expanded to other centres. In view of the issue of overcrowded neonatal intensive care units (NICU) in the government hospitals with increasing number of premature and LBW babies born, this technology review was requested by the Senior Principal Assistant Director, Obstetrics and Gynaecology and Paediatrics Services Unit, Medical Services Development Section, Medical Development Division, Ministry of Health to assess whether the implementation of KMC may solve the issue by reducing the length of hospital stay of such babies.

Objective/ aim

The objective of this systematic review was to assess the effectiveness, safety, cost/ cost- effectiveness and organizational implication of KMC compared with conventional care for premature and low birth-weight infants in reducing the length of hospital stay.

Results and conclusions

A total of 192 titles were identified through the Ovid interface and PubMed. Seven articles related to KMC were included in this review: two systematic reviews, two randomised controlled trials, one non randomised controlled trial, one cross sectional study and one cost analysis study.

a. Effectiveness

- There was good level of evidence to demonstrate that KMC:
 - reduced the length of hospital stay by 2.2 days as compared to conventional care in stabilized LBW infants
 - increased breastfeeding rate, duration and exclusivity up to six months post-birth
 - promoted better infant growth compared to conventional hospital care
 - was associated with reduced risk of mortality at discharge or 40 to 41 weeks' postmenstrual age and at latest follow up; however, at six months and beyond, the difference between KMC and conventional care groups was no longer significant
- There was limited good level of evidence to show that KMC benefited in cardio-respiratory stability compared to conventional hospital care.
- The evidence suggesting that KMC promoted normal thermoregulation was inconclusive. Babies with birth weight of less than 1500g, who require stable thermoregulation and environmental humidification were not well represented in the available studies.
- There was fair level of evidence to suggest that KMC improved maternal satisfaction and bonding/ attachment between mother and infant.

b. Cost/ Cost-effectiveness

A cost analysis conducted in Nicaragua found that the total average cost of care for a neonate before practising KMC was US \$ 2,322, while after practising KMC the cost was US \$ 1,808. The largest expenditure was on training of health professionals but this cost was offset by the amount saved with shorter hospitalisation, elimination of incubator use, and lower medication and infant formula costs.

c. Safety

There were no reported adverse events or negative outcomes on KMC in the studies retrieved.

d. Organizational implication

Education and training in KMC should be based on the same basic understanding of the concept and accompanied by the creation of awareness, committed champions, multidisciplinary teamwork and continuous support from the authority. One way of initiating a policy of early discharge from hospital is to establish a KMC ward. The presence of committed individuals who are knowledgeable about KMC as agents of change is considered as a prerequisite for successful implementation. Misperceptions about KMC should be addressed. Information about KMC should be included in the curricula of all health care professionals. The gradual introduction of KMC, supported by appropriate educational strategies, may lead to broader acceptance, less resistance and better results in the long term.

Methods

Electronic databases were searched through the Ovid interface: Ovid MEDLINE® In-process and other Non-indexed citations and Ovid MEDLINE® 1946 to present, EBM Reviews - Cochrane Central Register of Controlled Trials – August 2014, EBM Reviews - Cochrane Database of Systematic Reviews - 2005 to August 2014, EBM Reviews - Health Technology Assessment - 3rd Quarter 2014, EBM Reviews – NHS Economic Evaluation Database 3rd Quarter 2014, Embase – 1988 to 2014 week 36. Searches were also run in PubMed. Google was used to search for additional web-based materials and information. Additional articles were identified from reviewing the references of retrieved articles.

KANGAROO MOTHER CARE

1. BACKGROUND

Worldwide, an estimated 13 million babies are born prematurely each year, with 92% of them born in less developed countries. Premature infants are more likely to suffer from respiratory and sensory deficits and learning disabilities than infants carried to term.¹ Meanwhile, low birth weight (LBW), defined as weight at birth of less than 2500g irrespective of gestational age, is associated with an increased risk of neonatal morbidity and mortality, neurodevelopmental disabilities, and may even be an important risk factor for adult diseases.^{2,3} Every year, about 20 million LBW infants were born worldwide, representing 15.5% of all births, with 95.6% of them in developing countries. LBW is a major contributor to infant mortality, accounting for 60 to 80% of neonatal deaths and about two thirds of infant deaths.² Concisely, the deaths of about two million newborns in the developing world, each year, are related to prematurity and LBW.⁴ Conventional neonatal care is a complex process of care which includes interventions that are already proven to lower the burden of both neonatal morbidity and mortality. It is expensive and needs both trained personnel and permanent logistic support. This complexity is critical mainly during the stabilization period, until the infant has adapted to extra-uterine life. In low- and middle- income countries, financial and human resources for this type of neonatal care are limited and hospital wards for LBW infants are often overcrowded.^{2,3} Thus, interventions for LBW infants that reduce both, the neonatal morbidity and mortality as well as costs would be an important advance in care.²

In the past three decades, kangaroo mother care (KMC) has been established as a safe and effective method of infant care, with the potential of improving the survival of LBW newborns, especially in low- and middle- income countries.^{2,5} It was first proposed and developed in Bogotá, Colombia, in 1978, by Dr. Edgar Rey as an alternative to the conventional method of care for LBW infants.^{2,3,6,7} KMC was initially conceived to address the lack of incubators, high rate of nosocomial infections, and infant abandonment in the local hospital.^{2,8} The term KMC is derived from similarities to marsupial caregiving. The mothers are used as “incubators” to maintain the infants’ body temperature and as the main source of food and stimulation for LBW infants while they mature enough to face extra- uterine life in similar conditions as those born at term.^{2,3} Although KMC was originally ideated as an alternative to the usual minimal in-hospital care for stable LBW infants, it is now considered by many as the most feasible, readily available, and preferred intervention for decreasing neonatal morbidity and mortality in developing countries, and is being offered increasingly to infants who require ventilator support.^{7,8}

Likewise, living the KMC experience has been shown to be a powerful and transforming event which help mothers and families to cope with the emotional challenges associated with caring for a high-risk neonate.⁸

The central component of KMC is skin-to-skin contact (SSC) in which infants are placed vertically between the mother's breasts firmly attached to the chest and below her clothes. SSC is offered to infants as far as the mother-infant dyad can tolerate it. Mothers can share the role of provider of SSC with others, especially the babies' fathers. The aim is to empower the mother (parents or caregivers) by gradually transferring the skills and responsibility for becoming the child's primary caregiver and meeting every physical and emotional need. The other two components of KMC are frequent and exclusive or nearly exclusive breastfeeding and attempt of early discharge from hospital regardless of weight or gestational age with strict follow-up. However, these two last components are less frequently identified as part of KMC.^{2,5} One of the most recent definitions of KMC is 'a standardized protocol- based care system for preterm and/ or LBW infants and is based on skin-to-skin contact between the preterm baby and the mother'.^{3,9} As it is conceptually simple, KMC reduces or eliminates the need for sophisticated, expensive equipment such as incubators and reduces the need for highly skilled medical personnel. It can therefore be practically applied in maternity units in low- or limited-resource settings.^{1,5}

In Malaysia, the KMC method is relatively new and has neither been widely practised nor widely known. Its implementation is patchy, limited to very few tertiary hospitals and not being expanded to other centres. In view of the issue of overcrowded neonatal intensive care units (NICU) in the government hospitals with increasing number of premature and LBW babies born, this technology review was requested by the Senior Principal Assistant Director, Obstetrics and Gynaecology and Paediatrics Services Unit, Medical Services Development Section, Medical Development Division, Ministry of Health to assess whether the implementation of KMC may solve the issue by reducing the length of hospital stay of such babies.

2. OBJECTIVE / AIM

The objective of this systematic review was to assess the effectiveness, safety, cost/ cost- effectiveness and organizational implication of KMC compared with conventional care for premature and low birth-weight infants in reducing the length of hospital stay.

3. TECHNICAL FEATURES

3.1 Components^{5,6,8,9}

The key components of KMC are:

- i. Skin-to-skin contact (SSC) between the mother and her baby (the kangaroo position):
 - is the hallmark i.e. major and central component of KMC
 - should be as early, continuous and prolonged as possible
 - with father/ substitute(s) participating as providers
- ii. Exclusive breastfeeding ideally (the kangaroo nutrition)
- iii. Early discharge from hospital in kangaroo position with strict and adequate follow up

3.2 Modalities^{2,9}

- i. Intermittent KMC: skin-to-skin care for short periods once or a few times per day and for a variable number of days
- ii. Continuous KMC: skin-to-skin care for ≥ 20 hours per day

3.3 How the intervention works

The KMC intervention assumes that the mother maintains the infant's body temperature and is the main source of nutrition and stimulation, which are the main components of the conventional neonatal care.² Maintenance of maternal milieu following birth is required to elicit innate behaviours from the neonate and the mother that leads to successful breastfeeding, thus survival. Separation from this milieu results in immediate distress cries and "protest-despair" behaviour. Healthy, full term infants employ a species-specific set of innate behaviours immediately following delivery when placed in SSC with the mother. In 2011, Widstrom described the sequence of nine innate behaviours as the 1) birth cry, 2) relaxation, 3) awakening and opening the eyes, 4) activity (looking at the mother and breast, rooting, hand-to-mouth movements, soliciting sounds), 5) a second resting phase, 6) crawling towards the nipple, 7) touching and licking the breast, 8) suckling at the breast and finally 9) falling asleep. Provided they are together and in intimate contact, this 'sensitive period' primes mothers and infants to develop a synchronous reciprocal interaction pattern.¹⁰ Even preterm infants have demonstrated the ability to complete the instinctive breast crawl, moving from between the mother's breasts over to a nipple and spontaneously latching on within the first hour of birth, if healthy and in kangaroo care within the first few minutes of birth.¹¹ Infants who are allowed uninterrupted SSC immediately after birth and who self-attach to the

mother's nipple may continue to nurse more effectively. Effective nursing increases milk production and infant weight gain.¹⁰

Oxytocin release has been suggested as one mediator for positive effects of mother-infant SSC.⁹ Oxytocin is secreted by the skin-to-skin touch and it acts as neurotransmitter on the parasympathetic nuclei, as well as having a sedation effect and an analgesic effect i.e. reduced pain response when held skin-to-skin.⁵ The kangaroo position itself induces combinations of sensory modalities: auditory stimulation by listening to the mother's voice, olfactory stimulation from the proximity of the mother's body, vestibular-kinesthetic stimulation from the infant's location on the adult's chest, tactile stimulation from the SSC, and visual stimulation, as the infant is placed in an upright position, which allows him or her to see the mother's face and body and contextual elements as she moves around.⁸ SSC through these sensory stimuli is a powerful vagal stimulant, which releases maternal oxytocin. Oxytocin causes the skin temperature of the mother's breast to rise, providing warmth to the infant. Oxytocin also antagonizes the flight-fight effect, decreasing maternal anxiety and increasing calmness and social responsiveness. During the early hours of birth, oxytocin may also increase parenting behaviours. SSC outcomes for mothers suggest improved bonding/ attachment with their babies, and increased sense of mastery and self enhancement, resulting in increased confidence. Sense of mastery and confidence predict breastfeeding duration where women with low breastfeeding confidence have three times the risk of early weaning and are associated with perceived insufficient milk supply.¹⁰ Thus, KMC makes it possible to avoid hypothermia via SSC, and hypoglycaemia via the administration of breast milk.⁸

3.4 Requirements for KMC implementation^{6,11,12}

The most important resources for KMC are the mother, personnel with special skills and a supportive environment. Some of the requirements of KMC include:

- i. Training of nurses, physicians and other staff involved in the care of the mother and baby
- ii. Educational material such as information sheets, posters and video films
- iii. Suitable chair/ rocker/ recliner for practicing mothers to sit on comfortably
- iv. Mother's clothing e.g. tube top, 'kanga' shirt (Figure 1)
- v. Baby's clothing i.e. hat, socks, diaper (Figure 2)
- vi. Privacy screen

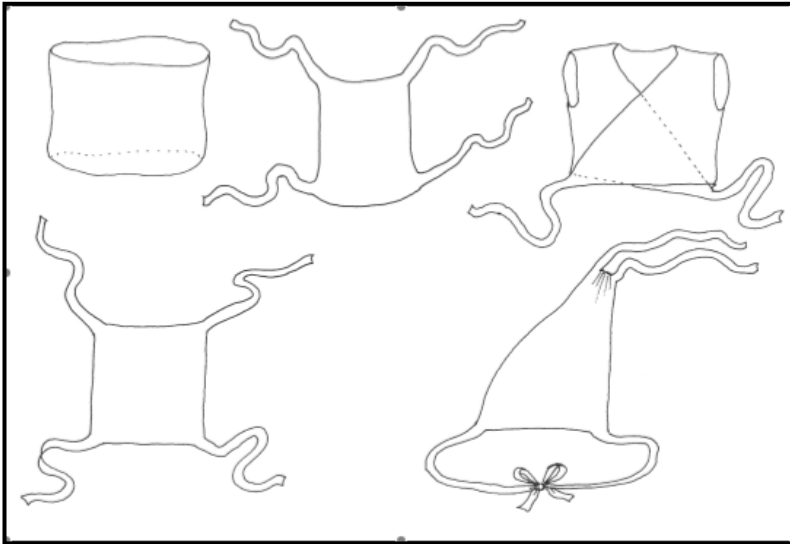


Figure 1: Mother's clothing for KMC



Figure 2: Baby's clothing for KMC

3.5 Eligibility criteria for baby^{6,11}

Almost every small baby can be cared for with KMC. The general recommendations on starting KMC should be adapted to the situation of the region, health systems or health facilities. An example of eligibility criteria for infants is:

- i. stable; no deterioration of condition within 24 hours before kangaroo care is started
- ii. all lines and tubes must be well secured
- iii. neonatal respiratory support in the form of oxygen supplementation or nasal CPAP is not a contraindication
- iv. mothers and fathers should be willing to give kangaroo care (Figure 3)



Figure 3: A mother and a father providing kangaroo care

3.6 Eligibility criteria for mother^{6,12}

All mothers can provide KMC irrespective of age, parity, education and culture. The points that must be taken into consideration when counselling on KMC are the mother's:

- willingness,
- general health; if the mother is ill or suffering from pregnancy or delivery complications, or skin lesions, she should recover before initiating KMC
- full-time availability; other family members can also offer intermittent skin-to-skin contact
- support from family and community

3.7 Kangaroo position^{6,11} (Figure 4)

- The baby is placed between the mother's breasts, chest-to-chest in an upright position, inclined at approximately 30 to 40 degrees above horizontal, with the ventral surface of the infant in skin-to-skin contact with the mother. Ascertaining that the full ventral surface of the infant, from navel to neck, is in SSC with the mother is essential as it is this area of the body that is rich in vagal nerve receptors and thermal receptors.
- The head is turned to one side in a slightly extended, sniffing position. Hyperextension or hyperflexion of the head must be avoided as it may cause obstructive apnea. If possible, the face of the infant is positioned so that the parent can see the infant's facial expression.
- The hips are flexed and abducted in a 'frog' position; arms should also be flexed. This flexed position of the extremities ensures that motor development is facilitated.
- Baby's abdomen should be at the level of the mother's epigastrium.
- The parent's comfort level and the need for positioning device to support the infant are assessed.

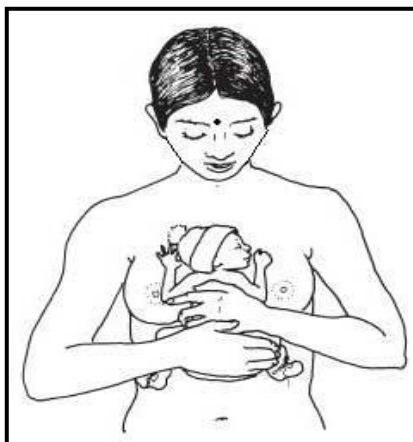


Figure 4: The kangaroo position

3.8 Monitoring^{11,12}

Babies on KMC should be monitored carefully especially during the initial stages to ensure that the:

- position is correct,
- airway is clear,
- breathing is regular,
- color is pink, and
- temperature is maintained normal

All routine cardiorespiratory monitoring should be continued. Pulse oximetry should be continued as ordered. Allow 15 to 20 minutes before and after transfer for infant's vital signs to stabilize. Temperature should be monitored before, during and after KMC.

3.9 Duration^{6,8,11}

Skin-to-skin contact should start gradually in the nursery, with a smooth transition from conventional care to continuous KMC. The length of skin-to-skin contact should be gradually increased up to 24 hours a day, interrupted only for changing diapers. Early start of the intervention gives qualitative compensation for lost intra-uterine experience and avoids input overload. Any amount of kangaroo care is better than none, but the minimum duration is one hour to permit one complete cycle of sleep. Therefore, sessions that last less than one hour should be avoided. A minimum two-hour span of KMC is important to provide the stimulation the mother needed to increase milk volume and facilitate milk letdown. Frequent transfer of the infant in and out of the kangaroo position should be avoided as it may be disruptive to the dyad and require a lot of energy and effort for the infant. SSC should continue for as long as possible until the baby shows signs that she has outgrown the need for KMC usually when the baby reaches term (gestational age around 40 weeks) or 2500g; she starts wriggling to show that she is uncomfortable, pushes out her limbs, cries and fusses every time the mother tries to put her back skin-to-skin. Breastfeeding, of course, continues.

3.10 Discharge criteria^{2,6,12}

In general, the following criteria are to be met before a KMC baby can be discharged:

- good general health of the infant with no overt illness
- no evidence of infection
- feeding well, and receiving exclusively or predominantly breastmilk

- gaining weight at least 10 to 15 gram/kg/day for at least three consecutive days
- stable temperature for at least three consecutive days
- the mother and family members are confident to take care of the baby in KMC
- the baby is able to be brought for regular follow-up visits

4. METHODS

4.1 Searching

Electronic databases were searched through the Ovid interface: Ovid MEDLINE® In-process and other Non-indexed citations and Ovid MEDLINE® 1946 to present, EBM Reviews - Cochrane Central Register of Controlled Trials – August 2014, EBM Reviews - Cochrane Database of Systematic Reviews - 2005 to August 2014, EBM Reviews - Health Technology Assessment - 3rd Quarter 2014, EBM Reviews – NHS Economic Evaluation Database 3rd Quarter 2014, Embase – 1988 to 2014 week 36. Searches were also run in PubMed. Google was used to search for additional web-based materials and information. Additional articles were identified from reviewing the references of retrieved articles. Appendix 1 showed the detailed search strategies.

4.2 Selection

A reviewer screened the titles and abstracts against the inclusion and exclusion criteria and then evaluated the selected full text articles for final article selection

The inclusion and exclusion criteria were:

Inclusion criteria

Problems	Premature infants/ babies/ neonates Low birth-weight infants/ babies/ neonates
Interventions	Kangaroo mother care Kangaroo care
Comparators	Conventional care
Outcomes	Reduced length of hospital stay Other aspects of effectiveness i.e. i. reduced mortality and morbidity ii. breastfeeding rates, duration and exclusivity

	iii. physiological effects in terms of cardio-respiratory stability and thermoregulation iv. infant growth v. psychosocial effects in terms of maternal satisfaction and mother-infant bonding/attachment Safety Economic implication
Study design	Health Technology Assessment (HTA), Systematic Review, Randomised Controlled Trial (RCT), Non Randomised Controlled Trial, Cohort studies, Case Control studies, Cross Sectional studies, Case series, Case reports, economic evaluation
	English full text articles

Exclusion criteria

Study design	Studies conducted in animals and narrative reviews
	Non English full text articles

Relevant articles were critically appraised using Critical Appraisal Skills Programme (CASP) and graded according to US/Canadian preventive services task force (Appendix 2). Data were extracted and summarised in evidence table as in Appendix 3.

5. RESULTS AND DISCUSSION

A total of 192 titles were identified through the Ovid interface and PubMed. Seven articles related to KMC were included in this review: two systematic reviews, two randomised controlled trials, one non randomised controlled trial, one cross sectional study and one cost analysis study.

5.1 EFFECTIVENESS

5.1.1 Length of Hospital Stay

Conde-Agudelo A and Diaz-Rosello JL conducted a Cochrane systematic review (first published in 2000 and latest edited and updated in 2014, issue 4) to determine whether there is evidence to support the use of KMC in LBW infants as an alternative to conventional neonatal care. The review included 18 RCT involving 2751 infants with LBW, defined as birth-weight

less than 2500g, regardless of gestational age. Six of the involved RCT included only infants with birth-weight $\leq 1500\text{g}$. With regards to length of hospital stay, they reported a significant decrease by 2.2 days in a meta-analysis of 10 studies involving 931 LBW infants that used intermittent KMC (mean difference [MD] -2.2 days, 95% CI -3.72 to -0.63, $P=0.0059$).^{2, level I}

On the other hand, Moore et al. conducted a Cochrane systematic review (first published in 2003 and latest edited and updated in 2012, issue 5) to assess the effects of early SSC for mothers and their healthy newborn infants. The systematic review included 34 RCT involving 2177 participants, by which the participants were mothers and their healthy full term or late preterm (34 to less than 37 completed weeks' gestation) newborn infants having had early SSC (starting less than 24 hours after birth), and controls who had undergone standard patterns of care (held swaddled or dressed in their mothers' arms, or placed in open cribs or under radiant warmers). There was no mention on the birth-weight range of the infants involved. In the review, a meta-analysis involving two studies with 42 infants found no difference between the intervention group of SSC and the control group who received usual hospital care in the length of hospital stay of late preterm infants 34 to 36 weeks' gestational age (MD -95.30 hours, 95% CI -368.50 to 177.89).^{10, level I}

5.1.2 Mortality and morbidity

The 2014 systematic review by Conde-Agudelo A and Diaz-Rosello JL showed a significant reduction in the risk of mortality at discharge or 40 to 41 weeks' postmenstrual age (risk ratio [RR] 0.60, 95% CI 0.39 to 0.92; eight studies, 1736 infants) and at latest follow-up (RR 0.67, 95% CI 0.48 to 0.95; 11 studies, 2167 infants) for KMC group as compared to control group. Overall, there was no difference between groups in the risk of mortality at six months of age or at six months follow up, and at twelve months corrected age. Apart from that, in stabilised infants, KMC was associated with significant reduction in severe infection/ sepsis at latest follow up (RR 0.56, 95% CI 0.40 to 0.78; seven studies, 1343 infants), severe illness (RR 0.30, 95% CI 0.14 to 0.67; one study, 283 infants) and lower respiratory tract disease (RR 0.37, 95% CI 0.15 to 0.89; one study, 283 infants) at six months follow up, and nosocomial infection/ sepsis (RR 0.45, 95% CI 0.27 to 0.76; three studies, 913 infants) and hypothermia (RR 0.34, 95% CI 0.17 to 0.67; six studies, 698 infants) at discharge or 40 to 41 weeks' postmenstrual age. There was no overall difference in the risk of mild/ moderate infection or illness at latest follow up.^{2, level I}

5.1.3 Breastfeeding outcomes

In the 2012 review by Moore ER et al., more SSC dyads were still breastfeeding at one to four months post birth compared to those on usual hospital care (RR 1.27, 95% CI 1.06 to 1.53, P=0.0093; 13 studies, 702 dyads). Another meta-analysis involving seven studies with 324 mother-infant dyads also found that a longer duration of breastfeeding was achieved by the SSC dyads; however, the difference did not reach statistical significance. Sensitivity analysis excluding one study with inconsistent results removed heterogeneity and made the difference statistically significant (MD 64 days, 95% CI 37.96 to 89.5, P<0.00001). For breastfeeding exclusivity, more SSC infants were exclusively breastfed up to three to six months post-birth (RR 1.97, 95%CI 1.37 to 2.83, P=0.00026; three studies, 149 dyads).^{10, level I}

In general, the systematic review by Conde-Agudelo A and Diaz-Rosello JL pointed towards the same direction with regards to breastfeeding outcomes. The study found that there was increased likelihood of exclusive breastfeeding at discharge or 40 to 41 weeks' postmenstrual age in the KMC group compared to the conventional group (63.8% vs 54.2%, RR 1.20, 95% CI 1.07 to 1.34; five studies, 1333 dyads) and at one to three months follow-up (86.9% vs 76.5%, RR 1.20, 95% CI 1.01 to 1.43; five studies, 600 dyads), or any breastfeeding (exclusive and/ or partial) at discharge or 40 to 41 weeks' postmenstrual age (88.5% vs 76.0%, RR 1.20, 95% CI 1.06 to 1.36; nine studies, 1576 dyads) and at three months follow-up (79.7% vs 69.8%, RR 1.14, 95% CI 1.06 to 1.23; five studies, 924 dyads).^{2, level I}

Hake-Brookes SJ and Anderson GC in 2008 conducted a RCT in Ohio and Washington to determine the effects of kangaroo care (KC) on breastfeeding status in 66 mother-preterm infant dyads from postpartum through 18 months. The birth-weight range of the infants was 1300g to 3000g. The in-hospital phase of this study lasted five days or until the infant was discharged, whichever occurred first. Then after, follow-up assessment was done at six weeks and at three, six, twelve and eighteen months. The study found that KC dyads showed greater breastfeeding exclusivity over time, from hospital discharge through 18 months (p=0.047). The difference was statistically significant at 6 months (p=0.041). It was also shown that higher percentage of KC dyads breastfed at full exclusivity in the first four of the six time points (up to six months). KC dyads were also reported to have breastfed significantly longer than dyads in standard nursery care (5.08 months vs 2.05 months, p=0.003).^{13, level II-1}

In a cross-sectional study in 2013 by Heidarzadeh M conducted in Egypt, it was found that KMC group had more exclusive breastfeeding at the time

of hospital discharge than conventional method care group (62.5% vs 37.5%, $p=0.00$). KMC group also had higher breastfeeding rate at hospital discharge compared to conventional care group (97.9% vs 46.4%).^{14, level II-³} Two hundred and twenty eight (90.8%) of the infants involved had birth-weight of $\leq 1500\text{g}$ whereas the rest had birth-weight of $>1500\text{g}$.

5.1.4 Physiological effects

The systematic review by Moore ER et al. reported that a study by Bergman 2004 utilised SCRIP (stability of the cardio- respiratory system) scores during the first six hours post-birth to compare 31 late preterm infants in SSC with 13 late preterm control infants. The study found that SSC infants had significantly higher SCRIP scores during the first six hours post-birth, indicating better stabilisation (MD 2.88, 95% CI 0.53 to 5.23). Meta-analysis on studies looking at infant heart rate (three studies, 183 infants) and respiratory rate (four studies, 215 infants) 75 minutes to two hours post-birth were also carried out. It was found that SSC infants had a lower mean heart and respiratory rates, albeit the results were statistically significant only after one study with inconsistent results was omitted (heart rate MD -5.77, 95% CI -7.46 to -4.11, respiratory rate MD -4.76, 95% CI -6.12 to -3.41). In terms of thermoregulation, infant axillary temperature at 90 minutes to two hours post birth was reported in three studies including a total of 168 dyads. Due to heterogeneity between studies, meta-analysis was not carried out for this outcome. In the studies by Christensson 1992 and Christensson 1995, results favoured the SSC group (RR 0.40, 95% CI 0.19 to 0.61, and RR 0.50, 95% CI 0.17 to 0.83 respectively) whereas in the study by Villalon 1993, temperatures were on average slightly higher for the control group at this time point (although at other time points reported results favoured the intervention group). The authors concluded that therefore, in view of these inconsistencies, findings in this study were difficult to interpret.^{10, level I}

Mitchell AJ et al. in 2013 conducted a RCT to compare bradycardia and desaturation events in preterm infants in kangaroo care (KC) versus standard incubator care (SC). The study involved 38 infants; 19 in KC group and another 19 in SC group, and was carried out continuously beginning day five till day ten of life. The mean birth-weight for infants in the KC group was $1311.5 \pm 216.6\text{g}$ whilst in the SC group, the mean birth-weight was $1213.2 \pm 169.8\text{g}$. In the KC group, mothers (or fathers) held infant in kangaroo position for two hours a day and during the remaining 22 hours, infants received routine incubator care similar with the control group. The study found that there were significant differences for infants within the KC group; there were fewer bradycardia events ($p=0.048$) and oxygen desaturation events ($p=0.017$) in the two hours during when

mothers (or fathers) held their infants in kangaroo position compared to when they were receiving routine incubator care.^{15, level II-1}

5.1.5 Infant growth

The 2014 review by Conde-Agudelo and Diaz-Rosello JL reported that infants in the KMC group gained more weight per day (MD 3.7g, 95% CI 1.9 to 5.6; 10 trials, 1072 infants), length per week (MD 0.29cm, 95% CI 0.27 to 0.31; two trials, 251 infants) and head circumference per week (MD 0.18cm, 95% CI 0.09 to 0.27; three trials, 369 infants) as compared to those in the conventional care group.^{10, level I}

In 2013, Samra NM, El Taweel A and Cadwell K carried out a non-randomised controlled, trial to evaluate the effect of intermittent KMC on 40 LBW neonates (22 in the KMC group, 18 in the control group) with delayed weight gain. The mean birth-weight for infants in the KMC group was 1381.8 ± 391.1g whereas in the control group, the mean birth-weight was 1502.8 ± 285.7g. The study found that the mean daily weight gain was significantly higher in the KMC group of neonates (22.1 ±2.5g) compared to those receiving routine NICU care (10.4 ±2.5g), p<0.001. The mean postnatal age at which the babies regained their birth weight was also significantly less in the KMC group (15.7 ±0.7 days) compared to the control group (24.6 ±3.8 days), p<0.001.^{16, level II-2}

5.1.6 Psychosocial effects

In the Cochrane review by Conde-Agudelo and Diaz-Rosello JL, it was reported that mothers of infants in the KMC group were more satisfied with the method of care than mothers of the control group (91% vs 78%, RR 1.17, 95% CI 1.05 to 1.30; one study, 269 mothers). The same review also reported three studies (Charpak 1997, Gathwala 2008, Roberts 2000) that evaluated mother-infant attachment and one study that looked into mother-infant interaction. Charpak 1997 found significant higher scores in KMC group for mother's sense of competence, mother's feelings of worry and stress, mother's sensitivity and infant responsiveness. Gathwala 2008 demonstrated higher mother-infant attachment at three months follow up in KMC group (MD 6.24, 95% CI 5.57 to 6.91, P<0.00001), whereas Roberts 2000 in his study found that the score on "relationship with the infant" was significantly higher in the KMC group (MD 1.00, 95% CI 0.35 to 1.65, P=0.0025). The trial by Neu 2010 on mother- infant interaction at six months of age reported that dyads in KMC group showed more symmetrical and less asymmetrical co-regulation than control, but multivariate analysis showed no significant difference.^{2, level I}

5.2 SAFETY

There was no retrievable evidence on the adverse events of KMC. No negative outcomes associated with SSC were reported in any of the included studies.

5.3 COST/ COST- EFFECTIVENESS

The Cochrane review by Conde-Agudelo and Diaz-Rosello JL reported on the overall cost for KMC in two studies. In the Cattaneo 1998 study, the overall cost was “about 50% less for KMC”. Specifically, it was US \$ 19,289 for KMC and US \$ 39,764 for conventional care. In the Sloan 1994 study, “costs of neonatal care were greater in control than in the KMC group”. Overall, when the available data at six month follow up for 49 infants (24 KMC, 25 controls) were evaluated, the cost of hospital stay and post-neonatal care at five months was US \$ 741 greater for the control group than KMC group.²

Broughton EI et al. conducted a cost analysis to assess the cost-savings of implementing KMC in Nicaragua, which included training, implementation and ongoing operating costs, and to estimate the economic impact on the health system if KMC were implemented in other maternity hospitals in the country. A pre/ post intervention approach was used whereby a total of 46 randomly selected infants before implementation were compared to 52 after implementation. The average costs for all drugs and infant formula were found to be US \$ 4.97 before KMC and US \$ 3.65 after KMC. The difference was due to lower cost for infant formula and medications in the post-KMC period. The total average cost of care for a neonate was US \$ 2,322 in the pre-KMC period and US \$ 1,808 in the KMC period. The largest part of these costs was training of three health professionals at the regional KMC training centre for 15 days. The combined cost, considered a single, fixed expense, was just over US \$ 23,000 but the amount of money saved with shorter hospitalisation, elimination of incubator use, and lower medication and infant formula costs would offset the cost of initial training and implementation of health workers and changes to the hospital system, thus compensating the expense, after treatment of 45 premature neonates or after one to two months of implementation. After 12 months, implementing KMC was projected to save more than US \$ 233,000. Expanding KMC to 12 other facilities was reckoned to save approximately US \$ 233,000 using the referral hospital incubator use estimate or around US \$ 166,000 with the more conservative incubator use in a year.¹

5.4 ORGANIZATIONAL IMPLICATION

Institutional readiness for the implementation of KMC covers the areas of physical, human and educational resources.¹¹ A review of education and training practices in the implementation of KMC across the world was discussed at the Seventh International Workshop on KMC in 2008, resulting in identification of and recommendations for some of the key implementation and training issues. Education and training in KMC should be based on the same basic understanding of the concept and accompanied by the creation of awareness, committed champions, multidisciplinary teamwork and continuous support from the authority.⁵

One way of initiating a policy of early discharge from hospital is to establish a KMC ward, where mothers' compliance to KMC rules can be monitored and other family members can be trained.⁴ One beneficial side effect of KMC has been the introduction of appropriate high-risk infant follow-up programs, usually up to one year of corrected age or longer, which have improved the survival and quality of life of these infants.⁸

The presence of committed individuals, who are knowledgeable about the benefits, practice and requirements of KMC, as agents of change is considered as a prerequisite for successful implementation. Three different functions were identified for role-players in the process of KMC implementation: drivers, trainers and implementers. Drivers take the initial initiative, support training and give guidance on implementation processes. Educators and trainers support the efforts of the drivers by spreading the message in different ways to different target audiences. The implementers are all the healthcare workers on the ground, who, as part of their job descriptions and daily activities, have to ensure that KMC is maintained and remains practised.

While KMC appears to be a simple method, it is far more complex than it appears at first and may require a mindset change for which planning, training and follow-through are needed. Misperceptions such as that the incubator is the only standard of care or that KMC is the cure-all in the care of premature babies should be addressed.⁵ Administrative recognition by having a policy in place and administrative support and encouragement are needed for optimal implementation.¹¹

Education and training needed to be planned at a national or regional level and systematic efforts are then made to bring KMC training to health workers from all or a selection of facilities in a particular country or region. Locally relevant educational models that also incorporate the universal aspects of KMC are consequently developed.⁵ Information about KMC should be included in the curricula of all health care professionals. All healthcare professionals, midwives, nurses and physicians working in the

antenatal, intranatal and neonatal care should be trained in the skills necessary to implement the KMC policy pertaining to their area of care.⁹ Teaching opportunities that have been used in KMC implementation initiatives include bedside teachings in the wards, journal clubs activities, educational bulletin boards, simulation and demonstration activities, newsletters summarising the latest evidence on KMC and printed cloth bearing KMC messages. By any means, the implementation pathways for KMC should be based on a multidisciplinary approach.⁵

Skepticism of healthcare providers regarding the benefits of KMC, reluctance to change existing arrangements, misperceptions about additional work for staffs and additional costs and fear about safety of the infant if more care responsibilities are given to the mother are among the common forms of resistance identified.⁵ KMC is considered by some as sub-standard care because it is perceived as a “poor man’s alternative for developing countries. Contrarily, KMC is actually based on sound scientific principles, has been properly evaluated and is also used in developed countries. KMC is also considered to represent extra work for staff whereby healthcare professionals perceive implementation and monitoring of the kangaroo position, kangaroo nutrition, early discharge from hospital and strict follow up as additional workload. Nonetheless, in-hospital KMC does not necessarily represent extra work but rather, a different or perhaps better way of performing tasks that are already normal components of good-quality in-hospital neonatal care. The main provider of the basic needs of an infant and the first-line monitor of the infant’s health status in the practice of KMC is the mother, who gradually yet progressively relieves healthcare personnel of many routine activities. The workload during this period is not new but parallels in-patient minimal care offered to stable premature or LBW infants who remain hospitalised until they meet predefined discharge criteria. Correspondently, subsequent follow-up of KMC infants is not qualitatively or quantitatively different from good quality clinical follow-up of preterm and LBW infants.⁴

There is almost always resistance to change when new practices are introduced. Additionally, institutional cultures vary and implementation plans often have to be adapted to local circumstances. Because attitude is may be slow to change, the repetition of important messages was deemed essential. The gradual introduction of KMC, supported by appropriate educational strategies, may lead to broader acceptance, less resistance and better results in the long term. The sustainability of centres of excellence as training facilities is largely dependent on the continuation of funding, whereby funding should be included in the government budget.⁵

5.5 LIMITATIONS

This technology review has several limitations. The selection of studies was done by one reviewer. Although there was no restriction in language during the search but only English full text articles were included in this report. Although the Cochrane systematic reviews included many studies, of which all are RCTs, and involved many subjects, the methodological quality of the included trials was mixed and there was high heterogeneity for some outcomes. On a similar note, certain outcomes in the systematic reviews were only measured in one or very few studies. Apart from that, some of the studies retrieved were observational studies, which are considered to have high risk of bias.

6. CONCLUSION

6.1 Effectiveness

- There was good level of evidence to demonstrate that KMC:
 - reduced the length of hospital stay by 2.2 days as compared to conventional care in stabilized LBW infants
 - increased breastfeeding rate, duration and exclusivity up to six months post-birth
 - promoted better infant growth compared to conventional hospital care
- There was limited good level of evidence to show that KMC benefited in better cardio-respiratory stability compared to conventional hospital care
- The evidence suggesting that KMC promoted normal thermoregulation was inconclusive. Babies with birth weight of less than 1500g, who require stable thermoregulation and environmental humidification were not well represented in the available studies.
- There was fair level of evidence to suggest that KMC improved maternal satisfaction and bonding/ attachment between mother and infant.

6.2 Cost/ Cost-effectiveness

A cost analysis conducted in Nicaragua found that the total average cost of care for a neonate before practising KMC was US \$ 2,322 and US \$ 1,808 in the KMC period. The largest expenditure was on training of health professionals but this cost is offset by the amount saved with shorter hospitalisation, elimination of incubator use, and lower medication and infant formula costs. Further well- designed economic evaluations are needed to assess the cost- effectiveness of KMC.

6.3 Safety

There were no reported adverse events or negative outcomes with KMC.

6.4 Organizational implication

Education and training in KMC should be based on the same basic understanding of the concept and accompanied by the creation of awareness, committed champions, multidisciplinary teamwork and continuous support from the authority. One way of initiating a policy of early discharge from hospital is to establish a KMC ward. The presence of committed individuals, who are knowledgeable about the benefits, practice and requirements of KMC, as agents of change is considered as a prerequisite for successful implementation. Misperceptions about KMC should be addressed. Information about KMC should be included in the curricula of all health care professionals. The gradual introduction of KMC, supported by appropriate educational strategies, may lead to broader acceptance, less resistance and better results in the long term.

7. REFERENCES

1. Broughton EL, Gomez J, Sanchez N et al. The cost-savings of implementing kangaroo mother care in Nicaragua. *Rev Panam Salud Publica*.2013;34(3):176-182
2. Conde-Agudelo A, Diaz-Rosello JL. Kangaroo mother care to reduce morbidity and mortality in low birthweight infants. *Cochrane Database of Systematic Reviews* 2014, Issue 4. Art. No.: CD002771.
3. Rangey PS, Sheth M. Comparative effect of massage therapy versus kangaroo mother care on body weight and length of hospital stay in low birth weight preterm infants. *Int J Paediatr*. 2014. Art ID 434060.
4. Charpak N, Ruiz-Pelaez JG. Resistance to implementing kangaroo mother care in developing countries, and proposed solutions. *Acta Paediatrica*.2006;95:529-534
5. Bergh AM, Charpak N, Ezeonodo A et al. Education and training in the implementation of kangaroo mother care. *SAJCH*.2012;6(2):38-45
6. Kangaroo mother care: a practical guide. Department of Reproductive Health and Research, World Health Organization 2003. Available at http://www.who.int/maternal_child_adolescent/documents/9241590351/en/ Accessed on 11/08/2014.
7. Jefferies AL. Kangaroo care for preterm infant and family. *Paediatr Child Health*.2012;17(3):141-143
8. Charpak N, Ruiz JG, Zupan J et al. Kangaroo mother care: 25 years after. *Acta Paediatrica*.2005;94:514-522
9. Nyqvist KH, Anderson GC, Bergman N et al. Towards universal kangaroo mother care: recommendations and report from the first European conference and seventh international workshop on kangaroo mother care. *Acta Paediatrica*.2010;99:820-826
10. Moore ER, Anderson GC, Bergman N et al. Early skin-to-skin contact for mothers and their healthy newborn infants. *Cochrane Database of Systematic Reviews* 2012, Issue 5. Art. No.: CD003519.
11. Ludington-Hoe SM, Morgan K, Abouelfettouh A. A clinical guideline for implementation of kangaroo care with premature infants of 30 or more weeks' postmenstrual age. *Advances in Neonatal Care*.2008;8(3S):S3-S23

12. Peinado M, Floren A. Powerpoint presentation on Kangaroo Mother Care. Available at <http://www.dominicankids.org/PDF/kangaroo-s.pdf> Downloaded on 11/08/2014.
13. Hake-Brookes SJ, Anderson GC. Kangaroo care and breastfeeding of mother-preterm infant dyads 0-18 months: a randomized controlled trial. Neonatal Network.2008;27(3):151-159
14. Heidarzadeh M, Hosseini MB, Ershadmanesh M et al. The effect of kangaroo mother care (KMC) on breast feeding at the time of NICU discharge. Iran Red Cres Med J.2013;15(4):302-306
15. Mitchell AJ, Yates C, Williams K et al. Effects of daily kangaroo care on cardiorespiratory parameters in preterm infants. J Neonatal Perinatal Med.2013;6(3):243-249
16. Samra NM, El Taweel A, Cadwell K. Effect of intermittent kangaroo mother care on weight gain of low birth weight neonates with delayed weight gain. J Perinat Educ.2013;22(4):194-200

8. APPENDIX

8.1 Appendix 1: LITERATURE SEARCH STRATEGY

Ovid MEDLINE® In-process & other Non-Indexed citations and OvidMEDLINE® 1948 to present
--

- 1 INFANT, PREMATURE/ (42819)
- 2 ((infant* or neonat* or babies) adj1 (prematu* or preterm)).tw. (37016)
- 3 INFANT, LOW BIRTH WEIGHT/ (15802)
- 4 ((low-birth-weight or low birth weight) adj1 (infant* or neonate* or babies)).tw. (8181)
- 5 KANGAROO-MOTHER CARE METHOD/ (91)
- 6 (care method* adj1 (kangaroo-mother or kangaroo mother)).tw. (3)
- 7 (care adj1 (kangaroo or kangaroo mother or kangaroo-mother or method* kangaroo-mother)).tw. (215)
- 8 1 or 2 or 3 or 4 (72945)
- 9 5 or 6 or 7 (281)
- 10 8 and 9 (205)
- 11 limit 10 to humans (192)

OTHER DATABASES	
EBM Reviews - Cochrane Central Register of Controlled Trials	} Same MeSH, keywords, limits used as per MEDLINE search
EBM Reviews - Cochrane database of systematic reviews	
EBM Reviews - Health Technology Assessment	
EMBASE	

PubMed

((((((((((((INFANT, PREMATURE[MeSH Terms]) OR INFANT, LOW BIRTH WEIGHT[MeSH Terms]) OR infant* premature[Title/Abstract]) OR premature infant*[Title/Abstract]) OR neonatal prematur*[Title/Abstract]) OR prematur* neonatal[Title/Abstract]) OR infant* preterm[Title/Abstract]) OR preterm infant*[Title/Abstract]) OR infant* low-birth-weight[Title/Abstract]) OR infant* low birth weight[Title/Abstract]) OR low-birth-weight infant*[Title/Abstract]) OR low birth weight infant*[Title/Abstract])) AND (((((((((((KANGAROO-MOTHER CARE METHOD[MeSH Terms]) OR care method* kangaroo-mother[Title/Abstract]) OR kangaroo-mother care method*[Title/Abstract]) OR kangaroo mother care method*[Title/Abstract]) OR care method* kangaroo mother[Title/Abstract]) OR method* kangaroo-mother care[Title/Abstract]) OR method* kangaroo mother care[Title/Abstract]) OR kangaroo-mother care[Title/Abstract]) OR care kangaroo-mother[Title/Abstract]) OR kangaroo mother care[Title/Abstract]) OR care kangaroo mother[Title/Abstract])

8.2 Appendix 2

DESIGNATION OF LEVELS OF EVIDENCE

- I Evidence obtained from at least one properly designed randomized controlled trial.
- II-1 Evidence obtained from well-designed controlled trials without randomization.
- II-2 Evidence obtained from well-designed cohort or case-control analytic studies, preferably from more than one centre or research group.
- II-3 Evidence obtained from multiple time series with or without the intervention. Dramatic results in uncontrolled experiments (such as the results of the introduction of penicillin treatment in the 1940s) could also be regarded as this type of evidence.
- III Opinions of respected authorities, based on clinical experience; descriptive studies and case reports; or reports of expert committees.

SOURCE: US/ CANADIAN PREVENTIVE SERVICES TASK FORCE (Harris 2001)

Evidence Table: Effectiveness

Question: How effective is KMC compared with conventional care?

Bibliographic citation	Study Type / Methodology	LE	Number of patients and patient characteristics	Intervention	Comparison	Length of follow up (if applicable)	Outcome measures/ Effect size	General comments
1. Moore ER, Anderson GC, Bergman N et al. Early skin-to-skin contact for mothers and their healthy newborn infants. Cochrane Database of Systematic Reviews 2012, Issue 5. Art. No.:CD003519	<p>Systematic review</p> <p>Objective: to assess the effects of early SSC on breastfeeding, physiological adaptation, and behaviour in healthy mother-newborn dyads</p> <p>Methods: Cochrane Pregnancy and Childbirth Group's Trials Register (November 2011) was searched. Personal contact with trialists was made, and bibliography on KMC maintained by Dr. Susan Ludington was consulted.</p> <p>Selection criteria: randomised controlled trials comparing early SSC with usual hospital care</p>	I	<p>34 RCTs involving 2177 participants were included.</p> <p>Types of participants: mothers and their healthy full term or late preterm (34 to less than 37 completed weeks' gestation) having early SSC starting less than 24hrs after birth, and controls undergoing standard patterns of care.</p> <p>30 studies included only healthy full term infants.</p> <p>4 studies were done with late preterm infants.</p>	Early SSC	Usual hospital care	NA	<p>i. breastfeeding rates</p> <ul style="list-style-type: none"> - more SSC dyads were still breastfeeding 1-4months post birth (average risk ratio (RR) 1.27, 95% CI 1.06 to 1.53, overall effect Z=2.60, P=0.0093) <p>ii. breastfeeding duration</p> <ul style="list-style-type: none"> - longer duration of breastfeeding in SSC dyads (mean difference (MD) 43days, 95% CI -1.69 to 86.79, P=0.059). After sensitivity analysis done with 1 study with inconsistent results removed, MD 64 days, 95% CI 37.96 to 89.5, Z=4.85, P<0.00001) <p>iii. breastfeeding exclusivity</p> <ul style="list-style-type: none"> - no difference in number exclusively breastfeeding at hospital discharge, at 1month post birth, and at 1year post birth - more SSC infants were exclusively breastfeeding up to 3 to 6 months post birth (RR 1.97, 95%CI 1.37 to 2.83, Z=3.65, P=0.00026) <p>iv. infant physiological outcome</p> <ul style="list-style-type: none"> - Bergman 2004: SSC infants had higher SCRIP scores 	<p>13 studies 702 dyads</p> <p>7 studies 324 dyads</p> <p>3 studies 149 dyads</p>

						<p>during 1st 6hrs post birth (MD 2.88, 95% CI 0.53 to 5.23, Z=2.4, P=0.016)</p> <ul style="list-style-type: none"> - SSC infants had lower mean heart rate 75min to 2hrs post-birth than control infants (MD -5.77, 95%CI -7.46 to -4.11) - SSC infants had lower mean respiratory rate 75min to 2hrs post-birth (MD -4.76, 95% CI -6.12 to -3.41) - Christensson 1992 &1995: infant axillary temperature 90mins to 2hrs post birth(RR 0.40, 95% CI 0.19 to 0.61 and RR 0.50, 95% CI 0.17 to 0.83 respectively) <p>v. length of hospital stay</p> <ul style="list-style-type: none"> - no difference between SSC and control groups of late preterm infants 34 to 36 wks gestational age (MD-95.30 hrs, 95% CI -368.50 to 177.89, Z=0.68, P=0.49) <p>vi. infant body weight change</p> <ul style="list-style-type: none"> - no difference between groups in body weight change day 14 post birth (MD -8.00grams, 95% CI-175.60 to 159.61, Z=0.09, P=0.93) <p>vi. maternal-infant bonding</p> <ul style="list-style-type: none"> - Bystrova 2003: no difference for maternal affective involvement at 12months post birth - SSC dyads appeared more mutual and reciprocal (MD 1.30, 95% CI 0.24 to 2.36, Z=2.40, P=0.017) 	<p>3 studies 183 infants</p> <p>4 studies 215 infants</p> <p>2 studies 42 infants</p> <p>2 studies 43 infants</p> <p>Full term infants</p>
--	--	--	--	--	--	--	--

						<p>v. other outcomes</p> <ul style="list-style-type: none"> - mothers who held their infants in SSC indicated a strong preference for the same type of post delivery care in the future compared to mothers who held their infants swaddled (86% vs 30%, RR 2.82, 95% CI 2.08 to 3.82) - Mothers who held their infants SSC displayed less anxiety day3 post birth (MD-5.00, 95% CI-9.00 to -1.00) <p>Authors' conclusion: Limitations included methodological quality, variations in intervention implementation and outcomes. The intervention appears to benefit breastfeeding outcomes and cardio-respiratory stability and decrease infant crying, and has no apparent short or long term negative effects. Further investigation is recommended. To facilitate meta-analysis, future research should be done using outcome measures consistent with those in the studies included here. Published reports should clearly indicate if the intervention was SSC with time of initiation and duration and include means, standard deviations and exact probability values.</p>	<p>Full term infants</p>
--	--	--	--	--	--	---	--------------------------

Evidence Table : Safety

Question: How safe is water birth compared with conventional delivery?

Bibliographic citation	Study Type / Methodology	LE	Number of patients and patient characteristics	Intervention	Comparison	Length of follow up (if applicable)	Outcome measures/ Effect size	General comments
2. Conde-Agudelo A, Diaz-Rosello JL. Kangaroo mother care to reduce morbidity and mortality in low birthweight infants. Cochrane Database of Systematic Reviews 2014, Issue 4. Art. No.: CD002771.	<p>Systematic review</p> <p>Objective: to determine whether there is evidence to support the use of KMC in LBW infants as an alternative to conventional neonatal care</p> <p>Search methods: The standard search strategy of the Cochrane Neonatal Group was used, including searches in MEDLINE, EMBASE, LILACS, POPLINE, CINAHL databases (all from inception to March 31, 2014) and the Cochrane Central Register of Controlled Trials. In addition, web page of the Kangaroo Foundation, conference and symposia proceedings on KMC, and Google scholar were searched.</p> <p>Selection criteria: randomized controlled trials comparing KMC</p>	I	<p>18 RCTs involving 2751 infants were included.</p> <p>Types of participants: LBW infants (defined as birthweight less than 2500g) regardless of gestational age.</p> <p>16 studies evaluated KMC in LBW infants after stabilisation.</p> <p>1 study evaluated KMC in LBW infants before stabilisation.</p> <p>1 study evaluated early onset KMC vs late onset KMC in relatively stable LBW infants</p>	KMC	Conventional neonatal care	NA	<p>i. mortality</p> <ul style="list-style-type: none"> - significant reduction in the risk of mortality at discharge or 40-41wks' postmenstrual age (RR 0.60, 95% CI 0.39 to 0.92) and at latest follow up (RR 0.67, 95% CI 0.48 to 0.95) - no overall difference in risk of mortality at 6mths of age or 6mths follow up, and at 12mths corrected age <p>ii. infection/ illness</p> <p>in stabilised infants, KMC was associated with significant reduction in:</p> <ul style="list-style-type: none"> - severe infection/ sepsis at latest follow up (RR 0.56, 95% CI 0.40 to 0.78), - severe illness at 6mths follow up (RR 0.30, 95% CI 0.14 to 0.67), - nosocomial infection/ sepsis at discharge or 40-41wks' postmenstrual age - lower respiratory tract disease at 6mths follow up (RR 0.37, 95% CI 0.15 to 0.89) - hypothermia at discharge or 40-41wks' postmenstrual age (RR 0.34, 95% CI 0.17 to 0.67) - no overall difference in risk of mild/ moderate infection or illness at latest follow up <p>iii. length of hospital stay</p>	<p>8 studies 1736 infants, and 11 studies 2167 infants</p> <p>7 studies 1343 infants 1 study 283 infants</p> <p>3 studies 913 infants</p> <p>1 study 283 infants</p> <p>6 studies 698 infants</p>

	<p>vs conventional neonatal care, or early onset KMC (starting within 24hrs after birth) vs late onset KMC (starting after 24hrs after birth) in LBW infants.</p>					<ul style="list-style-type: none"> - decreased by 2.2days (95% CI 0.6 to 3.7) with intermittent KMC <p>iv. infant growth KMC infants gained more</p> <ul style="list-style-type: none"> - Weight per day (MD 3.7g, 95% CI 1.9 to 5.6, Z=4.03, P<0.0001) - Length per week (MD 0.29cm, 95% CI 0.27 to 0.31, Z=29.15, P<0.00001) - Head circumference per week (MD0.18cm, 95% CI 0.09 to 0.27, Z=3.91, P=0.000092) <p>v. breastfeeding</p> <ul style="list-style-type: none"> - increased likelihood of exclusive breastfeeding at discharge or 40-41wks' postmenstrual age (RR 1.20, 95% CI 1.07 to 1.34) and at 1-3mths follow up (RR 1.20, 95% CI 1.01 to 1.43), or any breastfeeding at discharge or 40-41wks' postmenstrual age (RR 1.20, 95% CI 1.06 to 1.36) and at 3mths follow up (RR 1.14, 95% CI 1.06 to 1.23) - no difference at 6-12 months follow up and onset of breastfeeding <p>vi. maternal satisfaction</p> <ul style="list-style-type: none"> - mothers of the KMC group were more satisfied with the method of care than mothers of the control group (91% vs 78%, RR 1.17, 95% CI 1.05 to 1.30) <p>vii. mother-infant attachment/ interaction</p> <ul style="list-style-type: none"> - Charpak 1997: significant higher scores in KMC group for scores in mother's sense of 	<p>10 studies 931 infants</p> <p>10 studies 1072 infants 2 studies 251 infants</p> <p>3 studies 369 infants</p> <p>5 studies 1333 dyads</p> <p>5 studies 600 dyads</p> <p>9 studies 1576 dyads</p> <p>5 studies 924 dyads</p> <p>1 study 269 mothers</p>
--	---	--	--	--	--	---	--

						<p>competence, mother's feelings of worry and stress, mother's sensitivity and infant responsiveness</p> <ul style="list-style-type: none"> - Gathwala 2008: higher attachment scores at 3months follow up in KMC group (MD 6.24, 95% CI 5.57 to 6.91, Z=18.18, P<0.00001) - Roberts 2000: score on "relationship with the infant" was significantly higher in the KMC group (MD 1.00, 95% CI 0.35 to 1.65, Z=3.02, P=0.0025) - Neu 2010: dyads in KMC group showed more symmetrical and less asymmetrical coregulation than control, but multivariate analysis showed no significant difference <p>viii. early vs late onset KMC (Nagai 2010)</p> <ul style="list-style-type: none"> - no difference in mortality at 4wks' age and at 6mths' age, and in morbidity, severe infection, exclusive breastfeeding and weight gain at 4 weeks' age - significant reduction in body weight loss from birth to 48hrs (MD 43.3g, 95% CI 5.5 to 81.1, Z=2.24, P=0.025) and in length of hospital stay (MD 0.9 days, 95% CI 0.6 to 1.2, Z=5.16, P<0.00001) - non-significant increase in likelihood of exclusive breastfeeding at 6months' age 	
--	--	--	--	--	--	---	--

							<p>Authors' conclusion: The evidence from this updated review supports the use of KMC in LBW infants as an alternative to conventional neonatal care mainly in resource-limited settings. Further information is required concerning effectiveness and safety of early onset continuous KMC in unstabilised or relatively stabilised LBW infants, long term neurodevelopmental outcomes, and costs of care.</p>	
--	--	--	--	--	--	--	---	--

Evidence Table: Safety

Question: How safe is water birth compared with conventional delivery?

Bibliographic citation	Study Type / Methodology	LE	Number of patients and patient characteristics	Intervention	Comparison	Length of follow up (if applicable)	Outcome measures/ Effect size	General comments
3. Hake-Brookes SJ, Anderson GC. Kangaroo care and breastfeeding of mother-preterm infant dyads 0-18 months: a randomized controlled trial. Neonatal Network.2008; 27(3):151-159	<p>Randomised controlled trial</p> <p>Purpose: to determine the effects of kangaroo care (KC) on breastfeeding status in mother-preterm infant dyads from postpartum through 18months</p> <p>Computerised minimisation method was used.</p> <p>Mothers in KC group were encouraged to experience KC with their infants as soon as possible postbirth and as often as possible and for as long as possible each time.</p> <p>All infants, regardless of group, received standard medical and nursing care. Postpartum nurses, as well as lactation consultants when available, provided breastfeeding assistance to mothers in both groups at mother's request.</p>	II-1	<p>- 66 mother-infant dyads</p> <p>Inclusion criteria for infants:</p> <ul style="list-style-type: none"> - Apgars of 6 or more at 5mins - 1300-3000g at birth - 32-36 completed weeks gestation - Healthy enough to experience KC 	Kangaroo care (KC)	Standard nursery care	<p>The in-hospital phase lasted 5days or until the infant was discharged, whichever occurred first.</p> <p>Follow-up assessment were done at 6wks, 3,6,12 and 18months</p>	<p>Breastfeeding exclusivity</p> <ul style="list-style-type: none"> - KC dyads showed greater breastfeeding exclusivity over time, from hospital discharge through 18mths, p=0.047 - Difference was statistically significant at 6mths, p=0.041 - Higher percentage of KC dyads breastfed at full exclusivity in the first four of the six time points (up to 6mths) - No dyads in either group were breastfeeding exclusively at 12 or 18mths <p>Breastfeeding duration</p> <ul style="list-style-type: none"> - KC dyads breastfed significantly longer than control dyads, 5.08 months vs 2.05 months, p=0.003 	

Evidence Table: Safety

Question: How safe is water birth compared with conventional delivery?

Bibliographic citation	Study Type / Methodology	LE	Number of patients and patient characteristics	Intervention	Comparison	Length of follow up (if applicable)	Outcome measures/ Effect size	General comments
<p>4. Samra NM, El Taweel A, Cadwell K. Effect of intermittent kangaroo mother care on weight gain of low birth weight neonates with delayed weight gain. J Perinat Educ.2013;22(4):194-200</p>	<p>Nonrandomised controlled, quasi-experimental design</p> <p>Objective: to evaluate intermittent KMC on weight gain of LBW neonates with delayed weight gain</p> <p>Parents of 40 LBW infants (birth weight <2500g) consented to participate.</p> <p>Study started at day 8 postnatal.</p> <p>In KMC group, intermittent KMC began twice daily, 7 days per week, for at least 1hr.</p> <p>Weight without clothes for all babies was measured 3x/day using an electronic scale by the same investigator.</p>	<p>II-2</p>	<p>40 LBW infants</p> <ul style="list-style-type: none"> - 22 KMC group, 18 control group -admitted to NICU in the first day of life - Preterm LBW: born less than 37 weeks' gestational age - birth weights appropriate for gestational age (AGA) - weight loss of 10-30% of birth weight during first week -- generally stable and met criteria for discharge except for not starting weight gain until day 7 	<p>KMC</p>	<p>Routine NICU care</p>	<p>From day 8 postnatal until babies regained their birth weight</p>	<p>The mean postnatal age at which the babies regained their birth weight was significantly less in the KMC group, (day 15 -17 vs day 20-30, p<0.001)</p> <p>The mean daily weight gain was significantly higher in the KMC group compared to the control group. (20-28g vs 8-15g, p<0.001)</p>	

Evidence Table: Safety

Question: How safe is water birth compared with conventional delivery?

Bibliographic citation	Study Type / Methodology	LE	Number of patients and patient characteristics	Intervention	Comparison	Length of follow up (if applicable)	Outcome measures/ Effect size	General comments
<p>5. Heidarzadeh M, Hosseini MB, Ershadmanesh M et al. the effect of kangaroo mother care (KMC) on breast feeding at the time of NICU discharge. Iran Red Cres Med J.2013;15(4):302-306</p>	<p>Cross sectional study</p> <p>Objective: to evaluate the effects of KMC on exclusive breastfeeding at the time of discharge</p> <p>251 premature newborns admitted to NICU between May 2008 and May 2009 were evaluated.</p> <p>Mothers who performed KMC were included in KMC group, and those who did not were allocated in the conventional method care (CMC) group.</p> <p>A semistructured questionnaire, pregnancy history and the socioeconomic status were filled by mothers Data about the infant's feeding and weight during hospital stay were collected from medical records.</p> <p>Duration of KMC was at least 1-3 hrs, repeated at least 3x a day.</p>	<p>II-3</p>	<p>251 premature newborns</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> - At least 28 weeks' gestational age - Newborn that breastfed or had parenteral nutrition - Newborn that used mechanical ventilation with stable situation 	<p>KMC</p>	<p>CMC</p>	<p>NA</p>	<p>KMC group had more exclusive breastfeeding at the time of hospital discharge than CMC group (62.5% vs 37.5%, p=0.00)</p> <p>KMC group had higher breastfeeding rate (exclusive and mixed) than CMC group (97.9% vs 46.4%).</p> <p>There was 4.1 time increase in exclusive breastfeeding by KMC.</p>	

Evidence Table: Effectiveness

Question: How effective is KMC compared with conventional care?

Bibliographic citation	Study Type / Methodology	LE	Number of patients and patient characteristics	Intervention	Comparison	Length of follow up (if applicable)	Outcome measures/ Effect size	General comments
6. Mitchell AJ, Yates C, Williams K et al. Effects of daily kangaroo care on cardiorespiratory parameters in preterm infants. J Neonatal Perinatal Med.2013;6 (3):243-249	<p>Randomised controlled trial</p> <p>Objective: to compare bradycardia and desaturation events in preterm infants in kangaroo care (KC) versus standard incubator care (SC)</p> <p>In the KC group, mothers (or fathers) held infants skin-to-skin in an upright position on the chest for 2hrs/ day. Infants wore knitted caps, covered over the back with blankets to maintain warmth, temperature monitored every 30mins during holding. There was continuous monitoring of HR, RR and sPO2. During remaining 22hrs of the day, infants received routine positioning.</p> <p>In SC group, infants were cared for in incubators as usual, but could be held skin-to-skin for a maximum 15mins daily at parent's request.</p>	II-1	<ul style="list-style-type: none"> - 38 infants, 19 kangaroo care, 19 standard incubator care - 27 to 30 weeks gestational age - Weighed at least 1000g - Were receiving caffeine 6mg/kg - Were receiving nasal CPAP or nasal cannula 	Kangaroo care	Standard incubator care	5 days, from days of life 5 to 10	<p>Frequency of bradycardia and O2 desaturation were summarised using the mean number of events per hour.</p> <p>Overall effect of treatment group, Bradycardia, p=0.02 O2 desaturation, p=0.0015</p> <p>Significant differences for infants within KC group; fewer bradycardia events, (p=0.048) and O2 desaturation events (p=0.017) when being held compared to when they were in incubator</p>	

Evidence Table: Safety

Question: How safe is water birth compared with conventional delivery?

Bibliographic citation	Study Type / Methodology	LE	Number of patients and patient characteristics	Intervention	Comparison	Length of follow up (if applicable)	Outcome measures/ Effect size	General comments
<p>7. Broughton EL, Gomez J, Sanchez N et al. The cost-savings of implementing kangaroo mother care in Nicaragua. Rev Panam Salud Publica.2013;34(3):176-182</p>	<p>Pre/ post- intervention study</p>	<p>-</p>	<p>46 randomly selected infants before implementation were compared to 52 after implementation.</p>				<p>average costs for all drugs and infant formula were US\$ 4.97 before KMC and US \$ 3.65 after KMC. The difference was due to lower cost for infant formula and medications in the post-KMC period.</p> <p>The total average cost of care for a neonate was US \$ 2,322 in the pre-KMC period and US \$ 1,808 in the KMC period. The largest part of these costs was training of three health professionals at the regional KMC training centre for 15 days.</p> <p>The combined cost, considered a single, fixed expense, was just over US \$ 23,000 but the amount of money saved with shorter hospitalisation, elimination of incubator use, and lower medication and infant formula costs would offset the cost of initial training and implementation of health workers and changes to the hospital system, thus compensating the expense, after treatment of 45 premature neonates or after one to two months of implementation.</p> <p>After 12 months, implementing KMC was projected to save more than US \$ 233,000.</p> <p>Expanding KMC to 12 other facilities was reckoned to save approximately US \$ 233,000 using the referral</p>	

							hospital incubator use estimate or around US \$ 166,000 with the more conservative incubator use in a year	
--	--	--	--	--	--	--	--	--