

Recommendations for the implementation of Kangaroo Mother Care for low birthweight infants

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Good quality care of low birth weight infants could reduce neonatal mortality in low-income countries, but the technologies used in rich countries are inappropriate. Kangaroo Mother Care does not need expensive and sophisticated equipment, and for its simplicity it can be applied almost everywhere, including peripheral maternity units of very low-income countries. Kangaroo Mother Care (KMC) can also contribute to the humanization of neonatal care and to better bonding between mother and baby in both poor and rich countries. A group of health professionals with experience in KMC met in a workshop to discuss its effectiveness, safety, applicability and acceptability in different settings: from first and second level maternity units in settings with very limited resources, to second and third level units in settings with limited resources, to second and third level maternity and neonatal care units in settings with ample resources and infant mortality rates < 15/1000. The paper summarizes the recommendations of this group of health professionals for the implementation of KMC in these various settings, together with suggested research priorities. = *Lull, Jirf/m'eight i/(fat)Ts. Kangaroo MOTHER Care*

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Kangaroo mother care (KMC) is defined as early, prolonged and continuous (as allowed by circumstances) skin-to-skin contact between a mother and her newborn low birth weight infant (LBWI), both in hospital and after early (depending on circumstances) discharge, until at least the 40th week of post-natal gestational age, with ideally exclusive breastfeeding and proper follow-up. Since its first description in 1983 (1), KMC has been extensively studied but seldom in controlled trials. Two published trials from industrialized countries (2, 3), though conducted on a small number of subjects and with skin-to-skin contact

limited to 1-3 h/d, showed that KMC is safe in terms of physiologic response and offers some benefits in terms of

prevalence and duration of breastfeeding, reduced hospitalization, and reduced crying at 6 months. Two trials from developing countries, the first a randomized trial (4) and the second a two-cohort study (5) showed that KMC, after initial stabilization, is safe in terms of mortality and may reduce severe morbidity, with fewer readmissions. KMC offers other benefits: (i) it reduces the need for expensive and sophisticated equipment, often inappropriate in low-income countries—its simplicity means that it can be applied almost everywhere, including very peripheral maternity units; (ii) it reduces the need for skilled personnel and it concentrates the attention of available health professionals on essential components of newborn care such as thermal control, early mother-baby contact and breastfeeding; (iii) it contributes to the humanization of neonatal care and to better bonding between the mother and her LBWI; and (iv) it allows mothers to become competent and confident in the care of their newborn babies both in hospital and at home.

For these features and the potential for cost containment, KMC is now widely practised in many developed and developing countries. This paper summarizes the recommendations of a group of 36 health professionals from 15 countries of Africa, Asia, Europe and North and South America (see Appendix) who attended a workshop in Trieste, Italy, from 14 to 26 October 1996. After the presentation and discussion of preliminary results from several studies, of summary results from completed and published studies, and of experiences from different sites, the workshop participants split into three groups to reach a

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consensus on the implementation of KMC in three different settings:

(i) *first and second level maternity units in settings with very limited resources*: these are usually rural hospitals or health centres in low-income countries, without equipment and supplies for the care of LBWI, without postgraduate doctors or with no doctors at all, and most often staffed only by a small number of skilled nurses or midwives. In these facilities, newborn infants are usually kept with their mothers and are discharged early. Exclusive breastfeeding is the rule.

(ii) *Second and third level maternity units in settings with limited resources*: this group includes most district and provincial hospitals in several countries, but only a small number of urban tertiary care hospitals in very low-income countries, with the number of deliveries ranging from few hundred to several thousands per year. A common feature is the availability of skilled personnel (specialist nurses and midwives, paediatricians, obstetricians, or at least very experienced physicians) and of basic equipment and supplies for the care of LBWI (incubators, radiant warmers, oxygen therapy, drugs, CPAP and, some times, ventilators). Staff and equipment, however, do not meet all of the needs. The equipment may be subject to frequent breakdowns, power cuts and lack of maintenance and spare parts; the presence of competent physicians may be restricted to a few hours per day. The result is suboptimal care: > 1 baby per incubator, limited hygiene, inadequate thermal control, insufficient clinical surveillance and followup. In these settings, LBWI are often kept in nurseries and have limited contact with their mothers. Exclusive breastfeeding is insufficiently promoted; formula feeding with a bottle or a gastric tube is the usual feeding pattern.

(iii) *Second and third level maternity and neonatal care units in settings with ample resources and infant mortality rates < 15/1000*: these are health facilities with adequate human, material and financial resources for highly sophisticated neonatal care. These hospitals are rarely found in developing countries, but are common in industrialized countries. The availability of expensive technology and sophisticated neonatal care results in low levels of neonatal mortality, even in very LBWI, but is not usually complemented by humanization of care. This often implies a limited contact between mothers and infants, even over long periods of time, formula feeding with bottle or gastric tube plus parenteral nutrition, and a difficult shift to breastfeeding, if any, around discharge.

Recommendations

KMC in first and second level maternity units in settings with very limited resources

It seems useful to establish different birthweight cut-offs for the care of LBWI in these settings: 2:1800 g, between 1200 and 1799 g and < 1200 g. Should a scale be unavailable, birth weight could be estimated by the use of surrogates (e.g. chest circumference) or LBWI could more simply be

grouped into three categories (large, small and very small) by their appearance. The problems, the type of care and the role and possible benefits of KMC differ considerably in these three groups.

Large LBWI, or birthweight 1800-2499g.

In this group, prematurity-related problems, such as respiratory distress syndrome (RDS), are uncommon and most deaths are due to asphyxia or infections, with hypothermia and hypoglycaemia contributing an important role. Because KMC improves bonding (6), promotes breastfeeding (3), and facilitates thermal control (7), it can help decrease the high levels of neonatal mortality and morbidity observed in this group (8). This is particularly true in settings where neonatal hypothermia is common, i.e. in many more settings than previously thought (9, 10). KMC in these circumstances can be used also for re-warming mildly or moderately hypothermic newborn infants (11); it is also the best method available for transport (within facilities, between facilities and between homes and facilities) when needed (12). KMC can result in considerable savings and more efficient use of staff time, for regular assessment of the baby and support to mothers, and it can

help enact a more human approach to birth care. Because of its effect on breastfeeding and on the confidence of mothers to deal with small babies, KMC usually allows an earlier and safer discharge from hospital, and it improves the perspective for survival and growth.

Small LBWI, or birthweight 1200-1799 g. In this group, the size and importance of prematurity related problems, and in particular of RDS, depend on the premature-to-SGA ratio existing in each specific population, and are usually much greater than in the previous group. The potential of KMC to reduce mortality and morbidity is likely to be optimal in LBWI of 2:32 weeks of gestational age. Regular reassessment by trained staff of how these infants breathe, feed and maintain their temperature is needed. When infants are observed to do well, KMC can be implemented and continued as for larger babies with the same advantages. When infants present breathing or feeding problems, there is no evidence that KMC alone will help. If at all possible, these LBWI should be transferred to a higher level of care, where more skilled staff and better equipment (incubators and CPAP) is available. If referral is impossible, for reasons ranging from cost to distance and to parental rejection, or does not guarantee a higher level of care, these LBWI may have to be cared for with KMC at the first level hospital or facility. There is no evidence, however, to suggest that KMC alone will increase survival or reduce morbidity in this subgroup of LBWI with breathing or feeding problems.

Very small LBWI or birthweight <1200 g. In this group, morbidity and mortality are extremely high and prematurity related problems are the most important causes of death. Though there are some reports of good outcome (8), there is no evidence that KMC at birth for

these newborn infants at this level of care will reduce mortality and morbidity. These LBWI should therefore be transferred, if possible, to a second or third level hospital for specialized care; if possible, referral should even precede birth (transport *in Utero*). If referral is impossible, or if the referral hospital is unable to provide specialized care, these LBWI may have to be kept at the first level hospital or facility. Although some of these infants may survive, there is no evidence that survival will in general increase with KMC. Many of these LBWI

will die if kept at this level, irrespective of the method of care. As this will happen at the mother's breast if KMC is adopted, operational research should be carried out on the acceptability of such an event in any given society, before issuing guidelines. Those infants who survive will progressively move into the previous two groups.

KMC in second and third level maternity units in settings with limited resources-

In these settings, despite the availability of some human and material resources, neonatal mortality may be relatively high, even in relatively mature newborn infants (2.: 1800 g), because of overcrowding, inadequate thermal control (13), hospital infections, breakdowns or improper use of equipment and insufficient surveillance and follow-up. The practice of separating the mother from her baby jeopardizes bonding and breastfeeding, thus decreasing the chances of survival after discharge. Despite the need for more evidence on specific research issues, this is the kind of setting for which more data are available (4,5, 14). These data show that KMC can decrease morbidity and improve the wellbeing of LBWI, during hospital stay and after discharge, by preventing hypothermia and infections,

by promoting earlier establishment and continuation of breastfeeding, and by substantially increasing the ability and self-confidence of mothers in taking care of their babies. KMC is well accepted by mothers and staff and it can decrease the cost of hospital care for LBWI. The extent to which KMC is applicable varies with birthweight and gestational age, but in these settings KMC is indicated for all preterm and LBWI, from about 32 weeks of gestational age onwards. Even newborn infants <32 weeks of gestational age can be put on KMC, after proper stabilization of the vital functions requiring usually between one and five days. The criteria for stabilization should be defined in any given

setting and will depend on the skills and competence of staff, and on the 'availability of equipment. The criteria for eligibility to KMC can be very broad. All LBWI can be placed on KMC provided they are free of severe disease or malformation, are able to breath autonomously, and the mother or a relative is available (alive, not severely ill, in the hospital, willing to collaborate, supported by the family).

KMC in second and third level maternity units in settings with ample resources.

In these settings, KMC promotes breastfeeding (3, 15),

provides effective thermal control (2, 16), has no adverse effect on energy expenditure (17), enhances physical growth (15), allows a quicker adaptation to extrauterine life (18), and contributes to humanization of neonatal care. In addition, KMC empowers the mother by involving her as the central person in the caring process and by improving her overall competence and confidence (19, 20), and fosters the adaptation and progress of a family in which a premature birth occurred. Finally, KMC might result in dramatic cost savings for high technology neonatal intensive care units; this is an important benefit in times of limited resources and rationing of health care (21). In these settings, KMC can be applied to LBWI of any post-conceptual age from 28 weeks onward, of any gestational age, of any weight (as low as 600 g), including sick newborn infants, as tolerated by the mother-infant dyad, by the family and by the healthcare system (3, 22-26). KMC should be offered to all mothers of LBWI and is likely to be particularly beneficial for adolescent mothers and for those with

social risk factors. KMC can be applied throughout all phases of hospitalization (27), during the stabilization period, that might be shortened, during the transition period, while the newborn infant is growing, and just before discharge; it can also be continued after discharge. KMC should last as much as possible during the day and for as long as possible; when skin-to-skin contact can not be continuous, it should be as frequent as possible, provided each contact lasts more than 60 minutes to avoid an excess of manipulation. Contraindications of KMC include: instability of the vital functions (in this case LBWI can be progressively "weaned" to KMC while the vital functions stabilize), extremely low birthweight (in this case KMC can be started after the first week of life), and critical phase of an acute illness or acute exacerbation of an underlying illness

(in this case specific treatment should get priority over KMC). Other possible contraindications include necrotizing enterocolitis, chest tubes, pulmonary hypertension and persistent foetal circulation, therapy with vasopressors, the "weaning" phase after intensive care, and newborn infants who do not tolerate being moved in and out of KMC.

Requirements

Irrespective of the setting and of available resources, there are five groups of critical requirements for the implementation of KMC.

Information and support to mothers

The mother must be available and willing to participate. The decision to adopt KMC must be taken by consensus between the mother and the family on one side and the physician and nurses on the other. Mothers should be properly informed and adequately instructed. If possible, all women attending antenatal care, or at least those who are at risk for a premature delivery, should be informed that this is the policy of the hospital for LBWI. There should be

an open-door policy for relatives, adequate room space, a comfortable chair for each mother (if possible with an adjustable back), full eating and bathroom facilities, and some recreation. Mothers can be replaced, when they need to separate from their babies and for variable periods of time, by any family member, such as the father or the grandmother, or a close friend (28). The KMC programme should consider that mothers need psychological, social and educational support not only during hospitalization, but also after discharge (4, 5). The long period in hospital and the repeated contacts after discharge should be used by the health personnel to teach mothers and their families not only the skills of KMC itself, but also the abilities involved in all aspect of infant health care. In addition, the KMC programme should set up a system by which the target mothers can have quick and direct contact with a trained provider whenever they need it.

Training of health personnel

The number and type of staff available does not affect the possibility of implementing KMC, provided there is mutual agreement among all the personnel involved and between them and the mothers, and provided an adequate training and education programme is in place. Ideally, there should be a written hospital (or national) policy and guidelines. The hospital should administer a course to the staff and should repeat it for newly recruited health professionals. The staff should be able to monitor or regularly reassess the clinical conditions of LBWI, in particular breathing, feeding, temperature, and the passing of urine; it should also be able to provide the necessary support to mothers. In-service training of health professionals on KMC, breastfeeding and thermal control should be carried out in every hospital where LBWI are cared for. In addition, staff should have good knowledge of infant development and the relative care, and on how to provide encouragement and support. The information on the advantages of KMC and on its use in the hospital should be conveyed also to all the other staff, in particular to those involved in MCH and antenatal care. As soon as possible, nursing and medical schools should include KMC in their curricula. Continuing education is needed in addition to initial training.

Skin-to-skin contact and thermal control

Continuous and prolonged skin-to-skin contact between the mother and the baby should be ensured to the greatest possible extent during day and night. The baby should stay in an upright or semi-oblique position between the mother's breasts, with a secure ventral contact. The baby should be naked except for the napkin, a hat and socks, when the room temperature is $>20^{\circ}\text{C}$, and covered by a cotton sleeveless shirt when the room temperatures falls to $<20^{\circ}\text{e}$. The KMC hospital room where the mother and newborn infant stay should be heated at a temperature of at least 20°C if the environmental temperature is lower.

Complementary methods of thermal control, such as a warm room, should be used where needed.

Breastfeeding

The promotion of breastfeeding is an essential part of the KMC programme. Breastfeeding should be included in the general policy of the hospital and should be promoted with all mothers. The hospital staff will make sure that every mother involved in KMC be able to express breast-milk, store expressed breast-milk, breastfeed her preterm or LBWI, maintain exclusive breastfeeding (whenever possible and safe) at regular intervals during day and night, appropriately feed the baby with a cup, a spoon or a dropper if needed. Exclusive breastfeeding is the rule, but it depends on the regular assessment of weight and height gains during follow-up, both in hospital and after discharge. In cases of insufficient weight gain $\approx 10\text{-}15\text{ g/kg/d}$ and after ruling out other causes of failure to thrive, a supplement with preterm formula should be given, if available, by cup or spoon to obtain an adequate nutrition. Breastfeeding promotion is crucial for newborn care, in particular when caring for sick and/or fragile infants, but attaining an appropriate weight gain in LBWI must get priority over the golden rule of maintaining exclusive breastfeeding. Expressed breast-milk should be used before the development of adequate sucking ability; placing the newborn infant in KMC during tube feeding, with the mouth very close to the mother's nipple, will facilitate lactation, the letdown reflex, and the infant's ability to breastfeed. Newborn infants who are still unable to suck can also start on KMC, as this will stimulate their sucking ability and facilitate the early initiation of breastfeeding. Newborn infants who are unable to feed, e.g. ventilated infants, will initially be fed on expressed breastmilk using any method considered appropriate (cup, spoon, dropper, syringe, tube), except a bottle; direct breastfeeding will be progressively started as soon as the baby shows sucking ability. The staff should have extra training on breastfeeding for LBWI, in particular concerning stimulation of breastfeeding, expression and conservation of breast-milk, mode of administration of expressed breast-milk, and daily monitoring of growth. Simple breastfeeding on demand is inadequate for LBWI, and the staff should know how to implement a breastfeeding programme that keeps into consideration the nutritional needs of each baby. The staff should also have the knowledge and skills to decide when and how to supplement breastfeeding with preterm formula or another suitable supplement (vitamins, micronutrients, preterm formula), if they are available.

Discharge

A LBWI with KMC can be discharged from the hospital when the following criteria are met: the baby is able to suck on the breast and to swallow adequately, the baby is thriving and is definitely gaining weight (and has at least recovered its birthweight), its temperature is stable in the

kangaroo position, and the mother is able to care for the baby at home and to come for follow-up. If the mother can not ensure an adequate follow-up, the discharge weight of the baby should be 2: 1500 g. If these criteria are fulfilled, the baby can be discharged in the kangaroo position and with the recommendation to use hat and socks. Mothers should be taught to use an elevated sleeping position while on KMC. The follow-up should be hospital-based and should provide infants with the best paediatric care available in each setting until a post-conceptual age of at least 40 weeks. Later on, the baby will join the normal follow-up programme for high-risk infants. The organization of a proper follow-up is part of the KMC programme and must be integrated into each locally developed policy, with clinics that give priority to booked LBW! visits. A support structure in the community made up of experienced nurses and mothers with previous KMC experience would be an important asset.

Research needs

More research is needed on the effectiveness and safety of KMC as a means to stabilize premature and LBWI just after birth. Some health system research is needed on the applicability of KMC in different settings (e.g. on cultural and managerial barriers that may hinder its implementation). But the two most important topics for research regard KMC at birth for very LBWI in first and second level maternity units in settings with very limited resources, and KMC for home deliveries not assisted by trained personnel. Though there is evidence that KMC is beneficial for LBW! born and assisted in hospitals, there is no clear scientific evidence that this is also true for home deliveries. Studies on KMC for the home care of LBWI who are born at home and cannot be taken to hospitals would be welcome, keeping into account local cultures and current local activities to improve birth care at home. More evidence of the advantages of KMC over other methods of care appears to be needed on KMC in LBWI <30 weeks of post-conceptual age, <32 weeks of gestational age, <1000 g of birthweight, and in newborn infants who are critically ill. Research is also needed on methods of breastfeeding and feeding supplements in LBWI <32 weeks of gestational age, on thermal control provided by skin-to-skin contact between a LBWI and a male member of the family, or a female who has not recently given birth, as episodes of hyperthermia have been reported in these cases (28), on the effect of combining KMC, warmed humidified oxygen and non-nutritive suckling on LBWI with grunting and/or tachypnea, and on the cost/benefit ratio of KMC, including direct and indirect costs and intangible benefits.

Conclusions

The results of the studies presented at the workshop, combined with those from previous studies, show that KMC

can decrease morbidity and improve the wellbeing of LBWI by preventing hypothermia and infections, by promoting earlier establishment and continuation of breastfeeding, and by substantially increasing the ability and self-confidence of mothers in taking care of their babies. If widely implemented, KMC has the potential to improve the health and survival of LBWI, particularly in settings with limited resources; but benefits to both mothers and babies can be obtained also in settings where expensive technology for conventional newborn care is available. Though the workshop focused on preterm and LBWI, these recommendations do not preclude the use of KMC for full term newborn infants and their mothers; KMC will benefit these mother-infant dyads and their families as well. Shiau (personal communication) has just obtained data on the benefits of KMC in 58 Taiwanese mother-full term infant dyads: increased quality of mother-infant contact, decreased maternal anxiety, decreased breast engorgement by self-report and chest circumference, improved breastfeeding status, and a trend toward more rapid breast-milk maturation.

The workshop participants agreed that the attention of national and international health authorities should be drawn to these potential benefits of KMC. For this purpose, they decided to establish a network—the International Network on KMC (INK)—with the purpose of promoting the use of KMC in developed and developing countries, and in the wider context of an evidence-based and humanistic approach to childbirth and newborn care. The objectives of the INK include the dissemination of knowledge, the advocacy for and support to implementation programmes, and the exchange of information among researchers. The INK will also provide technical expertise and training materials to institutions, professional associations, non-government organizations, national and international agencies, and lay associations. The institutions and individuals attending the workshop will form the initial core of the network, but new partners will be welcome.

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Does Kangaroo Mother Care Save Lives?

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Summary

To assess the impact of the introduction of kangaroo mother care (KMC) in hospitals using the Perinatal Problem Identification Programme (PIIP) in South Africa, a survey was conducted of the PIIP sentinel sites in South Africa requesting information on the practice of KMC in the hospital and if practised, when it had been initiated. Data on live births and the neonatal deaths of infants weighing between 1000 and 1999 g for each institution were obtained from the national PIIP database and, where applicable, divided into two periods, before and after the introduction of KMC. The practice of KMC and PIIP data could be combined for 40 of the hospitals that had responded to the survey. Of these, eight hospitals had not initiated KMC by January 2005, 21 had PIIP data for a period after KMC had commenced and 11 had PIIP data for periods before and after the introduction of KMC. The neonatal death rate (NNDR) for all hospitals with no KMC or before the introduction of KMC was 88.14/1000 live births, whereas the NNDR for hospitals with KMC or after the introduction of KMC was 71.43/1000 live births (relative risk (RR) 0.81; 95% confidence interval (CI) 0.72-0.91). For the 11 hospitals that had reliable PIIP data for periods before and after the initiation of KMC, the NNDR was 87.72/1000 live births before KMC and 60.76/1000 live births after KMC had been introduced (RR 0.62; 95% CI 0.53-0.73). The large and significant reduction in the NNDR of neonates weighing between 1000 and 1999 g was associated with the introduction of KMC.

Introduction

Kangaroo mother care (KMC) is a method of caring for immature neonates whereby the mother keeps the baby between her breasts (skin-to-skin contact), feeds the baby breast milk on demand and there is early discharge. The method was first used by Martinez and Rey in Bogotá, Colombia in the late 1970s [1]. This was, amongst other reasons, a response to overcrowding in neonatal units. Since then, it has been intensively investigated as a method of caring for stable immature infants [2, 3].

KMC was introduced in South Africa in the early 1990s and has been investigated in local conditions [4-10]. Various training and outreach programmes have been developed [10], and some provinces adopted KMC as the preferred method of caring for stable immature infants. At the first Perinatal Problem Identification Programme (PIIP) national workshop for PIIP sentinel sites and the Department of Health in November 2000, KMC was recommended as the method of choice for hospitals caring for stable immature infants [11]. PIIP is a simple computer-based perinatal care audit programme that has been in use nationally for about 5 years [12]. The institutions that use PIIP and submit their data are called PIIP sentinel sites, and they send their data through to the MRC Maternal and Infant Health Care Strategies Research Unit, which amalgamates the data (national database) and, together with the National Department of Health, analyses the data and feeds it back to the sentinel sites and other institutions in the form of the 'Saving Babies' reports [13].

A survey was conducted of the PIIP sentinel sites to assess the status of implementation of KMC and its possible contribution to the reduction of neonatal death rate (NNDR).

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Method

Institutions using PPIP are requested to register their use of software with Dr J.D. Coetzee and the MRC Maternal and Infant Health Care Strategies Research Unit. This is to ensure that each institution will be notified of upgrades in the software and to assist in the collation of the perinatal care surveys published as the 'Saving Babies' reports. Each institution that is on the register receives a copy of the 'Saving Babies' reports. These reports contain the recommendations of the perinatal care surveys and information on new developments, such as KMC [13].

A mail survey was conducted on all registered PPIP users. The survey asked each institution to report on whether they had implemented KMC or not. If they had, the questionnaire further requested information on when KMC was started and various questions relating to how KMC was practised.

The responding institutions that had submitted PPIP data to the national database were divided into those that had indicated that they had introduced KMC and those that had not. In those that had implemented KMC it was ascertained whether there were PPIP data available before the introduction of KMC. When this was the case, a 'before-and-after' analysis was performed.

The main beneficiaries of KMC are neonates born who weigh between 1000 and 1999 g [13], hence the NNDR of infants between 1000 and 1999 g was compared for hospitals practising and not practising KMC and before and after the implementation of KMC. Relative risks were used for comparison.

Results

Questionnaires were sent to the 145 registered PPIP users. Seventy-eight hospitals (54%) responded to the survey. Every province and level of care was represented in those that returned the questionnaire. Seventy hospitals (90%) reported that they had implemented some form of KMC by January 2005. The level of implementation varied between sporadic (1 = 2; 3%), intermittent (n = 29; 41%), continuous (n = 12; 17%) and both intermittent and continuous KMC (n = 24; 34%), with three hospitals (4%) not responding to the question. Twenty-four institutions reported that they had created a special ward for KMC.

Due to the small numbers in each category, all hospitals that indicated some form of KMC practice were included for the purpose of analysis, without any further sub-classifications. Forty-nine of these institutions had submitted PPIP data to the national database. Eight of these institutions had either not implemented KMC by January 2005, or had started after the date for which PPIP data were available; 21 had implemented KMC for a further 16 hospitals 'before-and-after' PPIP data were available.

Four hospitals had submitted data but were excluded, as the timing of starting KMC could not be determined. A further five were excluded from the

16 hospitals with 'before-and-after' data, three because their data were known to be unreliable and two because PPIP data were only available for a period of 6 months or less.

The first part of Table 1 illustrates the births, deaths and NNDR of neonates who weighed between 1000 and 1999 g of the 40 hospitals included in the analysis. The NNDR for all hospitals with no KMC or before the introduction of KMC was 88.14/1000 live births, whereas the NNDR for hospitals with KMC or after the introduction of KMC was significantly reduced at 71.43/1000 live births [Relative Risk (RR) 0.81; 95% confidence intervals (CI) 0.72-0.91].

The second part of Table I compares the 'before-and-after' data of the 11 hospitals for which reliable information was available. There was a significant reduction in neonatal deaths in the weight category 1000 and 1999g (RR 0.62; 95% CI 0.52-0.72). The NNDR was 87.72/1000 live births before KMC and 60.76/1000 live births after KMC had been introduced. The data were consistent throughout the sample with all sites showing a reduction in neonatal deaths, if neonatal deaths were present.

Discussion

This survey of information from PPIP sites has demonstrated a significant and large reduction of neonatal deaths of infants weighing between 1000 and 1999 g in institutions where KMC has been implemented. This is the first demonstration of the value of having national surveys such as the 'Saving Babies' perinatal care survey based on the PPIP national database, as the impact of recommendations can be assessed. The introduction of KMC has been a success story.

This study has several weaknesses. First, a large number of respondents (37%) did not have PPIP data in the national database. The majority of these sites had only recently implemented PPIP as part of the roll-out of PPIP in various provinces, and had not yet submitted data to this database.

Second, the comparison between those sites that have and that have not implemented KMC is open to significant bias. Arguably, sites that do institute KMC may have better functioning neonatal services than those that do not, and thus would be expected to have lower NNDRs. This is somewhat counteracted by results from hospitals with 'before-and-after' data.

Furthermore, the study did not look at neonatal deaths of bigger infants which might have given information on changes in general neonatal care. Finally, only data from PPIP sites were used.

TABLE I
Comparison of NVDR between institutions that have and have not implemented KMC

Institutions	Live births 1000-1999	Deaths 1000-1999	NVDR 1000-1999	P
All hospitals with 'before' and/or 'after' data (n=40)	4107	362	88.14	RR 0.61 95% CI 0.32-0.91
No KMC (n=8) and Before KMC (n=11)	13748	982	71.43	
Only After KMC (n=11)	3623	118	65.72	
Only hospitals with 'before' and 'after' data (n=11)	4530	273	60.26	RR 0.62 95% CI 0.32-0.73

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We have no information on how many other institutions have implemented KMC, but are not using PPIP.

Despite not being an elegant epidemiological study, the magnitude of the reduction in deaths is large and probably outweighs the weaknesses of the study. The large sample size (17 855) of neonates also adds *some* robustness to the data.

No randomized trial has demonstrated a reduction in mortality with the practice of KMC, as the sample sizes and power have all been *too* small to achieve this [2]. Individual reports from hospitals have demonstrated a reduction in deaths previously [14]. As far as we could determine, this survey provides a considerably stronger association between the introduction of KMC and the reduction of neonatal mortality of immature infants.

Given that KMC contributes to cost-efficiency [4] and appears to be associated with a significantly lower mortality rate than conventional care for stable immature infants, the ideal is for all health care facilities providing antenatal and postnatal care to have a systematic KMC programme. All Level I hospitals providing labour and neonatal care should have a special ward or allocated beds in another appropriate ward where mothers could practise *continuous* 24-h KMC until the infant is ready for discharge. It is recommended that all Level 2 and 3 hospitals implement at least *intermittent* KMC, with provision for mothers to lodge in order to facilitate the establishment of breastfeeding and the practice of KMC. All Level 2 hospitals should preferably have their own KMC unit for practising continuous KMC, but must at least be able to refer stable infants to a step-down facility for continuous KMC. There are various training programmes and educational materials available for the implementation of KMC.