



## Kangaroo Mother Care

Guest editor: Adriano Cattaneo<sup>1</sup>

### Summary

Globally, prematurity is the first cause of death in children under five. In absolute terms, almost one million babies die because of prematurity each year, mostly in South Asia and sub-Saharan Africa. The risk of death increases with decreasing gestational age and with poverty. It is estimated that neonatal mortality could be reduced by 19% if all neonates could experience similar mortality rates as the richest 20%. Deaths are caused mainly by the immaturity of vital organs and systems. Preterm babies who survive are at risk for moderate, severe or mild long-term cognitive and behavioural impairment and may be affected by retinopathy, with visual impairment, including blindness. Other important conditions, such as infections, jaundice, feeding difficulties and malnutrition, often leading to stunting, as well as some non-communicable diseases (high blood pressure, cardiovascular diseases, obesity, diabetes) are also more frequent in preterm than in term infants, with subsequent major negative individual, family and social effects.

Kangaroo Mother Care (KMC), one of the few health practices developed in low income countries and transferred to high income ones, has been shown by systematic reviews to reduce mortality associated with prematurity at discharge. KMC means early, continuous and prolonged skin-to-skin (STS) contact between the mother and the baby, initiated at birth and continued at home after early discharge, with exclusive breastfeeding and adequate support and follow-up. The core of KMC is STS, with increased success in exclusive breastfeeding. KMC results in a higher rate and a longer duration of exclusive breastfeeding when compared with conventional care of preterm infants; the total duration of any breastfeeding is also higher after KMC. Severe infection/sepsis, nosocomial infection/sepsis, hypothermia, hypoglycaemia, severe illness, lower respiratory tract disease and hospital readmissions are also reduced by KMC, while weight, length and head circumference gain, and maternal satisfaction, maternal-infant attachment and home environment are improved. KMC has also beneficial neurodevelopmental, cognitive, emotional, behavioural and social impacts that have been recently shown to persist until 20 years of age.

Based on the above evidence, the Lancet in 2014 and the World Health Organization (WHO) in 2015 included KMC among the recommended interventions to improve preterm birth outcomes. Although the evidence of positive outcomes has been available for more the 10 years and a WHO practical manual exists since 2003, coverage remains low and the universal coverage target for 2030 appears unrealistic. Strong political will, adequate investments, skilled and motivated health professionals, and regular monitoring and accountability are needed to scale up KMC coverage. In addition, concerned parents should advocate for KMC implementation in their health systems. Parental demand can help overcome indifference and resistance to KMC by health care systems, which are often pushed by industries to use expensive, and less appropriate technologies.

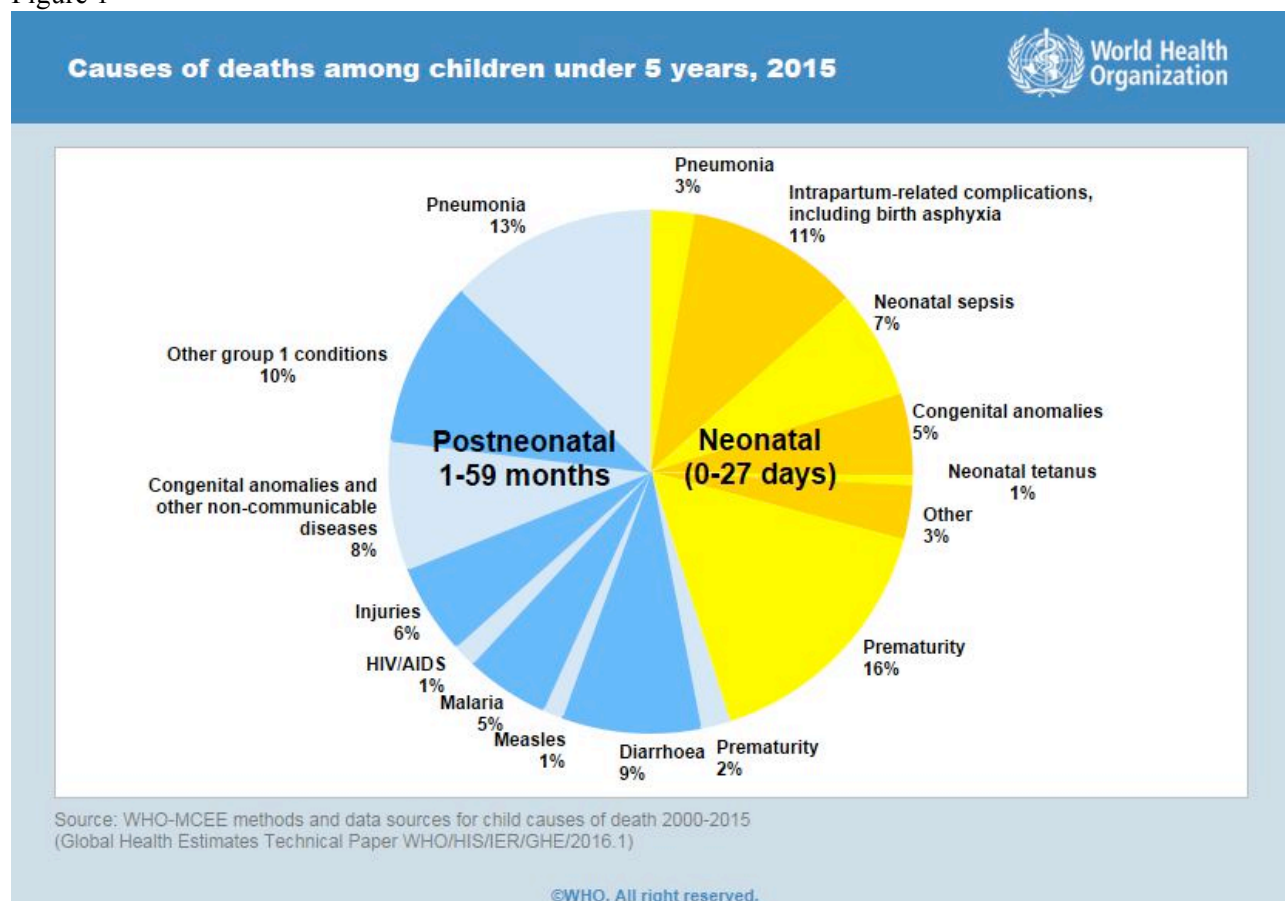
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## Introduction

Prematurity, defined as the birth of a live newborn infant before the completion of 37 weeks of pregnancy, is the single most important cause of child death in the world (Figure 1). Globally, prematurity (18%) contributes to child death more than pneumonia (13%) and diarrhoea (9%). About 2% of all deaths attributed to prematurity occur in the post-neonatal period. The majority, however, i.e. 16%, occur in the first four weeks of life and are classified as neonatal deaths. Of these, about two thirds are early neonatal deaths that occur in the first week of life, primarily concentrated in the first 48 hours of life. About two thirds of the estimated 2.7 million annual neonatal deaths in the world occur in preterm infants, mostly in South Asia and sub-Saharan Africa.<sup>2,3</sup> The risk of death is inversely associated with gestational age, i.e. babies born extremely preterm (less than 28 weeks of gestational age) are more likely to die than those born very preterm (28 to less than 32 weeks of gestational age) and those born moderately preterm (32 to less than 37 weeks of gestational age). In addition, preterm infants that are born small for their gestational age (SGA) have a higher risk of death compared to those with a birthweight that is adequate for their gestational age. It is estimated that up to 40% of preterm infants may also be SGA caused by intrauterine growth restriction due to multiple birth, infection, pre-eclampsia, maternal nutrition or exposure to environmental toxic substances, including cigarette smoke.<sup>4</sup> Finally, preterm infants from poorer households have a higher risk of death compared to those from wealthier families. On the basis of data from 51 countries that account for 75% of all neonatal deaths, it is estimated that neonatal mortality could be reduced by 19% if all neonates could experience the mortality of the richest 20%.<sup>5</sup>

Figure 1



<sup>2</sup> UNICEF. Child mortality estimates. New York (NY): United Nations Children's Fund; 2015

<sup>3</sup> Lawn JE, Blencowe H, Oza S et al: Every Newborn 2: progress, priorities, and potential beyond survival. Lancet 2014;384:189-205

<sup>4</sup> Lee AC, Katz J, Blencowe H et al. National and regional estimates of term and preterm small for gestational-age in 138 low-middle income countries in 2010. Lancet Glob Health 2013;1:e26-36

<sup>5</sup> Save the Children. State of the world's mothers: surviving the first day. London, UK: Save the Children International, 2013

Neonatal and child deaths are not the only consequence of prematurity. Of the estimated 13 million preterm infants who survive their first month of life, almost 3% suffer from moderate or severe long-term neurodevelopmental (cognitive and behavioural) impairment and about 4.5% suffer from mild impairment. In addition, almost 200,000 preterm infants are affected by retinopathy, with 32,000 having visual impairment, including blindness.<sup>6</sup> Other important conditions, such as infections, jaundice, feeding difficulties and malnutrition, often leading to stunting, are also more frequent in preterm than in term infants. Prematurity, especially when associated with intrauterine growth restriction followed by rapid post-neonatal weight gain, also increases the risk of non-communicable diseases (high blood pressure, cardiovascular diseases, obesity, diabetes) later in life.<sup>7</sup> Finally, the long-term consequences of prematurity also contribute to significant negative social effects, as measured by educational attainment, employment and economic productivity for individuals, and by increased social and economic burden for families, communities and health and social systems.<sup>8</sup>

What causes so much death, disease and disability in preterm infants? The primary reason is the immaturity of vital organs, in particular the lungs and the cardiorespiratory system. Very and extremely preterm babies may be unable to breathe and may need assisted respiration for some hours or days to survive. Those who breathe, or survive with assisted respiration, suffer the consequences of the immaturity of other organs. For example, they are unable to maintain their body temperature; warmth must be provided through other means to avoid hypothermia and its consequences, including death. Also, the immaturity of their ability to feed at the breast, absorb and metabolize nutrients, makes feeding and nutritional adequacy a challenge. Finally, the immaturity of the immune system increases the susceptibility and vulnerability of preterm infants to infections, i.e. they are more easily and severely affected. Although prematurity and intrauterine growth restrictions can to some extent be prevented,<sup>9,10</sup> from all the above, however, it is clear that effective interventions must be put in place after birth to reduce the burden of death, disease and disability associated with preterm birth. Kangaroo Mother Care (KMC) is one low-cost, sustainable and effective intervention.

### **What is KMC?**

KMC was developed in Bogotá, Colombia, in the mid '70s. Importantly, KMC is one of the few health practices developed in low income countries and then transferred to high income ones; another example is oral rehydration therapy for childhood diarrhoea. Usually, health practices and technologies are developed in high income countries to be then transferred to low income ones. The original definition of KMC, later on adapted by WHO in its practical guide,<sup>11</sup> was:

- early, continuous and prolonged skin-to-skin (STS) contact between the mother and the baby, initiated in hospital and continued at home;
- exclusive breastfeeding;
- early discharge with adequate support and follow-up.

The implementation of the above definition remains far from consistent. In particular:

- There is debate on the definition of “early”. In most places, STS is initiated when the baby is stable, i.e. when respiratory and heart rates are self-regulated without external assistance. But this means that many preterm infants will die before KMC is initiated. There is a biological rationale and some evidence, though not fully conclusive, that initiation of STS as early as possible after birth, even in unstable infants, may help them achieve physiological stability, and thus prevent many deaths.<sup>12,13</sup>

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<sup>6</sup> Blencowe H, Lee AC, Cousens S et al. Preterm birth associated neurodevelopmental impairment estimates at regional and global level for 2010. *Pediatr Res* 2013;74(suppl 1):17–34

<sup>7</sup> Barker DJ, Thornburg KL. The obstetric origins of health for a lifetime. *Clin Obstet Gynecol* 2013;56:511–9

<sup>8</sup> Lawn JE, Blencowe H, Darmstadt GL, Bhutta ZA. Beyond newborn survival: the world you are born into determines your risk of disability-free survival. *Pediatr Res* 2013;74(suppl 1): –3

<sup>9</sup> March of Dimes, PMNCH, Save the children, WHO. Born Too Soon: the global action report on preterm birth. Eds: Howson CP, Kinney MV, Lawn JE. World Health Organization. Geneva, 2012

<sup>10</sup> Newnham JP, Dickinson JE, Hart RJ et al. Strategies to prevent preterm birth. *Frontiers in Immunology* 2014;5:584

<sup>11</sup> WHO. Kangaroo Mother Care: a practical guide. World Health Organization. Geneva, 2003

<sup>12</sup> Bergman NJ, Linley LL, Fawcus SR. Randomized controlled trial of skin-to-skin contact from birth versus conventional incubator for physiological stabilization in 1200- to 2199-gram newborns. *Acta Paediatr* 2004;93:779-85

<sup>13</sup> Chi Luong K, Long Nguyen T, Huynh Thi DH et al. Newly born low birthweight infants stabilise better in skin-to-skin contact than when separated from their mothers: a randomised controlled trial. *Acta Paediatr* 2016;105:381-90

- Continuous and prolonged STS contact is strongly recommended but not easily achieved. There are health services (structural, educational and managerial) and cultural constraints.<sup>14,15,16</sup> In many hospitals, especially in high income countries, STS contact is intermittent, with episodes of 2-4 hours followed by breaks that may last hours or even the whole day. As the benefits of KMC are related to the length of the STS contact, in a dose-response fashion, strategies that will help overcome constraints and resistance are highly needed.
- Early discharge is possible when adequate follow up, first in health facilities then at home, can be ensured. This is possible in centres of excellence, where a sufficient number of competent and motivated health professionals, in a multidisciplinary team, are available. It is more difficult where the health system is weak and does not guarantee referral and counter-referral, or where skilled health professionals are scarce. These obstacles to early discharge and adequate follow up can be overcome only by actions aimed at improving the health system.

This significant heterogeneity in the definition of KMC is well illustrated in a systematic review that considered 1035 papers and reports; of these, only 299 defined KMC.<sup>17</sup>

The core component of KMC is STS, but the component that seems to be applied more successfully is exclusive breastfeeding. A Cochrane review, and a number of local and national reports, show that KMC results in a higher rate and a longer duration of exclusive breastfeeding when compared with conventional care of preterm infants.<sup>18</sup> The total duration of any breastfeeding is also higher when KMC is practiced. This seems to be due to several factors:

- The STS contact, even if not as early, continuous and prolonged as recommended, is certainly the most important factor.
- The closeness of mother and baby results in increased maternal awareness of her infant's needs.
- The easier access to the breast by the preterm baby, as opposed to the difficulty of moving the infant in and out of an incubator or other warming device.
- The increasing confidence of the mother in handling her baby, as compared to the dependence on the ward staff in conventional care.

Also, the hospitals that implement KMC are often *baby friendly hospitals*, where the influence of marketing for a greater use of breastmilk substitutes is restricted, and preterm infants do not represent a significant market opportunity for the infant formula industry, due to the small size of this subgroup of infants.

### **What are the benefits of KMC?**

The above-mentioned Cochrane review states that, “compared with conventional neonatal care, KMC was found to reduce mortality at discharge (or at 40 to 41 weeks' postmenstrual age and at latest follow-up), severe infection/sepsis, nosocomial infection/sepsis, hypothermia, severe illness, and lower respiratory tract disease. Moreover, KMC increased weight, length, and head circumference gain, breastfeeding at discharge or at 40 to 41 weeks' postmenstrual age and at one to three months' follow-up, mother satisfaction with method of infant care, and improved some measures of maternal-infant bonding and the home environment. Researchers noted no differences in neurodevelopmental and neurosensory outcomes at 12 months' corrected age.” These results are derived from meta-analyses of data from 21 randomized controlled trials, involving 3042 infants, carried out mainly in low-resource settings and published before June 2016.

Another systematic review, completed in 2016, screened 1035 articles and analysed the results of the 124 studies that met the inclusion criteria for neonatal outcomes.<sup>19</sup> Compared to conventional care, KMC was

<sup>14</sup> Vesel L, Bergh AM, Kerber KJ et al. Kangaroo mother care: a multi-country analysis of health system bottlenecks and potential solutions. *BMC Pregnancy and Childbirth* 2015;15 (Suppl 2):S5

<sup>15</sup> Chan GJ, Labar AS, Wall S, Atun R. Kangaroo mother care: a systematic review of barriers and enablers. *Bull World Health Organ* 2016;94:130–41

<sup>16</sup> Seidman G, Unnikrishnan S, Kenny E et al. Barriers and enablers of kangaroo mother care practice: a systematic review. *PLoS ONE* 2015;10(5):e0125643

<sup>17</sup> Chan GJ, Valsankar B, Kajeepeta S et al. What is kangaroo mother care? Systematic review of the literature. *J Glob Health* 2016;6(1):010701

<sup>18</sup> Conde-Agudelo A, Díaz-Rossello JL. Kangaroo mother care to reduce morbidity and mortality in low birthweight infants. *Cochrane Database of Systematic Reviews* 2016, Issue 8. Art. No.: CD002771

<sup>19</sup> Boundy EO, Dastjerdi R, Spiegelman D et al. Kangaroo mother care and neonatal outcomes: a meta-analysis.

associated with a 36% reduction in mortality, lower rates of sepsis, hypothermia, hypoglycaemia and hospital readmissions. It was also associated with increased exclusive breastfeeding. Newborns receiving KMC had lower mean respiratory rate and pain measures, and higher oxygen saturation, temperature, and head circumference growth. Similar results were reported also by an earlier review.<sup>20</sup>

KMC has significant positive neurodevelopmental, cognitive, emotional, behavioural and social impacts, in addition to those on health and nutrition. Some of these are long-term beneficial effects as demonstrated in a supplementary analysis to the mortality effects of a randomised controlled trial carried out in Bogotá, Colombia. In the '90s,<sup>21</sup> Tessier et al observed a change in the mothers' perception of her child. Compared to mothers in conventional care, those practicing KMC were more responsive to their infant's clues and more resilient to stress; in other words, they had a better bonding.<sup>22</sup> At 12 months of corrected age, the KMC infants had a higher IQ; the difference was most significant for infants who were more premature (30–32 weeks of gestational age), had required intensive care, and had a diagnosis of doubtful or abnormal neurological development at 6 months.<sup>23</sup> The same infants were studied 20 years later. The effects on IQ and home environment were still present. KMC parents were more protective and nurturing, reflected by reduced school absenteeism and reduced hyperactivity, aggressiveness, externalization, and socio-deviant conduct of young adults.<sup>24</sup>

Based on all the above evidence, in its 2015 recommendations on interventions to improve preterm birth outcomes, WHO included KMC among the recommended interventions, although in a conservative way, i.e. only for clinically stable newborns (Figure 2).<sup>25</sup>

Figure 2

7.0. Kangaroo mother care is recommended for the routine care of newborns weighing 2000 g or less at birth, and should be initiated in health-care facilities as soon as the newborns are clinically stable.	<b>Strong recommendation</b> based on moderate-quality evidence
7.1. Newborns weighing 2000 g or less at birth should be provided as close to continuous Kangaroo mother care as possible.	<b>Strong recommendation</b> based on moderate-quality evidence
7.2. Intermittent Kangaroo mother care, rather than conventional care, is recommended for newborns weighing 2000 g or less at birth, if continuous Kangaroo mother care is not possible.	<b>Strong recommendation</b> based on moderate-quality evidence

KMC had already been included among the recommended interventions in the 2014 Lancet Every Newborn Series.<sup>26</sup> It is important to note that the authors of this article observed that high-income countries were also taking up KMC because of its long-term developmental benefits. Finally, KMC was also included among six

Pediatrics 2016;137:doi: 10.1542/peds.2015-2238. Epub 2015 Dec 23

<sup>20</sup> Lawn JE, Mansa-Kambafwile J, Horta BL et al. Kangaroo mother care to prevent neonatal deaths due to preterm birth complications. *Int J Epidemiol* 2010;39:i144–i154

<sup>21</sup> Charpak N, Ruiz-Pelaez JG, Figueroa de CZ, Charpak Y. A randomized, controlled trial of kangaroo mother care: results of follow-up at 1 year of corrected age. *Pediatrics* 2001;108(5):1072–9

<sup>22</sup> Tessier R, Cristo M, Velez S et al. Kangaroo mother care and the bonding hypothesis. *Pediatrics* 1998;102(2):390-1

<sup>23</sup> Tessier R, Cristo M, Velez S et al. Kangaroo mother care: a method for protecting high-risk low-birthweight and premature infants against developmental delay. *Infant Behav Dev* 2003;26(3):384–97

<sup>24</sup> Charpak N, Tessier R, Ruiz-Pelaez JG et al. Twenty-year follow-up of kangaroo mother care versus traditional care. *Pediatrics* 2017;139(1):e20162063

<sup>25</sup> WHO recommendations on interventions to improve preterm birth outcomes. World Health Organization. Geneva, 2015

<sup>26</sup> Bhutta ZA, Das JK, Bahl R et al. Every newborn 3: Can available interventions end preventable deaths in mothers, newborn babies, and stillbirths, and at what cost? *Lancet* 2014;384:347-70

effective interventions for improving neonatal health and later survival by the authors of an overview of systematic reviews, published in 2015.<sup>27</sup>

### **Why is KMC uptake so slow?**

The evidence on the effectiveness of KMC has accumulated since the mid 90's and its implementation has been promoted for more than 10 years, particularly since the publication of the 2005 Lancet series on Neonatal Survival which included KMC in its list of effective interventions.<sup>28</sup> Yet, in the first article of the Every Newborn Lancet series of 2014, the authors state that “coverage for kangaroo mother care is an example of a highly effective intervention for which assessment, policy formulation and adoption, and programme implementation have lagged.”<sup>29</sup> The problem is that data on KMC coverage are unavailable. Since no country has integrated data on KMC into their health information systems or periodic surveys, the 50% coverage target for 2020 and the 75% for 2030, let alone the universal coverage target for 2035, proposed by the authors of the 5<sup>th</sup> article in the Lancet series,<sup>30</sup> appear unrealistic, if KMC uptake is not measured and reported. Clearly political will, adequate investment, skilled and motivated health professionals, monitoring, reporting and accountability, all need to be in place to achieve the projected targets.

On the other hand, do we need to wait for all the prerequisites (e.g. policies, funds, pre-service training) to be in place before we move KMC forward? Learning from breastfeeding, did mothers and activist groups wait until all the conditions were set to start working for its protection, promotion and support? Concerned parents could already start putting pressure on the health system and increase demand for KMC. In many countries there are already formal and informal groups and associations of parents of preterm infants. Currently these groups and associations act mainly to improve parental resilience through their networks, and to ensure that preterm infants get the best possible hospital and post-discharge care. They accept as a norm the conventional care offered by neonatal intensive care units to their children. They may start requesting that conventional care be replaced by KMC, not only because of the evidence base, but also because it is more physiologic, it enhances bonding, it empowers parents. This pressure by parents, if possible combined by peer pressure, would help overcome indifference and resistance to KMC by health professionals,<sup>31</sup> often offered no alternatives to the expensive and often inappropriate technologies pushed by medical industries. For these health professionals, KMC may look like an inferior poor man's alternative that leads to the invasion of their wards by parents, limiting their power and consuming their time. It is important to turn this vision upside down and to show, by providing examples, that a neonatal ward open 24 hours a day to families engaged in the care of their preterm infants becomes not only happier and more human, but also more effective and less costly.

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<sup>27</sup> Lassi ZS, Middleton PF, Crowther V, Bhutta ZA. Interventions to improve neonatal health and later survival: an overview of systematic reviews. *EBioMedicine* 2015;2:985-1000

<sup>28</sup> Darmstadt GL, Bhutta ZA, Cousens S et al (the Lancet Neonatal Survival Steering Team). Evidence-based, cost-effective interventions: how many newborn babies can we save? *Lancet* 2005;365:977-88

<sup>29</sup> Darmstadt GL, Kinney MV, Chopra M et al. Every Newborn 1: who has been caring for the baby? *Lancet* 2014;384:174-88

<sup>30</sup> Mason E, McDougall L, Lawn JE et al. Every Newborn 5: from evidence to action to deliver a healthy start for the next generation. *Lancet* 2014;384:455-67

<sup>31</sup> Charpak N, Ruiz-Pelaez JG. Resistance to implementing Kangaroo Mother Care in developing countries and proposed solutions. *Acta Paediatr* 2006;95:5229-34



## Abstracts

### KMC – why?

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**Badiee Z, Faramarzi S, MiriZadeh T. The effect of kangaroo mother care on mental health of mothers with low birth weight infants. *Adv Biomed Res* 2014; 3:214**

Preterm birth rates have been reported to range from 5% to 7% of live births in some developed countries, but are significantly higher in developing countries. The mothers of premature infants are at risk of psychological stress because of separation from their infants. One of the methods influencing the maternal mental health in the postpartum period is kangaroo mother care (KMC). This study was conducted to evaluate the effect of KMC of low birth weight infants on maternal mental health. The study was conducted in the Department of Pediatrics of Isfahan University of Medical Sciences, Isfahan, Iran. Premature infants were randomly allocated into two groups. The control group received standard care in the incubator. In the experimental group, caring with three sessions of 60 min KMC daily for 1 week was practiced. Mental health scores of the mothers were evaluated by using the 28-item General Health Questionnaire. Statistical analysis was performed by the analysis of covariance using SPSS. The scores of 50 infant-mother pairs were analysed totally (25 in KMC group and 25 in standard care group). Results showed the positive effects of KMC on the rate of maternal mental health scores. There were statistically significant differences between the mean scores of the experimental group and control subjects in the post-test period ( $P < 0.001$ ). KMC for low birth weight infants is a safe way to improve maternal mental health. Therefore, it is suggested as a useful method that can be recommended for improving the mental health of mothers.

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**Charpak N, Tessier R, Ruiz JG, et al. Twenty-year follow-up of Kangaroo Mother Care versus Traditional Care. *Pediatrics* 2017;139(1):e20162063**

Kangaroo mother care (KMC) is a multifaceted intervention for preterm and low birth weight infants and their parents. Short-

and mid-term benefits of KMC on survival, neurodevelopment, breastfeeding, and the quality of mother–infant bonding were documented in a randomized controlled trial (RCT) conducted in Colombia from 1993 to 1996. Again in 2012–2014 it was decided to evaluate the persistence of these results in young adulthood. A total of 494 (69%) of the 716 participants of the original RCT known to be alive were identified; 441 (62% of the participants in the original RCT) were re-enrolled, and results for the 264 participants weighing  $\leq 1800$  g at birth were analysed. The KMC and control groups were compared for health status and neurologic, cognitive, and social functioning with the use of neuroimaging, neurophysiological, and behavioural tests. The effects of KMC at 1 year on IQ and home environment were still present 20 years later in the most fragile individuals, and KMC parents were more protective and nurturing, reflected by reduced school absenteeism and reduced hyperactivity, aggressiveness, externalization, and socio-deviant conduct of young adults. This study indicates that KMC had significant, long-lasting social and behavioural protective effects 20 years after the intervention. Coverage with this efficient and scientifically based health care intervention should be extended to the 18 million infants born each year who are candidates for the method.

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**Chi Luong K, Long Nguyen T, Huynh Thi DH, et al. Newly born low birthweight infants stabilise better in skin-to-skin contact than when separated from their mothers: a randomised controlled trial. *Acta Paediatr* 2016;105(4):381-90**

Transition of foetus from the intra-uterine life to extra-uterine life is a stressful process and neonates, particularly preterms, need support for stabilisation. Traditionally, technological interventions like incubator care are used to stabilise the neonates. However, animal studies have found that separation from mothers actually exacerbate the instability resulting in release of cortisol. A randomised controlled trial compared stability of cardio-respiratory system scores at 360 minutes after birth in preterm infants receiving skin-to-skin contact and another group of infants receiving

traditional incubator care. Results showed that infants who received skin-to-skin care have less need for respiratory support, intravenous fluids and antibiotic use during the neonatal unit stay. Skin-to-skin contact prevented instability thereby mitigating a need for medical treatment for these conditions.

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**Brooks B, Firek B, Miller C, et al. Microbes in the neonatal intensive care unit resemble those found in the gut of premature infants. *Microbiome* 2014;2:1-16**

The microbiomes of very low birth weight infants are highly susceptible to procedures and environmental influences in the Neonatal intensive care unit (NICU). These include the routine use of antibiotics and the high rate of birth interventions and caesarean births. Infants in NICUs come into contact with a wide variety of pathogenic microorganisms primarily through air, contact with equipment, staff, clinical items, baby toys etc. This study paired the microbes found in the NICU environment to those colonizing the infant gut. Two infants rooming in the same location, who were greater than 31 weeks gestation and 1.250g at birth, were enrolled in the study during the first month of life.

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**Hendricks-Munoz K, Xu J, Parikh H, et al. Skin-to-Skin care and the development of the preterm infant oral microbiome. *Am J Perinatol* 2015;32:1205-16**

For premature infants the saliva and oral microbes are shown to have importance in facilitating digestion and the development of the intestinal flora. Since the colonization of the gut is influenced by the newborn's early contacts, mode of delivery, NICU environments, incubators, use of antibiotics and other medications, including contact with care providers and importantly maternal contact, the study reported on the impact of skin-to-skin on the development of oral microbial ecology and its impact on digestion and immune development. The study included 42 infants >1,500g and ≤32 weeks of gestation. All infants were receiving tube feeding - 6 received infant formula and 36 received human milk. No infants received antibiotics 7 days before and during the time

of sampling. Infants who received skin-to-skin had a greater colonization with *Streptococcus* species and those not receiving skin-to-skin were colonized with higher levels of species of *Pseudomonas*, *Corynebacterium*, *Staphylococcus*, *Neisseria* and *Actinobacter* associated with increased gut dysfunction and necrotizing enterocolitis (NEC). None of the infants receiving skin to skin developed NEC compared to 3 in the non-skin-to-skin group. The premature infants receiving skin-to-skin also acquired oral microbial maturity at an earlier age while infants not receiving skin-to-skin care had delayed oral microbial development. The authors speculate that the reduced stress factors associated with skin-to-skin care have a role in the pace of microbial maturation.

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**Cong X, Xu W, Janton S, et al. Gut Microbiome development patterns in early life of preterm infants: impacts of feeding and gender. *PLoS ONE* 2016;11(4):e0152751**

The gut microbiota is known to be influenced by vaginal or caesarean birth, feeding methods, maternal skin-to-skin contact, as well as a number of other environmental factors. To determine the impact of mode of feeding and gender on gut microbe development, this study analyzed 378 stool samples from 29 stable and healthy premature infants over the first 30 days of life. Interestingly, male infants were found to have lower diversity immediately after birth and females had higher numbers of Clostridiales and lower Enterobacteriales as compared to males. Those infants receiving their mothers own breastmilk had greater diversity of gut microbes and higher levels of Clostridiales and Lactobacilliales. The non-breastfed infants had a different microbiome pattern dominated by Enterobacteriales species for the first 30 days of life. Delayed maturation of the gut microbiome has been associated with NEC and sepsis in non-breastfed infants, hence mode of feeding, directly at the breast and increased contact with a mother's skin have greater microbe diversity, including the important *Bifidobacterium* strains. In preterm infants the anaerobic *Bifidobacterium* and *Bacteroidetes* are present in lower numbers than full term infants and the importance of a



mothers own milk may be critical in the maturation of the microbiota for preterm infants. The stress of infant and mother separation after birth may also affect the development of the gut microbiota.

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**Hartz L, Bradshaw W, Brandon D. Potential NICU environmental influences on the neonate's microbiome: a systematic review. *Adv Neonatal Care* 2015;15:324-35**

The impact of the NICU environment on the microbial colonization of high needs and premature infants is the focus of this systematic review. Out of 250 articles, eleven were used as sources to review potential environmental influences on the development of the infant's microbiota in order to address best care in the NICU. One study ( a pretest-posttest design with 10 preterm infants), looked at infection rates after skin-to-skin care for 90 minutes for 5 consecutive days found that only one infant developed a hospital-sourced infection within 7 days after skin-to-skin care ended. Three studies looked at the relationship between NEC and the gut microbiome. In one study the stool samples of those who developed NEC compared to controls that did not develop NEC showed a higher prevalence of Proteobacteria and Actinobacteria one week before being diagnosed with NEC. The stool of the controls that did not develop NEC had lower levels of both and they received human milk 57% of the time compared to those who developed NEC and received human milk 27.8% of the time. Another study showed that infants who received human milk had gut microbes more similar to those of healthy breastfed full-term infants and were at lower risk for NEC. The review concluded "how the microbiome of the NICU, the care givers, feeding types, and antibiotics affect the development of the infant's microbiome over time requires further study". A key item of what is known: human milk and the caregiver's skin influence the microbiome of neonates. What can be done now given the current knowledge is to implement evidence-based infection control and skin care practices.

### **KMC - how?**

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**Bergh AM, de Graft-Johnson J, Khadka N, et al. The three waves in implementation of facility-based kangaroo mother care: a multi-country case study from Asia. *BMC International Health and Human Rights* 2016;16:4**

Kangaroo mother care has been highlighted as an effective intervention package to address high neonatal mortality pertaining to preterm births and low birth weight. However, KMC uptake and service coverage have not progressed well in many countries. The aim of this case study was to understand the institutionalisation processes of facility-based KMC services in three Asian countries (India, Indonesia and the Philippines) and the reasons for the slow uptake of KMC in these countries. Three main data sources were available: background documents about the state of implementation of KMC in the three countries; visits to a selection of health facilities with KMC implementation; and data from interviews and meetings with key stakeholders. The establishment of KMC services at individual facilities began many years before official prioritization for scale-up. Three major themes were identified: pioneers of facility-based KMC; patterns of KMC knowledge and skills dissemination; and uptake and expansion of KMC services in relation to global trends and national policies. Pioneers of facility-based KMC were introduced to the concept in the 1990s and established the practice in a few individual tertiary or teaching hospitals, without further spread. A training method beneficial to the initial establishment of KMC services in a country was to send institutional health-professional teams to learn abroad, notably in Colombia. Further in-country cascading took place afterwards and still later on, KMC was integrated into newborn and obstetric care programs. The patchy uptake and expansion of KMC services took place in three phases aligned with global trends of the time: the pioneer phase with individual champions where the global focus was on child survival (1998–2006); the newborn-care phase (2007–2012); and lastly the current phase where small babies are also included in action plans. This paper illustrates the complexities of implementing a new healthcare intervention.

Although preterm care is currently in the limelight, clear and concerted country-led KMC scale-up strategies with associated operational plans and budgets are essential for successful scale-up.

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**Vesel L, Bergh AM, Kerber KJ, et al; KMC Research Acceleration Group. Kangaroo mother care: a multi-country analysis of health system bottlenecks and potential solutions. BMC Pregnancy Childbirth 2015;15 Suppl 2:S5**

Preterm births contribute significantly to the under-five child deaths globally. Most of neonatal deaths are happening in the low and middle-income countries, mainly in sub-Saharan Africa and South Asia. Kangaroo Mother Care, which involves a continuous skin-to-skin contact, breastfeeding support and early hospital discharge with follow-up support, is a low-cost, effective intervention to prevent mortality in preterm neonates. However, uptake of this simple intervention at country level is slow. A multi-country study of health system bottlenecks and possible solutions in 12 countries of Africa and Asia with on-going KMC programmes explored health system bottlenecks affecting scaling-up of KMC. With the use of quantitative and qualitative methods, the study found significant and very major bottlenecks in Asian countries in comparison to African countries. Some major bottlenecks revealed were: leadership and governance issue like lack of KMC guidelines; lack of adequate health financing; shortage and poor training of health workforce; lack of adequate space for the performance and monitoring of KMC and transport services in the health care facilities; poor data on LBW babies and lack of KMC coverage data in the existing health information system; and poor community adherence due to traditional practices and cultural beliefs. Researchers have also provided appropriate solutions to address identified bottlenecks.

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**Bergh AM, Kerber K, Abwao S, et al. Implementing facility-based kangaroo mother care services: lessons from a multi-country study in Africa. BMC Health Serv Res 2014;14:293**

In many countries, particularly in Africa and Asia, the Ministry of Health has collaborated

with the development partners to implement KMC in health care facilities. However, the approach and results to implement KMC varies from country to country. A cross sectional mixed-method research study with quantitative and qualitative components evaluated implementation of the KMC programme in four African countries: Malawi, Mali, Rwanda and Uganda. In these countries, 95% of assessed health facilities demonstrated some evidence of KMC. Important factors identified in implementation were: training and orientation; supportive supervision; integration of KMC into quality improvement; continuity of care; high-level acceptance and support for KMC implementation; and client-oriented care. There were several facilitating factors and challenges among all the factors mentioned above. Facilitating factors identified were: inclusion of KMC in pre-service curricula and in-service training; project-driven interventions bringing additional resources for supervision; use of KMC registers and inclusion of KMC in mortality and morbidity review meetings for integrating KMC into quality improvement; including KMC in antenatal care and adequate follow-up services to provide continuity of care beyond the facility; governmental and institutional support through a national policy for KMC; guidelines and KMC champions at different levels in the health system; and client-oriented care through promotion of companions in the care of mother and baby. Challenges were: sub-optimal training; inadequate supervision; no standardized reporting on KMC; KMC not included in antenatal care and poor follow-up of KMC babies; low uptake in the use of maternal and newborn services and cultural beliefs preventing optimal practice of KMC.

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**Smith ER, Bergelson I, Constantian S, et al. Barriers and enablers of health systems adoption of kangaroo mother care: a systematic review of caregiver perspectives. BMC Pediatr 2017;17:35**

This systematic review to look at barriers and enablers to increase uptake of KMC from a “caregivers” viewpoint, identified 2875 abstracts of which 98 were included in the analysis. One-third of the studies were from

the Americas, about one-quarter in African countries, the remainder from Europe, Asia, Mediterranean and Western Pacific. The researchers identified four areas of interaction between the caregivers and the KMC intervention: acceptance and bonding, social support, time and medical concerns. The buy-in and bonding was less accepted when health workers failed to fully explain the intervention and parents felt it was forced on them, some felt uncomfortable, others felt fear and stigma at having a preterm infant. Positive buy-in occurred when parents felt that KMC “calmed” their babies. They observed that their babies slept longer during skin-to-skin and described their babies as less anxious and more willing to breastfeed and happier than when in the incubator. Mothers felt more at ease and useful having their babies close. The lack of social support from families, communities or hospital workers was a barrier to acceptance of KMC while childcare support from spouse, family and community increased the practice. Where

gender roles were more equal there was greater acceptance of KMC. Peer support and well trained hospital staff increased the uptake of KMC. The recommended time of at least two weeks after birth was also a barrier for some, especially if the mother was depressed, alone or had a C-section, for others the commute from home to the hospital and for some the workloads at home after discharge. Where parents had unlimited visiting hours and had unhindered access to their babies the uptake was greater. Medical concerns were also a barrier to KMC practice especially if the mother also had clinical conditions, pain or a C-section. When mothers practiced KMC they felt that it relieved their post-partum stress. In conclusion the researchers recommended the promotion and integration into health care systems and family and social contexts of the “enablers” identified as needed for successful adoption of KMC.

**Prepared by the International Baby Food Action Network (IBFAN)**

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