Understanding Kangaroo Mother Care
Kangaroo Mother Care
Outline

- KMC components, origin, and research
- Oxytocin physiology and role in temperature regulation
- KMC and body temperature regulation
- KMC effect on Neurophysiologic Outcomes
- KMC effects on stress, nosocomial Infections and Mortality reduction
- KMC effects on physiological stress
- Role of KMC in Brain development
- Epigenetics, early intervention and developmental outcomes
KMC Components

- Kangaroo Position
- Kangaroo Nutrition
- Kangaroo Discharge and Follow-up

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KMC Components
KMC Components

• **1\textsuperscript{st} : Kangaroo position**
  – The infant is placed almost naked in strict upright ventral position between the mother’s breast, in direct contact with her skin, as long as possible

• **2\textsuperscript{nd} : Kangaroo Feeding and Nutrition strategy**
  – Ideally exclusive breastfeeding to have a weight gain similar to the growth during the intra-uterine life (15 g/kg/day) until full term

• **3\textsuperscript{rd} : Early Discharge and strict ambulatory follow up**
  – Discharge in kangaroo position regardless of weight and gestational age when the child is able to coordinate sucking, swallowing and breathing, gaining weight for 3 days and have parents informed, trained and ready to come to follow up visits
KMC Origin

- KMC was first practiced in Bogotá, Colombia in 1979
- UNICEF reported this practice to the rest of the world in 1983: “Intriguing & incredible survival of ‘kangaroo babies’ unparalleled in medical literature”
- This was the first time that the word ‘Kangaroo’ was used in describing this practice
First Research on KMC Practice

- Whitelaw visited Bogotá in 1985 → 1st description of KMC in English medical literature
KMC Research

- Research on KMC in many countries - reviewed in 1991
- First International Workshop was held in Trieste, Italy in 1996
- At the 2nd workshop in Bogota, Colombia 1998 it was agreed to use the term KMC to define the programme of skin to skin care, breastfeeding and early discharge
- WHO guidelines developed (2003)
Hypothesis of How KMC Works

Neuro-endocrine mechanisms involved

Skin-to-skin Touch

Release of Oxytocin

Central Stimulation of the Vagal nerve or Parasympathetic Nervous System (PSNS)

Influence the physiology and endocrinology of the infant to optimize growth and development

Kerstin Uvnäs-Moberg Trends Endocrinol Metab 1996;7;no4:126-131
OXYTOCIN: PHYSIOLOGY, ROLE IN TEMPERATURE REGULATION, SEDATION & ANTI-STRESS EFFECTS
Oxytocin Physiology

Produced in supraoptic & paraventricular nuclei of hypothalamus by:

**Magnocellular neurons**
- Posterior pituitary
- Released into blood circulation
- Act as **HORMONE** on:
  - Uterine contractions
  - Stimulation of milk ejection

**Parvocellular neurons**
- Act as **NEUROTRANSMITTER** in:
  - Locus coeruleus & amygdala
  - Hippocampus & olfactory bulb
  - Red nucleus of stria terminalis
  - Substantia nigra & Raphe nuclei
  - Limbic system & median eminence
  - Vagal nuclei (NTS) & spinal cord

This widespread distribution allows oxytocin to have major regulatory functions


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Role of Oxytocin in Temperature Regulation

- Circulation in the skin overlying the mammary gland is increased during suckling resulting in increased skin temperature - this makes suckling more pleasant for pups
  Kerstin Uvnäs-Moberg TEM 1996

- Circulating oxytocin mediates this cutaneous vasodilation
  Eriksson et al. 1996b

- Temperature of breasts and chest increases not only during breast feeding but also when milk ejection is triggered psychologically
  Lind et al. 1971
Oxytocin: Sedation and Anti-stress Effects

- Administration of oxytocin to male and female rats induced sedation and anti-stress effects (anxiolytic-like) Particularly after repeated administration
- Stimulation of α-2 receptors enhanced the anti-stress effects by inhibiting the noradrenalin system
- Cerebral areas involved were the amygdala, hypothalamus, locus coeruleus and nucleus tractus solitarius (NTS) [PSNS]

Oxytocin’s Analgesic Effects

- Oxytocin administered in mice has an analgesic effect in response to (formalin-induced) pain
- Oxytocin acts on the κ- & δ-opioid receptors in the brain
- Chronic (X 7 days) administration of oxytocin did not produce tolerance
  

KMC: Effect on Painful Procedures

- Preterm infants exhibit less audible and inaudible (facial grimacing, eye squeezing and brow bulging) crying during and after heel pricks when in KMC compared to incubator
  
  R Kostandy, et al. 2008;9(2)

- KMC reduces crying associated with painful procedures (Weller & Feldman)
KMC
AND BODY TEMPERATURE REGULATION
KMC: Effect on Body Temperature

- Mothers are able to maintain their baby’s temperature within a very narrow temperature range which is not the case in incubator care.

- A thermal synchrony develops between mom & baby.
- The mother’s core temperature may rise 2°C or drop 1°C in a short period of time, in order to maintain this narrow range.
Comparison of Thermal Control on a LBW Baby in Incubator Care vs KMC in a South African Hospital
Thermal Synchrony in Twins

- Mother’s breasts have the ability to thermally accommodate multiple infants simultaneously
- Each breast acts independently to keep a twin warm

Photos by S Ludington

Case studies by S Ludington

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KMC: Effect on Neurophysiologic Outcomes

- Sleep organisation
- Brain maturation
- Brain complexity

Graven SN, Browne JV. 2008
Sleep Organization: Sleep Phases

- **NREM (Quiet Sleep)**
  - Stage 1  Drowsy
  - Stage 2  Light – onset of slow wave sleep
  - Stage 3  Deep slow sleep
  - Stage 4  Deep slow wave sleep

  **Crucial for creation of long term memories & learning**

- **REM (Active Sleep, Dream Sleep)**
  - Paradoxical sleep – rapid eyelid & muscle movements
  - ↑ Heart rate & Resp rate

  **Critical component associated with the development of the sensory systems**
Sleep and Sleep Cycles

- Sleep and sleep cycles are essential for:
  - Sensory system development in the foetus and young infant
  - Creation of long-term memory and learning
  - Preservation of brain plasticity

- Sleep deprivation in foetus and neonate has profound effects on early sensory development and creation of permanent neural circuits for the primary sensory systems
Sleep Cont.

- Sleeping is not a passive process
- Sleep is driven by cholinergic cells which stimulate sleep actively – (can be inhibited by depressant drugs)
- Each specific EEG wave that occur during REM sleep plays a specific role in sensory system development (smell, taste, visual, auditory, touch, motion, position, emotion, or memory)
- REM sleep deprivation between 30 wks GA and 4-5 mnths results in delayed or disordered development of any or all of the systems above
Importance of Sleep Cycling

REM sleep deprivation between 30 wks GA & 4-5 months results in delayed or disordered development of any or all of the receptor systems.

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Sleep Cycling

- REM sleep is supposed to be active, so HR increases and RR is irregular
Sleep Pattern in NICU

- In the NICU, infants demonstrate a very chaotic version of this cycling pattern.

- Incubator Infants only have 10-20 seconds of quiet sleep. (HR and RR also does not change)
- Separation and care giving environment that disrupts sleep
KMC: Effect on Sleep Organization

- Increase in quantity of sleep and Quiet Sleep
- Normal cycling with organised sleep pattern
- Less sleep arousals, HR & RR variation during REM sleep
- Preterm sleep cycles generally require 60 min. to complete and within 5 min. of the onset of KMC, cycling begins

![Graph showing sleep patterns](image)
KMC EFFECTS ON STRESS, NOSOCOMIAL INFECTIONS AND MORTALITY REDUCTION
KMC: Effect on Stress

- Cortisol levels have been studied as a sign of physiological stress in preterm infants
- There was $\geq 60\%$ reduction in cortisol levels in stable preterms receiving KMC for 20 min or more
  - KMC reduces stress in preterm infants most likely due to
    - The buffering protection of adult support
    - Secretion of oxytocin and stimulation of the PSNS
KMC: Effects on Nosocomial Infections

- Infants who received 24/7 KMC had ↓ infections by discharge (3 randomized trials)

- ↓ Infections in infants who received KMC (Cochrane meta-analysis)

- ↓ Nosocomial infections may be due to:
  - Enhanced stratum corneum barrier function when hydration increases and trans-epidermal water loss decreases
  - Improved immunity
    - Oxytocin
    - Less stress
    - Breastmilk
KMC reduces Mortality?

A meta-analysis by Joy Lawn et al 2010, shows that KMC substantially reduces neonatal mortality amongst preterm babies (birth weight <2000 g) in hospital, and is highly effective in reducing severe morbidity, particularly from infection.

Cochrane review, 2003
“Not enough evidence that kangaroo mother care is an effective alternative to standard care for low birthweight babies.”

Cochrane review, 2011
“Kangaroo mother care (KMC) is an effective and safe alternative to conventional neonatal care in low birthweight (LBW) infants mainly in resource-limited countries.”
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 the effectiveness and safety of:

- early-onset continuous KMC in unstabilised
- or relatively stabilized LBW infants,
- as well as long-term neurodevelopmental outcomes and costs of care.

Where are we now? 2016

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KMC Benefits for the Baby

- **Vagal Nuclei (PSNS)**
  - ↑ GI-function
  - ↑ growth
  - Stabilize CVS
  - Resp stability
- **Skin-to-Skin Touch**
- **Skin-to-Skin Temperature Synchrony Warm breast skin temperature**
- **Oxytocin**
  - Analgesic effect
    - K&δ opioid receptors
    - No tolerance
  - Sedation effect
    - ↑ Sleep organisation
    - ↑ Sleep cycling
  - Anti-stress effect
  - ↑ Neurodevelopment
  - ↑ Brain maturation
  - Less Crying
  - Better BM volume, BF earlier
- **Social interaction**
- **Bonding & attachment**
- **Better Survival**
- **Better immune effect** (Faster wound healing)

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Mother-Infant Separation (Research on Rats)

When rat pups are separated from their mothers they become distressed with:

- ↑ Vocalisation activity
- ↓ Thermogenesis
- Behavioural activity ↓(cold) ↑(warm)
- ↓ Heart rate (no food)
- Endocrine changes:
  - ↓ growth hormone levels
  - ↑ cortisol levels rise sharply
- Disturbed sleep-wake states
  - ↑ arousals
  - ↓ REM sleep

Kuhn et al. 1990, MA Hofer 1994

Infant in incubator:

- ↑ Crying
- ↑ Activity
- (N) HR if fed
- ↓ GH
- ↑ cortisol
- No Sleep cycles
- ↑ arousals
- ↓ Quiet sleep

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KMC EFFECTS ON PHYSIOLOGICAL STRESS
Stressful Influence on the Developing Brain

Positive Stress

Tolerable Stress

Toxic Stress

www.developingchild.harvard.edu
Positive Stress

- Moderate, short-lived stress responses, such as brief increases in heart rate, blood pressure or mild changes in stress hormone levels such as cortisol
- Precipitants may include: discomfort, external stimuli, tiredness, hunger and thirst
- It is an important and necessary aspect of healthy development that occurs in the context of stable and supportive relationships

www.developingchild.harvard.edu
Tolerable stress

- Stress responses that could disrupt brain architecture, but are buffered by supportive relationships that facilitate adaptive coping
- Precipitating factors are: absence of mother, painful procedures, harsh lighting, loud noise, inappropriate touch and handling, feeding difficulty, lack of consistency
- Generally occurs within a time-limited period, which gives the brain an opportunity to recover from potentially damaging effects

www.developingchild.harvard.edu
Toxic stress

- Strong and prolonged activation of the body's stress management systems in the absence of the buffering protection of adult support
- Precipitating factors are - continuous absence of parent, interventions & procedures not buffered by support

**Chronic stress is toxic to developing brains**

- Prolonged activation of the stress response systems (*excessive cortisol*) can disrupt the development of brain architecture and other organ systems, and increase the risk for stress-related disease and cognitive impairment, well into the adult years

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When toxic stress response occurs continually, or is triggered by multiple sources, it can have a cumulative toll on an individual’s physical and mental health—for a lifetime.
ROLE OF KMC IN BRAIN DEVELOPMENT
Human Brain Development

Neural Connections for Different Functions Develop Sequentially

- Sensory Pathways (Vision, Hearing)
- Language
- Higher Cognitive Function

FIRST YEAR

Birth (Months) (Years)

-8 -7 -6 -5 -4 -3 -2 -1 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19


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Brain Architecture and Skills are Built in a Hierarchical “Bottom-Up” Sequence

- Neural circuits that process basic information are wired earlier than those that process more complex information.
- Higher circuits build on lower circuits
- Skills beget skills
- The development of higher level capabilities is more difficult if lower level circuits are not wired properly
Brains subjected to toxic stress have underdeveloped neural connections in areas of the brain most important for successful learning and behaviour in school and the workplace.

**Persistent Stress Changes Brain Architecture**

**Normal**
- Typical neuron – many connections

**Toxic Stress**
- Damaged neuron – fewer connections

Prefrontal Cortex and Hippocampus

Sources: Radley et al. (2004) Bock et al. (2005)

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Institutionalized

Never Institutionalized

The Developing Brain

- During early **sensitive periods** of development, the brain’s circuitry is most open to the influence of external experiences, for better or for worse.
- Chronic or extreme adversity can interrupt normal brain development.

[www.developingchild.harvard.edu](http://www.developingchild.harvard.edu)
galleryhip.com/premature-babies-in-incubators.html
The Developing Brain

- We now know that genes provide the initial blueprint for building brain architecture.
- Environmental influences affect how the neural circuitry actually gets wired.

Jack P. Shonkoff; 2010  (Fox, Levitt, & Nelson, 2010; Meaney, 2010)
Reciprocal interactions among genetic predispositions and early experiences affect the foundations of learning, behaviour, whether both physical and mental health will be strong or weak.

Jack P. Shonkoff; 2010 (Fox, Levitt, & Nelson, 2010; Meaney, 2010)
The Developing Brain

- The foundations of healthy development and origins of many impairments can be found among biological “memories” created through gene-environment interactions in the early years of life.
- In some cases these may begin as early as the prenatal period.

Jack P. Shonkoff; 2010; Barker, 1997; Davis & Sandman, 2010; D’Onofrio et al., 2010
The Developing Brain

▪ These “memories” can be manifested within the circuitry of the developing brain and the physiological systems that influence a variety of biological functions such as:
  ▪ Stress management
  ▪ Immunological responsiveness
  ▪ Metabolic regulation
  ▪ Neuro-endocrine regulation
  ▪ Cardiovascular integrity
▪ These “memories” are often mediated through epigenetic modifications

Jack P. Shonkoff; 2010
EPIGENETICS, EARLY INTERVENTION AND DEVELOPMENTAL OUTCOMES
Epigenetics

- Epigenetics is commonly defined as changes in gene expression that occur without a change in DNA sequence
  

- Epigenetics are also defined as somatically heritable states of gene expression resulting from changes in chromatin structure without alterations in the DNA sequence including
  - DNA methylation
  - Histone modifications
  - Chromatin remodeling

Sang-Woon Choi, S Friso; 2010
Epigenetics Research (Using Rats)

**Background**—Childhood maltreatment and early trauma leave lasting imprints on neural mechanisms of cognition and emotion.

**Methods**—Infant rats were exposed to stress in first postnatal week. Then DNA methylation patterns and gene expression throughout the life span were assessed, as well as in the next generation of infants.

**Results**—Early maltreatment produced persisting changes in methylation of BDNF DNA that caused altered BDNF gene expression in the adult prefrontal cortex also in off spring.

**Conclusions**—These results highlight an epigenetic molecular mechanism potentially underlying lifelong and trans-generational perpetuation of changes in gene expression and behaviour incited by early abuse & neglect.
Epigenetics

- There are more evidence that the social environment early in life, like severe or chronic stress has long-lasting impact on mental and physical health trajectories via epigenetic marking of specific genes.

- One important aspect of the basic epigenetic mechanisms is that although the epigenetic markings are long-lasting they are nevertheless potentially reversible.

Brain Plasticity and the Ability to Change Behavior Decrease Over Time

- Brain circuits stabilize with age, making them increasingly more difficult to alter.
- The window of opportunity for adaptive development remains open for many years, but the costs of remediation grow over time.
- It is more efficient, both biologically and economically, to get things right the first time than to try to fix them later.
Early Interventions

- Early intervention can prevent the consequences of early adversity
- Research shows that later interventions are likely to be less successful—and in some cases are ineffective.
- While there is no “magic age” for intervention, it is clear that, in most cases, intervening as early as possible is significantly more effective than waiting

Kangaroo mother care is one intervention that can make a huge difference in the toxic stress an infant experience during a very vulnerable stage of life

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Long-term developmental outcomes – Colombia study

- First study
  - 1993 to 1996*
  - Randomised controlled trial (n = 746 infants)
  - Safety and effectiveness of KMC
  - Early developmental outcomes (Griffiths at 12 months)

Results

“KMC infants had a **higher IQ** than those given traditional care … The difference was most highly 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**.

The main impact of KMC was on the development of **personal relations** and on **planning functions** related to brain developmental stage at birth.”

Long-term developmental outcomes – Colombia study

- **Second study** 2012 to 2014*
  - 716 infants known to be alive
  - 441 (62%) re-enrolled
  - Results analysed for 264 participants weighing ≤1800g at birth

- **Comparison** KMC and control group for:
  - Health status
  - Neurologic, cognitive and social functioning

- **Measurements**
  - Neuroimaging
  - Neurophysiological and behavioural tests

Long-term developmental outcomes – Colombia study

Results

- KMC effects at 1 year on IQ and home environment still present after 20 years
- KMC parents more protective and nurturing – reflected by reduced
  - school absenteeism
  - hyperactivity, aggressiveness
  - externalisation, and socio-deviant conduct of young adults
- Neuroimaging: KMC group – larger volume of the left caudate nucleus

Conclusions

“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.”

Prevent Separation

- If possible – no baby should be separated from their mother
- If there is separation – introduce skin-to-skin care as soon as possible and as often as possible
Kangaroo Mother Care: Discharge and Follow-up
Kangaroo discharge and follow-up policies

The Kangaroo Mother Care method, includes a follow up program in 2 steps:

1) From discharge from the neonatal unit up to 40 weeks of gestational age

2) From term up to one year of corrected age
Objectives

– The use of KMC allows the transfer of the responsibilities for the physical and emotional care of the infant from the health care personnel to the family, particularly the mother (and any other accepted caregiver providing the kangaroo position – e.g. the father, grandparents, etc.).

– Since continuous kangaroo position permits adequate temperature regulation by the infant and permanent care and direct observation by the provider of the position, the infant’s care can be “de-medicalized” sooner than when the baby is kept in an incubator or a crib.
Aspects included in the KMC follow-up

- Re-enforcement of the training in kangaroo position and kangaroo nutrition for families trained in KMC at the hospital who are discharged home and training of new parents who are discharged directly from a hospital that does not implement KMC.
- Regular monitoring of somatic growth, neurological and psychomotor development, as compared to standards during the first year of life.
Aspects included in the KMC follow-up cont.

- Early identification, treatment, and rehabilitation of any disorders in preterm and/or LBW infants, which may include the intervention of specialists.
- Support and counseling strategies for the family.
- Quality monitoring of the kangaroo clinical practice.
- Active immunization.
Early discharge from the Neonatal Unit

**Child’s eligibility criteria for discharge**

- The child’s adaptation has been successful; he or she is regulating his or her temperature in kangaroo position and has an adequate sucking–swallowing-breathing coordination.
- The child demonstrated adequate weight gain in the Neonatal Unit in kangaroo position and incubator, for at least 3 days, if older than 10 days. (The child may lose weight during the first few days and eligibility criteria for a stable child during the first week are different).
- The child completed his treatment, if any.
- If the child is receiving oxygen through a cannula, it must be below ½ l/min. (If the country has the possibility of domiciliary oxygen)
- The child is breastfed and/or fed with extracted milk.
- There is a Kangaroo Mother Program available able to offer adequate follow-up.
Early discharge from the Neonatal Unit

Mother’s eligibility criteria for discharge

• She has accepted to participate in the KMC Program and has received the necessary training in KMC.
• She feels able to care for her child using KMC (position and nutrition) at home.
• She succeeds in in-hospital training. In particular, she has adequate breastfeeding and milk extraction techniques.
• She is physically and mentally able to care for her child.
• The mother should not be under anti-depressive drugs or using sleeping pills.
• She is supported by her family in the KMC ward or/and in the outpatient KMC program.
Early discharge from the Neonatal Unit

**Family’s discharge eligibility criteria**

- The family is committed to and able to attend follow-up visits in the follow-up programme and to comply with its requirements.
- The family has the will to be trained in KMC.
- The family understands well KMC and it is feasible for them to care for the baby at home.
- The family is available and will cooperate to care for the baby and to ensure his or her safety.
- The family will comply with follow-up appointments, specialized medical exams, breastfeeding schedules, and drugs prescriptions.

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Early discharge from the Neonatal Unit

Family’s discharge eligibility criteria cont.

- The family will adapt to the temporary changes implied by the adoption of KMC at home: maintain the kangaroo position 24 hours a day (sleep in a semi-sitting position) and redefine the roles of all family members, to support the primary caregiver.
- Family members involved in Kangaroo Care should be free of infectious or contagious, skin disease, fever, or significant obesity, and must be physically and mentally able to manage the child under the KMC.
Physical structure of a KMC follow-up program

• Follow-up activities are usually organized daily.
• Ideally, the space for the follow-up program should be located within a hospital where there is a Neonatal Unit equipped with human and technological resources in case of an emergency.
• Ideally, the staff of the follow-up program includes a pediatrician, a nurse, a psychologist, and a social worker trained in KMC. When necessary, other health professionals join the team, such as nutritionists, physiotherapists, ophthalmologists, optometrists, and orthopedists.
• Each child is assessed individually and each family receives personalized recommendations; yet, at the same time, the entire group is taught about KMC procedures and benefits in group sessions.
• Sick children are not admitted in the follow-up program to avoid possible contamination.
Assessment of the newborn when admitted to the KMC follow-up program

1. The gestational age at birth is determined according to the Lubchenco’s classification curves.
2. The anthropometric parameters are assessed (weight, height, head perimeter).
3. A full clinical assessment is conducted (from head to toes).
4. KMC training is reinforced or initiated as necessary.
5. Brain ultrasound and ophthalmologic screenings are requested if possible and if necessary.
6. Routine and specific drugs are prescribed.
7. The need for oxygen is assessed.
8. The need for family support is assessed and provided.
Assessment of the newborn when admitted to the KMC follow-up program cont.

**Gestational age at birth**

- The infant will be classified according to the correlation between the age and weight at the time of birth (using the Lubchenco’s classification) and the classification should be noted in the medical record.
- It is important to make parents aware that the initial period of care until the infant reaches 40 weeks will be difficult and extremely demanding; but the benefits of these efforts will continue for the rest of the infant’s life.
Anthropometric parameters (weight, height, head circumference)

- The weight, height (during supine position), and head circumference, are generally considered to be the most important indicators of growth and nutritional status.

- Anthropometry must be a routine procedure in the neonatal unit and follow-up program as it helps to identify infants who are at a higher risk for morbidity and mortality, as well as those who may present nutritional problems.

- During the first visit and every subsequent visit, anthropometric measurements should be recorded in the charts specific to the child’s gender and age.
Anthropometric measurements are usually compared to data from a reference population similar to the target population.

- Establish the gestational age.
- Measure weight, height, and head circumference of the infant.
- Record these measurements with a dot in the corresponding place on the growth charts.
- Interpret the growth indicators according to percentiles or standard deviations.
- Connecting the dots from consecutive visits shows the child’s growth trend’, and any abnormality can then help health personnel to recognize deviations in a timely manner.
KMC training

- It begins upon first contact in the follow-up or in the KMC ward.
- It is a sensitive period requiring careful attention since the child will be under the mother’s supervision, whether in the KMC ward (rooming-in) or at home.
- It is important to increase the mother’s confidence and to trust her.
- The health team must be available to solve any problems, even by phone.
- It is important to keep in mind the risk of hypoglycemia if the mother is not ready and an expert in feeding her child.
- It is necessary to discuss the possibility of using nutritional supplements, especially for children hospitalized and separated for a long period of time from their mothers. Milk production increases progressively, but not from one day to the next.
KMC training

• All weak aspects of in-hospital training, or those in the process of being attained, must be reinforced.
• An explanation on ‘sun baths’ for management of jaundice should be included with the necessary precautions.
• The benefits and technique for infant massage should be discussed.
Key actions during the KMC follow-up

• Assessing if the child and the family meet the eligibility criteria for admission to rooming-in accommodation (KMC ward) or follow-up.
• Evaluating the knowledge of the mother and family members on KMC.
• Assessing the management of the child in kangaroo position.
• Assessing the breastfeeding technique.
• Assessing the quality of care provided by the mother/family at home and checking to see if the caregivers are able to identify alarm/danger signs in the child.
Key actions during the KMC follow-up cont.

- Making sure the family knows how to use the equipment for oxygen if the child needs it. (Only for countries where domiciliary oxygen is available)
- Explaining to the caregivers how the follow-up programme is conducted.
- Asking about the social and emotional situation of the family and informing the social worker and psychologist in order to intervene in a timely manner, if needed.
Evaluating the family need for support

- In the KMC follow-up program, it is important to develop an organized training/teaching plan that includes individual and group sessions on KMC.
- It is important to have a pediatrician available on call to answer the parents’ questions and concerns regarding care for their fragile infant.
- Training workshops conducted at the KMC follow-up help to reinforce the parents’/caretakers’ knowledge.
- Address parental concerns.

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KMC follow-up, up to 40 weeks of GA and a weight of 2500 g

• Check-ups (by pediatrician and nurse) and testing and screening for any abnormalities.

• The ideal frequency of these appointments is as follows:
  – Daily until target daily weight gain of 15g/kg is met. Women who live far away and are unable to secure accommodation near the hospital should remain in the KMC ward (rooming in) until daily weight gain is achieved to allow weekly travel.
  – Weekly until the infant has reached the gestational age of 40 weeks.
Activities during follow-up up to 40 weeks

- Careful and complete clinical assessment
- Regular monitoring of the somatic growth
  - After discharge, the monitoring is done on a daily basis to assess the child’s nutrition, and the parents’ adherence to KMC until weight gain has been achieved.
  - The goal is to achieve a weight gain around 15-20 g/kg/day, a weekly average increase in height of 0.8 cm, and an increase of head circumference of 0.5 to 0.8 cm.
  - There may be a “normal” weight loss around 10% of birth weight during the first 10 days of life.
Activities during follow-up up to 40 weeks

- **Strategies in case of insufficient weight gain**
  - Reinforce an adequate child’s position at the breast and check the frequency of feedings (every 1 ½ hours during the day and every 2 hours at night for small babies).
  - Assess the type of nutrition received by the infant during hospitalization, as well as the weight in the hospital before discharge.
  - Assess the compliance with KMC guidelines.
  - Educate the mother on the use of hindmilk and technique.
  - If the above still fails, or if no secondary causes for inadequate growth were found, breastfeeding should be supplemented either with fortification or with preterm formula, using a drop or spoon to avoid interfering with breastfeeding.
Activities during follow-up up to 40 weeks

• **Advice on child care for ‘kangaroo infants’ at home**
  - Mothers, families, and often the health staff must be reminded that the kangaroo position does not last long, only a few weeks.

• **Bathing:** A daily bath is not necessary and not recommended before 40 weeks, especially for those infants in kangaroo position.

• **Mother’s activities:** Mothers with a baby in kangaroo position can have several recreational and educational activities at home, as long as their baby is securely held in kangaroo position with a lycra band or binder.

• **Sleep and rest of kangaroo mother/caretaker:** The mother, the father, or other family member will sleep better with the baby in kangaroo position in a semi-sitting position, with a 15°-30° degree-tilt. This position reduces the risk of apnea and reflux.
Activities during follow-up up to 40 weeks

• Advice on child care for ‘kangaroo infants’ at home cont.
• Duration of the kangaroo position:
  • *Daily duration:* will need to increase gradually until it is as continuous as possible, day and night, interrupted only for diaper change and feeding sessions.
  • *Total duration:* As long as the mother and her baby are comfortable, skin-to-skin contact may continue, at first in the institution and later, at home.
• Preterm and/or low birthweight babies are not “discharged” from the Kangaroo Position using external criteria; instead, they are observed until they “request” the discharge (usually when the infant reaches 2500 g): when the position is no longer tolerated and the infant is thriving adequately.
Activities during follow-up up to 40 weeks

- **Ophthalmologic screening**
  - Examination of the retina through an indirect ophthalmoscopy to detect Retinopathy of Prematurity (ROP).
  - It is necessary to screen all at-risk preterm infants admitted in the Neonatal Unit (particularly those who received oxygen) in order to timely diagnose ROP.
  - In the KMC follow-up all preterm infants <37 weeks are screened at 31-32 weeks of gestational age or at 28 days of life.
  - Subsequent screenings are recommended until the vascularization of the retina is completed.
Activities during follow-up up to 40 weeks

- **Hearing screening and testing**
  - Screening is recommended at 40 weeks of gestational age with the use of optoacoustic emissions (OAE) and automated auditory brainstem response (AABR).
  - In case the child is found with hearing loss, refer the child and provide the parents with adequate indications to help them to equip the child with auditory amplification and likewise, to offer the required auditory stimulation.
  - The diagnosis must be immediately confirmed, within the first six months of age, by electrophysiological tests.
  - Inform and train parents on the benefits of an adequate auditory stimulation from birth as well as on the importance of periodical auditory assessment.

Kangaroo Mother Care—UNICEF for every child
Activities during follow-up up to 40 weeks

- **Neurological assessment at 40 weeks of gestational age using axial tone (Dr. Amiel Tison)**
- During the early critical phase, it is not possible to clinically assess neurological function in very preterm infants, since they are very small; they may be unstable or ventilated.
- This neglect to collect clinical information is understandable in the acute phase of neonatal adaptation, but seems unjustified when the child recovers, can breathe on his or her own and is able to tolerate some manipulation.
- At this point, and especially when the preterm baby reaches 40 weeks, the neurological evaluation can offer objective data on the anomalies or confirm normality.
Activities during follow-up up to 40 weeks

- Neurological assessment at 40 weeks of gestational age using axial tone (Dr. Amiel Tison)
- 1. Clinical assessment of axial tone
- Definition of muscle tone
- Passive tone is observed one segment at the time, with maneuvers that evaluate the amplitude of a slow stretching movement executed by the observer, the child is passive; the result is systematically measured or graded and expressed as an angle or as the amplitude of displacement.
- Active tone is the muscular activity of the infant, as he or she responds to the examiner’s maneuvers; the results are expressed by the presence or absence of an active motor response.
### Passive tone

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<tr>
<th></th>
<th>6 months 28 weeks</th>
<th>6½ months 30 weeks</th>
<th>7½ months 32 weeks</th>
<th>8½ months 34 weeks</th>
<th>8½ months 38 weeks</th>
<th>9 months 40 weeks</th>
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<tbody>
<tr>
<td><strong>1. POSTURE</strong></td>
<td>Completely hypotonic</td>
<td>Beginning flexion of thigh at hip</td>
<td>Stronger flexion</td>
<td>Frog-like attitude</td>
<td>Flexion of the four limbs</td>
<td>Hypertonic</td>
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<td><strong>2. HEEL TO EAR MANOEUVRE</strong></td>
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<td><strong>4. DORSAL FLEXION ANGLE OF FOOT</strong></td>
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<td><strong>5. ‘SCARF’ SIGN</strong></td>
<td>‘Scarf’ sign complete with no resistance</td>
<td>‘Scarf’ sign more limited</td>
<td>Elbow slightly passes midline</td>
<td>Elbow almost reaches midline</td>
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<td><strong>6. RETURN TO FLEXION OF FOREARM</strong></td>
<td>Upper limbs very hypotonic lying in extension</td>
<td>Flexion of forearms begins to appear, but very weak</td>
<td>Strong ‘return to flexion’. Flexion tone inhibited if forearm maintained 30 sec in extension</td>
<td>Strong ‘return to flexion’ Forearm returns very promptly to flexion after being extended for 30 sec.</td>
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### Active tone

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Activities during follow-up up to 40 weeks

- **Neurological assessment at 40 weeks of gestational age using axial tone (Dr. Amiel Tison)**
- The literature generally agrees that changes of the axial tone are important.
- By paying attention to these changes, using a standardized clinical method it is possible to follow the history of a brain lesion from the neonatal period through early childhood.
- This allows to identify the children who will benefit from an active intervention at the earliest time.
High risk follow-up from 40 weeks to 1 year of corrected age

• This final phase of the KMC method should be complemented with a high-risk newborn infant follow-up, at least until the infant reaches 1 year of corrected age.
• The rationale for this lies in the fact that kangaroo babies clearly belong to a category of high biological risk for inappropriate growth and sensory and neuro-psychomotor developmental deficits.
• Check-ups (by pediatrician and nurse) and testing and screening for any abnormalities.
• The ideal frequency of these appointments is as follows:
  – From 40 weeks to one year of corrected age, every 6 weeks.
Activities during follow-up from 40 weeks to 1 year of corrected age

- Physical examination
- Monitoring somatic growth
- Complementary feeding
  - Infants who are exclusively breastfed, should initiate complementary feeding at 6 months.
  - Infants who are receiving formula or mixed feeding (breastmilk and artificial milk) are encouraged to initiate complementary feeding at 4 months.
  - Mothers should breastfeed children at this age as often as the child wants, day and night. This will be at least 8 times in 24 hours in the case of preterm or LBW infant and sometimes up to 12 times in 24 hours.
  - It is important to remember that initially for small babies, breastfeeding is given at fixed intervals and not on demand, to ensure an appropriate, minimal intake
Activities during follow-up from 40 weeks to 1 year of corrected age

- **Optometric evaluation**
- The evaluation is carried out at 3 months of corrected age by a trained optometrist in refractive errors in children. Follow-up consultations may be required according to the criteria of the optometrist.
Activities during follow-up from 40 weeks to 1 year of corrected age

- **Neuromotor evaluation**
- The functional consequences of perinatal brain damage may fluctuate throughout childhood. Some may not be identified until later in life or even early adult life.
- Deficits that persist throughout the first year of life indicate neurological damage, even if they are subtle and without apparent functional consequences.
- These early deficits are sometimes described as ‘transient’, given that some deficits are too subtle to fully appear before the child is 2 to 4 years old.
- However, with the correct examination techniques, several deficits that persist in children can be identified and treated.
Activities during follow-up from 40 weeks to 1 year of corrected age

• The INFANIB screening or Infant neurological battery test

• The Infant neurological international battery, INFANIB, is a diagnostic/screening method used to identify children with neuromotor anomalies during the first year of life.

• INFANIB is used in children older than 40 weeks and is useful for conducting a “diagnostic screening” during the systematic monitoring of the preterm and LBW population of a KMC follow-up.

• The INFANIB evaluates global motor development, tone and archaic reflexes, allowing clinicians to detect multiple neurological alterations such as hypotonia, hypertonia, dystonia, and hemiparesis, among others
Activities during follow-up from 40 weeks to 1 year of corrected age

- **The INFANIB screening or Infant neurological battery test**
- This test makes it possible to combine results from the children’s neurological history, from onset to later findings.
- It is highly specific and sensitive.
- Facilitates early detection of neurological disorders.
- Offers the possibility of taking timely and adequate therapeutic action.
- The necessary elements to conduct the exam are:
  - A stretcher with a padded mat, the child must only wear a diaper.
  - The exam is carried out at three, six, nine, and twelve months of corrected age.
  - The exam must not be performed if the child exhibits irritability, fever, is ill, hungry, sleepy or tired; this could interfere with the results.
The INFANIB screening or Infant neurological battery test

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<td>Spasticity</td>
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<td>Tonic labyrinthine in supine</td>
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<td>Tonic labyrinthine in prone</td>
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<td>Asymmetric tonic neck reflex</td>
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<td>Factor II</td>
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<td>Head and trunk</td>
<td>Body derotative</td>
</tr>
<tr>
<td></td>
<td>All fours</td>
</tr>
<tr>
<td></td>
<td>Pulled to sitting</td>
</tr>
<tr>
<td></td>
<td>Sitting</td>
</tr>
<tr>
<td>Factor III</td>
<td></td>
</tr>
<tr>
<td>Vestibular</td>
<td>Body rotative</td>
</tr>
<tr>
<td></td>
<td>Sideways parachute</td>
</tr>
<tr>
<td></td>
<td>Forward parachute</td>
</tr>
<tr>
<td></td>
<td>Backwards parachute</td>
</tr>
<tr>
<td>Factor IV</td>
<td></td>
</tr>
<tr>
<td>Legs</td>
<td>Positive support reflex</td>
</tr>
<tr>
<td></td>
<td>Dorsiflexion of the foot</td>
</tr>
<tr>
<td></td>
<td>Foot grasp</td>
</tr>
<tr>
<td></td>
<td>Standing</td>
</tr>
<tr>
<td>Factor V</td>
<td></td>
</tr>
<tr>
<td>French angles</td>
<td>Abductor's angle</td>
</tr>
<tr>
<td></td>
<td>Popliteal angle</td>
</tr>
<tr>
<td></td>
<td>Heel-to-ear</td>
</tr>
<tr>
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<td>Scarf sign</td>
</tr>
</tbody>
</table>

Activities during follow-up from 40 weeks to 1 year of corrected age

- **The INFANIB screening or Infant neurological battery test**
- **Recommendations:**
  - Tone anomalies (hypotonia, hypertonia, and dystonia) at 40 weeks and an abnormal brain ultrasound during the neonatal period: intensive physical therapy and careful neurological follow up during the first year of life with a nuclear magnetic resonance imaging (MRI).
  - CAT scan or MRI are only requested if hydrocephaly is suspected or to document another lesion.
  - INFANIB is repeatedly administered throughout the year to assess the impact of physical and other therapies, encouraging the participation of the parents.
  - When INFANIB results are normal, physical therapy is suspended.

Kangaroo Mother Care—UNICEF for every child
## Summary

<table>
<thead>
<tr>
<th>Periodicity according to corrected age</th>
<th>Aims</th>
</tr>
</thead>
</table>
| 1.5 months                            | • Anthropometry measurements (growth assessment: weight, length, head circumference)  
• Physical examination  
• Exclusive breast feeding, if possible (revision of breastfeeding technique)  
• At-home stimulation recommendations (verbally or with an information leaflet)  
• Check immunization card |
## Summary

<table>
<thead>
<tr>
<th>Periodicity according to corrected age</th>
<th>Aims</th>
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</thead>
</table>
| 3 months                               | • Anthropometry measurements  
• Physical examination  
• EBF, if possible  
• Standardized neurological exam (i.e. INFANIB)  
• Clinical exam: hip dysplasia and optometry screening  
• At-home stimulation recommendations (verbally or with an information leaflet)  
• Refer to physical, occupational or speech therapy as needed  
• Check immunization card |
### Summary

<table>
<thead>
<tr>
<th>Periodicity according to corrected age</th>
<th>Aims</th>
</tr>
</thead>
</table>
| 4.5 months                             | • Anthropometry measurements  
• Physical examination  
• EBF, if possible if adequate growth is not achieved and socio-economic conditions are poor advise on supplementary nutrition.  
• Hearing screening: between three and six months of corrected age, with referral to speech therapy if needed, only for children who were screened at 40 weeks with abnormal results. |
### Summary

<table>
<thead>
<tr>
<th>Periodicity according to corrected age</th>
<th>Aims</th>
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</thead>
</table>
| 6 months                              | • Anthropometry measurements  
  • Physical examination  
  • Advise on initiation of complementary feeding  
  • Standardized neurological exam (i.e. INFANIB)  
  • Following the results of the INFANIB refer for additional exams if needed (i.e. MRI)  
  • Psychomotor development test, preferably adapted to the country (i.e. Griffiths, Bayley)  
  • At-home stimulation recommendations and exercises (verbally or with an information leaflet)  
  • Check immunization card |

Kangaroo Mother Care—UNICEF for every child
### Summary

<table>
<thead>
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<th>Periodicity according to corrected age</th>
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</table>
| 7.5 months                           | • Anthropometry measurements  
• Physical examination  
• Revise the infant’s diet  
• Check for improvement in abnormal or transient findings in neurological exam or in psychomotor development exam.  
• Refer to therapy as needed or continue with home exercise plan.  
• Check immunization card. |
### Summary

<table>
<thead>
<tr>
<th>Periodicity according to corrected age</th>
<th>Aims</th>
</tr>
</thead>
</table>
| 9 months                              | • Anthropometry measurements  
• Physical examination  
• Standardized neurological exam (i.e. INFANIB)  
• Following the results of the INFANIB refer for additional exams if needed (i.e. MRI)  
• At-home stimulation recommendations and exercises (verbally or with an information leaflet)  
• Check immunization card |
# Summary

<table>
<thead>
<tr>
<th>Periodicity according to corrected age</th>
<th>Aims</th>
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</table>
| 12 months                             | • Anthropometry measurements  
• Physical examination  
• Standardized neurological exam (i.e. INFANIB)  
• Following the results of the INFANIB refer for additional exams if needed (i.e. MRI)  
• Psychomotor development test, preferably adapted to the country (i.e. Griffiths, Bayley)  
• At-home stimulation recommendations and exercises (verbally or with an information leaflet)  
• Check immunization card  
• Walking and language assessment, if not reached by then, the child should be evaluated at 18 months |
Special thanks to:

Dr. Elise Van Rooyen
Head, Department of Paediatrics,
Kalafong hospital, Gauteng Health, MRC Unit for Maternal and Infant Health Care Strategies
University of Pretoria, South Africa

Dr. Julieta Villegas
KMC Consultant
References

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