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Online Appendix 1

A five-component swallowing and breastfeeding intervention for small and sick newborns, embedded in kangaroo mother care

Guidelines for speech-language therapists and healthcare workers to coach mothers

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The aim of the intervention is for mothers and their small and sick newborn babies to establish safe and independent breastfeeding. The practice of kangaroo mother care (KMC) is an integral part of the intervention. Mother-infant bonding and well-being, breastfeeding, and a baby's breathing, health and growth are better with KMC. The intervention can help babies move sooner from tube feeding to breast- and cup feeding, gain weight faster and be discharged earlier.

A hands-off approach is used to coach and monitor mothers. To build a mother's confidence and motivation to continue the intervention after coaching, she should *experience* the intervention techniques from the beginning. With support, mothers should *feel* their babies' first attempts at non-nutritive suckling (NNS), and *see* the effect of the somatic-oral techniques.

Coaching and monitoring are done individually or in groups. Use a doll to demonstrate the techniques or simulate the movements on the baby, almost without touching. A mother uses the techniques without a glove so that the baby becomes more familiar with her unique smell, touch, and the rhythm of her movements. Gloves provoke unfamiliar sensory experiences in babies. Always wash hands before starting the intervention. Fingernails should be short to prevent injury to the baby's mouth. The intervention may be necessary for a week or even several weeks, depending on the gestational age and feeding problems of the baby. The five intervention components are as follows:

1. Non-nutritive suckling

Start with KMC and NNS soon after birth. NNS is safe for babies <30 weeks gestational age. It is easy and can help with better feeding. There are two ways to activate NNS: let the baby suckle on the mother's near-empty breast or on her clean little finger. The mother slides her little finger into her baby's mouth, seeking entrance from the side of the mouth. She inserts her finger and positions the soft side of her finger on the front part of the baby's tongue. With her finger, she strokes the tongue 3 to 5 times with slow, rhythmical downward movements. Hold the finger on the tongue and wait for the baby to start suckling on the finger. Let the baby also suckle on the mother's finger while tube feeding with the baby in the KMC position. The KMC position is preferred and more beneficial when tube feeding preterm babies. Pacifiers are best avoided, as proper cleaning may be an additional burden on mothers and may cause infection. Allow NNS as much as possible, 3 minutes at a time, regularly during the day before breastfeeding or when tube feeding. To take suckling on a finger or breast forward, use somatic-oral stimulation:

2. Somatic-oral stimulation

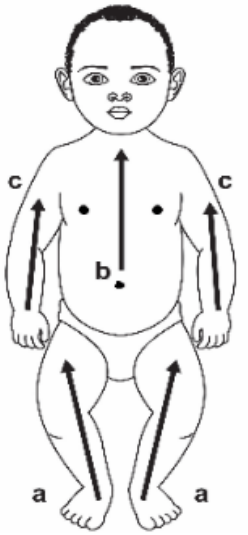
Stroking the body, face and mouth by hand or three fingers can activate the suckle-swallow-breathe pattern. Smooth, co-ordinated and ongoing suckle-swallow-breathing is necessary for breastfeeding. The baby learns the pattern through breastfeeding experience. The mother removes the baby from the KMC position and wraps them warmly (see 2.2) while she expresses the prescribed volume of breastmilk. Before placing the baby on the breast, she starts with somatic (body) stimulation. She opens the blanket to stroke the baby's body. Stroking should be gentle, but firm. Stroke slowly, not rushed. Wrap the baby again when stroking is completed. Then start stroking the mouth as shown in 2.3 and 2.4.

Do the somatic-oral stimulation sequence for 3 minutes, before each of the five daytime feeds. This means the stimulation is done for a total of 15 minutes per day, every day. The baby must be relaxed and calm during the whole routine. If the baby shows any signs of stress, stop the stimulation and calm the baby as explained in point 3 below. Details of the somatic-oral stimulation techniques are described and illustrated as follows:

2.1. Somatic (body) stimulation

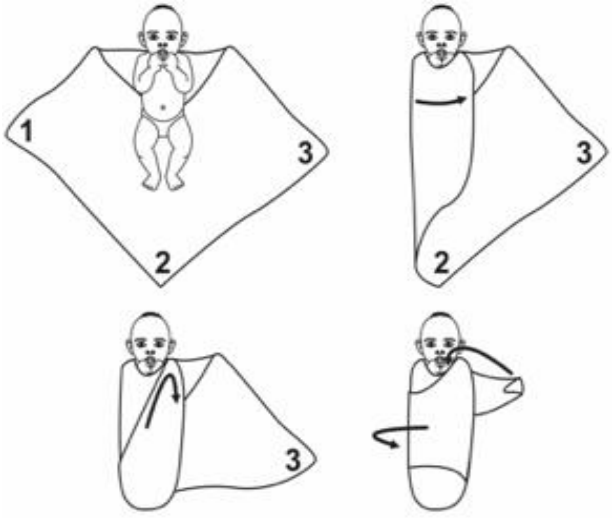
Stroke body, legs and arms 2x in the direction of the mouth.

a) Hold the baby's foot. Stroke one leg and then the other leg, from the foot upwards.
b) Stroke from the belly button upwards to the neck.
c) Hold the baby's hand. Stroke one arm, then the other arm, from the hand to the upper arm.



2.2 Wrap the baby in a thin blanket

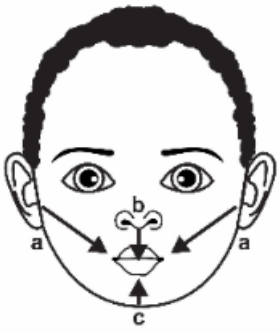
- Wrapping makes the baby feel secure and warm. More blankets can be used.
- Place the baby's hands in the middle, close to the mouth. This helps finger suckling for self-calming.
- Wrap the baby this way when the mother goes to the bathroom.
- Keep the baby in the KMC position at all other times.
- Oral (mouth) stimulation follows next.



2.3 Stroke outside the mouth

Activate the muscles of the face and mouth. Stroke 2x towards the mouth:

a) From one ear to the mouth, and from the other ear to the mouth.
b) Stroke downwards from the nose to the upper lip.
c) Stroke upwards from the chin to the bottom lip.



2.4 Stroke inside the mouth

- Slowly put the index finger into the baby's mouth, sliding the finger sideways over the cheek.
- Stroke the top and bottom gums 2x. Stroke from the middle to the one side, and then from the middle to the other side.
- Turn the finger and press against the roof of the mouth.
- Turn the finger again, press on the tongue and wait for NNS.

3. Manage stress in the mother and baby

Stress is harmful in mothers and babies when nothing is done about it. KMC helps mothers feel and see when their babies are stressed, but mothers and healthcare workers do not always know that stress interferes with feeding. Assist mothers in identifying stress signs in their babies. Babies with feeding problems may be hypersensitive, clench their gums, or gag when touched on their tongue. To reduce stress hold the baby between cupped hands or let them suckle on the mother's finger for a while to calm down. Then do the somatic-oral stimulation slowly, or only apply pressure with the hand around the mouth, instead of stroking. KMC reduces stress in both mother and baby. Hearing the mother's voice is soothing, and talking with her baby is calming for both. If the baby does not calm down, place them in the KMC position and continue tube feeding. Wait with breast- and cup feeding until the baby is calm. To reduce stress, a NICU and KMC ward should be quiet. Bright light should be avoided.

Stress signs in babies

- Yawning (tired)
- Pushing the hands and fingers out (stop sign)
- Covering the face with a hand
- Frowning
- Coughing
- Moving the arms and legs too much (flailing)
- Arching backward
- Crying
- Sneezing
- Hiccupping
- Shaking

What to do to calm the baby

Place the baby in the KMC position or wrap in a blanket. Let the baby suckle on the mother's finger or hold the baby between your cupped hands and apply pressure.

Important: If the baby coughs while feeding, stop feeding immediately. Watch the baby's breathing carefully before trying to feed again.

4. Provide postural support for mother and baby during feeding

When breastfeeding or cup feeding, a mother should sit in a chair with sufficient back support and armrests, with her feet on the floor. She should hold the baby sideways in one arm, against her body, with the baby's head resting in her bent elbow. Her other hand is then free to help the baby latch onto her breast. This is the cradle-hold breastfeeding position, which we recommend for preterm babies. Keep a small baby wrapped during feeding. The baby's head, neck and body should be in a straight line, with the body flexed and the shoulders slightly forward. The baby's chin should be close to their chest. Sitting on a bed while feeding a small baby is tiring for a mother, as feeding takes long. She may lower her arm supporting her baby, causing the baby's head to move sideways, making it difficult to keep the suckle-swallow-breathe pattern going.

Stroke the cheek to open the baby's mouth and to latch onto the nipple and areola of the breast. The baby should start to suckle when feeling the nipple. Initially, the baby will only suckle on the near-empty breast for NNS. While still on tube feeds, the baby should also start suckling on the breast. If the mother dips her finger in breastmilk, she may help her baby suckle. When the baby stops suckling from the breast, give cup feeding in the breastfeeding position and/or tube feeding in the KMC position. Babies stop suckling when they are tired or satisfied.

While breast- and cup feeding avoid holding the baby by the neck only. This holding method often extends the baby's neck while the body and shoulders are unsupported, making swallowing more difficult. For better support, use the cradle-hold breastfeeding position for cup feeding as well. This hold allows the neck to bend slightly forward with the baby's chin closer to the chest and facilitates the suckle-swallow-breathe pattern. To save the baby's energy while gaining weight, cup feeding is introduced to top up breastfeeding attempts, and/or to wean the baby from tube feeds. Babies are discharged when gaining weight on breastfeeding, not on cup feeding.

5. **Make sure the baby swallows safely**

A safe and ongoing suckle-swallow-breathe pattern for breastfeeding is a major achievement for small and sick newborns. Initially, swallowing may be delayed, disrupting breathing and causing coughing and choking. Coughing and choking cause respiratory aspiration, a serious issue. Milk is spilled, reducing the amount that the baby feeds. It may also cause the baby to resist feeding. When there is too much milk in the mouth or milk flows too fast, it is difficult to swallow. This may happen with bottle-, syringe- and cup feeding, but rarely with breastfeeding as the baby controls the size of the feeding bolus.

A mother can control the milk flow better with cup feeding, which is why bottles and syringes are best avoided. Let babies pace themselves with breastfeeding attempts and observe them carefully. Feed very small amounts of milk with cup feeding and wait for the baby to swallow. To help babies close their lips, stabilise the jaw, and swallow, the mother presses with her finger under the baby's chin. She will see and feel the baby swallow when the lips and tongue move.

Closing remarks

The WHO and UNICEF recommend immediate and continuous KMC, and breastmilk feeding or direct breastfeeding for small and sick newborn babies. A mother learning to breastfeed her vulnerable baby needs much support and encouragement from healthcare workers, other mothers, and their families. Pasteurised donor breastmilk from a human milk bank, or milk formula can be used when indicated.

Establishing breastfeeding in small and sick newborns is achievable with intervention. We recommend using all five components of the swallowing and breastfeeding intervention with the practice of KMC as its impetus.

A handout for mothers and more information are available in the following document:

Van Rooyen, E. (2023). *Feeding preterm and low-birthweight newborns. A one-stop resource document for developing country-specific implementation guidelines, protocols, standard operating procedures, and job aids*. Version 1.2. UNICEF and University of Pretoria. https://www.up.ac.za/media/shared/717/KMC/feeding-for-preterm-lbw-infants_technical-resource-doc_-v1.2-2023-10-23.zp243054.pdf