

Feeding development solutions for neonatal intensive care

Feeding in the NICU is a unique challenge. Medela supports NICU professionals with evidence-based solutions to increase breastfeeding and maximise the use of human milk.





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Medela understands that feeding develops as a continuum rather than just a series of distinct, isolated events or states. Therefore, Medela offers a feeding development portfolio of comprehensive, evidence-based solutions. A portfolio that aims to provide milk to the hospitalised infant not only as close to breastfeeding as possible, but also in a manner that supports each infant's feeding ability and maturation.

This brochure supports NICU (Neonatal Intensive Care Unit) professionals in finding the optimal evidence-based solution for each situation alongside the infant's feeding development progression. It is an overview of Medela's NICU feeding solutions and as such, the entry point to more detailed materials and initiatives dedicated to human milk and breastfeeding.

Medela: Comprehensive solutions for human milk and breastfeeding

For more than 50 years Medela has strived to enhance mother and baby health through the life-giving benefits of breastmilk. During this time, the company has focussed on understanding mothers' needs and infants' behaviour. The health of both mothers and their infants during the precious breastfeeding period is at the centre of all activities. Medela continues to support exploratory research into human milk and breastfeeding, and incorporates the outcomes into innovative breastfeeding solutions.

Through new discoveries surrounding the components of human milk, the anatomy of the lactating breast and how the infant removes milk from the breast, Medela has developed a set of solutions to support NICUs in providing human milk and improving breastfeeding.

Medela understands the difficulties of providing human milk in the NICU. There are challenges from the mother's side to reach an adequate milk supply and from the infant's side to ingest the milk; plus there are issues of hygiene and logistics when meeting these challenges. The portfolio Medela offers is directed towards obtaining human milk, promoting human milk feeding, and supporting all infants in achieving breastfeeding as early as possible.

Medela aims to provide the most recent, evidence-based knowledge to support breastfeeding and human milk use in the NICU. The goal of the innovative, research-based products, together with the educational materials, is to overcome the difficulties associated with human milk provision in the NICU.



Scientific research

Medela strives for excellence in scientific research – an attitude that has enabled the company to develop advanced breastpump and breastmilk feeding technologies. Medela works with experienced medical professionals and seeks collaboration with universities, hospitals and research institutions worldwide.



Products

Helping mothers to express milk is Medela's core competency. This includes careful and hygienic collecting of breastmilk in BPA-free containers. Easy solutions for labelling, storing, transporting, warming and thawing – all help to safely manage precious human milk. And for human milk to reach the infant, Medela has developed a range of innovative products for different feeding situations.



Education

Within Medela, research and education are closely linked. Medela connects clinicians and educators in ways that lead to professional growth, exchange of knowledge and interaction with the broader scientific community.



Passionate about human milk

Science and practitioners agree that human milk is the best nutritional source for infant growth and development, and that breastfeeding is the most natural and safe way to provide it. Moreover, breastfeeding offers mutual benefits to mothers and their infants.

Human milk: Unique and irreplaceable

Human milk is the natural food for all infants. It is unequalled and universally recognised as the optimal feeding choice for every infant. Globally, the benefit of human milk is agreed upon, with the World Health Organization (WHO) and societies for children, paediatrics and neonates recommending human milk as the exclusive nutritional source for full-term infants for the first six months of life¹⁻³. This recommendation ensures that infants receive the complete nutritional, immunological and developmental benefits of human milk⁴, in addition to the physical and psychological benefits that breastfeeding provides to the mother and her infant¹.

Human milk reduces the risk and severity of debilitating morbidities in premature infants in a dose-response manner, with higher doses of human milk leading to the greatest protection^{5, 6}. Premature infants who receive mother's milk during their stay in the NICU have a reduced risk of nosocomial infection, sepsis, necrotising enterocolitis, chronic lung disease, retinopathy of prematurity, developmental and neurocognitive delay, and rehospitalisation after NICU discharge⁷⁻¹⁴. Human milk from the infant's mother cannot be replaced by artificial sources, making the feeding of human milk a NICU priority.

Preterm infants miss the rapid foetal growth that normally occurs *in utero* during the last trimester¹⁵. Adaptation to extrauterine life occurs far too early, creating a unique and complex set of challenges for preterm infants and their caregivers.

Breastfeeding: Safe, efficient and best for mother and infant health

Besides the value of providing breastmilk, breastfeeding also assists in the transition from intrauterine to extrauterine life by mutually enhancing and regulating infants' and mothers' physiological systems.

Breastfeeding is often the first direct mother-infant interaction^{16, 17}. Body contact during breastfeeding helps regulate the infant's acid-base balance, temperature, energy reserve conservation¹⁸, adjustment of respiration, crying, and nursing behaviours^{19, 20}. Similarly, breastfeeding increases the mother's attention to her infant's needs²¹, improves the initiation and maintenance of lactation, as well as the efficiency of the mother's energy economy, resulting in better exploitation of ingested calories²². Furthermore, the release of hormones, prolactin and oxytocin, during breastfeeding are associated with lower levels of maternal stress and enhanced bonding²³.

Healthy breastfeeding infants are able to safely coordinate milk removal from the breast, without physiological compromise²⁴. The use of vacuum during breastfeeding has been shown to play a key role in this function^{24, 25}. The mechanical action of breastfeeding is further associated with benefits for the oral-facial development of the infant²⁶ including improved dentition, perioral and masseter muscle and palatal growth^{27, 28}, reduced risk of acute otitis media and improved speech and tonal quality in later childhood²⁹⁻³¹ compared to conventionally bottle-fed infants⁸.

Breastfeeding is the most convenient, safe and hygienic method of feeding since there is no preparation and handling time required and milk is always available at the right temperature. It is clearly the most natural and most effective way to provide nutrition, protection against infection, and promotion of normal growth and development to all infants.



The challenges with breastfeeding in the NICU

Achieving the goal of breastfeeding in the NICU is particularly challenging. Fragile, vulnerable, medically compromised infants generally cannot go directly to their mothers' breast and feed effectively after birth³²⁻³⁴. Therefore, for NICU infants, breastfeeding, which may seem like a rather simple premise, is in practice a complex task requiring attention to the needs of both the mother and her infant.

Challenges for the infant

Safe and successful oral feeding requires not only appropriate sucking, swallowing, and breathing, but also the coordination of these three functions in order to minimise adverse episodes of apnoea, bradycardia, oxygen desaturation, and aspiration³⁵⁻³⁷. For preterm infants, a combination of issues affect their ability to safely feed; these include hypotonia (low muscle tone), neurological and gastro-immaturity, and underlying medical complications such as gastro-oesophageal reflux and chronic respiratory disease³⁴. Together these problems make it difficult for the hospitalised infant to create and maintain the vacuum required for breastfeeding, and additionally difficult to coordinate swallowing and breathing safely³⁵⁻³⁷. Birth defects such as cleft lip and palate can limit the ability to breast-feed even further^{38, 39}.





Challenges for the mother

Preterm birth interrupts the mother's breast development and she must subsequently adapt to lactation earlier than expected⁴⁰. Mothers of preterm infants, especially extremely low-birth-weight infants, experience both physiological and emotional difficulties that adversely affect breastfeeding success^{41–43}. When the infant cannot go to the breast, or cannot effectively remove milk from the breast, the mother requires assistance to initiate and maintain a sufficient milk supply^{42, 43}. The stress associated with maternal-infant separation, in addition to inadequate breast stimulation, can interfere with the establishment of breastfeeding and increase the likelihood of complications^{44, 45}. For many mothers of preterm infants, this means they must initially rely on the support of healthcare professionals and a breastpump to express milk for their infant, and if their milk supply is low, they may also need to rely on donor milk temporarily.



Supplementation of breastmilk

Expressed milk from the mother, as well as donor milk, likely require fortification to meet the increased energy demands of the preterm infants^{13, 46}. The food for these infants needs to be higher in caloric value, but in smaller, more concentrated, volumes. Therefore, the preparation of feeds may involve not only expressed breastmilk, but also the fortification thereof, before being fed to the infant. This adds an extra layer of complexity.

Furthermore, other circumstances can make feeding directly at the breast a challenge. For example, some mother's medications make direct breastfeeding unsafe⁴⁷, and on some occasions own mother's milk requires treatment, for example pasteurisation, preventing breastfeeding altogether⁴⁸. Likewise, mothers may be unable to be present in the hospital for every feed throughout the day⁴¹.

When infants are unable to feed at the breast, the principal goal is to provide human milk to these infants, while developing their natural oral feeding skills, thus facilitating exclusive breastfeeding as early as possible^{5, 41}.





Bridging the gap: Feeding the hospitalised infant

In order to bridge the gap in feeding development NICUs constantly work on optimising processes and procedures to

- I provide a feeding experience as close to breastfeeding as possible
- I support the development of breastfeeding

Medela shares these goals. Utilising research-based and process-optimised innovations, as well as research reviews and the latest study summaries, Medela supports you and your patients in making informed choices.

While the primary goal of all non-oral feeding techniques is mainly to get nutrition to the infant efficiently at the lowest possible risk, the focus of Medela's oral feeding portfolio is on providing feeding options to infants in a way that supports their individual oral feeding abilities at each stage of their development.

Non-oral feeding methods

The delivery of an extremely premature infant is a nutritional emergency. In order to mitigate degrees of starvation in these infants, efforts rely heavily on the total or partial parenteral provision of nutrients.

This does, however, come with potential risks such as bacterial and fungal infection, mechanical complications related to venous line placement, and miscalculations and errors in supply and administration. Therefore, very preterm infants are transferred to alternative methods, such as enteral feeding, as soon as possible¹³.

Enteral nutrition is indicated for patients with a functional gastrointestinal tract but whose oral nutritional intake is insufficient to meet estimated needs. Prolonged use of feeding tubes has been considered harmful for the neonate because it might alter coordination of sucking, swallowing and breathing⁴⁹. Tubes can also be incorrectly placed⁵⁰ and a location for pathogenic colonisation⁵¹.

The risks associated with parenteral and enteral feeding methods, as well as the non-natural way in which they provide nutrition, are significant reasons to progress the infant to oral feeding as soon as possible.

The transition to oral feeding is usually supported by early non-nutritive sucking on a pacifier. This helps to train sucking in the preterm infant. Preterm infants who use a pacifier during tube feeding have improved feeding tolerance, accelerated transition from tube to oral feeding, increased weight gain and a reduced length of hospital stay⁵². Further, the readiness of an infant for oral feeding can be assessed to facilitate the transitions at an optimal time.



Medela's NICU oral feeding portfolio

Medela provides a range of differentiated products for diverse feeding situations, dedicated to support NICU professional caregivers and parents in providing the benefits of human milk and breastfeeding to preterm and NICU infants.

Goals of an oral feeding development portfolio for the NICU

- I Attain an early transition from tube feeding to oral feeds and breastfeeding
- I Utilise a combination of products, tailored according to each infant's feeding development
- I Offer a positive oral feeding experience for the NICU infant, parents and professionals
- I Allow infants to apply their natural feeding behaviour
- I Maintain the infant's breastfeeding ability when the breast is not available
- I Promote and support breastfeeding

Early oral exposure to human milk

As early as possible after birth, the infant should be exposed to the unique components of human milk, especially their mother's own colostrum¹³. For a healthy term born infant, the first breastfeed should occur in the first hour of life⁵³; however for a prematurely born or otherwise hospitalised infant this generally occurs later. During parenteral and enteral feeding, nourishment bypasses the oral cavity^{54, 55}. Very early on in the development of the infant, the practice of swabbing the oropharyngeal regions can be an option to facilitate the exposure to mother's milk, even before the infant is capable of sucking^{56, 57}.



Finger Feeder

As the infant begins to mouth and suck, other feeding options can be utilised to help the infant's oral feeding skills develop. For example, offering small volumes of milk with a syringe. One tool that can be utilised for this practice is the Finger Feeder. This device enables small volumes of milk to be offered to the infant under direction of the healthcare professional. After attaching a syringe of breastmilk to the Finger Feeder, the device is offered by sliding it alongside the caregiver's finger that has been placed in the infant's mouth. When the caregivers sense the infant's attempts to suck and create a vacuum on their finger, they can reward the infant by depressing the syringe and delivering some human milk. This may help to reinforce the infants' natural sucking reflexes⁵⁸ and should encourage them to learn to build a vacuum for milk removal. Finger feeding appears to be supportive of breastfeeding rates in the hospital⁵⁹.

- I Encourage the infant's natural sucking behaviour⁵⁸
- I Carefully control the delivery of milk to the hospitalised infant



Encouraging at-breast feeding

As soon as the opportunity to breastfeed arises, it should be encouraged as often as possible^{60, 53}. This can occur in parallel to enteral feeding and oral feeding. An at-breast feed should not be considered only for the benefit of transferring milk, but also for the benefits of skin-to-skin contact^{61–63}, parental empowerment and involvement, the training of the infant to become more effective at breastfeeding, and the stimulation of the mother's milk production⁶⁰.

Contact Nipple Shield

To support the NICU infant in feeding at the breast, nipple shields are commonly used in the hospital⁶⁴. Medela's feeding solution portfolio includes a range of sizes of silicone Contact Nipple Shields designed to provide a breastfeeding experience as close to nature as possible. The nipple shields are thin and flexible with a cut out area for the infant's nose and face to have contact with the mother's skin.



- I Promote the latch of the infant to the mother's breast with the smooth silicone surface⁶⁴
- I Encourage the infant to create a vacuum to remove milk⁶⁴
- I Support milk transfer at the breast⁶⁵
- I Designed with a cut out area to maximise skin contact





First self-controlled oral feeds

Considering the risks and constraints posed by oro- and nasogastric enteral feeding⁴⁹, the infant should be fed orally as early as is considered safe. Once the infant can receive sufficient nutrient volumes orally, the enteral tubes can be removed and the infant will be one step closer to leaving the hospital. In the NICU, alternative methods of providing nutrition are commonly used in parallel to the development of breastfeeding⁶⁶.

Conventional bottle feeding has been questioned in terms of how supportive it is for protecting breastfeeding. The mechanics of feeding with a conventional bottle and teat are quite dissimilar to those required at the breast. A conventional teat allows the constant release of milk through the hole at its tip, without the requirement of vacuum⁶⁷. This can challenge the infant's ability to coordinate sucking, swallowing, pausing and breathing resulting in oxygen desaturation and stress^{68, 69}.



Calmita Starter

Medela has developed an innovative hospital feeding solution, Calmita, that has been shown to increase breastfeeding in the hospital⁷⁰. It incorporates a vacuum-controlled valve that prevents milk flow unless the infant applies a vacuum. This means that the infant must create a vacuum for milk to flow, and if the vacuum reduces below the valve threshold, milk will stop flowing. Infants can control milk intake, and suck, swallow, pause and breathe while feeding in a more natural way⁷¹. The Calmita Starter has a low vacuum threshold, allowing infants who can only apply a minimum vacuum, to actively remove milk.





Calmita Advanced

As infant feeding development progresses, Calmita Advanced can be offered. With the Advanced version, the vacuum-controlled valve requires the infant to suck a little stronger for milk to flow. Calmita is intended for hospitalised infants, and the design is appropriate for the oral anatomy of infants that are born prematurely or small for gestational age ⁷².

Recent research ⁷⁰ has shown that hospitalised premature infants feeding from Calmita, rather than a conventional teat, were discharged significantly earlier with an increased number of infants breastfeeding in the hospital.

- I Increase the chance of earlier discharge home ⁷⁰
- I Allow natural feeding behaviour, requiring the infant to create a vacuum ⁷¹
- I Help to improve breastfeeding in the hospital ⁷⁰
- I Reliable and user-friendly
- I Appropriate for all well-dissolved nutritional feeds



Supplemental Nursing System

Throughout the development of feeding, there may be occasions where breastfeeding can be supported by offering supplemental nutrition while the infant feeds at the breast. This may be helpful for a mother with a low milk supply, or the requirement of supplements in addition to the transfer of milk at the breast. The Medela Supplemental Nursing System works by filling a reservoir with the supplemental nutrition. The reservoir can be placed on the mother's chest or a pole, and is connected to very thin and flexible tubes that can be fixed alongside the mother's nipples. This ensures the infant is supplemented while receiving the benefits of breastfeeding.

- I Enable mothers to breastfeed, when they would be otherwise unable to
- I Help to stimulate mother's milk supply through direct sucking at the breast ⁷³
- I Train the infant to suck properly by creating a vacuum at the breast
- I An excellent partner for supporting skin-to-skin contact
- I Support bonding between mother and infant
- I Appropriate for all well-dissolved nutritional feeds





Finally: Full breastfeeding and returning home

As the time approaches for the infant to be discharged from the hospital, the ideal scenario would be:

- I The mother has successfully initiated and established her milk supply
- I The infant has developed the skills to safely and effectively receive sufficient nutrition from full breastfeeding

Reaching full oral feeds is often a prerequisite for discharge⁷⁴ and should be an event that parents feel extremely proud of achieving. Depending on the reason for hospitalisation, the transition from hospital to home can still have its difficulties. The provision of a discharge plan, with continual support and management of expectations is crucial for ensuring the continuation of breastfeeding for as long as possible⁶⁰.



Calma

For the mother and infant at home managing returning to work and other activities, Medela has developed Calma. This novel feeding solution helps to maintain the sucking behaviours that the infant has developed. Calma has the same functionality as Calmita Advanced, with a similar vacuum-controlled valve that requires the infant to create a vacuum for milk to flow, yet it has a size that is suitable for the oral anatomy of the term born infant^{67, 75}.

- I Enable infants to maintain their natural feeding behaviour learned at the breast^{67, 75}
- I Infants create their individual vacuum through a combination of tongue and jaw movements^{67, 75}
- I Help infants to drink, breathe and pause regularly⁷⁵
- I Support an easy transition from the breast to Calma and back
- I One size is sufficient for the entire breastfeeding period, just as in nature





For special circumstances

Medela also provides solutions for those infants who need a little extra support when it comes to feeding. Feeding difficulties tend to be complex, with each infant experiencing a unique set to overcome. Because of this, it is likely that NICU infants will have varied abilities to create a vacuum and coordinate sucking, swallowing and breathing. Therefore, individualised combinations of the products in this solution portfolio will support the development of feeding for these special circumstances.

The central premise of the products in the Medela portfolio is to support the infant in developing the ability to create a vacuum, which is key to remove milk during breastfeeding^{24, 25, 76, 77}. There are however, special circumstances that hinder or preclude the infant from creating a vacuum.



SpecialNeeds Feeder and the Mini SpecialNeeds Feeder

An infant born with cleft lip and palate may be anatomically unable to create an airtight seal during feeding^{38, 39} and therefore cannot generate vacuum. Infants with certain syndromes and neurological disorders may also have issues appropriately generating a vacuum due to hypotonia and coordination difficulties⁷⁸.

The SpecialNeeds Feeder is designed to allow the infant to use compression to extract milk. The caregiver can easily control the milk flow as appropriate by a slit valve mechanism.

For smaller infants, there is a Mini SpecialNeeds Feeder available to cater for various oral anatomies. By using a combination of devices, healthcare providers can tailor the solution for the individual patient. Finally, depending on the challenge, if the infant eventually develops the ability to create a vacuum, they can progress to a vacuum-requiring feeding device, such as Calmita, to support the ability to breastfeed.

- I Easy regulation of milk flow to suit the infant's abilities and efforts
- I Easy milk intake
- I No spillage
- I One-way valve to prevent air from entering the teat
- I Help when infants cannot create a vacuum
- I Support oral feeding in infants with cleft lip/palate^{79, 80}





Education

NICU professionals know that products are only one part of the equation to successful breastfeeding in the NICU. It is as important for all stakeholders to receive consistent, accurate information in order to

- I achieve a full commitment to support human milk use and breastfeeding by all staff and parents
- I support evidence-based decision-making
- I develop efficient and effective best practices for human milk handling and feeding

Medela works together with experts around the world to tackle and remove the barriers to the use of human milk and breastfeeding in the NICU.

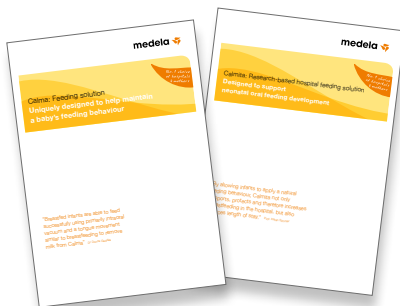
Beyond direct support of various basic and clinical research projects, Medela summarises existing knowledge on the various challenges and disseminates this knowledge through different materials, channels and events.





Research review: Feeding development of the preterm infant

Comprehensive examination of the published literature on feeding development of the preterm infant has been carried out. The resulting review highlights up-to-date and evidence-based methods to support human milk feeding and breastfeeding in the NICU.



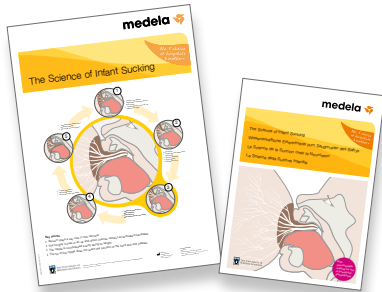
Study abstract papers

The study abstract papers provide the scientific and clinical context to specific process- and product innovations. By summarising, analysing and explaining the clinical research, they help to set the right expectations when implementing a new procedure or technology.



Infographics

Infographics take a large amount of information and then condense it into a combination of images, text and numbers. This allows viewers to quickly grasp the essential insights the data contains. The visual representations of data sets and instructive materials are a quick way for audiences of all levels to learn about a topic.



Posters and DVDs

Medela supports numerous research projects. The most significant outcomes of these projects are described and visualised through posters and DVDs. These include topics such as the science of infant sucking and breastmilk removal.



Online

For further and up-to-date information please visit <http://www.medela.com/nicu>.



Knowledge transfer events

Medela organises diverse symposia on different topics connected to human milk as regional stand-alone events or as part of national conferences. However, Medela's most important event is the annual International Breastfeeding and Lactation Symposium. Through this Symposium, Medela makes knowledge directly accessible to the practitioners. The Symposium is a platform for internationally renowned researchers to give insights into their latest research findings in three key areas: latest recommendations for research-based practice, the unique components of human milk and the value of human milk in the NICU.

Please contact your sales representative for more information on all the items above, or visit www.medela.com

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