

# Nurturing infant health drop by drop: Oral administration of colostrum

Forward-thinking units are embracing oropharyngeal administration of colostrum to support the development of the infant oral mucosa and protect them against infection.

**Sarah M. Reyes, PhD, MSc**

## Executive summary

Health care providers have the unique opportunity to support lifelong health by ensuring each infant gets their mothers' milk. A large body of evidence suggests that feeding human milk, even just one time, confers benefits to the recipient infant.<sup>1-3</sup>

The first milk produced by mothers is called colostrum—a thick, sticky substance with uniquely high concentrations of immune factors, biologically active proteins, and nutrients, including vitamin A.<sup>4</sup> This abundance of vitamin A contributes to colostrum's rich golden color, earning it the moniker "liquid gold".

Each drop of colostrum plays a critical role in nurturing the newborn's developing oral and gastrointestinal microbiomes, protecting them from infections, and supporting their overall health.<sup>4,5</sup> Mounting evidence demonstrates that oral administration of colostrum is beneficial, even for premature infants who are unable to receive enteral feeds.<sup>6</sup>

This white paper reviews the importance of colostrum for infant health, emphasizing its unique composition and consistency as well as its small volume compared to mature mothers' milk. We also discuss the latest research on oropharyngeal colostrum therapy for premature infants and why forward-thinking units have embraced this practice as part of their hospital protocols.

**Colostrum**  
**Small volume ...**  
**... BIG impact**

# Physiological roles of colostrum

## Introduction

Human milk is widely recognized as the optimal source of nutrition for nearly all infants.<sup>1,7-9</sup> Research consistently shows that infants fed human milk indirectly or directly at the breast have improved health outcomes compared to those fed formula. Breastfed infants experience fewer episodes of otitis media and diarrhea. They also have lower incidences of respiratory illnesses, asthma, atopic dermatitis, obesity, childhood leukemia, diabetes mellitus, and sudden infant death syndrome (SIDS).<sup>10</sup>

Human milk-feeding often exhibits a dose-response effect, where increased consumption correlates with improved outcomes.<sup>11-13</sup> In many instances, feeding human milk, even just one time, is associated with improved health outcomes.<sup>2,3,10,12</sup>

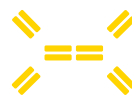
The first milk produced—colostrum—is thick and sticky with uniquely high concentrations of immune factors, bioactive proteins, and nutrients, including vitamin A.<sup>4</sup> This abundance of vitamin A contributes to colostrum's rich golden color, earning it the moniker “liquid gold”.

Many components of human milk are at their peak concentrations in colostrum.<sup>4,5</sup> It is currently thought that these elevated levels serve as “initial loading doses,” offering additional protection against infection as the infant immune system transitions from being tolerogenic in utero (which prevents miscarriage) to immunogenic after birth (which helps prevent and fight infections).<sup>14</sup>

## Bioactive components

Colostrum contains several biologically active (bioactive) components that play a critical role in nurturing the newborn's developing oral and gastrointestinal microbiomes, protecting them from pathogens, and supporting their overall health<sup>4,5</sup> (Figure 1).

In colostrum, there are high concentrations of maternal immune cells and antibodies, including activated macrophages, lymphocytes, neutrophils, and secretory immunoglobulin A (sIgA).<sup>4,5</sup> These maternally-derived immune factors provide passive immunity—a source of immediate and tailored protection against a wide range of pathogens, including local pathogens to which the mother has been exposed.<sup>15</sup>



### Maternally-derived immune factors

Maternal immune cells and antibodies, such as secretory IgA that provide added protection against infection.



### Probiotics

Health-promoting bacteria that colonize oral and gastrointestinal microbiomes.



### HMOs

Indigestible oligosaccharides that serve as food or “prebiotics” and decoys for pathogenic bacteria.



### Bioactive proteins

Antimicrobial proteins, including lactoferrin and lysozyme.

Figure 1. Bioactive components in colostrum

Colostrum also contains probiotics, health-promoting bacteria, including various species of *Bifidobacterium* and *Lactobacillus* that colonize the mucosa, crowding out pathogenic species<sup>16</sup> and promoting immune development.<sup>17</sup>

Human milk oligosaccharides (HMOs) in colostrum serve as food, or prebiotics, for these bacteria. HMOs are metabolized by health-promoting bacteria to create favorable oral and gastrointestinal microbiomes.<sup>18,19</sup> HMOs can also serve as decoy molecules, binding the pathogen's outer surface receptors used to colonize and cause infection.<sup>18</sup> The HMO-microbe complex is excreted through feces without causing infant illness.<sup>18</sup>

Colostrum is also particularly high in protein compared to mature milk because it contains elevated levels of bioactive proteins such as lysozyme,  $\alpha$ -lactalbumin, growth factors, and cytokines.<sup>20,21</sup> One of the most abundant bioactive proteins in colostrum is lactoferrin, which binds free iron otherwise used by pathogens for replication.<sup>22,23</sup>

## Volume & consistency

Human milk volume rapidly increases during the first week postpartum in coordination with the infant's stomach capacity. Vaginally delivered infants transfer about  $6.0 \pm 1.4$  mL/kg of human milk on day one and  $66 \pm 3.6$  mL/kg by day three after birth.<sup>24</sup>

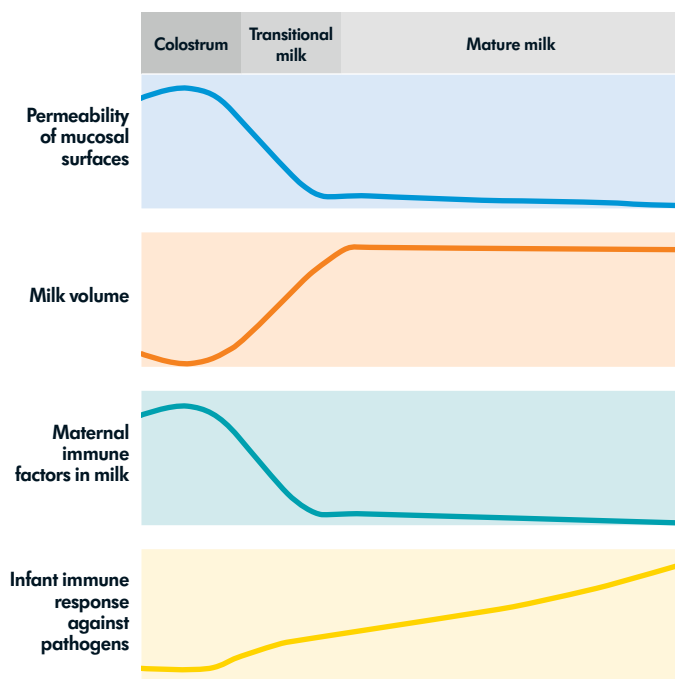
The physiological volume of colostrum meets the metabolic needs of a healthy, full-term newborn since glycogen stores, not oral intake, serve as the primary

energy source immediately after birth.<sup>25</sup> Glycogen stores gradually decrease in concert with increase in milk volume over the first week postpartum.<sup>26</sup>

Consistency is another notable feature of colostrum. The stickiness of colostrum is beneficial as it allows the infant to master the coordination of suckling, swallowing, and breathing.<sup>27</sup>

## Bridge to extrauterine life

Colostrum is an important part of the natural, coordinated, and complex process to adapt to extrauterine life. The transition to extrauterine life, prompted by birth, triggers various physiological changes including rapid development of the infant's mucosal surfaces (e.g., reducing the size of gap junctions) and immune system (e.g., increased ability to mount an immune response).<sup>28</sup> Colostrum's composition and quantity adjust during this period as the mammary gland transitions to producing mature milk<sup>4,24,29</sup> (Figure 2). Herein, we discuss some of these changes and highlight colostrum's role as a bridge to extrauterine life.



**Figure 2.** Approximate changes to milk composition and volume over time are coordinated with the development of mucosal surfaces and infant immune response against pathogens.

**Safeguards the mucosal barrier.** As it is swallowed, the thick, sticky colostrum coats the mucosal surfaces in the mouth, esophagus, and intestines, filling in gap junctions between epithelial cells with maternal immune cells and antibodies, such as sIgA. This establishes a protective layer, preventing pathogens from crossing the mucosal barrier and causing infection.<sup>30</sup>

Furthermore, growth factors in colostrum help in closing the large gap junctions present in infants' gastrointestinal epithelial cells, reducing the permeability of the gut and promoting intestinal development.<sup>30</sup>



### Safeguards the mucosal barrier

Colostrum provides a protective layer full of maternally-derived immune factors that prevent infection.



### Promotes a favorable microbiome

Colostrum creates a lumen environment that provides probiotic bacteria a competitive advantage over pathogens.



### Educates the immune response

Colostrum provides antigens and cytokines to help train infant's antigen-presenting cells to bind and carry them to lymphoid tissues.

**Figure 3.** Physiological roles of colostrum

**Promotes a favorable microbiome.** Although largely protected *in utero*, the infant is inoculated at birth with microbes from the mother's vagina, intestine, and skin, as well as from the surrounding environment.<sup>31,32</sup> Probiotic bacteria from colostrum can also contribute to the oral and gastrointestinal microbiomes.<sup>5,19</sup> As these bacteria metabolize HMOs, they produce short-chain fatty acids that slightly lower the pH of the intestinal lumen to create a slightly acidic microenvironment. This acidification can inhibit some pathogenic bacteria. In addition, colostrum contains very high concentrations of iron-sequestering proteins such as lactoferrin and transferrin, further reducing the ability of pathogenic bacteria to acquire needed iron to proliferate and cause infection.<sup>22,23</sup>

**Educates the immune response.** A major shift in immune response is one of the most significant changes infants undergo to adapt to extrauterine life. *In utero*, the fetal immune system is skewed toward a tolerogenic phenotype to avoid miscarriage.<sup>14</sup> However, at birth, the immune phenotype must switch to be immunogenic to prevent and fight infection.<sup>29</sup> Initially, newborns have limited capabilities to defend themselves against pathogens.

Consequently, colostrum compensates for the infant's limited immune response, serving as a vital bridge to extrauterine life.

Additionally, colostrum provides a wide range of immune factors that help train the immune system. For example, antigens and cytokines in colostrum help train the infant's antigen-presenting cells (APCs) to bind and carry them to lymphoid tissues locally in the gut (e.g., gut-associated lymphoid tissue (GALT)) and systemically (e.g., lymph nodes, spleen).<sup>30</sup> Because the infant's antigen-presenting cells are less effective than adults', maternally-derived APCs also help carry these antigens to lymphoid tissues.

Furthermore, growth factors in colostrum help develop the mucosal immune system. For example, transforming growth factor- $\beta$  (TGF- $\beta$ ) promotes the maturation of immune cells in GALT.<sup>28</sup>

In summary, colostrum is essential for the transition to postnatal life. The synergistic effects colostrum's stickiness and high concentrations of immune factors creates a protective barrier along the gastrointestinal tract, helping to seal and fortify against harmful pathogens and facilitating the absorption of essential nutrients.

## Clinical benefits of colostrum feeding

Even though colostrum is only produced for the first few days postpartum, the health benefits to the newborn are long lasting, even if the mother does not go on to breastfeed.<sup>2,3,10,12</sup> The sooner after birth and more frequently a newborn can begin receiving colostrum, the less likely he will need other interventions.

### Clinical benefits

There are several clinical benefits to feeding colostrum. Colostrum acts as a laxative, helping to clear meconium. Flushing of meconium also helps to reduce bilirubin buildup, thus helping to minimize jaundice.<sup>33</sup> Finally, colostrum provides several maternally-derived immune factors that help protect the infant against infection.<sup>4</sup> These clinical benefits can reduce the need for additional interventions during the hospital stay.<sup>34</sup>

## Feeding colostrum

**Initiation.** Ideally, within the first hour, the infant consumes colostrum at the breast. If this is unsuccessful or not possible (e.g., maternal-infant separation or acuity), the mother should be taught how to express her colostrum so that it can be fed to her infant as soon as possible. This ensures that the infant receives essential colostrum shortly after birth. Moreover, it can help foster maternal self-confidence and self-efficacy in breastfeeding,<sup>35</sup> and help reduce maternal stress, a factor associated with long-term breastfeeding success.<sup>36</sup> Furthermore, early initiation of breastfeeding or milk expression is crucial for both establishing a milk supply and successfully achieving breastfeeding goals.<sup>37-39</sup>



### Minimizes jaundice<sup>33</sup>

Colostrum acts as a laxative, effectively clearing meconium. This prevents bilirubin build up that causes jaundice.



### Protects against infection<sup>4</sup>

Maternal immune cells and antibodies, such as secretory IgA that provide added protection against infection.

Figure 4. Benefits of feeding colostrum

**Frequency.** The frequency of feedings is also important. Recent evidence suggests colostrum volume peaks within 6 hours after birth.<sup>40</sup> Therefore feeding colostrum within the first hour followed by every 2-3 hours replenishes the vital human milk components, ensuring the mucosal barrier is adequately protected, and the infant receives sufficient nutrition for metabolic demands.<sup>25</sup> Given these data, exclusive human milk feeding should be prioritized and routine supplementation avoided, especially in the first week after birth when establishing the milk supply.<sup>25</sup>



### At birth, then every 2-3 h

Feeding colostrum within an hour of birth, and every 2-3 hours thereafter replenishes vital milk components, ensuring adequate protection for the mucosal barrier

Figure 5. Timing and frequency of colostrum feeding

**As supplementation.** Mounting evidence suggests that antenatal milk expression serves as a safe, valuable tool to address concerns about insufficient milk supply and may avoid early postpartum formula supplementation.<sup>41,42</sup> If expressed colostrum is to be used as supplementation, parents should be taught appropriate expression and storage techniques to ensure expressed colostrum is safe.

## Colostrum for preterm infants

### Oral colostrum therapy

Given the physiological roles and clinical benefits of colostrum, there is increasing interest in using colostrum as immune therapy for infants born prematurely. This method involves administering a small volume of 0.1-0.2 mL to the inside of the infant's cheeks until oral feeds begin.<sup>6,43,44</sup>

Orally administered colostrum has been shown to be safe even in the smallest and most fragile infants, born <1,000 grams and unable to receive enteral feeds.<sup>44,45</sup> Mounting evidence has driven many NICUs to improve standard of care by adopting oropharyngeal administration to their hospital protocols.

**Improves immune protection.** Evidence suggests that this practice indeed provides immune protection. Research has shown that providing colostrum orally through a syringe increases urine sIgA and lactoferrin in premature infants, indicating effective absorption of these immunoprotective components.<sup>46</sup> Moreover, a recent systematic review with meta-analysis reported a 28% lower risk of sepsis among infants that received oropharyngeal administration of colostrum or mother's own milk compared to controls who received no colostrum or a placebo (e.g., sterile water).<sup>6</sup>

Results from other research also suggest immune protection from orally administered colostrum in preterm infants, including associations with reduced incidence of late-onset sepsis, NEC and ventilator associated pneumonia in very low birth weight (VLBW) infants.<sup>6,44,47</sup>

**Improves the oral microbiome.** The importance of the oral microbiome on pathogen protection and immune development is often underappreciated.<sup>45</sup> However, the physiological roles of colostrum in the intestinal lumen also apply in the oral cavity. Colostrum coats the oral cavity and pharynx with a sticky layer of maternally-derived immune factors that provide pathogen protection and support the development of local lymphoid tissues (e.g., oropharyngeal-associated lymphoid tissue, OFALT), which together foster a favorable microbiome.<sup>19,45</sup> Compared to controls, infants who received oropharyngeal colostrum had higher abundances of Bifidobacterium and Bacteroides in the first week of life.<sup>45</sup>

**Improves breastfeeding outcomes.** Oropharyngeal administration of colostrum has the indirect benefit of supporting breastfeeding, including sustained HM feedings in very low birth weight (VLBW) infants. VLBW infants who received oropharyngeal colostrum were significantly more likely to receive most of their enteral feeds from human milk through discharge than those who did not.<sup>43</sup>

These benefits to breastfeeding outcomes are likely due to encouraging and supporting mothers to pump early and often.<sup>48,49</sup> This approach has been shown to facilitate parents' active involvement in their infant's care, foster bonding, and increase maternal confidence.<sup>48</sup>

Whether fed at  
the breast, by syringe,  
or in another way,  
**Every drop of  
colostrum  
truly counts!**

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# Improving the standard of care through oral immune therapy

## Resources to help you take action

Jenny Murray, BSN, RN, IBCLC

### Policies/Guidelines

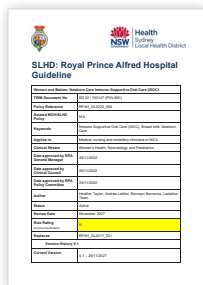
Medela does not endorse any particular policy, protocol or guideline. The following resources are only intended as examples to evaluate a variety of practices that could be used as a guide for your institution. Please click on each image to access the resource.



Oropharyngeal application of colostrum or mother's own milk in preterm infants: a systematic review and meta-analysis (nih.gov)



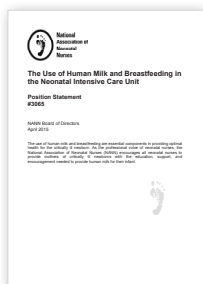
Guideline for Mouth Care on the Neonatal Unit (piernetwork.org)



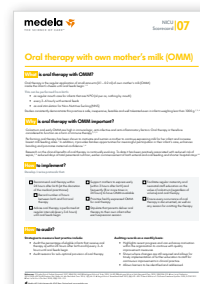
Women and Babies: Newborn Care Immuno-Supportive Oral Care (ISOC) (nsw.gov.au)



Oral therapy | NICU Lactation Quality Improvement | Medela



The Use of Human Milk and Breastfeeding in the Neonatal Intensive Care Unit (lww.com)

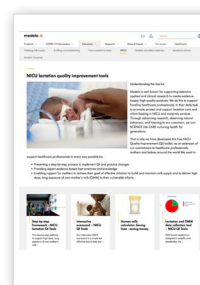


Implementing oral therapy with own mother's milk (OMM) | Medela (non-branded available)



Impact of Oropharyngeal Administration of Colostrum in Preterm Newborns' Oral Microbiome - PMC (nih.gov)

### QI Tools



Please click on the image to access the Q1 NICU Toolkit.

Working with leading experts, Medela has created simple but effective resources that NICUs can use to assess the human milk practices they have in place, collect data, identify the potential for improvement and implement evidence-based best practices.

For additional information or non-branded tools, please reach out to your local Medela sales consultant.