Initiation of Lactation:
At Risk Mothers and Proactive Interventions

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Objectives

- Describe the normal progression of human lactation
- Identify how newborn sucking patterns affect maternal milk volume production
- Identify several evolving trends in maternal health demographics that are associated with delayed onset of lactogenesis or suboptimal milk production
- Discuss potential benefits of preventing low milk volumes in at risk mothers
- Summarize evidence-based strategies and technologies that can be used proactively to prevent milk volume issues in mothers at risk for low milk volumes

Mom’s Journey:
What are we trying to achieve?

Successful lactation for:
- Successfully breastfeeding moms
- Mothers needing initiation help
- Pump dependent moms
…regardless of gestational age at delivery
Breastfeeding Initiation

Focus is on practices in infant care that impact breastfeeding

Nipple Pain in Breastfeeding: Another Reason Mothers Stop Breastfeeding


The Scope of Lactation Initiation Difficulties

More than half of “low risk” US mothers are at risk for lactation initiation difficulties
- Delayed onset of lactogenesis
- Suboptimal milk production

These risks are associated with slower infant weight gain and mothers not meeting their breastfeeding goals


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Mammary gland development = # Alveoli = Production Capability

Mom’s Journey: Initiate

Basic Lactation Physiology
Prolactin

- Declining progesterone ➔ lactocyte sensitivity to prolactin
- Infant sucking stimulates pulsatile ↑ in prolactin release
- Prolactin release stimulates milk production in lactocyte
- Shifts in milk composition from colostrum to mature milk
- Increase in milk volume – onset of lactogenesis
Basic Lactation Physiology

Oxytocin

- Oxytocin ➔ MER
- After the onset of lactogenesis, milk removal drives further milk production

Lactogenesis = \[ \text{Milk potential} \rightarrow \text{Production Capability} \]

The lactocyte has to be ‘activated’ or ‘switched on’.
Evolving Version

- Influence of infant sucking patterns
- Involvement of other hormones and development of hormone receptors
  - Sucking stimulation of prolactin receptors
  - Insulin and insulin receptor upgrading
  - Role of cortisol

1. Key prolactin-mediated signaling pathways

   http://scrippslabs.com/scripps-news-volume-16-number-1
How the Evolving Version of Lactation Informs Clinical Practice

- Importance of initial infant sucking pattern
- Mammary gland programming in the initiation phase
- Timing of initial breast stimulation

The First Two Weeks Post-Birth is a Critical Time to Initiate and Build Milk Volumes

- Animal and human studies demonstrate that complex endocrine, anatomic and biochemical changes occur during this time that appear to “program” milk production over the course of lactation
- The mammary gland is extremely sensitive to the effects of prolactin and its effect on milk yield programming during this period
- The concept of a critical period such as this is established in the dairy industry

Importance of Initial Infant Sucking


The infant’s initial sucking pattern is characterized by frequent, irregular sucking bursts accompanied by frequent pauses.
Infant sucking pattern after milk volumes have been established.

Initiation: A Critical Period for Protecting Maternal Milk Volumes

- Significant hormonal, anatomical and milk composition changes take place
- The mammary gland transitions from preparing to make milk (Secretory Differentiation) to synthesizing and secreting milk (Secretory Activation)
- Initiation is a one-time event that is either achieved or not achieved
- Interference with the initial process impacts the initiation of lactation.
- Maintaining milk volumes becomes difficult
The Scope of Lactation Initiation Difficulties

More than half of “low risk” US mothers are at risk for delayed lactogenesis or suboptimal milk production

These risks are associated with slower infant weight gain and mothers not meeting their breastfeeding goals


Risk Factors for Delayed Onset of Lactogenesis and Sub-Optimal Milk Production

General
- Medical conditions:
  - PCOS
  - Breast surgery
  - Thyroid disease
  - Maternal-infant separation
  - Infant supplementation

Additional
- Primiparity & Maternal age > 30
- Over weight/obese: BMI > 27
- Insulin resistance/diabetes
- Long, difficult labor
- Cesarean section: emergent

Primiparity

- 38% of all US births in 2015 to first-time mothers
- 33% - 44% have DOL
- Their infants had 7-fold risk of >10% weight loss by day 3
  - Increased risk of dehydration
  - Delayed meconium passage
  - Higher bilirubin
  - Risk of readmission
  - Shorter BF duration


Maternal Age

- 44% of all births to women ≥ 30
- Average age at birth is 26.4
- Compounded risk if these moms are having their first babies

Cesarean Section

- Currently 32%
- Risk associated with maternal age
- Risk ↑ with urgent C/S
- Studies also link difficult labors to lactation problems
- Urgent C/S and long labors often go together


Maternal BMI and Insulin Resistance

In 2016, the CDC reported nearly half of women are overweight or obese before they become pregnant and nearly half gained too much weight in pregnancy

CDC. Advancing the health of mothers in the 21st century. cdc.gov/chronicdisease/resources/publications/aag/maternal.htm

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Maternal BMI and Insulin Resistance

Early lactation success study
(N-R et al 2010)

Delay in lactogenesis in primiparas

• 31% in normal weight
• 43% in overweight
• 52% in obese


The Role of Insulin in Lactation

• Insulin receptors increase dramatically during lactogenesis
• Insulin facilitates glucose entry into cells, including lactocytes
• Glucose is necessary for milk synthesis
• It influences synthesis of lipids and proteins
• Up-regulation of mammary metabolism, stimulating expression of genes involved in milk synthesis
• With insulin resistance or deleted insulin, lactocytes struggle to produce milk

Any diabetes or insulin resistance in pregnancy is associated with a 2.6 fold risk of low milk supply within the first 3 months postpartum.


Impact of High Fat Diet in Pregnancy

Risk Factor Summary

- Primiparity
- Maternal age ≥ 30
- Cesarean section
  - Protracted, stressful birth experience
- Increased BMI
- Insulin resistance/diabetes
- High fat diet

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What are we trying to achieve?

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…regardless of gestational age at delivery
Supportive Care Alone is Not Sufficient

- RCT of overweight and obese low income women
  - SBFPC support
  - SOC
- Outcomes:
  - SBFPC support did not influence EBF rates
  - Any BF rates trended higher in first 2 months in SBFPC group but were lower from 3 - 6 months
- Conclusions
  - Specialized care did not improve EBF at any time and did not improve BF continuation beyond first 2 weeks

Proactive Interventions

- Initiate breastfeeding or pumping within 1-3 hours
- If mother is at risk, consider early use of a breast pump pattern that mimics early infant sucking
- Monitor mother’s milk volume and infant weight
Timing of Pumping Initiation

<table>
<thead>
<tr>
<th>Time</th>
<th>Volume of Milk (mL)</th>
<th>Early initiation (n=10)</th>
<th>Late initiation (n=10)</th>
<th>P</th>
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<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Mean</td>
<td>Mean</td>
<td></td>
</tr>
<tr>
<td>Initial expression session</td>
<td>4.19</td>
<td>0.1</td>
<td>0.14</td>
<td></td>
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<tr>
<td>Day 1</td>
<td>19.2</td>
<td>0.7</td>
<td>0.06</td>
<td></td>
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<tr>
<td>Day 2</td>
<td>76.7</td>
<td>2.2</td>
<td>0.01</td>
<td></td>
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<tr>
<td>Day 3</td>
<td>142.3</td>
<td>45.4</td>
<td>0.14</td>
<td></td>
</tr>
<tr>
<td>Day 4</td>
<td>185.7</td>
<td>69.9</td>
<td>0.09</td>
<td></td>
</tr>
<tr>
<td>Day 5</td>
<td>282.0</td>
<td>85.8</td>
<td>0.06</td>
<td></td>
</tr>
<tr>
<td>Day 6</td>
<td>322.0</td>
<td>191.9</td>
<td>0.06</td>
<td></td>
</tr>
<tr>
<td>Day 7</td>
<td>355.0</td>
<td>188.8</td>
<td>0.1</td>
<td></td>
</tr>
<tr>
<td>Total at 1 week</td>
<td>1374.7</td>
<td>608.1</td>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td>3 weeks</td>
<td>N=8</td>
<td>N=7</td>
<td>0.01</td>
<td></td>
</tr>
<tr>
<td>6 weeks</td>
<td>N=6</td>
<td>N=4</td>
<td>0.07</td>
<td></td>
</tr>
</tbody>
</table>


- Convenience sample
- Assigned by when they started pumping
- Instructed pump ≥ 8 times/day for 15 minutes
- Symphony 2.0 (2-phase)
- Hand expression not assessed, not SOC

Within 1 hour
n=10
Between 1-6 hours
n=10
After 6 hours
n=20

Values for Three Categories of Initiation Time Point of Breastmilk Expression for Comparison with Two Categories (Up to 6 hours versus more than 6 hours)

<table>
<thead>
<tr>
<th>Breastmilk (mL)</th>
<th>Within 1 hour (n=10)</th>
<th>&gt; 1 and &lt; 6 hours (n=10)</th>
<th>After 6 hours (n=20)</th>
<th>p value a</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial amount</td>
<td>0.1 (0.0-0.3)</td>
<td>0 (0-0.1)</td>
<td>0 (0-0.6)</td>
<td>0.002</td>
</tr>
<tr>
<td>Day 1</td>
<td>7.0 (2.8-28.6)</td>
<td>0.61 (0.0-4.4)</td>
<td>0 (0-3.5)</td>
<td>0.122</td>
</tr>
<tr>
<td>Day 2</td>
<td>10.0 (4.1-106.7)</td>
<td>5.5 (0-20.0)</td>
<td>4.3 (1.5-17.1)</td>
<td>0.009</td>
</tr>
<tr>
<td>Day 3</td>
<td>88.0 (14.2-208.8)</td>
<td>19.5 (0-45.2)</td>
<td>11.5 (1.5-45.4)</td>
<td>0.099</td>
</tr>
<tr>
<td>Day 4</td>
<td>88.5 (62.3-399.7)</td>
<td>28.2 (15.3-40.8)</td>
<td>49.4 (13.9-183.4)</td>
<td>0.213</td>
</tr>
<tr>
<td>Day 5</td>
<td>232.4 (95.2-405.7)</td>
<td>71.3 (34.9-117.8)</td>
<td>112.1 (50.5-182.4)</td>
<td>0.099</td>
</tr>
<tr>
<td>Day 6</td>
<td>294.0 (182.8-370.7)</td>
<td>217.7 (79.3-267.5)</td>
<td>87.1 (40.4-140.2)</td>
<td>0.003</td>
</tr>
<tr>
<td>Day 7</td>
<td>305.2 (244.0-304.8)</td>
<td>185.7 (86.8-293.2)</td>
<td>126.7 (65.3-182.7)</td>
<td>0.005</td>
</tr>
<tr>
<td>Week 3 (n=23)</td>
<td>545.5 (468.1-818.1)</td>
<td>238.9 (87.8-442.9)</td>
<td>224.3 (100.7-334.8)</td>
<td>0.007</td>
</tr>
<tr>
<td>Week 6 (n=14)</td>
<td>440.0 (352.1-526.4)</td>
<td>209.0 (64.1-355.8)</td>
<td>268.7 (124.3-284.7)</td>
<td>0.024</td>
</tr>
<tr>
<td>Lactogenesis stage II (hours)</td>
<td>90 (24-120)</td>
<td>126 (108-204)</td>
<td>72 (60-108)</td>
<td>0.047</td>
</tr>
</tbody>
</table>

Lactating at

- 3 weeks 70% (7/10) 70% (7/10) 45% (8/18) 0.243
- 6 weeks 40% (4/10) 40% (4/10) 30% (4/13) 0.080

Data are median (interquartile range [25th-75th percentile]) or percentage values as indicated.

*p values obtained from the Kruskal-Wallis test.

Optimal Time to Initiate Breast Milk Expression in Mothers Delivering Extremely Premature Infants

Leslie Parker, Martina Medela, Sullivan Sanda and Charlene Kruger

Abstract submitted 2017

Breast Milk Expression

<table>
<thead>
<tr>
<th></th>
<th>1 hour</th>
<th>1-3 hours</th>
<th>3-6 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Still lactating: 3 weeks</td>
<td>68%</td>
<td>88%</td>
<td>70%</td>
</tr>
<tr>
<td>6 weeks</td>
<td>60%</td>
<td>63%</td>
<td>54%</td>
</tr>
<tr>
<td>At Discharge</td>
<td>33%</td>
<td>62%</td>
<td>35%</td>
</tr>
<tr>
<td>Onset of Lactogenesis</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Hand Expression as an Adjunct to Breastfeeding or Pumping

• RCT of mothers of VLBW infants
• Compared electric pumping to hand expression in the first 7 days
• Statistically more milk throughout the first week and at 14 and 28 days
The infant’s initial sucking pattern is characterized by frequent, irregular sucking bursts accompanied by frequent pauses.
Evidence to Support the Importance of Initiation Technology

Development of Symphony PLUS™

Mothers of Infants < 34 Wks Admitted to NICU

- N = 34
  - INITIATE program followed by Standard 2.0 for maintenance (Symphony® PLUS™)

- N = 38
  - Standard 2.0 for initiation and Standard 2.0 for maintenance

Randomized Block Design for equal representation of births < 27 wks among groups

This slide represents partial information regarding groups and interventions. Please see original publication for additional material.
Breast Pump Suction Patterns that Mimic the Human Infant During Breastfeeding
Meier et al, 2012

Pump-dependent mothers with preterm infants produce significantly higher milk volumes with Initiation Technology.

Human Milk and Breastfeeding Outcomes in Infants with Congenital Heart Disease
Torowicz et al, 2015

Maternal milk volumes approached 500 mL within the first week of pumping with Symphony® PLUS™ Initiation Technology™.
Milk Production After Preterm, Late Preterm and Term Delivery: Effects of Different Breast Pump Suction Patterns
Post et al, 2015

Average Daily Milk Production

- Symphony® PLUS™
- Initiation Technology INITIATE program followed by MAINTAIN program
- Standard 2.0 program alone

Where Do We Go From Here?
Right time, Right Mom and Right Intervention

**When**
Critical window starts 1-3 hours after birth

**Who**
More than half of US mothers at risk

**What**
Appropriate use of clinically validated initiation practices & technology

---

Challenges

- Assess and act proactively
- Consider mom’s goals, preferences and condition
- Support the breastfeeding relationship
- Participate in setting a new standard of care
During the first year.


CDC. Advancing the health of mothers in the 21st century. cdc.gov/chronicdisease/resources/publications/aag/maternal.htm


