





### How to grow a 22-23 week infant...

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FANNP's National Neonatal Nurse Practitioner Symposium: Clinical Update and Review, 2025 ©





Photo by SJ McElroy




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### Disclosures

- Academic Advisory Board Member for NECSociety, Lactalogics, and Noveome
- Collaborations with Defensin Therapeutics (provides peptides)
- Funding through NIH/NIDDK
- All photos were obtained with parental permission

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### Disclosures



Don't give up.  
I believe in you all.  
A person's a person  
no matter how small.  
- Dr. Seuss

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### Disclosures/Early Acknowledgement

- Susan Carlson, dietitian at University of Iowa
- Jon Klein, Medical Director and Professor emeritus, University of Iowa
- Katy Wright, dietitian University of California, Davis

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### Objectives

- A historical perspective on viability
- What defines viability
- Current national guidelines and outcomes
- Why the 22-23 week gut is unique
- How to grow a 22-23 week infant (at UC Davis)
  - Fluid management
  - PN
  - Feeding protocol
  - Monitoring

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### vi·a·bil·i·ty

- **Definition of *viability*:** the quality or state of being viable: such as
  - **(1):** the ability to live, grow, and develop
  - **(2):** the capability of a fetus to survive outside the uterus

Merriam-Webster.com Dictionary, Merriam-Webster,


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The limits of viability in 1971 (one year before I was born) was determined to be 28 weeks...

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## Infant care before 1850 (Europe)


- Before the late 19th century, physicians essentially ignored infants.
- There were no hospitals for children. Church sponsored “foundling homes” were created for unwanted and sick infants.

A painting of a young child in a white dress sitting on a small table, with a dark, shadowy figure standing behind them. The scene is dimly lit, with the child's face and dress highlighted against a dark background. The figure behind the child is mostly in shadow, appearing as a dark silhouette. The overall mood is somber and mysterious.

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# Infant care before 1850 (Europe)

- Before the late 19th century, physicians essentially ignored infants.
- There were no hospitals for children. Church sponsored "foundling homes" were created for unwanted and sick infants.
- The admission rate in Paris was >7000 infants per year. In Moscow it was > 14,000.
- Infant mortality rates at these centers were **85% to 95%.**

A historical photograph showing a young child, likely a baby or toddler, sitting on a small wooden table. The child is wearing a light-colored, possibly white, dress. Behind the child, a dark, draped figure, possibly a statue or a person in a dark cloak, is visible. The setting appears to be indoors, with a dark background. The photograph has a vintage, slightly grainy quality.

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## A new emphasis on infant care

- France realized it would run out of soldiers and workers if infant mortality rates continued
- An increase in infant welfare began

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## A new emphasis on infant care

- France realized it would run out of soldiers and workers if infant mortality rates continued
- An increase in infant welfare began
- The discipline of obstetrics was established on October 18, 1881
- The first infant incubators were developed by modifying poultry incubators from the Paris zoo
  - Stephane Tarnier

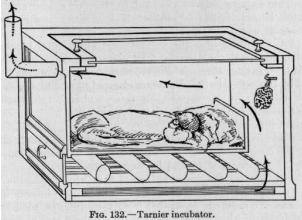
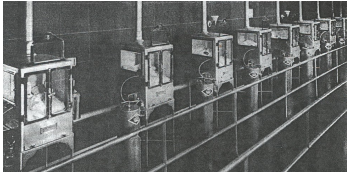


FIG. 132.—Tarnier incubator.

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## US Infant care in the early 1900's

- In 1915, the US infant mortality rate (all newborns) was 99.6/1,000 live births (~10%)
- In the early 1900's, Dr. Martin A. Conney emigrated to the US and opened an exhibit of incubators for premature infants on Coney Island



1930's Chicago World's Fair:  
"Science Finds, Industry Applies, Man Conforms"

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The spark that lit a fire

- Born at 12:52 PM on Aug 7, 1963 at Otis Air Force Base
- 34 weeks gestation 4lb 10.5 oz
- Diagnosed with Idiopathic respiratory distress syndrome (RDS)
- He was flown to Boston Children’s Hospital.
  - His blood had to be run across the street to be run on a blood gas machine—one of only a few in existence nationwide.
- At the time, there was no surfactant and no ventilators. He was placed in a hyperbaric chamber at 27 hours of life



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The spark that lit a fire

Pronounced dead at 4:04 AM on Aug 9 (39 hours)

**Kennedy Baby Dies  
At Boston Hospital;  
President at Hand**  
By The Associated Press  
BOSTON, Friday, Aug. 9—  
The new baby boy of President and Mrs. Kennedy died



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Since Patrick Kennedy

- The NICHD was founded in 1962 and further funded by the government following the Kennedy death in Oct of 1963
- “The Surfactant System of the Lung” (published 1968)
- The first mass produced infant ventilator “the baby bird” (1971)
- The first surfactants were developed and brought to market (1990)

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So how early is too early?

- Gestation at which 50% of infants survive
  - 1960’s 30-31 weeks
  - 1970’s Limit of viability defined at 28 weeks
  - 1980’s 26-27 weeks
  - 2000’s 24 weeks
- 0.5% of births are before the third trimester and account for >40% of infant mortality



Photo by J Specht

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So how early is too early?

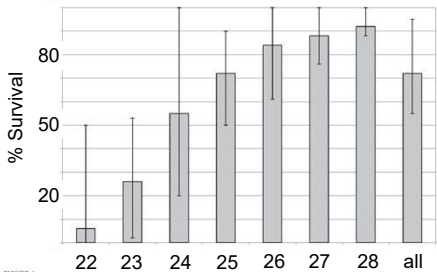
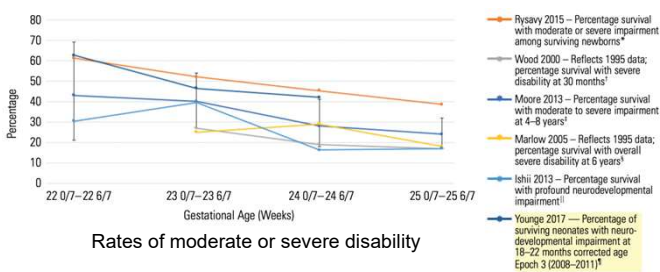


FIGURE 1 Survival to discharge according to GA among 5075 VLBW infants born in NICHD MRC centers between January 1, 2003, and December 31, 2007. The thin lines indicate ranges across centers.

Stoll BJ, et al. Pediatrics 2010

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So how early is too early?



Rates of moderate or severe disability

ACOG Consensus. Obstet Gynecol 2017

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So we are all speaking the same language...

- Death and survival are very different
- No/Mild NDI
  - Normal hearing/vision
  - No CP
  - Cognitive > 85 (>70 for BSID II)
- Moderate NDI
  - Mild or moderate CP, GMFCS 2-3
  - Cognitive 70-84
- Severe NDI
  - Blind or deaf
  - Severe CP, GMFCS >3
  - Cognitive < 70

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So how early is too early?

Systematic Reviews ajog.org

Proactive neonatal treatment at 22 weeks of gestation: a systematic review and meta-analysis Check for updates

Carl H. Buckes, MD; Brian K. Rivera, MS; Leanne Pavlek, MD; Lindsey J. Beer, M Charles V. Smith, PhD; Jeffrey A. Bridge, PhD; Edward F. Bell, MD; Heather A.

- Meta-analysis of 31 studies, 2226 infants born at 22 weeks and were provided proactive treatment
- Pooled survival of 29%
- Prenatal steroid use doubled survival from 19.5% to 39%

**TABLE 8**  
**Morbidity among survivors**

| Morbidity         | Pooled prevalence, % |
|-------------------|----------------------|
| BPD (any)         | 78.0                 |
| Severe BPD        | 61.1                 |
| IVH (any)         | 31.7                 |
| Severe IVH or PVL | 25.2                 |
| Severe NEC        | 12.0                 |
| Severe ROP        | 39.0                 |

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ACOG Consensus Update 2021

|                           | 20 0/7 weeks to 21 6/7 weeks | 22 0/7 weeks to 22 6/7 weeks | 23 0/7 weeks to 23 6/7 weeks | 24 0/7 weeks to 24 6/7 weeks | 25 0/7 weeks to 25 6/7 weeks |
|---------------------------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|
| Antenatal corticosteroids | Not recommended 1A           | Consider 2C                  | Consider 2B                  | Recommended 1B               | Recommended 1B               |

- For 20 and 21 week infants, consider antibiotics but nothing else
- For 22 week infants, consider steroids antibiotics and resuscitation
- For 23 week infants, consider everything

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But then there is the Iowa data...

ORIGINAL ARTICLES www.jpeds.com • THE JOURNAL OF PEDIATRICS

Outcomes at 18 to 22 Months of Corrected Age for Infants Born at 22 to 25 Weeks of Gestation in a Center Practicing Active Management

Patricia L. Watkins, MD, MS, John M. Dagle, MD, PhD, Edward F. Bell, MD, and Tarah T. Colaizy, MD, MPH

University of Iowa, 2020

  
Photo by SJ McElroy

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But then there is the Iowa data...

|                 | 22 wk | 23 wk | 24 wk | 25 wk |
|-----------------|-------|-------|-------|-------|
| • Total infants | 20    | 50    | 79    | 99    |
| • Survived      | 70%   | 82%   | 89%   | 90%   |

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But then there is the Iowa data...

|  | 22 wk | 23 wk | 24 wk | 25 wk |
|--|-------|-------|-------|-------|
| • Total infants  | 20    | 50    | 79    | 99    |
| • Survived   | 70%   | 82%   | 89%   | 90%   |
| • At 18-22 mo <ul style="list-style-type: none"><li>• Follow up rate 79%</li></ul> |       |       |       |       |
| • severe NDI   | 18%   | 9%    | 4%    | 4%    |
| • <u>No/mild</u> MDI   | 55%   | 68%   | 79%   | 73%   |

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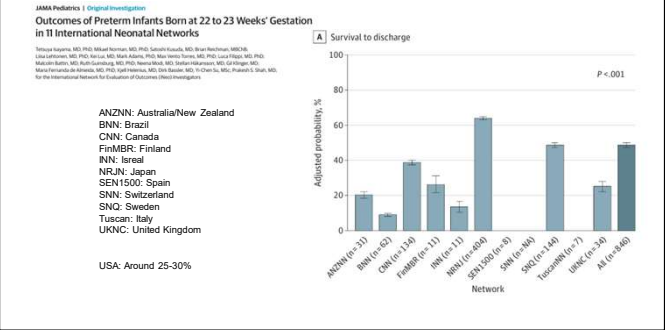


But then there is the Iowa data...

|                      | 22 wk                                     | 23 wk | 24 wk | 25 wk |
|----------------------|---|-------|-------|-------|
| • Total infants      | 20  | 50    | 79    | 99    |
| • Survived           | 70%                                       | 82%   | 89%   | 90%   |
| • At 18-22 mo        | None of these are statistically different |       |       |       |
| • Follow up rate 79% |   |       |       |       |
| • severe NDI         | 18%                                       | 9%    | 4%    | 4%    |
| • <u>No/mild</u> MDI | 55%                                       | 68%   | 79%   | 73%   |

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Most recent data



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UC Davis approach



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Two lessons  
we can  
apply from  
Ted Lasso



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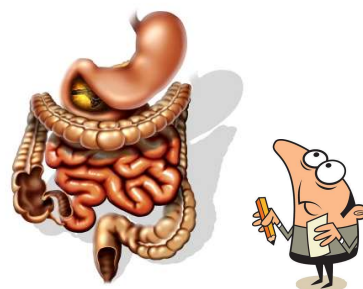
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### Complex ideas are difficult to exactly replicate



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The intestinal tract is the largest part of our bodies that interact with the external environment.



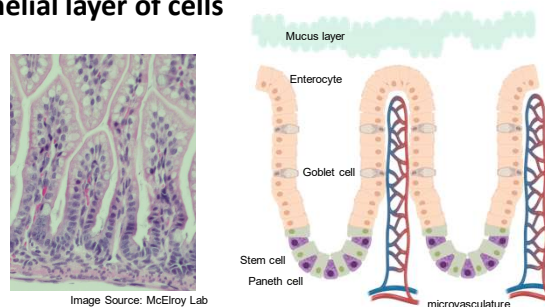
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### Relative surface areas of human tissue.



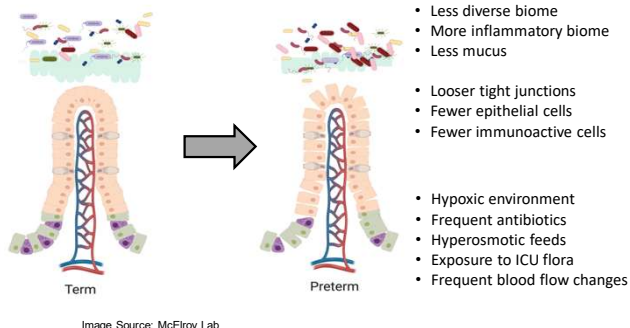
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### All that separates us from the “outside” is a single epithelial layer of cells



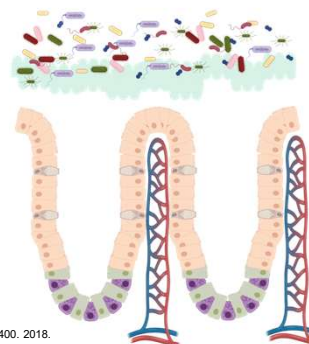
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### Term vs Preterm intestine



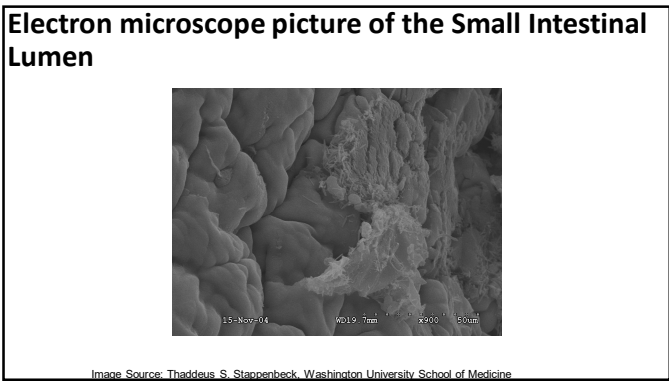
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Remember that we have 1.5-10 times the bacteria in our intestine than we have cells in our body

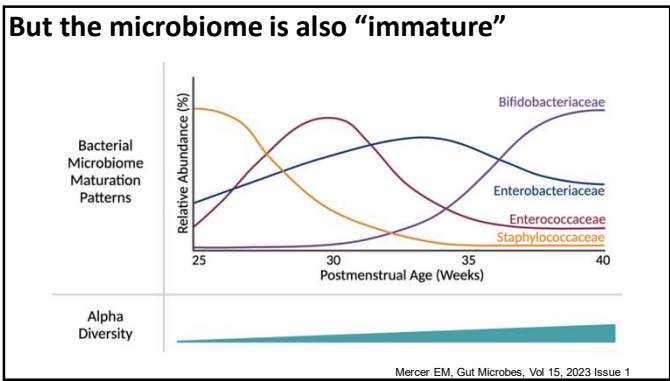


Gilbert J et al. Nat Med. 24, 392-400. 2018.  
Image Source: McElroy Lab

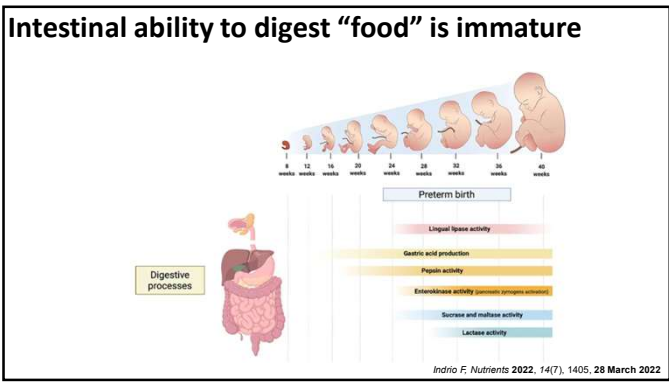
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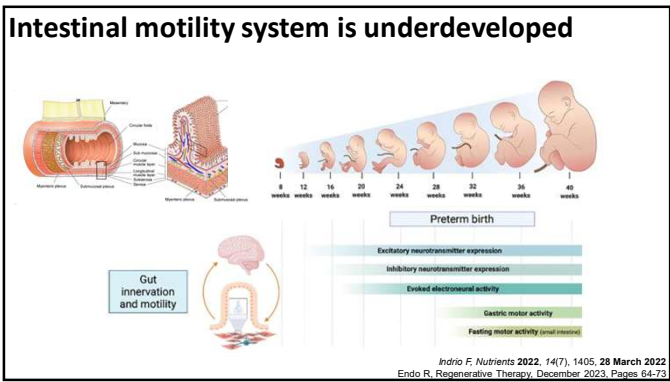
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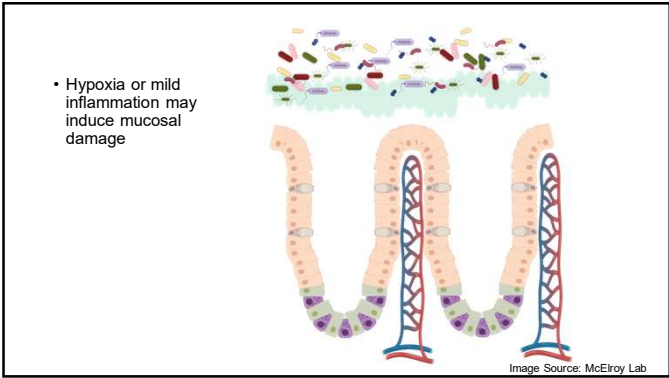
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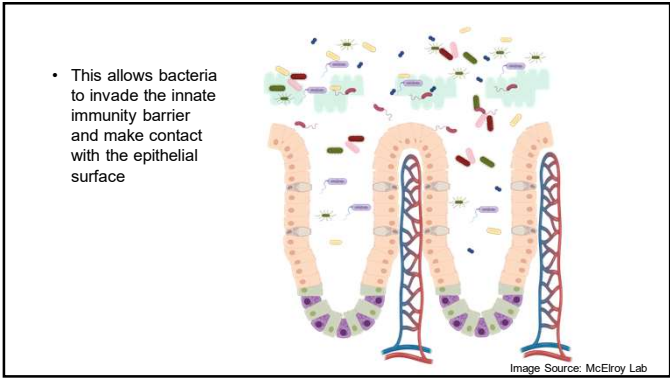
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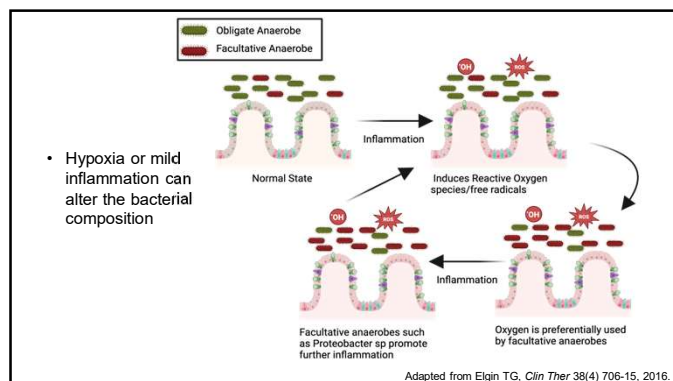
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### To grow a fetus outside the uterus you must consider...

- Developmental biology (pt is still a fetus)
- Underdeveloped defense systems (barrier and immune)
- Underdeveloped enzyme production
- Poor motility
- Risk for injury (NEC and SIP)

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### UC Davis approach to nutrition

UC DAVIS HEALTH | CHILDREN'S HOSPITAL

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### Developing the UC Davis "Cub" nutritional guidelines

- Initial planning session (Mar '23)
- Jon Klein visits UCDH (Apr '23)
- Team trip to University of Iowa (Jan '24)
- Small Baby Admission Guidelines updated (Feb '24)
- Cub Room opens (Feb '24)
- RD presentation on 3-IVF method (Apr '24)
- NICU Enteral Nutrition Guidelines updated (Apr '24)
- Availability of D3.5W in NICU (Sep '24)
- Full NICU Nutrition Guidelines go-live (Oct '24)

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### UC Davis goals

UC DAVIS HEALTH | CHILDREN'S HOSPITAL

"Our clinical guidelines aim to incorporate evidence, best practice, and local expert consensus into easily accessible, shared models...Our clinical guidelines aim to incorporate evidence, best practice, and local expert consensus into easily accessible, shared models."

-E Stieren MD, PhD

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### UC Davis approach to nutrition

UC DAVIS HEALTH | CHILDREN'S HOSPITAL

- We use a three-fluid approach for IVF and TPN during the "stabilization phase"

- Fluid needs during the "stabilization phase" are dynamic
- Initial PN orders are often made "blindly" and are time sensitive

<https://health.ucdavis.edu/pediatrics/clinical-guidelines/>

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UC Davis approach to nutrition

UC DAVIS HEALTH

CHILDREN'S HOSPITAL

Parental Nutrition

IV Dextrose D3.5-10%

0.45% Sodium Acetate

+

+

=

Total Nutrition Fluids

• We use a three-fluid approach for IVF and TPN during the “stabilization phase”

• This allows for concentration of PN, improved nutrition, and the flexibility to tighter control blood glucose control

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UC Davis approach to nutrition

UC DAVIS HEALTH

CHILDREN'S HOSPITAL

• PN is a complex, multi-component fluid

• Adjusting rates during the day is not an "easy fix" and can have many unintended consequences

• Titration of 3 IVF allows for flexibility & tighter BG control

Total Nutrition Fluids

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Overview of preterm PN requirements

|                              | Calorie Requirement | GIR Requirement                    | Protein Requirement         |
|------------------------------|---------------------|------------------------------------|-----------------------------|
| Initial (prevent catabolism) | 30-40 kcal/kg       | 3.5-4 minimum                      | 1.5-2.5 gm/kg (3 gm/kg max) |
| Early PN                     | 45-60 kcal/kg       | Increase by 0.5-1 if BG <150 mg/dL | 3-3.5 gm/kg                 |
| Goal PN                      | 90-100 kcal/kg      | 11-12 goal                         | 3-3.5 gm/kg                 |

<https://health.ucdavis.edu/pediatrics/clinical-guidelines/>

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UC Davis approach to nutrition

UC DAVIS HEALTH

CHILDREN'S HOSPITAL

• Initial total fluid goal ~ 100-130 mL/kg using the following IVF.

1. Starter PN (D10% AA3%) at 50 mL/kg

• Meets minimum protein & GIR goals to prevent catabolism with 23 kcal/kg, 1.5 gm/kg protein, 3.5 GIR

2. 0.45% Na Acetate at 0.5 mL/hr

3. IV dextrose (D3.5% - D10%) to make up remaining volume

Total Nutrition Fluids

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Glucose management

Target GIR for custom TPN order based on BG values

| Blood Glucose Value | Recommended GIR adjustment  |
|---------------------|---|
| <120 mg/dL          | If term/late preterm: increase by 2-3 mg/kg/min<br>If VLBW/stable preterm: increase by 1-2 mg/kg/min<br>If ELBW or <24 weeks, consider more cautious advance 0.5-1 mg/kg/min                                      |
| 120-150 mg/dL       | If term/late preterm: may increase by 1-2 mg/kg/min or maintain GIR<br>If VLBW/stable preterm: may increase by 0.5-1 mg/kg/min or maintain GIR<br>If ELBW: increase by no more than 0.5 mg/kg/min or maintain GIR |
| 150-180 mg/dL       | Maintain same GIR or reduce GIR by 1-2 mg/kg/min; goal to maintain minimum 3.5-4 mg/kg/min GIR  |
| >180 mg/dL          | Reduce GIR by 1-2 mg/kg/min; goal to maintain minimum 3.5-4 mg/kg/min GIR   |

<https://health.ucdavis.edu/pediatrics/clinical-guidelines/>

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Tri-fluid method in action

"Baby A" is a 22w5d infant with BW 600 gm who is now 4 hours old.  
Initial total fluid goal (TFG) is 120 mL/kg/d.

One-fluid approach

1. Starter PN (D10% AA3%) @ 120 mL/kg

Total: 120 mL/kg, 55 kcal/kg, 3.6 gm/kg protein, 8.3 GIR

Three-fluid approach

1. Starter PN (D10% AA3%) @ 50 mL/kg

2. 0.45% Na Acetate @ 0.5 mL/hr (20 mL/kg)

3. D3.5W @ 1.2 mL/hr (50 mL/kg)

Total: 120 mL/kg, 29 kcal/kg, 1.5 gm/kg protein, 4.7 GIR

<https://health.ucdavis.edu/pediatrics/clinical-guidelines/>

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10/15/2025

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### Tri-fluid method in action

"Baby A" is a 22w5d infant with BW 600 gm who is now 4 hours old.  
Now develops hyperglycemia with glucose >200

#### One-fluid approach

1. TPN rate reduced to 60 mL/kg & D3.5W y'in added at 60 mL/kg

Total: 120 mL/kg, 35 kcal/kg, 1.8 gm/kg protein, 5.6 GIR

#### Three-fluid approach

1. Starter PN (D10% AA3%) @ 50 mL/kg
2. 0.45% Na Acetate @ 0.5 mL/hr (20 mL/kg)
3. D3.5W @ 1.2 mL/hr (50 mL/kg)

Total: 120 mL/kg, 29 kcal/kg, 1.5 gm/kg protein, 4.7 GIR

In this system, you replace D3.5 with Na Acetate to maintain PN but decrease GIR

<https://health.ucdavis.edu/pediatrics/clinical-guidelines/>

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### Tri-fluid method in action

"Baby A" is a 22w5d infant with BW 600 gm who is now 4 hours old.  
Remains hyperglycemia with glucose >200

#### One-fluid approach

1. TPN rate reduced to 60 mL/kg & D3.5W y'in added at 60 mL/kg

Total: 120 mL/kg, 35 kcal/kg, 1.8 gm/kg protein, 5.6 GIR

Now what? Reduce vs D/C starter PN to lower GIR?

#### Three-fluid approach

1. Starter PN (D10% AA3%) @ 50 mL/kg
2. 0.45% Na Acetate @ 0.5 mL/hr (20 mL/kg)
3. D3.5W @ 1.2 mL/hr (50 mL/kg)

Total: 120 mL/kg, 29 kcal/kg, 1.5 gm/kg protein, 4.7 GIR

In this system, you replace D3.5 with Na Acetate to maintain PN but decrease GIR

<https://health.ucdavis.edu/pediatrics/clinical-guidelines/>

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### Tri-fluid method in action

"Baby A" is now 5 days old, on 150-160 mL/kg/day.

#### One-fluid approach

1. Custom TPN ordered @ 150 mL/kg
  - Contains: D5% AA2%
  - IL ordered at 1 gm/kg (5 mL/kg)

Provides: 155 mL/kg, 48 kcal/kg, 3 gm/kg protein, 5.2 mg/kg/min GIR

#### Three-fluid approach

1. Custom TPN ordered @ 50 mL/kg
  - Contains: D10% AA6%
  - IL ordered at 1 gm/kg (5 mL/kg)
2. 0.45% Na Acetate @ 20 mL/kg
3. D3.5W at 75 mL/kg

Provides: 150 mL/kg, 48 kcal/kg, 3 gm/kg protein, 5.3 mg/kg/min GIR

<https://health.ucdavis.edu/pediatrics/clinical-guidelines/>

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### Tri-fluid method in action

"Baby A" is now 5 days old, on 150-160 mL/kg/day.  
Now develops hyperglycemia with glucose >200

#### One-fluid approach

1. Reduce TPN (D5% AA2%) to 50 mL/kg
2. Continue 1 gm/kg IL (5 mL/kg)
3. Y'in D3.5W to 95 mL/kg

Provides: 155 mL/kg, 34 kcal/kg, 1 gm/kg protein, 4 mg/kg/min GIR

#### Three-fluid approach

1. Custom TPN ordered @ 50 mL/kg
  - Contains: D10% AA6%
  - IL ordered at 1 gm/kg (5 mL/kg)
2. 0.45% Na Acetate @ 75 mL/kg
3. D3.5W at 20 mL/kg

Provides: 150 mL/kg, 41 kcal/kg, 3 gm/kg protein, 4 mg/kg/min GIR

<https://health.ucdavis.edu/pediatrics/clinical-guidelines/>

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### Other key aspects

- Avoid adjustment of TPN rate unless clinically essential
- As status stabilizes, consolidate IVF as clinically appropriate
- Maintain minimum D10% concentration in TPN – allows for optimal Ca/PO4 solubility
- Hyponatremia and rising BUN most likely indicative of dehydration in this population rather than excessive sodium and/or protein load
- Goal to maintain BG <150-180 mg/dL
  - Minimize GIR ~ 3.5-4 mg/kg/min if hyperglycemic as first line management
  - Administration of insulin in BG remains >220



<https://health.ucdavis.edu/pediatrics/clinical-guidelines/>

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### Lipid management

- Intralipid® (100% soybean oil)
- SMOFlipid® (30% soybean oil, 30% MCT oil, 25% olive oil, 15% fish oil)
- Omegaven® (100% fish oil)
- At UCD, we use Intralipid as the lipid of choice for ELBW
  - Limited data that SMOF is better than Intralipid at equivalent doses
  - SMOF has lower levels of essential fatty acids which may be problematic in growth and development
  - Intralipid has the most drug compatibility data
- We target 2g/kg/day
  - Lower dose, but hepatoprotective and we are able to achieve good growth

<https://health.ucdavis.edu/pediatrics/clinical-guidelines/>

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Lipid management

| NICU Lipid Dosing Guidelines |  |   |               |                               |
|------------------------------|--|---|---------------|-------------------------------|
|                              | Initial Dose                                 | Advancement                                 | Maximum Dose* | Minimum Dose to Prevent EFAD  |
| Intralipid                   | <750 gm: 0.5 gm/kg                           | <750 gm: 0.5 gm/kg/d                        |               |                               |
|                              | 750-1000 gm or SGA, IUGR, or septic: 1 gm/kg | 750-1000 gm or SGA, IUGR, sepsis: 1 gm/kg/d | 3 gm/kg       | 0.5-1 gm/kg (2.5-5 mL/kg)     |
|                              | >1000 gm: 2 gm/kg/d                          | >1000 gm: 1 gm/kg/d                         |               |                               |
| SMOFLipid                    | 2-2.5 gm/kg**                                | 0.5-1 gm/kg                                 | 3 gm/kg       | 2.5-3 gm/kg** (12.5-15 mL/kg) |
| Omegaven                     | 1 gm/kg                                      | N/A   | 1 gm/kg       | 1 gm/kg (10 mL/kg)            |

\* Consider holding advancement if hyperglycemic with BG persistently > 150 mg/dL.  
\*\*SMOFLipid dose restriction can result in EFAD and is discouraged. Goal to start at 2-2.5 gm/kg and advance to goal dose within 24-48 hr. Infants who develop IFALD/PNAC should be transitioned to Omegeven for rescue treatment.  
\*Do not exceed 60% of total kcal due to risk of ketosis. Do not exceed infusion rate >0.15 gm/kg/hr.

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Lipid management

| Triglyceride Value | Recommended IL adjustment  |
|--------------------|--|
| <250 mg/dL         | Continue to advance as scheduled or maintain goal dose   |
| 250-400 mg/dL      | Reduce dose by 0.5-1 gm/kg<br>Ensure levocarnitine in PN (starting dose 10 mg/kg/d)  |
| >400 mg/dL         | Consider holding up to 24-48 hr<br>Optimize levocarnitine in PN (up to 20 mg/kg/d)<br>Do not withhold IL for >3 days in preterm infants due to risk of EFAD. If TG remains grossly elevated, provide minimum 0.5-1 gm/kg IL. |

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UCD NICU Trace Element Dosing Guidelines

| NICU TPN Trace Element Requirements |  |                                 |  |
|-------------------------------------|--|---------------------------------|--|
| Trace Elements                      | Preterm Requirements (from birth to term) (mcg/kg/d) | Term Requirements (mcg/kg/d)    |  |
| Zinc                                | 400-500  | <3 months: 250<br>>3 months: 50 |  |
| Copper (cupric chloride)            | 20-40  | 20                              |  |
| Selenium                            | 2-7  | 2                               |  |

| UCD Children's Hospital Standard Pediatric PN Trace Elements Guide (2022) |                     |            |           |            |           |
|---|---------------------|------------|-----------|------------|-----------|
| Multitryp*  | Patient weight (kg) | Zinc       | Copper    | Selenium   | Manganese |
| Standard dose: 0.35 mL/kg, 1 mL/d (max dose)                              | 2.5-3 kg            | 350 mcg/kg | 21 mcg/kg | 2.1 mcg/kg | 1 mcg/kg  |
|   | 3+ kg               | 1000 mcg   | 60 mcg    | 6 mcg      | 3 mcg     |

\* Preterm infants <2.5 kg will receive individually dosed TE (400 mcg/kg Zn, 3 mcg/kg Se, 20 mcg/kg Cu)  
\* Preterm infants that are 2.5-3 kg will need an additional 50 mcg/kg zinc added to meet needs.  
\* For infants >3 kg who require TPN > 14 days, assess if actual TE intake is appropriate to meet requirements for gestation & clinical status. Consult RD for assistance.

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Enteral feeding

- Buccal swabs on admission with EBM/DBM - up to 0.1 mL q 2-6 hr with cares
- Goal is to start trophic feeds (10-20 mL/kg) within 48 hr of life if clinically appropriate
- EBM > DBM > Formula
- Early IBCLC consult – goal to initiate pumping within 6 hr of delivery



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Enteral feeding

- Maintain trophic feeds during initial stabilization phase (up to DOL 5)
- Slow advances ~ 10-15 mL/kg usually tolerated best
- Extend feeds empirically over 1 hr due to poor motility
- 3-day course glycerin suppositories if no stool by 72 hr
- Fortify feeds to 24 kcal/oz once tolerating at least 40 mL/kg



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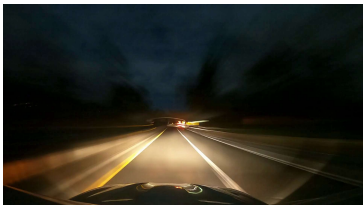
Enteral feeding

| NICU Enteral Feeding Advancement Guidelines |                                      |                           |                   |  |
|---|--------------------------------------|---------------------------|-------------------|--|
| BW (gm)                                     | Initial Feeding                      | Duration of trophic feeds | Advancement       | Fortification  |
| <750  | 10 mL/kg                             | 3-5 days                  | 10-20 mL/kg daily | * When tolerating 40 mL/kg x 24hr, fortify to 24 kcal/oz w/HMF<br>* Ensure fortified feeds tolerated x 24 hr prior to further advances   |
| 750-1000                                    | 10-20 mL/kg                          | Up to 3 days              | 20 mL/kg daily    |  |
| 1000-1500                                   | 20 mL/kg                             | 24-48 hr                  | 30 mL/kg daily    |  |
| 1500-2000                                   | 20 mL/kg                             | At least 24 hr            | 15-20 mL/kg BID   | Likely needed pending GA & clinical status:<br>* May fortify w/HMF if majority of feeds via NG.<br>* If progressing toward discharge, may add supplemental feeds of PDF 22-24 kcal/oz. |
| 2000-2500                                   | 20-30 mL/kg                          | Up to 24 hr               | 20 mL/kg BID      | Likely need supplemental feeds of PDF 22-24 kcal/oz at least 1-2x/d.   |
| >2500                                       | 40-60 mL/kg/d or ad lib with minimum | Up to 24 hr               | 20 mL/kg BID      | Only if needed. Evaluate need after tolerating goal volumes.   |

HMF = human milk fortifier (product used: Similac HMF Hydrolyzed Protein Concentrated Liquid)  
PDF = preterm discharge formula (i.e. Similac Neosure or Enfamil Enficare)

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Monitoring



- Extreme prematurity leads to constant dynamic fluctuations.
- You need a standard, robust monitoring structure to not miss changes
- This will increase blood loss (risk/benefit)

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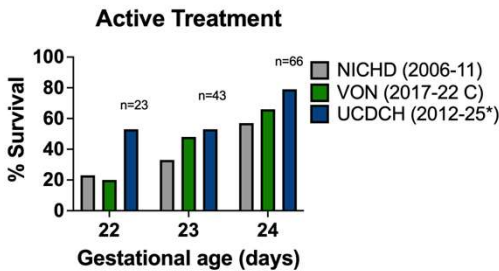
UC Davis Outcomes

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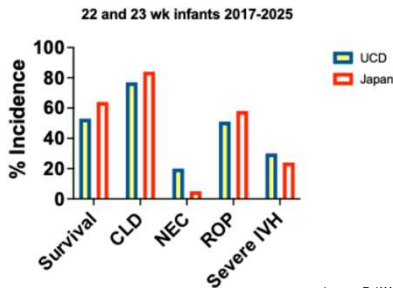
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Outcomes at the limits of viability



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Outcomes at the limits of viability



Isayama T, JAMA Pediatrics, 2023

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• And many many others!



22 week infant Same 22 week infant

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Questions?

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