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Care of Periviable Infants

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Learning Objectives

- Describe the cultural factors that impact survivability and neurologic outcomes for periviable infants born at 22–23 weeks gestation
- Understand differences in management strategies when caring for periviable infants born at 22–23 weeks gestation
- Review survival, morbidity, and 2-year outcomes for periviable infants born at 22–23 weeks gestation at a center with a proactive philosophical approach

Factors That Influence Survival Rates of Periviable Infants

Survival at 22 Weeks Gestation – Possible or Impossible?

TTS: twins born at 22 1/7-weeks

490 g

449 g

TTS, Twin to Twin Transfusion Syndrome.

Survival Is Improving for Premature Infants Born at 22 Weeks Gestation

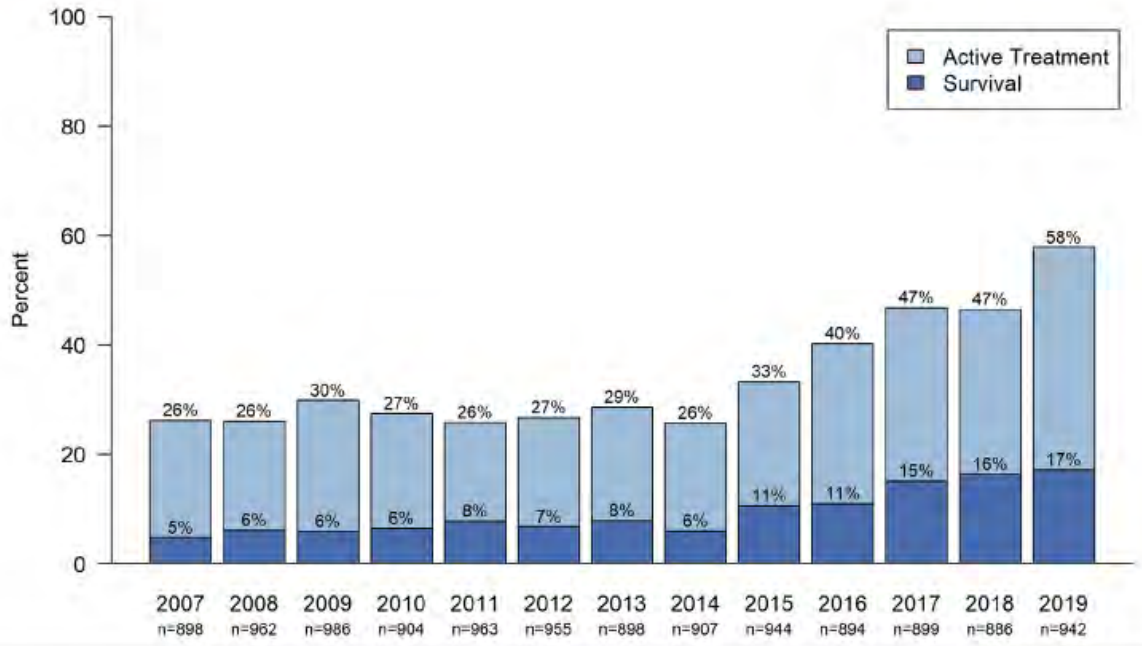

Figure 1. Active treatment and survival for liveborn infants at 22 weeks in the US. Active treatment is defined as respiratory support (including face mask ventilation, nasal continuous positive airway pressure, endotracheal intubation, surfactant therapy, or mechanical ventilation), chest compressions, or epinephrine. Survival is to hospital discharge or 1 year. The denominator includes all live births, including deaths that occurred in the delivery room. Data are from hospitals participating in the Vermont-Oxford Network.

Rysavy MA, et al. *J Pediatrics.* 2021;233:P16-25.E1. Used with permission from Elsevier.

Survival of Inborn *"Extremely Extreme Premature"* Infants Born at 22–24 Weeks Gestation at Iowa (2006–2019)

Weeks	22	23	24
Survival	59%	74%	85%
Number of live-born infants	61	90	109

64% survival at 22 weeks for NICU admissions

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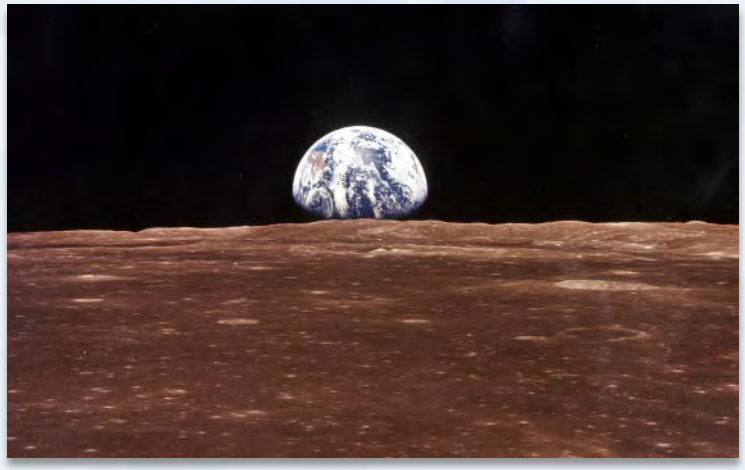
Apollo 11: July 20, 1969
Landing on the Moon – Hard, Difficult, and "Impossible"



Credit (clockwise from left): Mission Control Center by VCG Wilson/Corbis; Moonrise by NASA/Newsmakers, Hultan Archive; Prime Crew by NASA/Newsmakers, Hultan Archive; Aldrin descending lunar module ladder by NASA/Newsmakers, Hultan Archive; Apollo 11 mission insignia, Bettman Archive; Armstrong working on craft by NASA/Newsmakers, Hultan Archive;. All photos via Getty Images.

Foundations of Mission Control[1]

- **Achieve Through Excellence**
- **Competence**: There being no substitute for total preparation and complete dedication, for space **(or the NICU)** will not tolerate the careless or indifferent.
- **Teamwork:** Respecting and utilizing the ability of others, realizing that we work toward a common goal, for success depends on the efforts of all.
- *"To recognize that the greatest error is not to have tried and failed, but that in trying, we did not give it our best effort."*
  — Gene Kranz, NASA Flight Director

1) Failure is not an option, Gene Kranz, Berkley Books, New York, 2000, p.393.
Images: Top: by Bob McCall. Bottom: by Dorling Kindersley via Getty Images.

Philosophy

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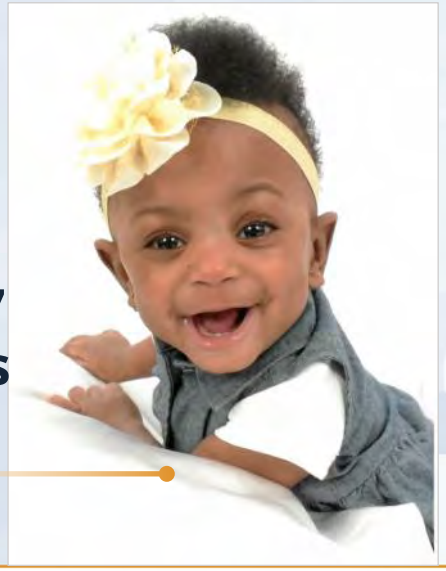
We expect these infants to survive and thrive.
Hard and Difficult, but it is **not Impossible.**

22 1/7 weeks
488 g

Age 5

22 6/7 weeks
465 g



22 2/7 weeks
379 g

Philosophical Differences

- Rates of active treatment account for 78% of between-hospital variation in survival among children born at 22 or 23 weeks of gestation and just 22% for those born at 24 weeks, but the rates of active treatment did not account for any of the variation in outcomes among those born at 25- or 26-weeks' GA. [1]
  Importantly, differences in hospital rates of active treatment did not account for all variation in outcomes.
  - For example, among hospitals that treated 100% of infants born at 24 weeks, rates of risk adjusted survival varied from 42–70%.
- **Therefore, factors other than just the decision to resuscitate contribute heavily to the variation in outcomes!**
- Of note, hospitals where active treatment was more often initiated had higher rates of risk-adjusted survival than hospitals where active treatment was less frequently initiated.

GA, gestational age.

1) Rysavy MA, et al. *NEJM* 2015;372:1801-1811.

Epidemiology of Extremely Extreme Prematurity

- In 2016, from US birth certificates (live births):
  - 22 weeks: 1,857
  - 23 weeks: 2,944
  - 24 weeks: 3,719
- All births in US: 3,945,875

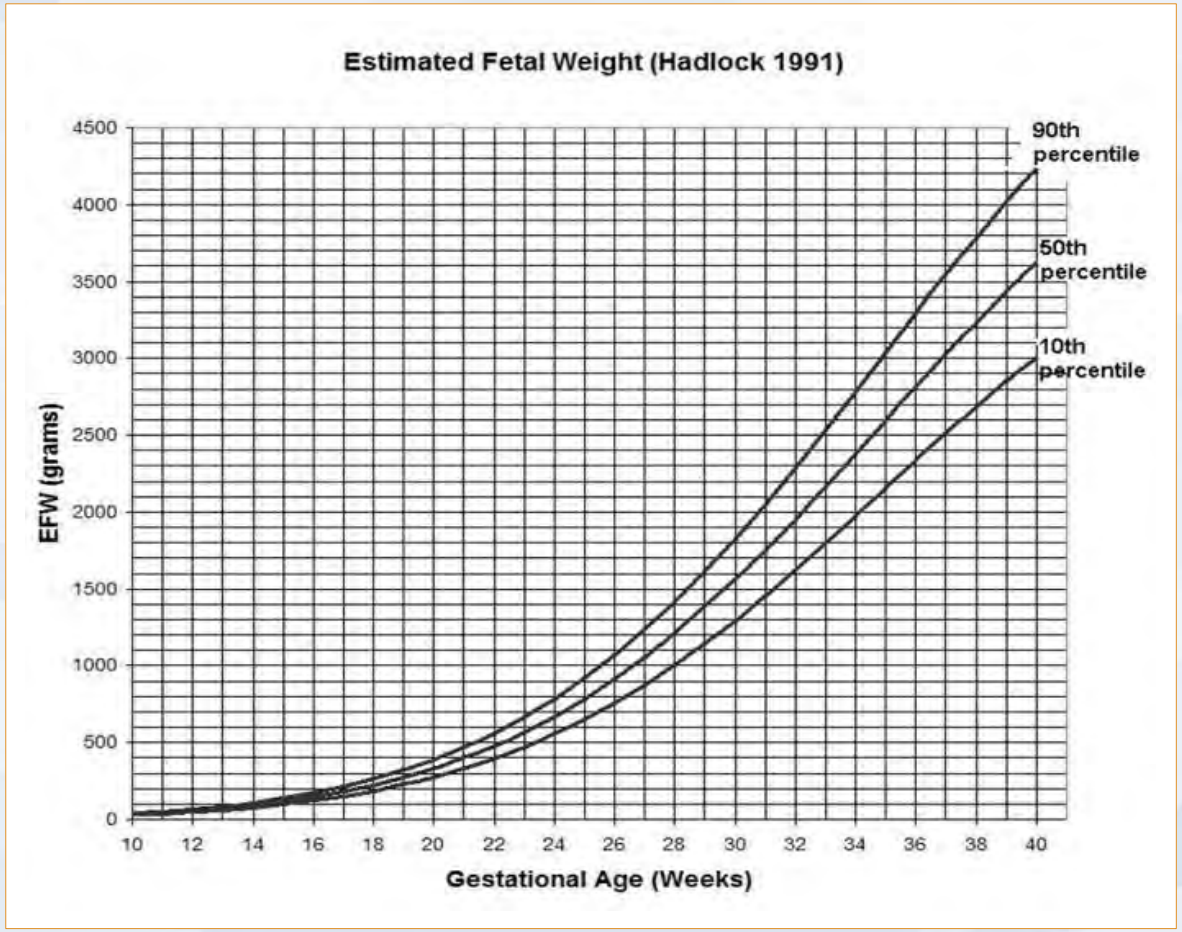
23 6/7 weeks twin 507 gm

Age 5

CDC Wonder Data Set. Premature Birth. https://www.cdc.gov/reproductivehealth/features/premature-birth/. Division of Reproductive Health, National Center for Chronic Disease Prevention and Health Promotion. Last reviewed: October 30, 2020.

“Periviable” Census on January 8, 2019

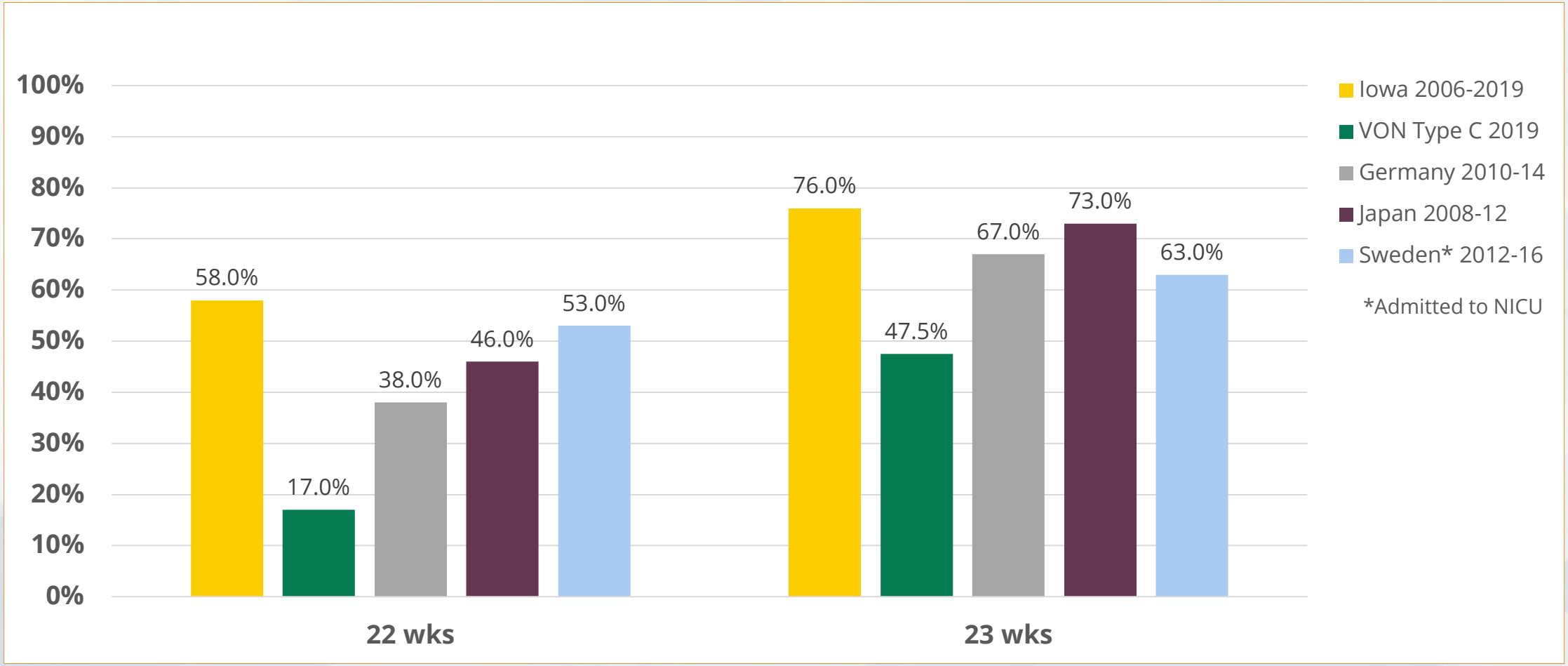
GA (baby)	BW (g)	PMA (baby) on 1/8/19
22w1d	490	28w4d
22w1d	449	28w4d
22w2d	545	22w6d
22w5d	550	28w3d
22w6d	517	28w3d
23w0d	510	36w6d
23w0d	512	36w6d
23w2d	634	29w5d
23w2d	580	38w4d
23w3d	660	26w5d



BW, birth weight; GA, gestational age; PMA, post-menstrual age.

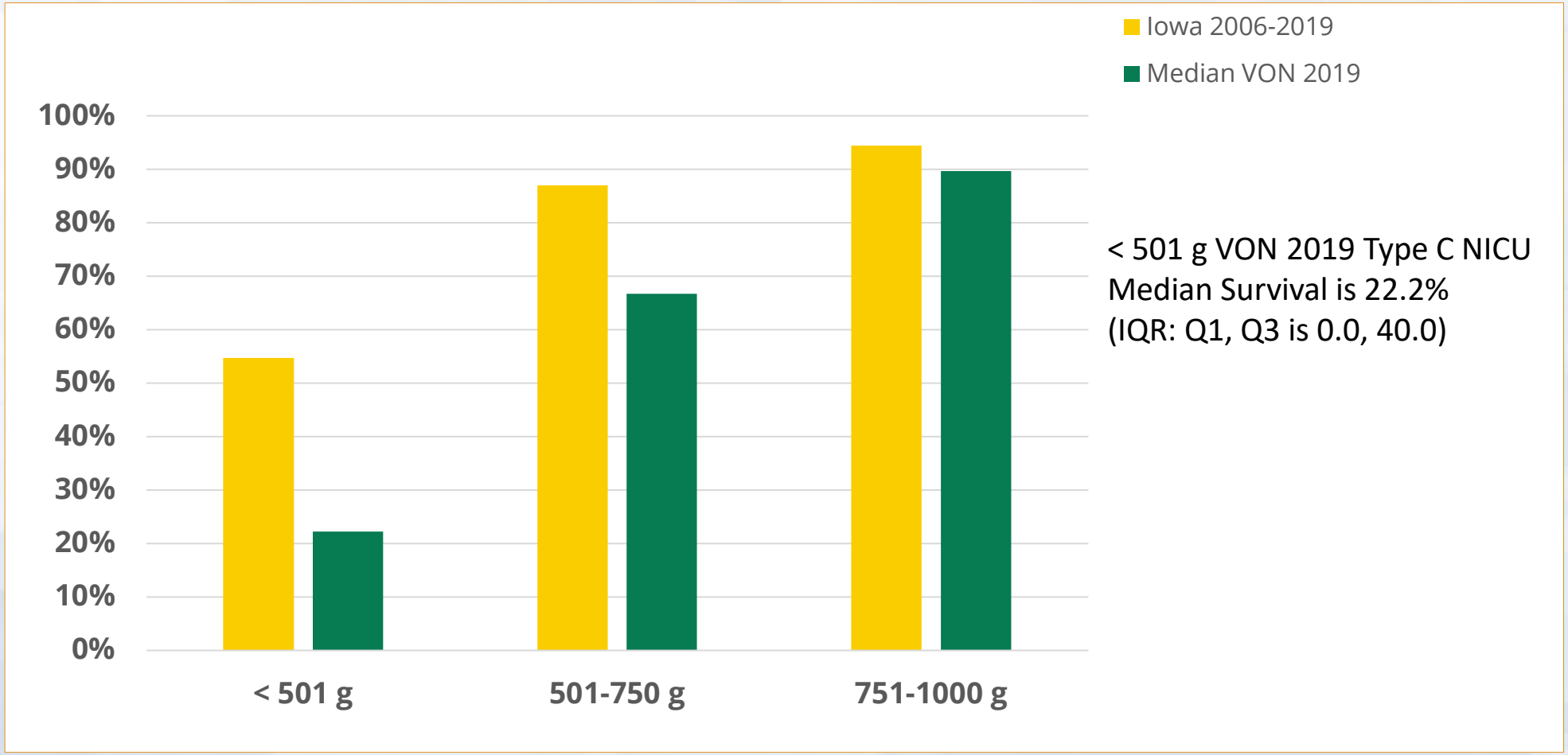
Hadlock FP, et al. *Radiology.* 1991;181:129-33.

Possible – Survival of Inborn Periviable Infants Born at 22-23 Weeks Gestation (all live-born)



EGA, estimated gestational age; NRN, Neonatal Research Network; VLBW, very low birth weight; VON, Vermont Oxford Network.

Survival of Inborn ELBW Infants ≤1000 Grams Birth Weight Categories 2006–2019



< 501 g VON 2019 Type C NICU Median Survival is 22.2% (IQR: Q1, Q3 is 0.0, 40.0)

VON, Vermont Oxford Network.

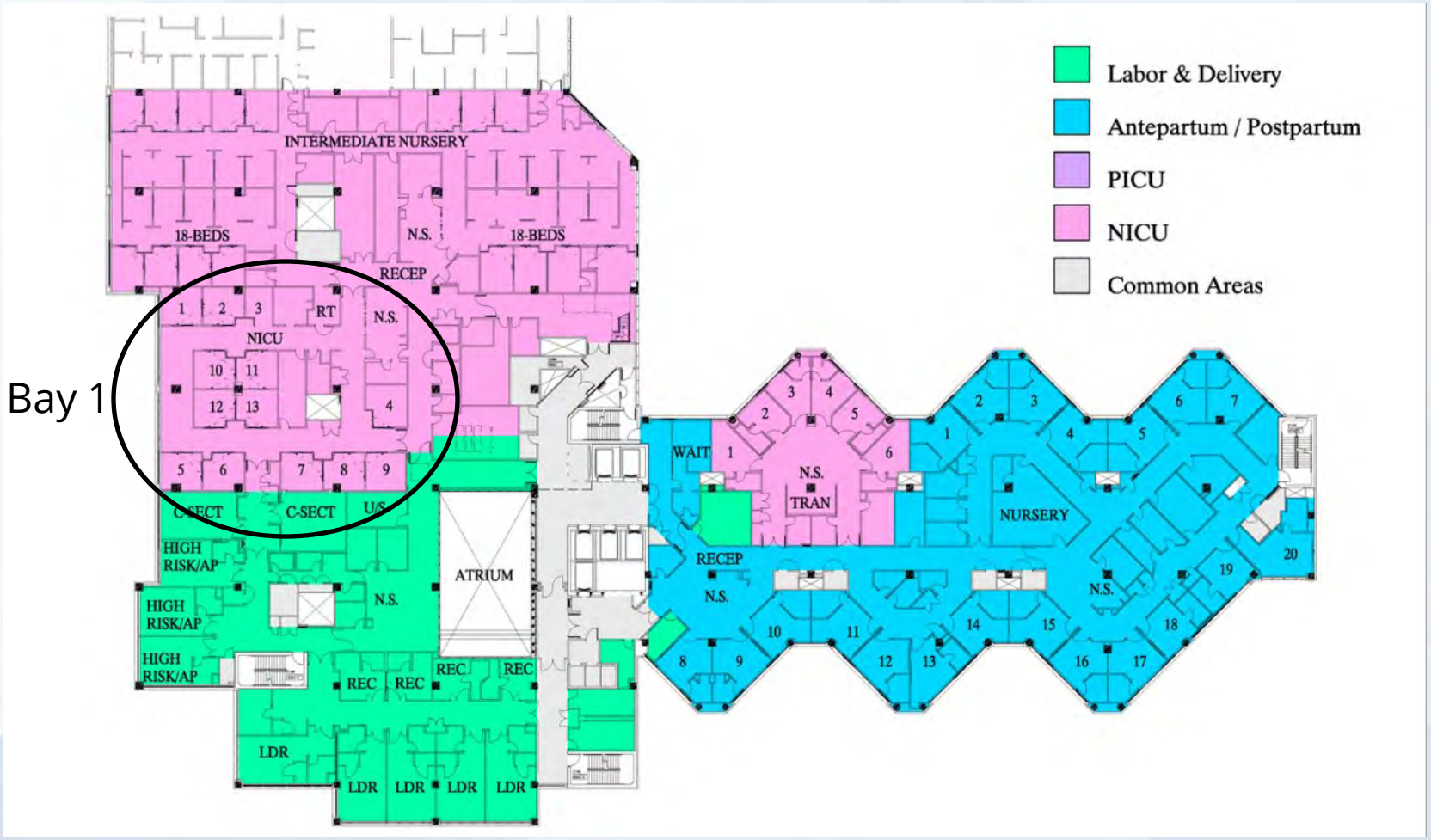
Strategies to Increase Survivability

"Small Baby" System
Dedicated Integrated Structure and Culture for Extremely Premature Infants
"The System is the Star"

Separate dedicated unit of 14 beds: Bay 1, NCCU - Neonatal Critical Care Unit

- All infants <28-30 weeks admitted here, as well as the most critically ill term infants
- Separate nursing staff
- Separate location integrated with labor and delivery
- Separate Critical Care Lab just for the NICU
- Separate medical team for just these 12–13 patients
  - Separate Attending service ("Neonatal Intensivists"), Fellow, NNP, 2 Residents, Dietician, Pharmacist, Respiratory Therapist

Structure: NICU 84 rooms with 88 beds



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Difference: Begin at the Beginning

Antenatal Steroids Are Critical

Interdisciplinary Teamwork with MFM

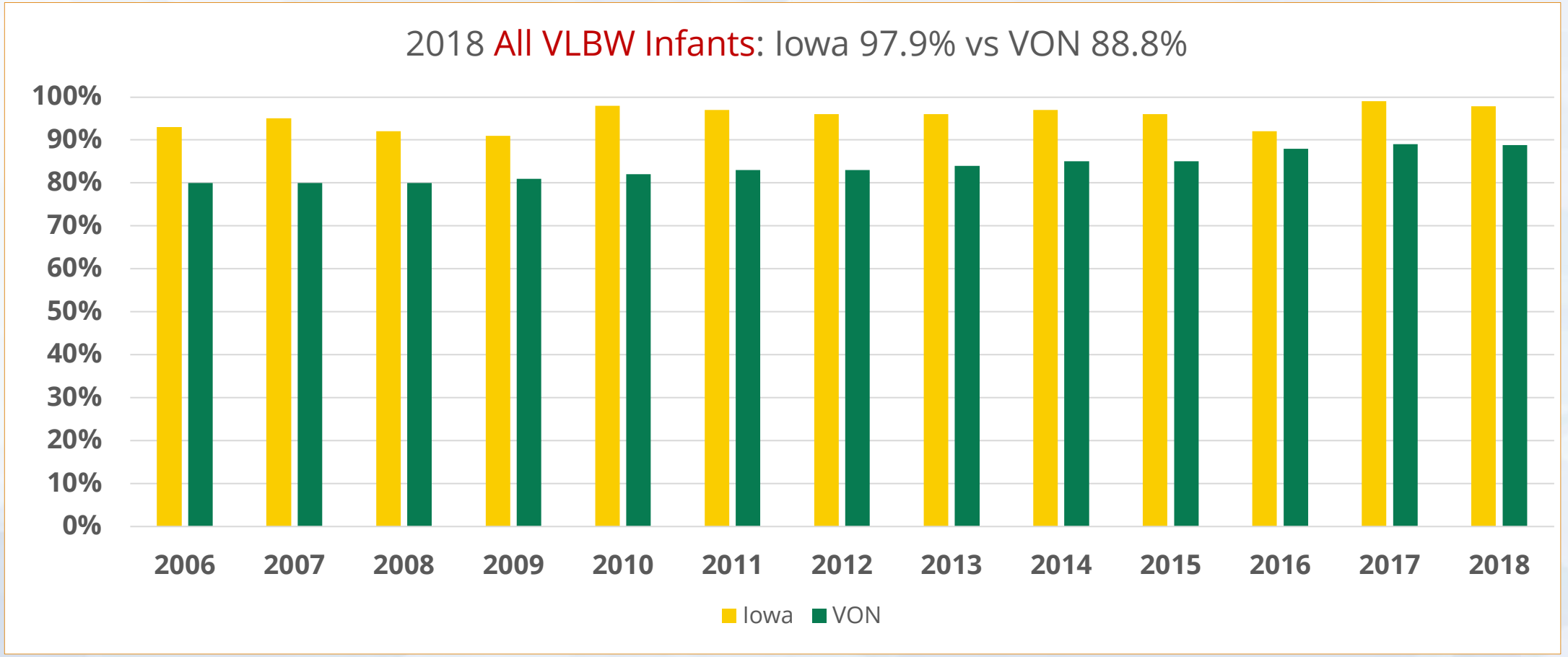
- ANS at 22–25 weeks gestation:
  - Reduces death, reduces severe IVH, reduces the incidence of NDI at 18–22 months, increases survival from 18% to 39% at 22 weeks gestation!

- Carlo W, McDonald S, Fanaroff A, et al. Association of antenatal corticosteroids with mortality and neurodevelopmental outcomes among infants born at 22 to 25 weeks gestation. *JAMA.* 2011;306(21):2348-2358.
- Mori R, Kusuda S, Fujimura M. Antenatal corticosteroids promote survival of extremely preterm infants born at 22 to 23 weeks of gestation. *J Pediatr.* 2011;159(1):110–114.
- Park CK, Isayama T and McDonald SD. Antenatal corticosteroid therapy before 24 weeks of gestation; A systematic review and meta-analysis. *Obstet Gynecol.* 2016;127:715–25.
- Weil JC, Catalano R, Profit J, et al. Impact of antenatal steroids on intraventricular hemorrhage in very-low-birth weight infants. *J Perinatol.* 2016 ;36, 352–356.
- Deshmukh M and Patole S. Antenatal corticosteroids in impending preterm deliveries before 25 weeks' gestation. *Arch Dis Child Fetal Neonatal Ed.* 2018;103:F173-176.
- **Ehret D, Edwards E, Greenberg L, et al**. Association of antenatal steroid exposure with survival among infants receiving postnatal life support at 22 to 25 weeks' gestation. *JAMA Network Open.* **2018;1(16):e183235.**

  - If everyone "already knows" ANS therapy, at ≥24 weeks, improves lung maturity and reduces RDS, NEC, severe IVH, and mortality, so…

ANS, antenatal corticosteroids; IVH, intraventricular hemorrhage MFM, maternal fetal medicine; NEC, necrotizing enterocolitis; RDS, respiratory distress syndrome.

Antenatal Steroids: Inborn Deliveries All VLBW Infants (22 to 33 Weeks EGA) 2006–2018



Infants delivered at **22-23 weeks** gestation antenatal steroid use was **91%** (2006-2015 Iowa Inborn cohort) [1]

1) Watkins PL, et al. *J Pediatr.* 2020;217:52-8.

Maternal Characteristics Iowa Cohort
Inborn and Outborn Infants Admitted 2004–2015

Mean ± SD on N (%)	22 weeks N=34	23 weeks N=76	24 weeks N=138
Maternal age	**25.32 ± 4.7**	**28.04 ± 6.8**	**26.55 ± 6.1**
Maternal race			
White	25 (74%)	46 (65%)	101 (76%)
Black	5 (15)	11 (15)	20 (15)
Other	4 (11)	14 (20)	12 (9)
C-Section	**0**	**37 (49%)**	**102 (75%)**
Multiples	**17 (50%)**	**19 (25%)**	**23 (17%)**
Hypertension	2 (6%)	2 (3%)	13 (10%)
Chorioamnionitis	7 (21%)	7 (9%)	13 (10%)
Diabetes	1 (3%)	1 (1%)	4 (3%)
Pre-eclampsia	0	1 (1%)	9 (7%)

Differences: Delivery Room Part 1

- Minimize Hyperoxia and Hypoxia during resuscitation
  - Delivery room Oximeter Protocol
    - » Initiate resuscitation with oxygen [1] not RA and not 30% oxygen; we start with 50% and titrate per saturation protocol

1) Oei JL, Saugstad OD, Lui K, et al. Targeted Oxygen in the Resuscitation of Preterm Infants, a Randomized Clinical Trial. *Pediatrics*. 2017;139(1):e20161452.
   - Mortality <28 weeks: Resuscitation with RA, 22% vs 6%with100% O_2

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NICU Delivery Room NRP Oximeter Protocol

Time after Birth	Preductal Target Saturation
1 minute	60 - 65%
2 minutes	65 - 70%
3 minutes	70 - 75%
4 minutes	75 - 80%
5 minutes	80 - 85%
10 minutes	85 - 95%

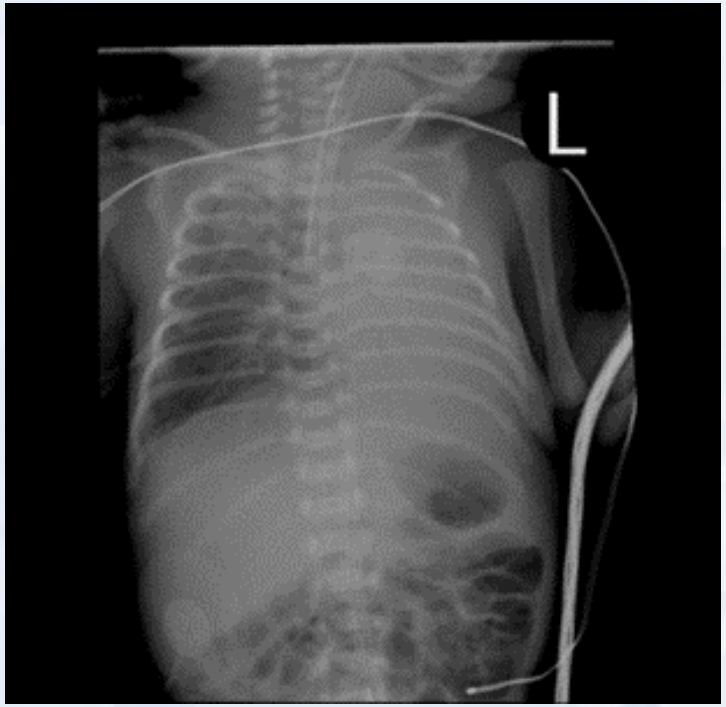
2010 AHA JM Klein 1/1/12

NRP, Neonatal Resuscitation Program; RA, room air.

1. Oei JL, et al. *Pediatrics*. 2017;139:e20161452.

Differences: Delivery Room Part 2

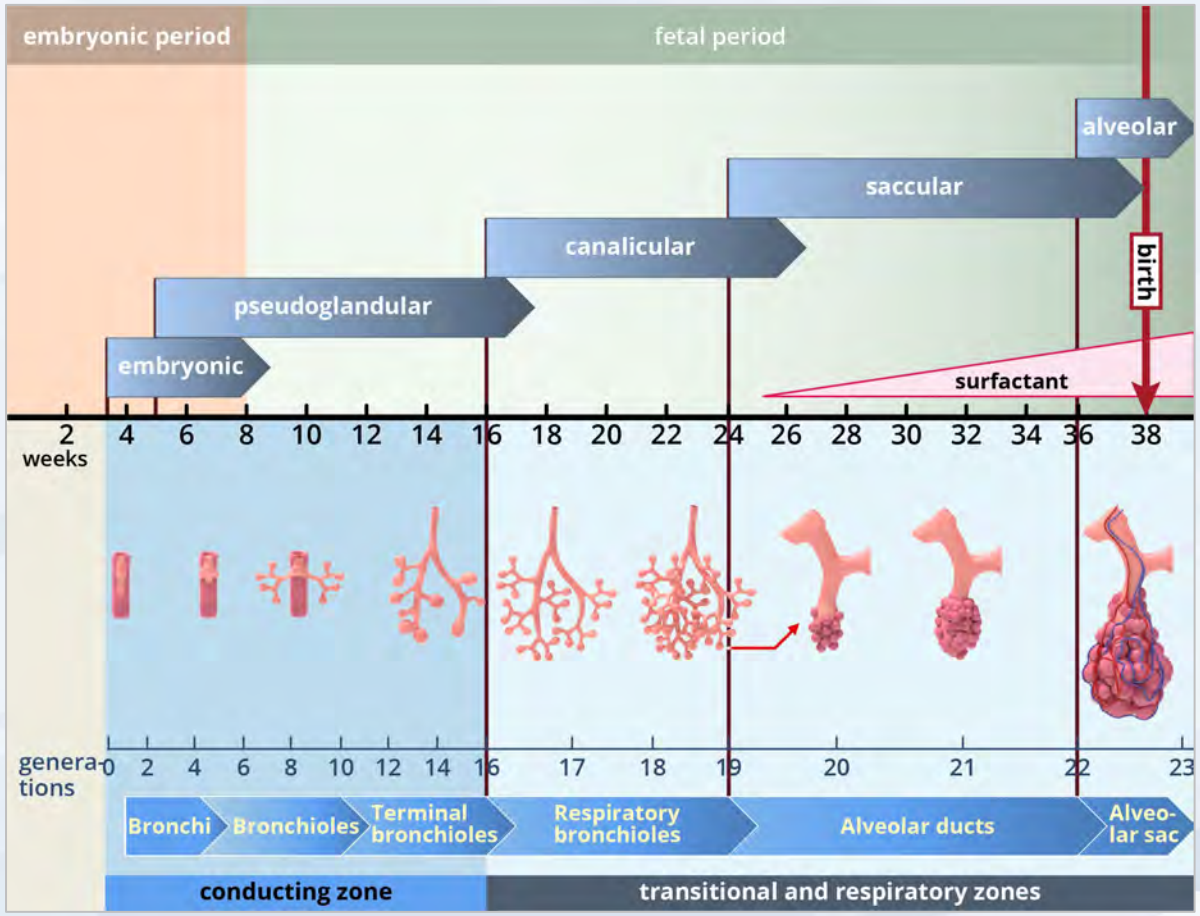
- Minimize Hypothermia
  - Plastic wrap (polyethylene blanket and hat), delivery room temperature 25°C, trans-warmer mattress for transport
- Intubate with 2.0 ETT at 22 weeks GA, 2.0/2.5 at 23 weeks:
  - ETT depth **5.5-6.0** cm at the lip
  - Transfer to NICU with gentle bagging via ETT, PEEP of 5 cm
  - Start on 1st Intention HFJV within 10 minutes of life
- Surfactant given within 20-30 minutes after initial chest radiograph



ETT, endotracheal tube; PEEP, positive end expiratory pressure.

Differences in the NICU: Ventilator Issues
Prime Directive: Minimize Risk of Pneumothorax and PIE

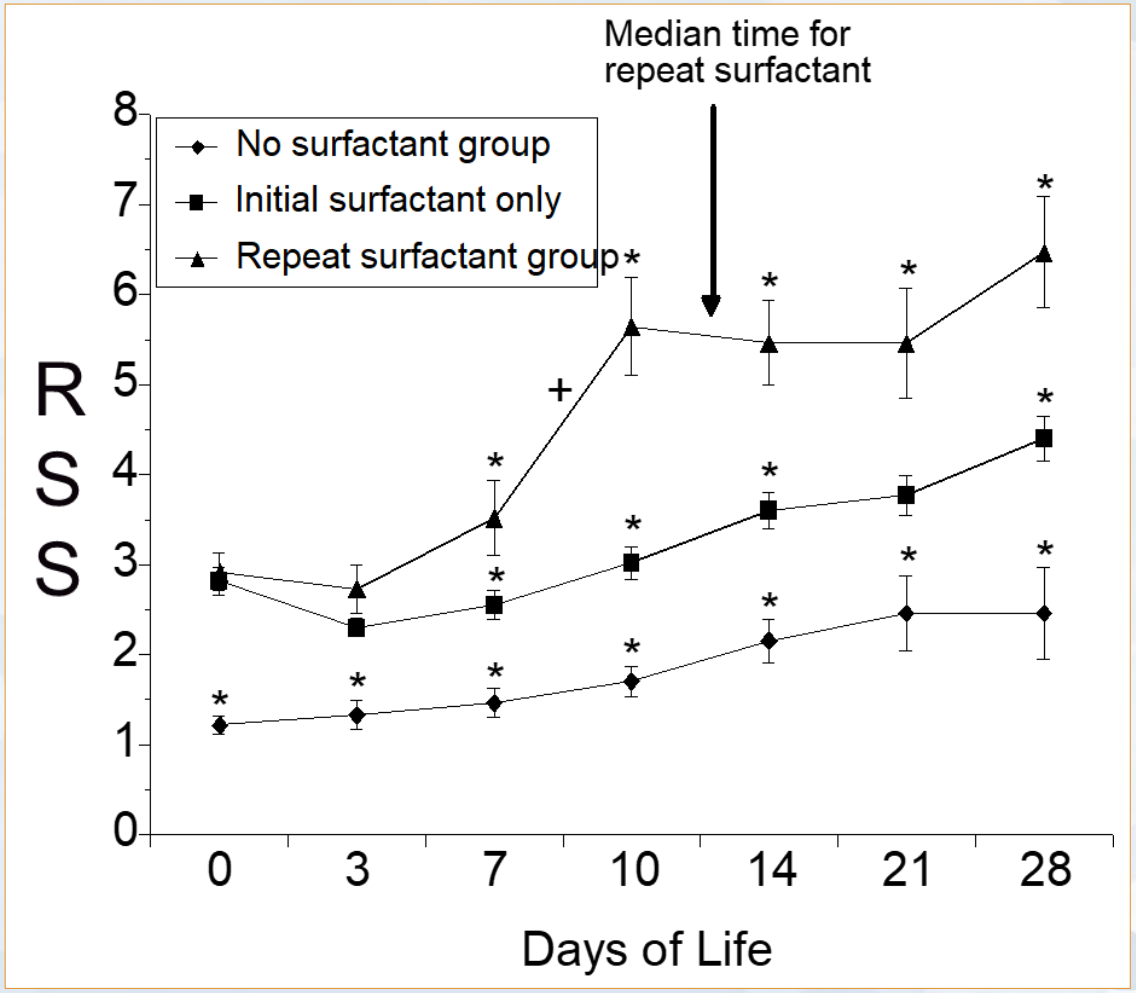
- Iowa is a **1st Intention HFV** Center
  - HFJV for all infants <27 weeks at birth
    - » Initial rate 300 BPM at 22-23 weeks GA (I:E of 1:9)
    - » Initial PEEP 5 cm to avoid overdistention
- Critical to avoid volutrauma (shear force injury) to the lung at 22 to 23 weeks GA
  - At the canalicular stage of lung development: terminal bronchioles branch to respiratory bronchioles which branch to alveolar ducts which terminate into alveolar sacs (thin walled and vascularized) beginning at 24 weeks, however cranial segments mature faster than caudal segments so there are a few areas of the lung mature enough for survival at 22 weeks gestation if you don't damage the lung.
  - Need antenatal steroids to accelerate maturation and a lung protective strategy



HFV, high frequency ventilation; HFJV, high frequency jet ventilation; PIE, pulmonary interstitial emphysema.

NICU Difference: Treat Post Surfactant Slump With Repeat Surfactant Therapy [1]

- 20% of Infants <1000 g with RDS develop post-surfactant slump after DOL 6
- PSS is the lack of endogenous surfactant production
- More than 70% of infants with PSS have an improvement in the Severity of their Respiratory Disease with treatment
- 2 or more doses of initial SRT for RDS was predictive of developing PSS (RR 2.4, 95% CI [1.2, 4.9, *P*=0.02])
- Controlling for GA: Antenatal steroids significantly reduced risk of developing PSS (OR 0.22, 95% CI [0.07, 0.67], *P*=0.008)
- Either calfactant or poractant alfa treats post-surfactant slump
- Always R/O a hemodynamically significant PDA as well as sepsis/pneumonia and atelectatrauma leading to surfactant dysfunction and inactivation



CI, confidence interval; DOL, day of life; GA, gestational age; OR, odds ratio; PSS, post-surfactant slump; RDS, respiratory distress syndrome; RR, respiratory rate; SRT, surfactant replacement therapy, RSS, respiratory severity score = FiO2 x MAP (mean airway pressure).

1. Katz LA, Klein JM. *J Perinatol.* 2006;26(7):414-22.

NICU Difference: Standardized Extubation Support

1. Avoid Atelectrauma
   - Extubate *"only when ready"* to have a sustainable respiratory drive. *"Don't push them off !"*
   - Failed extubation in the first weeks of life in this population (mean GA 25.8 weeks) is significantly associated with increased death before discharge: **28% vs 6% mortality** as well as increases in severe IVH and BPD. [1]
   - Minimize multiple failure attempts
   - Extubate to noninvasive ventilation (>800-850 grams); we use NAVA for noninvasive ventilation.

2. Nasal Intermittent PPV vs Nasal CPAP [2]

   ➢ NIPPV group:
   - Decrease rate of extubation failure, (23% vs 58%)
   - Lower rates of clinical (21% vs 39%) and physiologic BPD (11% vs 46%)

BPD, bronchopulmonary dysplasia; CPAP, continuous positive airway pressure; NAVA, neurally adjusted ventilatory assist; NIPPV, neonatal nasal intermittent positive pressure ventilation; PPV, positive pressure ventilation.

1. Chawla S, et al. *J Pediatr.* 2017;189:113-119.e2.
2. Ramanathan R, et al. *J Perinatol.* 2012;32:336-43.

Differences: Standardized NVN Strategies Minimize Hyperglycemia and Hyperlipidemia

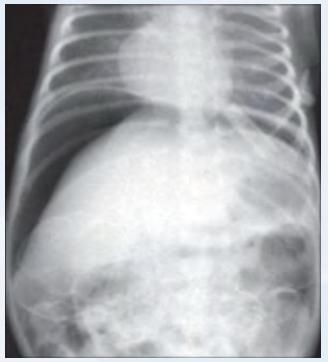
1. Glucose levels 50–150, Na levels 135–150
   - Initially, requires frequent labs
   - Total fluids, often up to 250–350 ml/kg/day, use 3 fluids: UAC fluid without dextrose, NVN at 80-100 ml per kg/day for optimal protein, calcium, phosphorus and D2.5 W carrier fluid
   - No or minimal humidification to accelerate keratinization
   - Strict regulation
   - Initial GIR may be <4 mg/kg/min
   - Buffer with sodium and potassium acetate to compensate for renal losses to avoid need for aggressive ventilation to maintain pH >7.25
2. Start Intralipids slowly, not <12 hours of life, @ 0.5–1.0 gm/kg/day; do not exceed 2 gm/kg/day (liver protective strategy)
   - Minimize NVN cholestasis
   - **Mortality rate** (pulmonary hemorrhage) increased significantly in 600 to 800 gm infants receiving Intralipid at <12 hours of life vs controls (48% vs 24%, $p = 0.032$) [1]
3. Goal NVN protein 3.5–4.0 gm/kg/day, starter NVN at birth
4. Photoprotection of NVN [2]

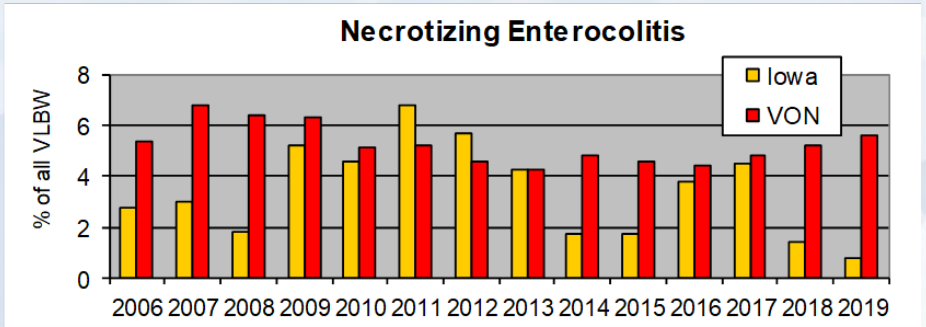
GIR, glucose infusion rate; NVN, neonatal venous nutrition.

1. Sosenko IR et al. *J Pediatr.* 1993;123:975.
2. Chessex P, et al. Shielding parenteral nutrition from light improves survival rate in premature infants, *JPEN J Parenter Enteral Nutr.* 2017;41:378-383.

Standardization of Gut Protective Strategies:
Minimize the Incidence of Spontaneous Intestinal Perforation (SIP) and Necrotizing Enterocolitis (NEC)

1. Avoid prophylactic Indomethacin:
   - 5% incidence of SIP with early Indomethacin alone
   - 19% incidence of SIP with the combination of Indomethacin plus Dexamethasone in ELBW patients (*NEJM* 2001 Jan 11; 344(2):95)
   - Hydrocortisone alone was not associated with an increase in SIP, however combined with Indomethacin the risk significantly increases (OR 9.37, 2.02-43.49, Shaffer ML et al, Meta-Analysis *J Pediatr* 2019; 207:136)
   - **Avoid the combination of indomethacin and steroids**
   - Address the PDA, after the 1st week of life or use a Targeted Neonatal Echocardiographic Hemodynamics Approach
2. Reduce NEC and focal intestinal perforation:
   - Early trophic feeds (10 ml/kg/day) within 24–36 hours
   - Maternal breast milk or donor
   - Advance slowly 10–12 ml/kg/day only if tolerating
   - Bolus when > 5 ml by pump over 1 hour
   - Probiotics
   - Early detection of meconium obstruction of prematurity [1] to minimize meconium relative ileus/intestinal injury





1. Siddiqui MMF, et al. *Arch Dis Child Fetal Neonatal Ed.* 2012;97:F147-F150.

Other Differences in Management Strategies

22 1/7-week twin 394 g

1. Infectious Disease
   - Prophylactic Nystatin for all patients on antibiotics
   - Prophylactic Fluconazole for at least the first 2 weeks and the skin has keratinized
2. Endocrine
   - Repeat thyroid screening at 1 month of age.[1] Based on TSH and free T4 values will be placed on thyroid replacement
   - Use stress dose and physiological hydrocortisone replacement for days to months depending on BP stability
3. Cardiopulmonary Failure
   - Rescue with inhaled NO if O_2 requirement > 60–70% with appropriate mean airway pressure, usually patients with PROM, pulmonary hypoplasia and/or pulmonary hypertension
4. Management changes since 2014
   - Probiotics
   - Delayed Cord Clamping
5. Use of Aggressive Phototherapy, significantly reduces overall NDI as well as profound impairment :[2]

BW (g)	1d	2d	3d	4d	5d	6d	7–14d
<1000	5	5	5	5	5	5	7

6. Targeted Neonatal Echocardiography since 2018
   - During 1st week of life to detect hemodynamically significant PDA shunts, pulmonary hypertension and assessment of ventricular function
   - Since 2018, Acetaminophen treatment for a hemodynamically significant PDA during the 1st week of life (40-50% efficacy at Iowa) then indomethacin

T4, thyroxine; TSH, thyroid stimulating hormone.

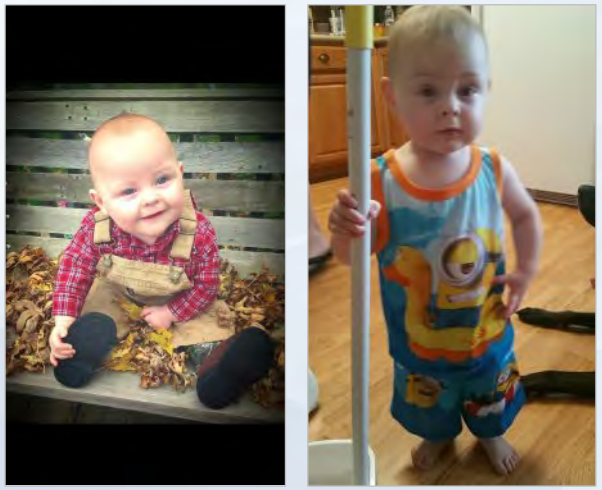
1. Kaluarachchi DC, et al. *J Perinatol.* 37:277-282, 2017
2. Morris BH, et al. *N Engl J Med.* 2008; 359:1885.

Prognosis Assessment

Outcomes of Inborn Infants: Acute Morbidity 2006–2018

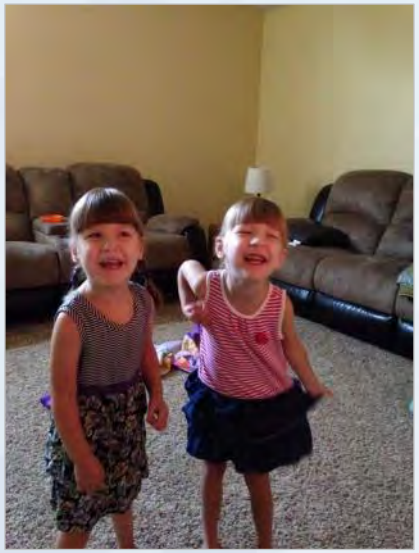
	N	Severe IVH	Cystic PVL	NEC incidence	ROP Laser therapy
22-week NICU admissions	45	22%	7%	18%	14% in survivors (29)
23-week NICU admissions	78	17%	8%	11%	2% in survivors (60)

22 3/7-week twin 544



Extremely extreme prematurity (< 24 weeks GA) is not hopeless

23 2/7-week twins 1st day of nursery school at age 4 (518 and 545 gm)



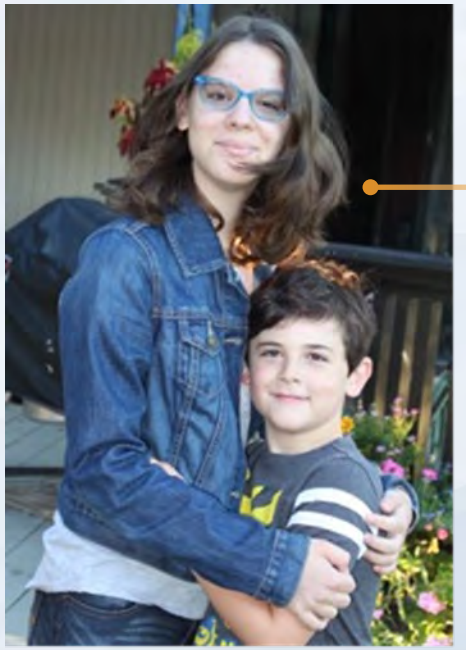
IVH, intraventricular hemorrhage; NEC, necrotizing enterocolitis; PVL, periventricular leukomalacia; ROP, retinopathy of prematurity.

Infant Characteristics (Inborn and Outborn) Admitted 2004–2015

Baseline Characteristics	22 weeks N = 34	23 weeks N = 76	24 weeks N = 138
Gestational age (median)	**22 3/7**	**23 3/7**	**24 3/7**
Survived to discharge	16 (47%)	53 (70%)	114 (83%)
Birthweight (grams)	**486 ± 69**	**584 ± 83**	**649 ± 129**

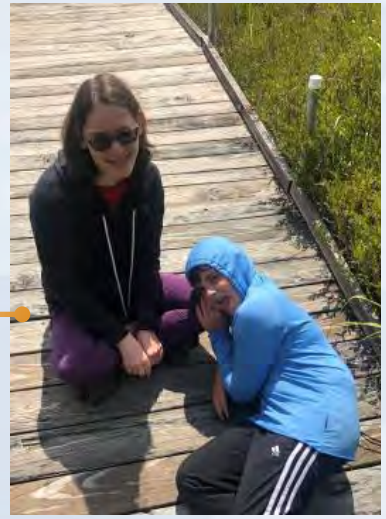
23 1/7 weeks

23 2/7 weeks



7th grade Honor student

Sophomore Honor student All As



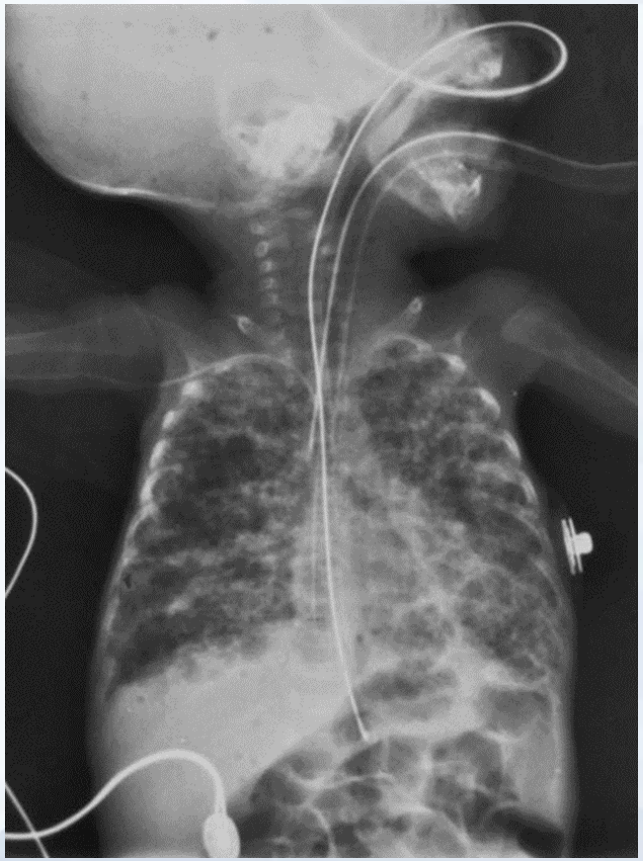
Univariate Factors Associated With Survival 22–24 Weeks GA
Inborn and Outborn (Admitted 2004–2015)

	Alive (n= 316)	Dead (n=83)	*P*-value	OR for survival	95% CI
Gestational age	**24.6 ± 0.9**	23.9 ± 1.1	<.0001	2.1	(1.6, 2.7)
Birth weight (grams)	**684 ± 141**	585 ± 156	<.0001	1.0	(1.0, 1.0)
Male sex	152 (48%)	**50 (60%)**	0.049	0.6	(0.4, 1.0)
Antenatal steroids	**271 (86%)**	60 (72%)	0.007	**2.3**	(1.2, 4.3)
Severe IVH	48 (15%)	**23 (26%)**	0.003	0.2	(0.1, 0.5)
Maternal age (years)	**27.7 ± 6.0**	26.4 ± 6.4	0.038	1.0	(0.9, 1.0)

After adjusting for multiple variables, survival was associated with higher gestational age, appropriate fetal growth, lack of severe IVH, and older mothers.

CI, confidence interval; GA, gestational age, IVH, intraventricular hemorrhage; OR, odds ratio.

Goal of 1st Intention HFJV Is to Avoid Lethal BPD [Grade III(A)] [1] and Grade 3 BPD - Invasive Respiratory Support at 36 weeks PMA [2]



- **Diagnosis of Grade 3 BPD**
  - "twofold higher rates of late death, serious respiratory morbidity, and moderate to severe neurodevelopmental impairment among infants receiving invasive rather than noninvasive positive airway pressure at 36 weeks' PMA, strongly supports the distinct classification of infants treated with invasive mechanical ventilation… "
  - Serious respiratory morbidity: tracheostomy, supplemental oxygen for >2 years,

BPD Severity Definition at 36 weeks PMA (2)
Grade 1: Nasal Cannula ≤ 2 LPM
Grade 2: Nasal Cannula > 2 LPM, Nasal CPAP, or NIPPV
Grade 3: Invasive Mechanical Ventilation

Therefore, for infants born at the canalicular stage of lung development, focus on 21st century clinical definition of BPD (Jensen, Invasive Mechanical Ventilation at 36 weeks PMA) instead of the 20th century definition (supplemental oxygen) at 36 weeks PMA

BPD, Bronchopulmonary dysplasia; LPM, liters per minute; PMA, postmenstrual age.

1. Higgins R, et al. *J Pediatr.* 2018;197:300-308
2. Jensen EA, et al. *Am J Respir Crit Care Med.* 2019;200(6):751-759.

Respiratory Outcomes for Infants Born at 22 to 23 Weeks of Gestation Treated With First Intention HFJV [1]

Key Respiratory Outcomes

Survival

- 22 weeks GA: 14/20 (70%)
- 23 weeks GA: 41/50 (82%)

Median duration of ventilation for 22–23 weeks GA: 63 days (IQR 47–78 days)

Median PMA at time of extubation 31.0 weeks PMA (IQR 29–33 weeks)

Grade 3 BPD at 22–23 weeks GA : Invasive Ventilation at 36 weeks PMA [2]

- 6% from 2006–2015
- 11% from 2016–2019

Tracheostomy at 22–23 weeks GA

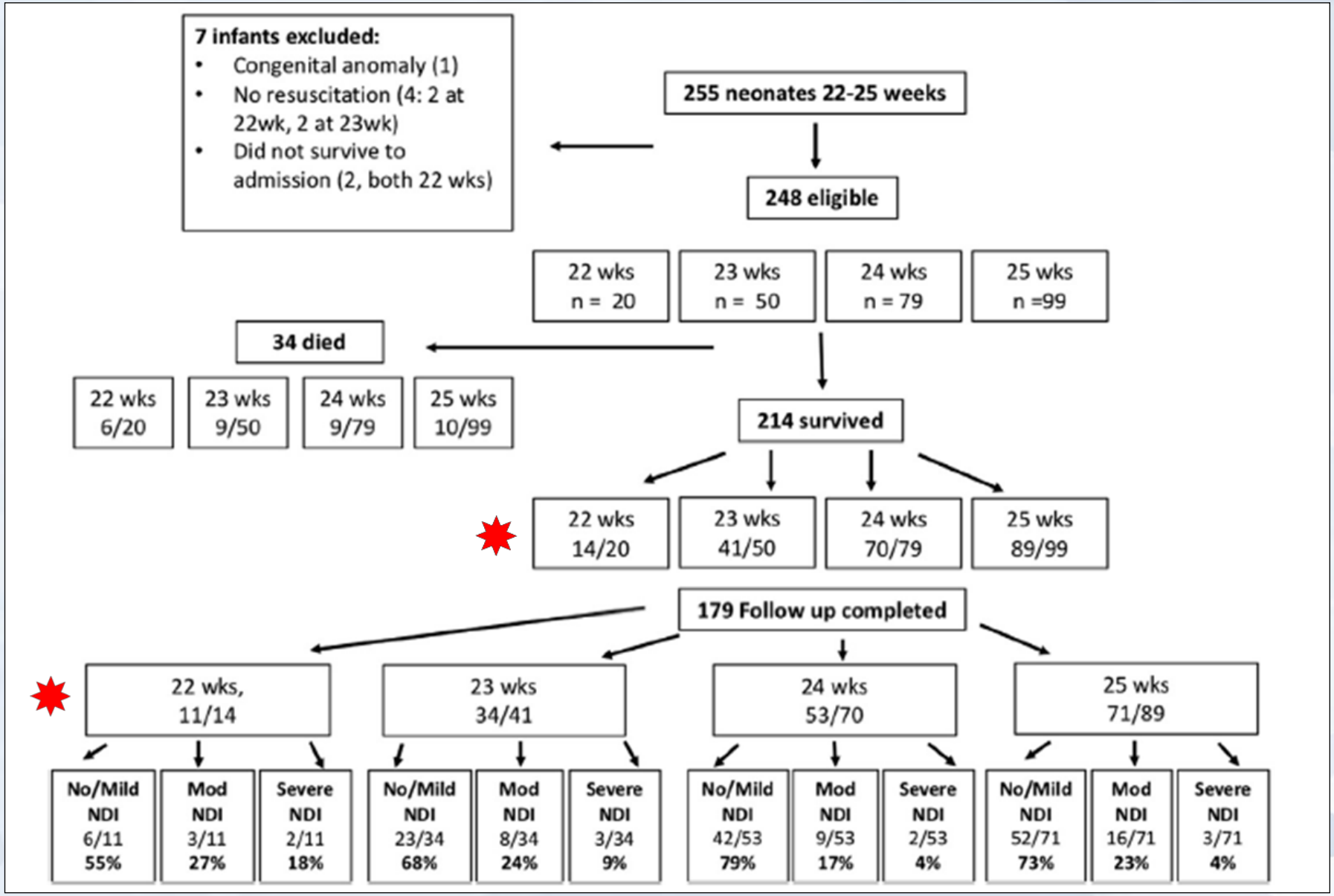
- 2%, 3 out of 144 infants (2006-2019)

Supplemental Oxygen at 18-22 months corrected age-17%

BPD Severity Definition at 36 weeks PMA (2)
Grade 1: Nasal Cannula ≤ 2 LPM
Grade 2: Nasal Cannula > 2 LPM, Nasal CPAP, or NIPPV
Grade 3: Invasive Mechanical Ventilation

1. Watkins PL, et al. *J Pediatr.* 2020;217:52-8
2. Jensen EA, et al. *Am J Respir Crit Care Med.* 2019;200(6):751-759.

Follow-up at Iowa: Neurodevelopmental Outcomes at 18–22 Months of Corrected Age in Survivors



No/Mild NDI	Bayley > 85, no CP
Moderate NDI	Bayley 70-85 and/or mild/moderate CP
Severe NDI	Bayley < 70 and/or severe CP and/or blindness/deafness

Watkins PL, et al. *J Pediatr.* 2020;217:52-58.e1. Used with permission from Elsevier.

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

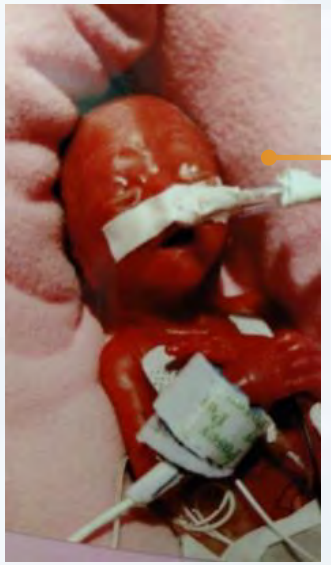
Patricia L. Watkins, MD, MS · John M. Dagle, MD, PhD · Edward F. Bell, MD · Tarah T. Colaizy, MD, MPH

- Retrospective cohort, 255 admitted infants, inborn, 22–25 weeks of gestation, 2006–2015
- Outcomes at 18–22 months of corrected age in survivors

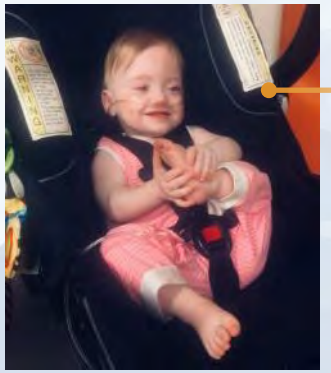
Outcomes	Infants delivered at 22–23 weeks (n=45)	Infants delivered at 24–25 weeks (n=124)	*P*-value
Home ventilator	0/42 (0%; 0%–1%)	1/124 (1%; 0%–5%)	.56
Supplemental oxygen	7/42 (17%; 8%–31%)	8/124 (6%; 3%–12%)	.05
Total parenteral nutrition	0/41 (0%; 0%–10%	0/124 (0%; 0%–4%)	1
Gastrostomy tube	3/40 (8%; 2%–21%)	19/125 (15%; 10%–22%)	.21
Oral diet consisting of solids	41/41 (100%; 90%–100%)	119/124 (96%; 91%–99%)	.19
Autism	0/41 (0%; 0%–10%)	2/89 (2%; 0%–8%)	.34
Vision (normal or corrected with glasses)	35/35 (100%; 88%–100%)	112/114 (98%; 93%–100%)	.58
Hearing (normal or corrected with hearing aids)	34/34 (100%; 88%–100%)	115/115 (100%; 96%–100%)	1
Cerebral palsy (including mild)	7/38 (18%; 9%–34%)	14/124 (11%; 7%–18%)	.02
Tracheostomy	1/42 (2%; 0%–12%)	3/125 (2%; 0%–7%)	.99
Ventriculoperitoneal shunt	3/42 (7%; 2%–20%)	3/121 (3%; 1%–7%)	.56

Watkins PL, et al. *J Pediatr*. 2020;217:52-58.e1.

Conclusion: Survival at 22–23 weeks GA is Extremely Difficult! But not impossible and not hopeless!



22 2/7 weeks
335 g



14 months

22 1/7-week twins, TTS, 490 and 449 g

2 years old

22 6/7-weeks twins
465 and 395 g

13-month-old,
Normal at 2-year F/U

Key Takeaways

- Develop a dedicated, integrated structure and culture for extremely premature infants.
- Antenatal corticosteroids are encouraged prior to 24 weeks to promote intact survival in extremely preterm infants.
- Lungs at the canalicular stage of fetal lung development are at high risk of mechanical injury so it is critically important to minimize both volutrauma with HFV and atelectrauma by extubating when developmentally appropriate.
- Competence, multidisciplinary teamwork and standardization of practice are essential to allow extremely preterm infants (22–24 weeks EGA) the potential to survive and thrive.