

Page to Practice - Lecture

Beyond the Numbers: Understanding and Addressing
Unexpected Term Neonatal Complications

Before We Get Started



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Any questions following this webinar can be sent to obgynsafety@acog.org

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What is “Page to Practice”?

A deep dive into clinical topics related to quality improvement, patient safety, and measurement held in a 2-session format:

- **Conversation:** A conversation between guidance document or article’s author(s) and an ACOG host. Discussion may include the why and how behind a publication, what new information or guidance it includes, and the author’s takeaways from it.
- **Lecture:** A webinar offering on the same or related topic to the previous offering, provided by national experts with actionable take aways for attendees via instructive teaching and slides.

Upcoming Page to Practice Sessions

**Consensus Statement
on Pain Management for
Pregnant Patients with
Opioid Use Disorder**

February 2025

Conversation

**Postpartum Care for the
Parent-infant Dyad
Affected by Opioid Use
Disorder**

February 2025

Lecture

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Today's Speakers



Danielle Ehret, MD, MPH



Elliott Main, MD

Unexpected Term Neonatal Complications and NICU Admission

Danielle Ehret, MD, MPH

Chief Medical Officer, Vermont Oxford Network
Professor of Pediatrics and Asfaw Yemiru Professor of Global Health
Larner College of Medicine, University of Vermont

ACOG Foundation: Page to Practice
December 10, 2025



Outline

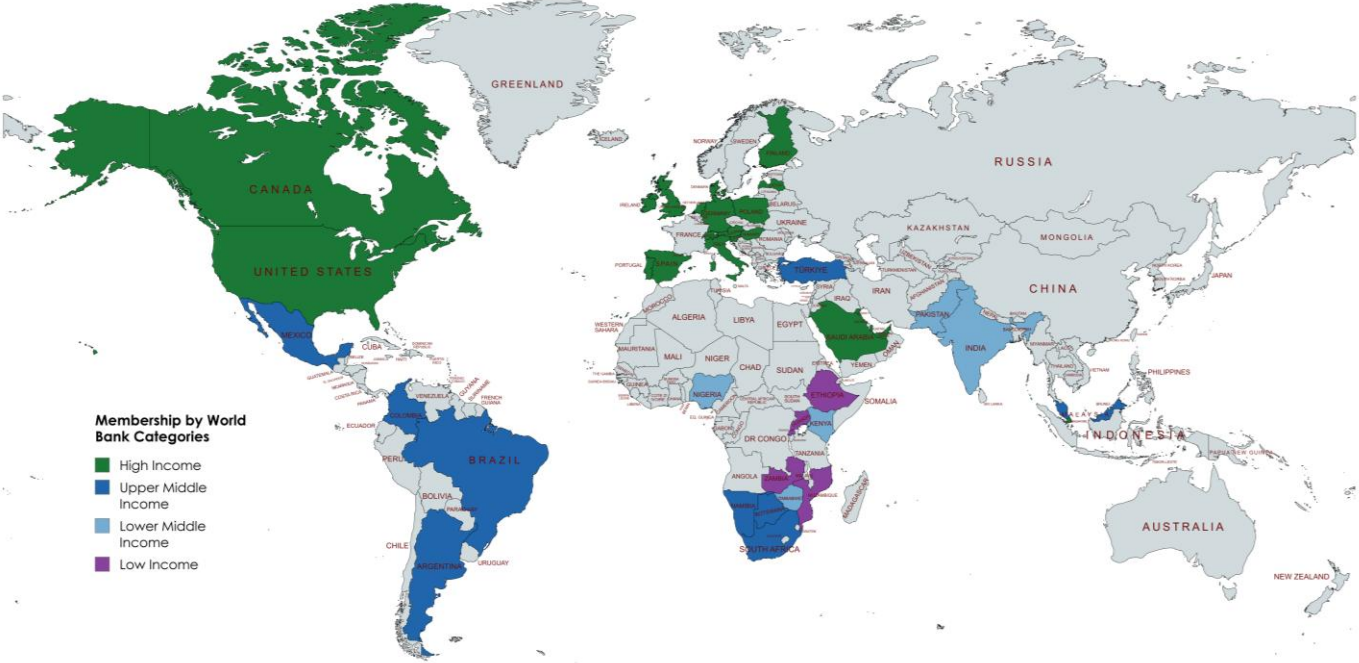
What Brings Term Neonates to the NICU?

Has the Landscape Changed Over Time in the US?

Example QI Initiative to Decrease Rates of
Unexpected Term Neonatal Complications (PC-06)

Vermont Oxford Network

Mission: To improve the quality, safety, and value of care for newborn infants and their families through a coordinated program of data-driven quality improvement, education and research.



1200+ centers in 41 countries



Term Neonatal NICU Admissions

Infants born in 2024 at 589 centers participating in VON database capturing all NICU admissions

N= 226,450 total infants; 108,450 \geq 37 weeks

48% of admissions

Term Neonatal NICU Admissions

Why are term infants admitted?

	Gestational Age – Weeks (%)	
	37-39	>39
Antenatal Steroids	3.8	1.4
Multiple Gestation	2.5	0.3
Cesarean Section	53.3	39.3
Congenital Anomaly	8.8	4.7
Small for Gestational Age	11.9	12.5
APGAR at 1 minute <4	10.5	17.4
Admission Temperature <36° C	3.7	4.2
Any Initial Resuscitation	51.2	53.9
Maternal Infection (Chorioamnionitis)	6.1	15.3
Maternal Hypertension	25.9	12.7

Ref: Vermont Oxford Network Database Summary for Infants Born in 2024. Burlington, VT: Vermont Oxford Network; 2025

Term Neonatal NICU Admissions

How many term infants are transferred to NICUs?

	37-41 weeks		>41 weeks	
	Infants (%) N= 108056	Centers Median (Q1, Q3)	Infants (%) N= 394	Centers Median (Q1, Q3)
Inborn	81.4%	93.0 (79.8, 98.5)	69.3%	100 (20, 100)

Ref: Vermont Oxford Network Database Summary for Infants Born in 2024. Burlington, VT: Vermont Oxford Network; 2025

Term Neonatal NICU Admissions

Procedures and Interventions

	Gestational Age – Weeks (%)	
	37-39	>39
Surfactant	5.1	4.1
Caffeine	1.1	0.6
Inhaled Nitric Oxide	1.8	2.5
Any Major Surgery	4.4	2.5

Ref: Vermont Oxford Network Database Summary for Infants Born in 2024. Burlington, VT: Vermont Oxford Network; 2025

Term Neonatal NICU Admissions

Procedures and Interventions

	37-41 Weeks' Gestational Age	
	Infants (%)	Centers Median (Q1, Q3)
Any Mechanical Ventilation	10.9	7.9 (4.5, 13.0)
Duration < 4 Hours	1.7	1.1 (0.0, 2.4)
Duration 4-24 Hours	3.0	2.4 (0.9, 4.1)
Duration 2-3 Days	2.2	1.3 (0.0, 2.7)
Duration 4-7 Days	2.0	0.9 (0.0, 2.4)
Duration 8-14 Days	0.9	0.0 (0.0, 0.7)
Duration >14 Days	0.3	0.0 (0.0, 0.0)

Ref: Vermont Oxford Network Database Summary for Infants Born in 2024. Burlington, VT: Vermont Oxford Network; 2025

Term Neonatal NICU Admissions

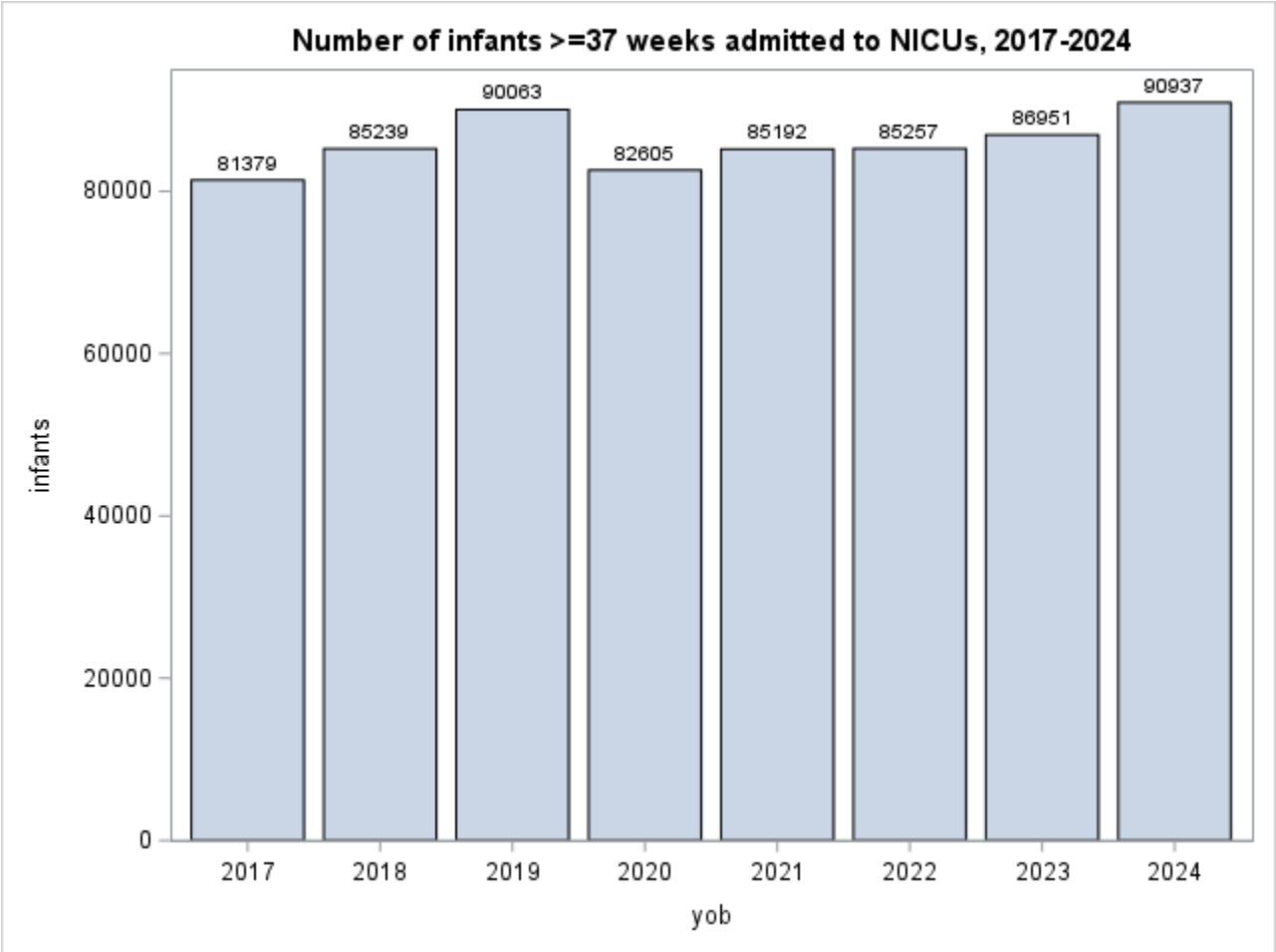
Outcomes among term infants admitted

	37-41 Weeks' Gestational Age	
	Infants (%)	Centers Median (Q1, Q3)
Mortality	1.1	0.6 (0.0, 1.5)
Any Late Infection	0.6	0.0 (0.0, 0.7)
Pneumothorax	4.0	3.2 (1.2, 5.2)
Hypoxic Ischemic Encephalopathy	3.0	2.2 (0.7, 4.2)
Seizure	2.1	1.6 (0.5, 3.2)
Meconium Aspiration	2.9	2.4 (1.0, 4.4)
Periventricular-Intraventricular Hemorrhage (Grade 1-4)	6.6	2.8 (0.0, 9.1)

Ref: Vermont Oxford Network Database Summary for Infants Born in 2024. Burlington, VT: Vermont Oxford Network; 2025

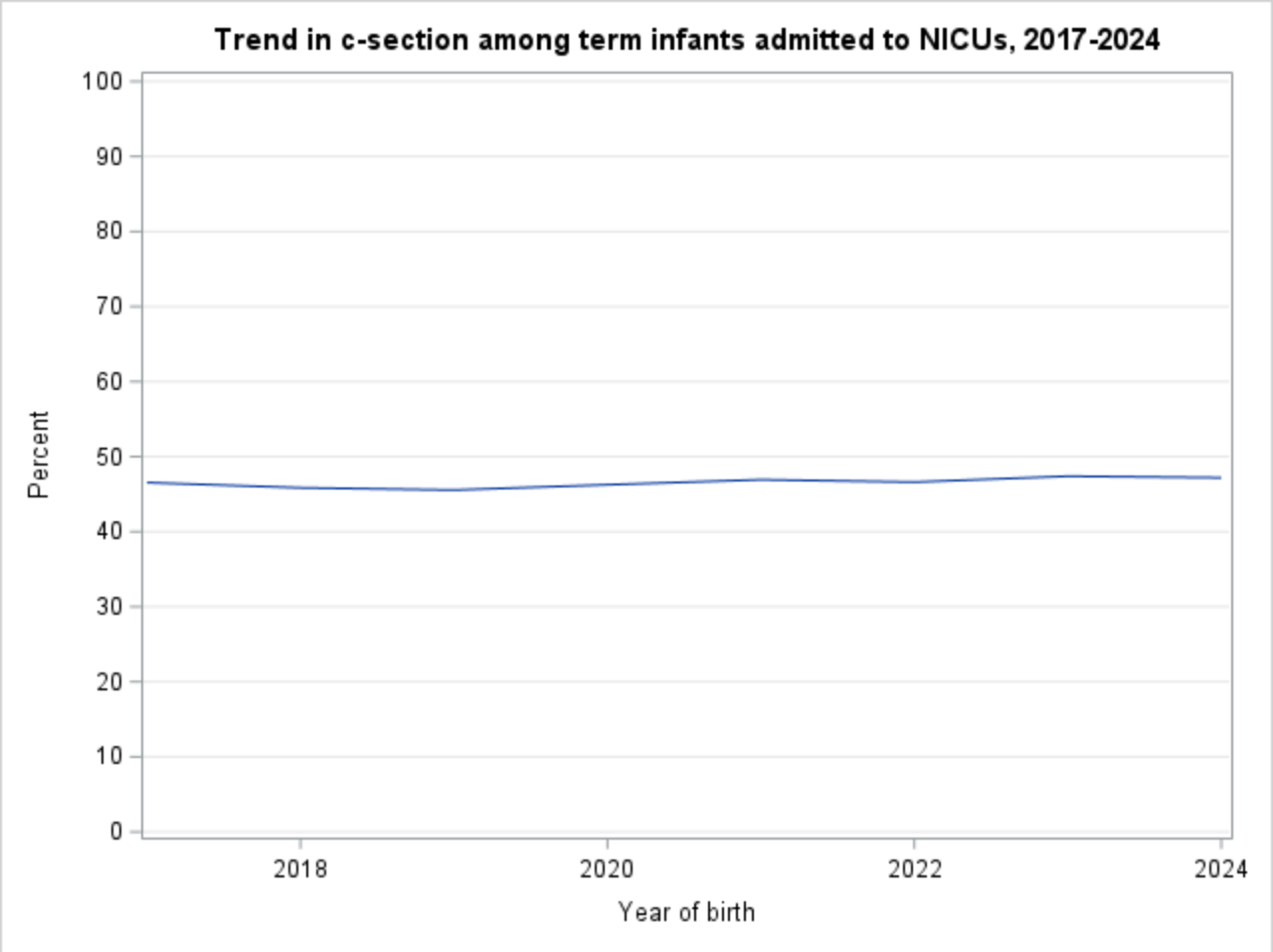
Term Neonatal NICU Admissions

Has the landscape changed over time in the US?



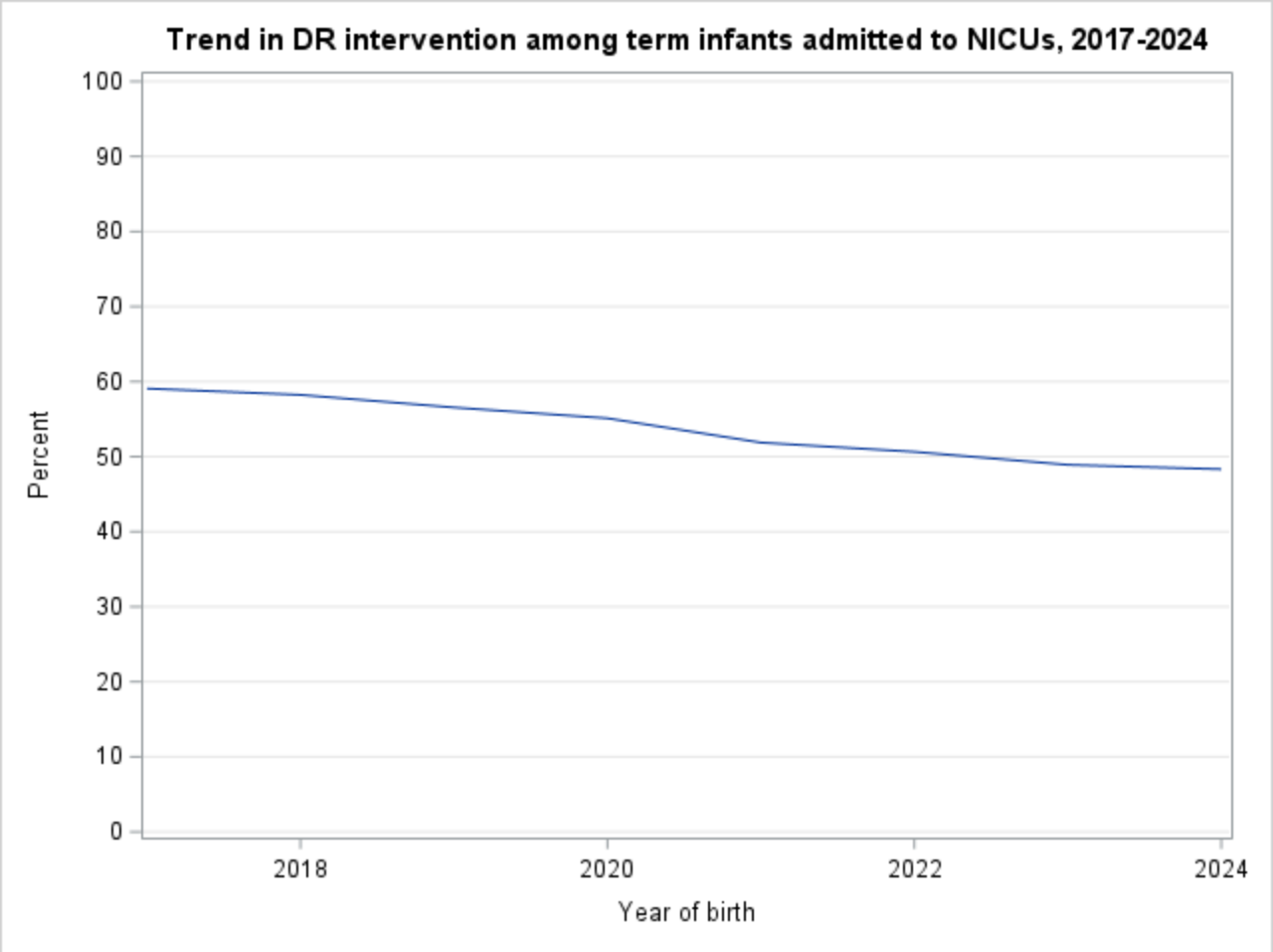
Term Neonatal NICU Admissions

Has the landscape changed over time in the US?



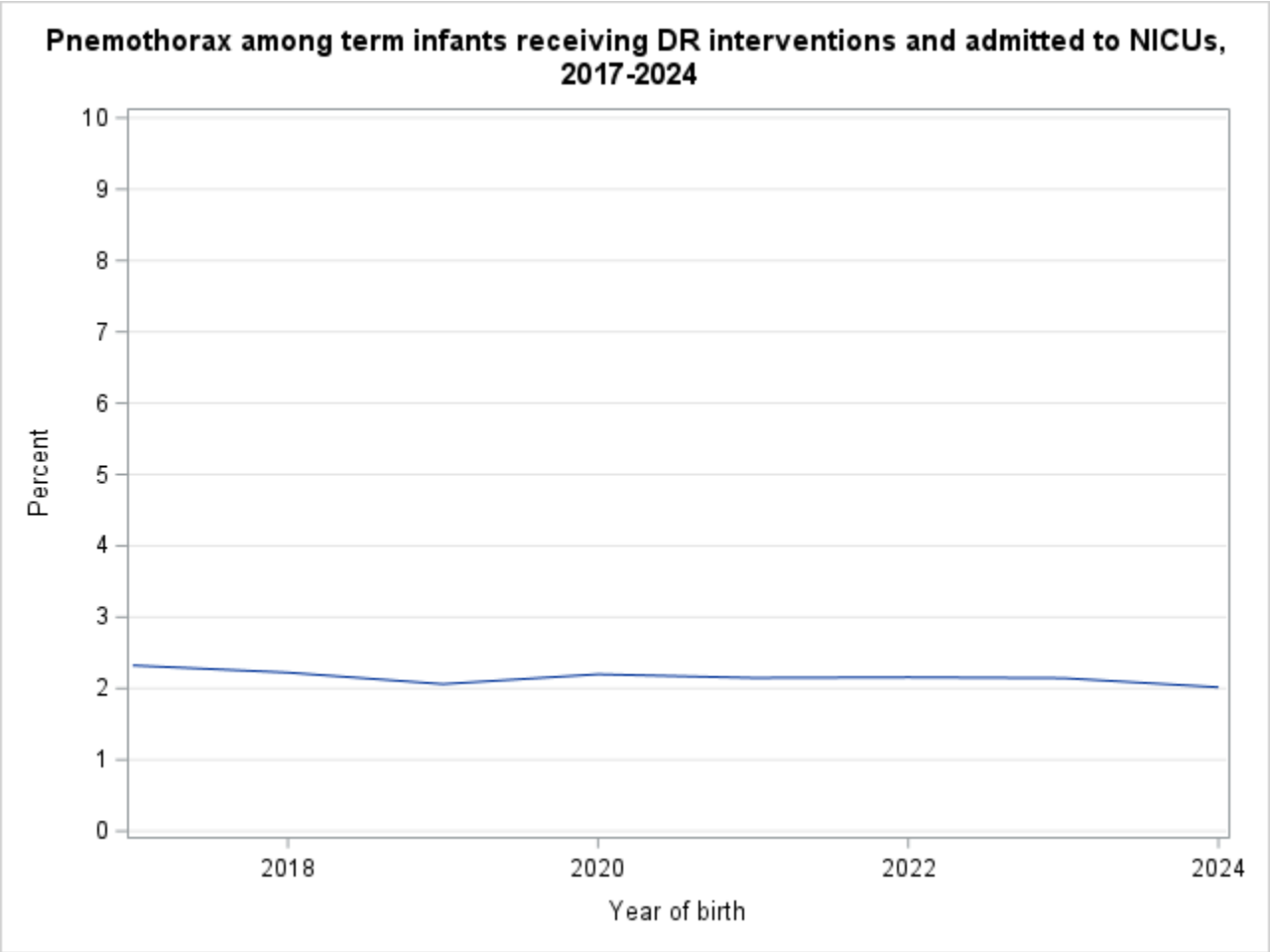
Term Neonatal NICU Admissions

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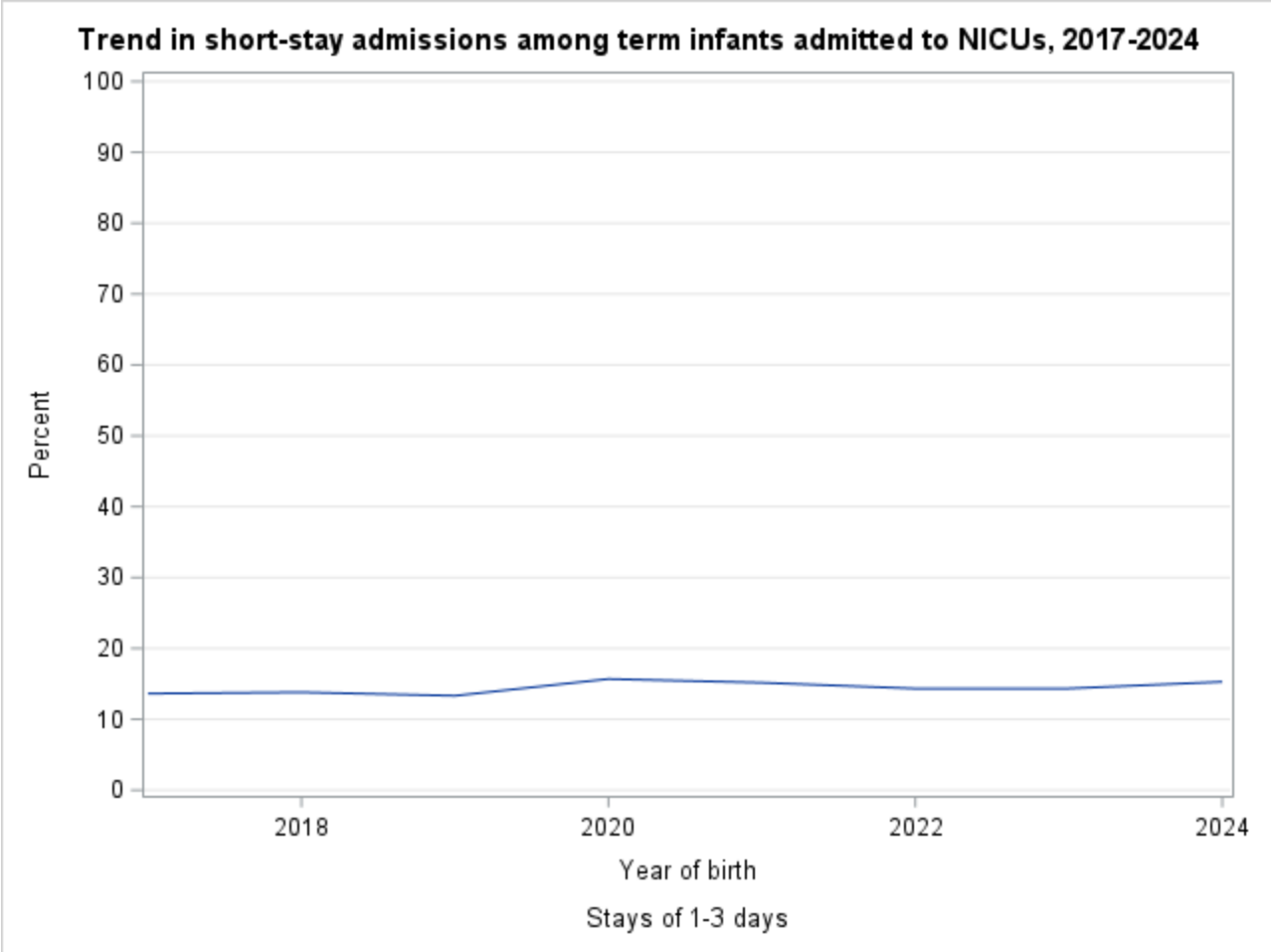
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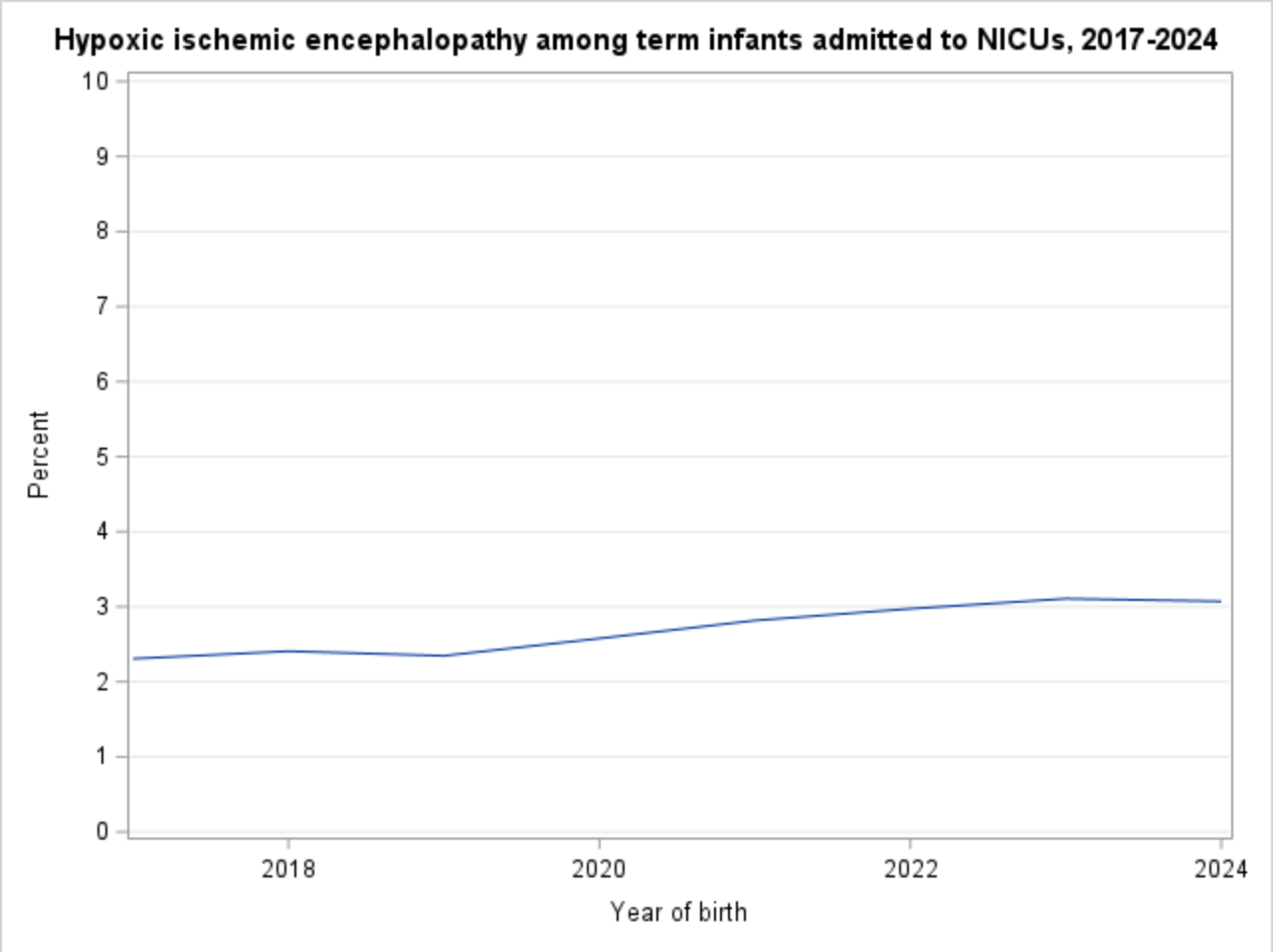
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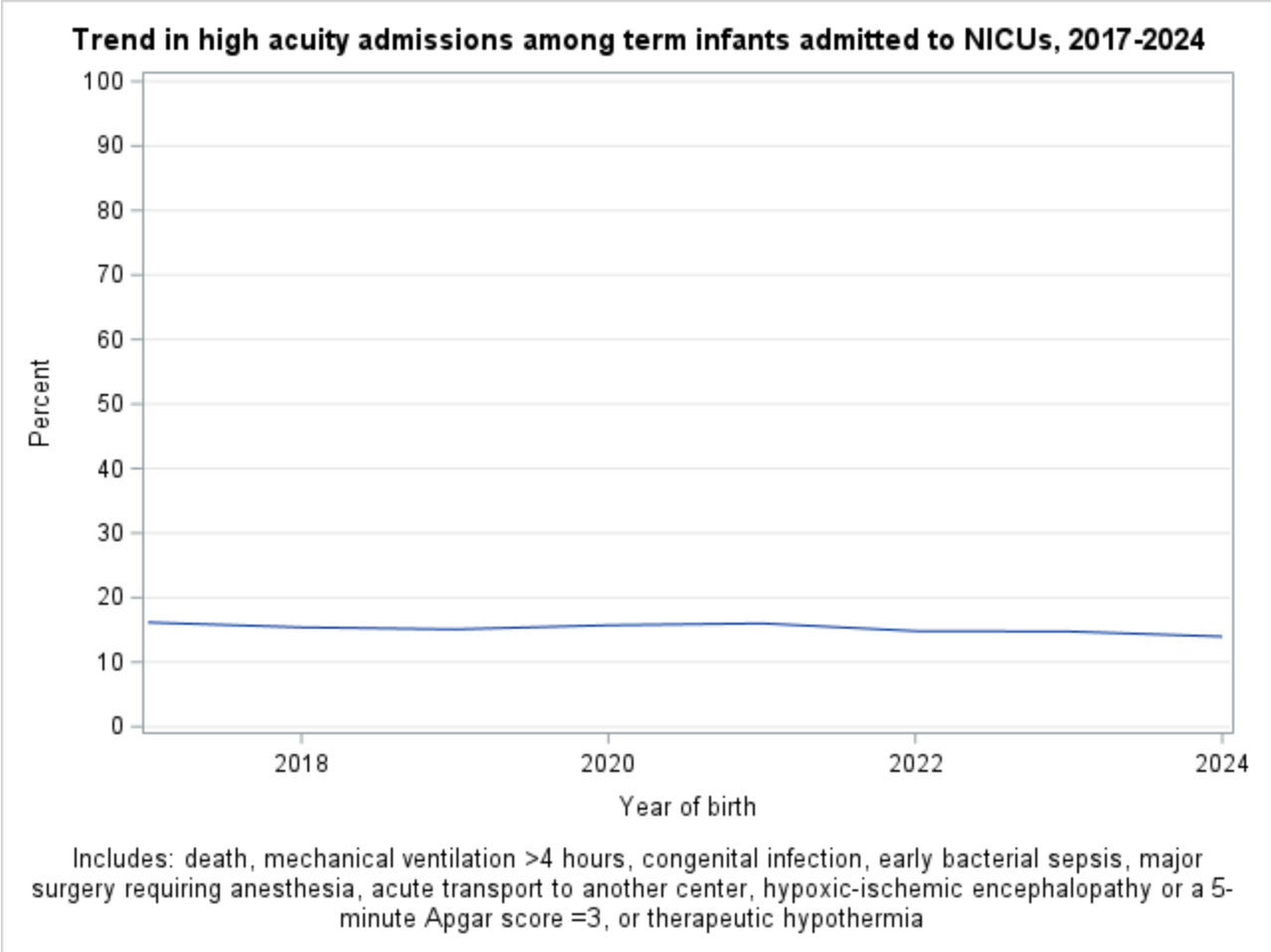
Term Neonatal NICU Admissions

Has the landscape changed over time in the US?



Term Neonatal NICU Admissions

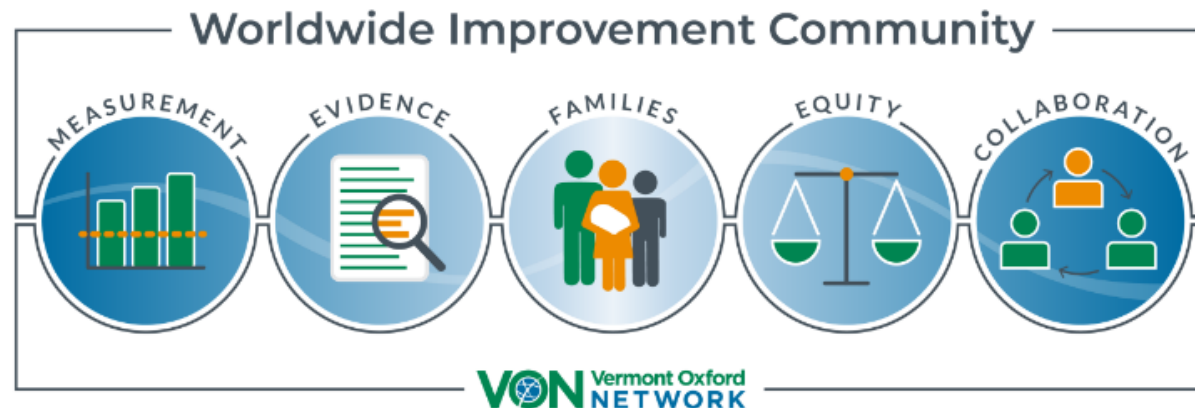
Has the landscape changed over time in the US?



QI Initiatives to Decrease PC-06

Improving Care Based on the Measure

- Communication
- Teamwork
- Multi-Disciplinary Delivery Room Resuscitation
- Standardization



Teamwork Communication Standardization

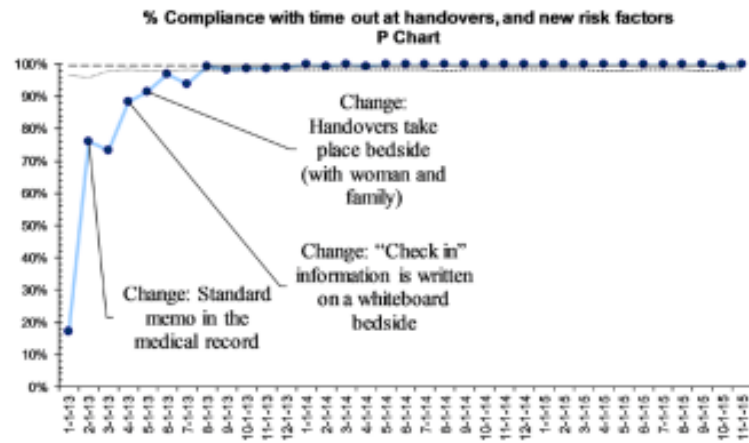
Successfully reducing newborn asphyxia in the labour unit in a large academic medical centre: a quality improvement project using statistical process control

Rikke von Benzon Hollesen,¹ Rie Laurine Rosenthal Johansen,¹
Christina Rørbye,² Louise Munk,² Pierre Barker,³
Anette Kjaerbye-Thygesen²

Hollesen RvB, et al. *BMJ Qual Saf* 2018;**27**:633–642. doi:10.1136/bmjqs-2017-006599

- Stakeholders: Regions of country, Society of OBGYN, Association of Midwives, Pediatric Society, Society for Patient Safety, Patient Compensation Association
- Development of perinatal clinical care bundles and measurement strategies
- Change concepts and change idea themes-
 - Listening to patients
 - Standardization

Teamwork Communication Standardization Improvement!



Hollesen RvB, et al. *BMJ Qual Saf* 2018;27:633–642. doi:10.1136/bmjqs-2017-006599

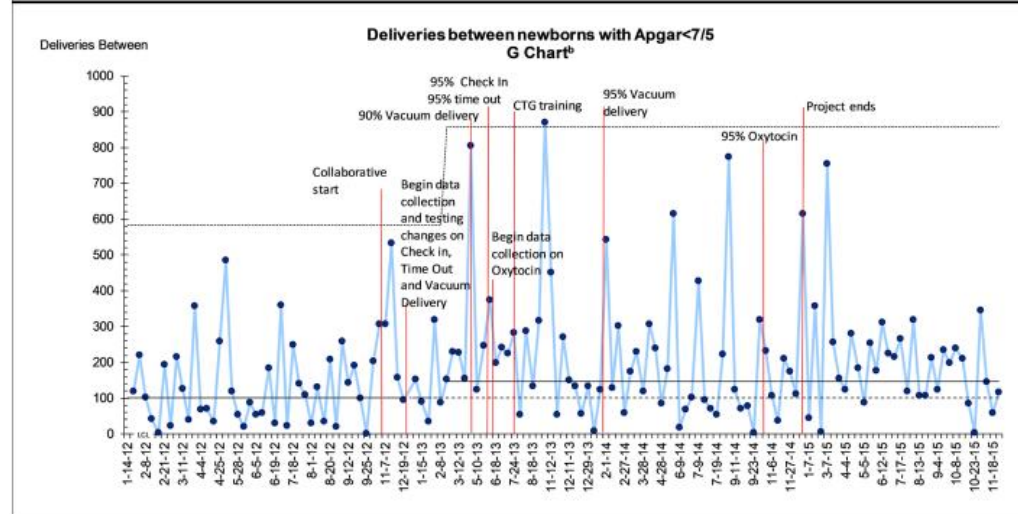
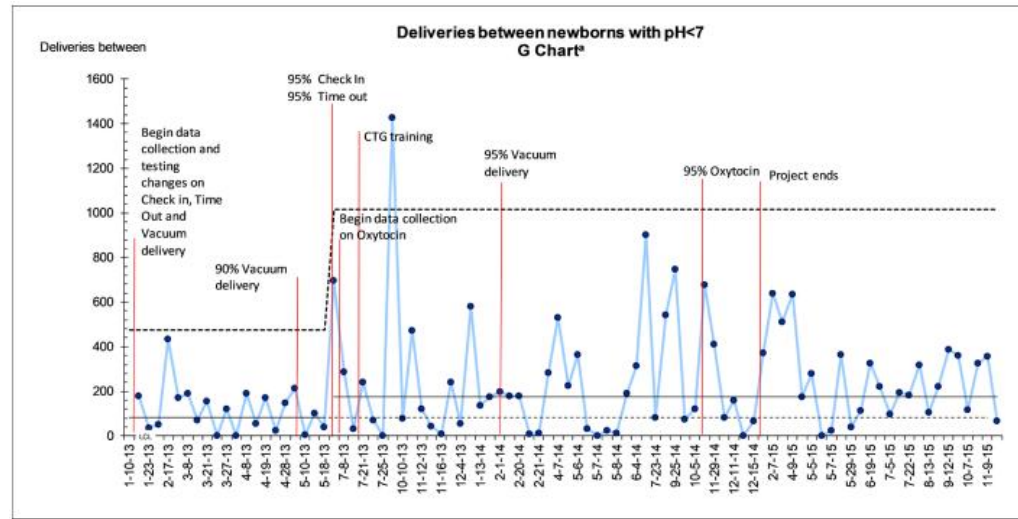


Figure 2 Outcome measures of asphyxia. Each point represents a newborn with asphyxia and the number of deliveries since previous asphyxia event. (A) Baseline is based on data from January 2013 to May 2013. (B) Baseline is based on historic data from January 2012 to December 2012. (...) shows the upper control limit, (—) shows the theoretical median, and (---) shows the extended baseline median.

Thank you!

Dehret@vtoxford.org

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NETWORK



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Center for Discovery, Innovation and Clinical Impact

CMQCC
California Maternal
Quality Care Collaborative

Unexpected Newborn Complications

The Joint Commission PC-6

Elliott K. Main, MD

Clinical Professor, Maternal-Fetal Medicine
Department of Obstetrics and Gynecology
Stanford University

Outline

- Term Baby Measures
- Unexpected Newborn Complications (UNC)
- QI Projects with UNC
- Effects of Cesarean reduction initiatives on neonatal outcomes

Dr. Main has no disclosure or conflicts

What is the Most Important Pregnancy Outcome for Mothers and their Families?



“A Good ‘Take-Home’ Baby...”

Avoiding Cesarean or Episiotomy
or moderate Maternal Morbidities
are clearly secondary...

If Baby Outcomes Are So Important, Why Were We Not Measuring Them?

Some of the historical issues...

- Which babies?
- What outcomes?
- Low rates of poor outcomes
- Which of the poor outcomes are related to care?



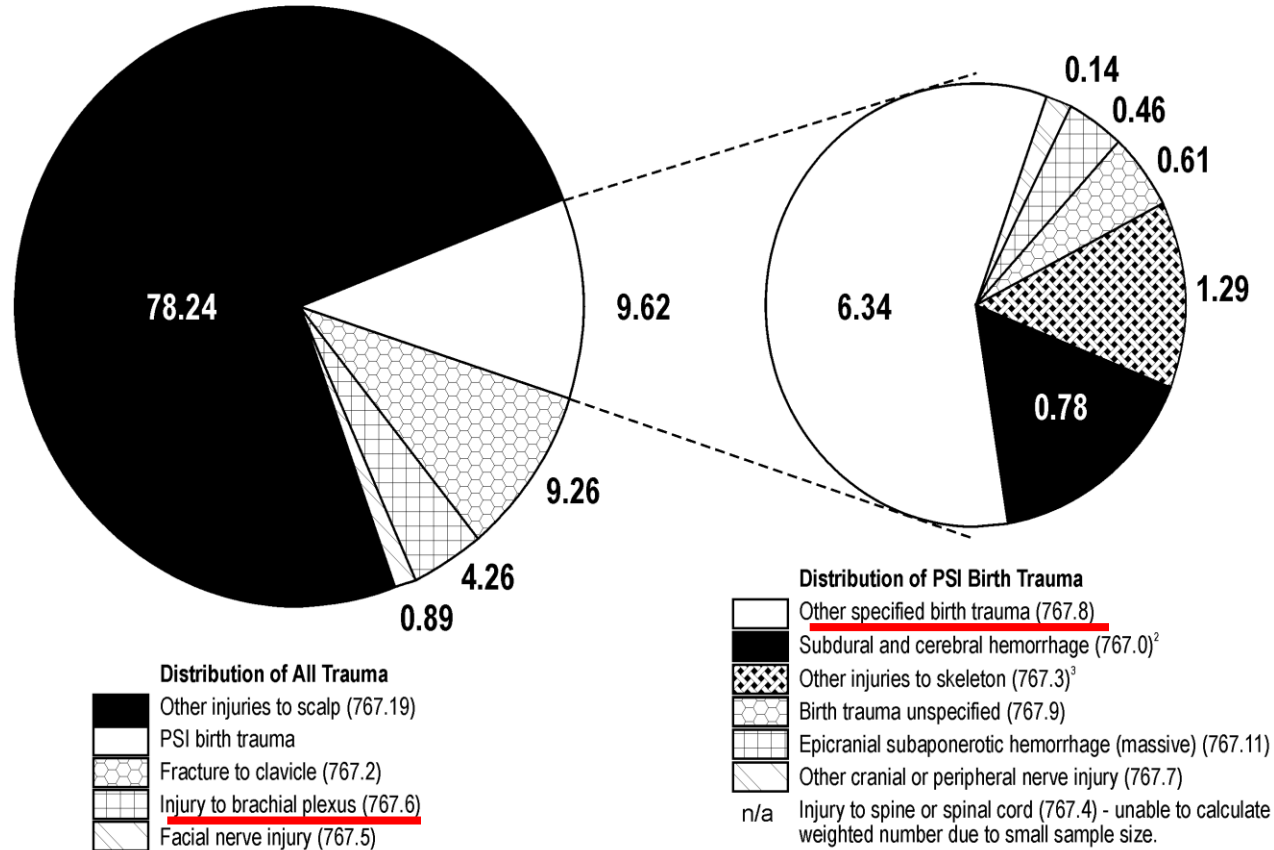
Survey of Prior Attempts to Measure Term Baby Outcomes

- AHRQ PSI 17: Birth Trauma Rate (injury to the infant)
- Rate of Term Baby NICU admissions (or Term baby NICU LOS)
 - NICUs vary in their admission criteria, even internally by shift or census or intermediate care nursery
 - Observation versus Confirmed Diagnoses
 - NICU Admission is not an ICD code (BC is terrible!)



AHRQ PSI 17: Birth Trauma

Figure 1. Distribution of all neonatal birth trauma and birth trauma considered to be a Patient Safety Indicator by AHRQ, 2004-2005¹.



Rates (per 1,000)

All Trauma: 25.9
PSI 17: 2.45

CS v. Vag (OR)

All Trauma: 0.55
PSI 17: 1.71

¹Denominator is total singleton live births with neonatal birth trauma in 2004-2005. However, percentages total 102.27 because some neonates had more than one type of neonatal birth trauma.

²Excluding infants weighing <2500g or EGA earlier than 37 weeks when using AHRQ guidelines for PSA #17

³Excluding infants with diagnosis Osteogenesis Imperfecta when using AHRQ guidelines.

AHRQ PSI 17: Birth Trauma

■ Critique:

- Small subset of all birth traumas (excludes brachial or facial nerve injuries)
- Very low rate: 2 per thousand births
- Dominated by non-specific codes (“Other...”)
- Easy to “show improvement” by adjusting coding practices for “Other birth trauma”
- Narrow view of birth outcomes...
- Not NQF endorsed

■ But it is easy to calculate!



Big Babies Are The Norm in Most NICUs

- Nationally, >50% of Level III/IV NICU admissions were >2,500g BWt and increasingly likely to be full term.
(Harrison W, Goodman D. JAMA Pediatr 2015;169:855-862)
- California Study of 130 NICUs/ 358,453 live births at GA of ≥ 34 weeks (Schulman J, etal. JAMA Pediatr 2018;172:17-23)
 - 35,921 infants were admitted to a NICU
 - Accounted for 79.2% of all inborn NICU admissions
 - Only 4,260 (11.9%) of these admissions met high acuity criteria
 - The proportion of infants admitted with high acuity conditions varied 40-fold: hospitals vary greatly how they handled respiratory transition issues, hypoglycemia, and r/o sepsis



High Acuity Conditions

1. Death,
2. Intubated or non-intubated assisted ventilation for 4 hours or more,
3. Early bacterial sepsis,
4. Major surgery requiring anesthesia,
5. Acute transport to another NICU,
6. Suspected encephalopathy or suspected perinatal asphyxia,
7. Active therapeutic hypothermia.



Unexpected Newborn Complications: The Joint Commission Measure (PC-06)



Acknowledgements

- Jeffrey Gould MD MPH
 - PI CPQCC and CMQCC, Neonatology
- Henry Lee, MD
 - Medical Director, CPQCC, Neonatology
- Shen-Chih Chang, PhD
 - Data Analyst, CMQCC
- Anisha Abreo, MPH
 - Data Analyst, CMQCC

The participants have no conflicts of interest or disclosures to report.



Which Babies?

- All Babies versus Term Babies?
 - Preterm infants have a wide range of outcomes related to gestational age, birth weight--Not a homogeneous group
 - Rates of prematurity and congenital malformations vary greatly among hospitals
 - Important principle: Some populations (e.g. premies and malformations) are not **expected** to have perfect outcomes
 - Preterm births are the focus of VON efforts



Our Goal: A Quality Measure of Term Baby Outcomes that can Reflect Both Maternal and Neonatal Care

- Risk Stratified vs. Risk Adjusted
- Low-risk Population vs Entire Population
- Easy to Collect



Unexpected Newborn Complications (PC-06) (Term neonatal composite outcome measure)

This measure simply asks:

Among babies without preexisting conditions:

No preemies, multiple gestations, birth defects or other fetal conditions; and who are normally grown and were not exposed to maternal drug use,

How many had severe or moderate neonatal complications?



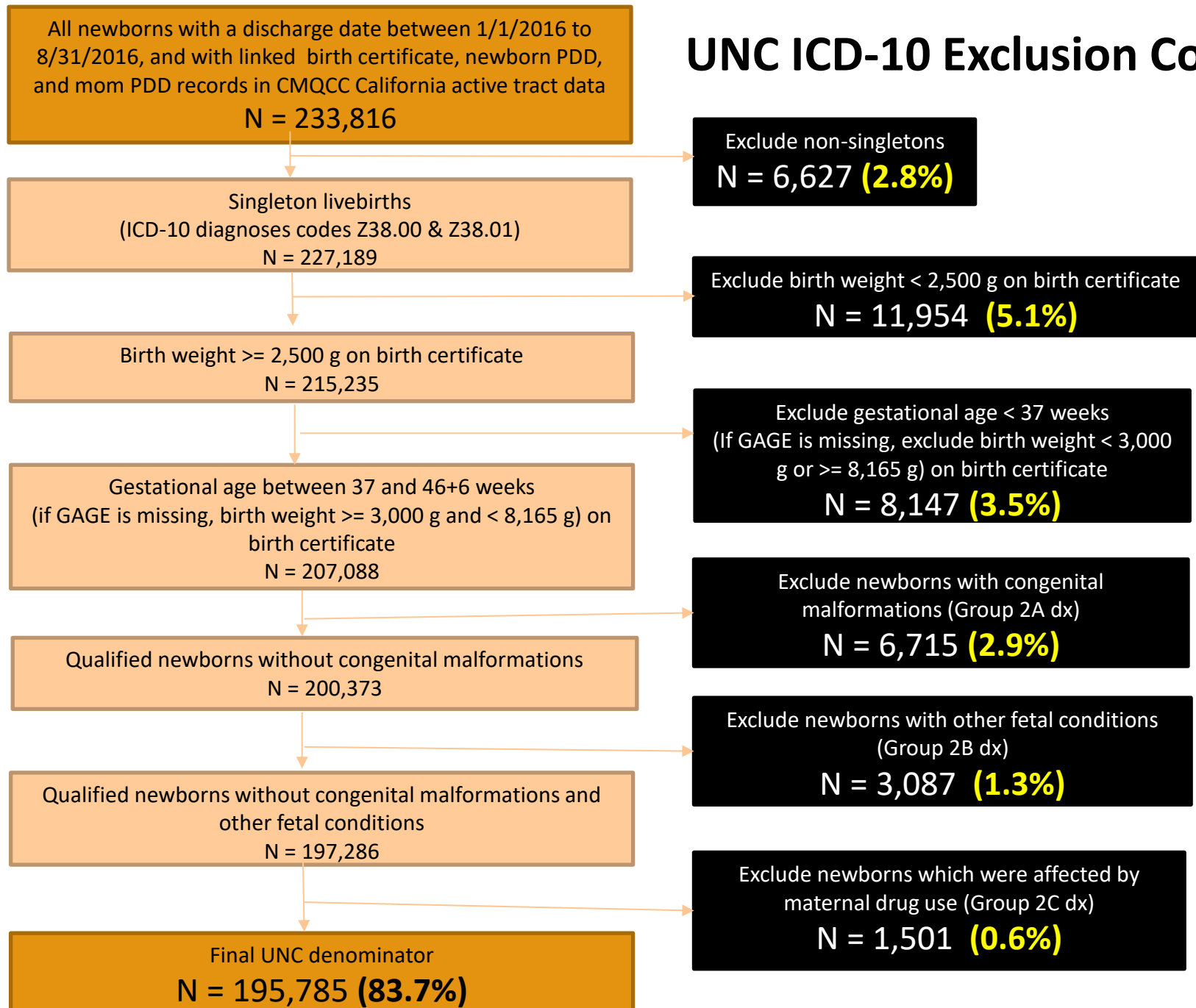
“A Good ‘Take-Home’ Baby...”

UNC Denominator: Inclusions / Exclusions

- Include: Singleton live births (ICD10)
- BWt ≥ 2.5 kg and GA ≥ 37 weeks
 - for PC-06, using ICD-10 codes for preterm and SGA
- Exclusions (ICD-10)-“Pre-existing Conditions”:
 - Congenital malformations (most Q codes)
 - Congenital disorders (from E and G codes)
 - Fetal-placental Conditions, Infections, IUGR, Hydrops, Rh sensitization (from A and P codes)
 - Maternal Drug Use and withdrawal symptoms (from P codes)



Flow Chart for Exclusions



Complications are Categorized from the Viewpoint of the Family:

Frame 1 (Severe): “Would I be fearful of my baby’s survival or long term outcome if my baby had...”

Frame 2 (Moderate): “Would I be upset if my baby had....”

Note that the concept of preventability is not used.



The Devil is ALWAYS in the Details...

- Use administrative data to minimize data burden
 - Allows for 100% survey--no sampling
- Provide safeguards for over-coding and under-coding
- Separate out Severe from Moderate complications
 - Important for Face Validity
- Identify diagnosis categories (“buckets”)
 - To understand the areas for improvement and facilitate QI projects



UNC: Coding Strategies-1

- After examining coding practices in over 300 hospitals, “variable coding styles” appeared:
- **Over-coding** Protection:
 - Sepsis vs. “R/O Sepsis”—Added a requirement for a prolonged newborn LOS: LOS >4 days
- **Under-coding** Protection:
 - Diagnoses are not always recorded (e.g. a systematic exclusion of hypoxia codes) however procedure codes are almost always coded as they tie to billing
 - Utilize both diagnosis and procedure codes for a “complication bucket” whenever appropriate (e.g nitric oxide, EEG, ventilator, ECMO)



UNC: Coding Strategies-2

■ **Over-coding** Protection:

- A number of moderate complication diagnoses required a longer LOS than usual to indicate that it was consequential—Added a requirement for a prolonged newborn LOS: LOS >4 days for a Cesarean and >2 days for a vaginal birth
- Examples: TTN, clavicle fracture, newborn affected by breech delivery

■ **Under-coding** Protection:

- Some cases had very few codes but very long LOS...suspicious for a morbidity
- Screened these cases first for neonatal jaundice, phototherapy, and a series of codes for social problems (e.g. homelessness, child welfare custody, residential institution)
- If none of these codes, these cases were considered moderate morbidity



Examples of “Severe UNC”

- Neurologic/Birth Injury
 - ICH, HIE, Asphyxia, Erb’s Paralysis, EEG
- Shock/Resuscitation
 - Arterial Line, CPR
- Respiratory
 - Pulm Hem, Vent, Chest tube, Nitric Oxide
- Infection
 - Septic shock, Sepsis with identified bacteria
- Transfer to higher level of care



Examples of “Moderate UNC”

- Neurologic/Birth Injury (with LOS requirement)
 - Fx. Clavicle, “affected by” forceps, CT or MRI
- Respiratory
 - CPAP, RDS, Pneumothorax
 - with LOS: TTP, Mec Aspiration
- Infection
 - Sepsis with identified bacteria but short LOS



Do Hospitals Caring for Higher Risk Mothers Have Higher Rates of UNC?

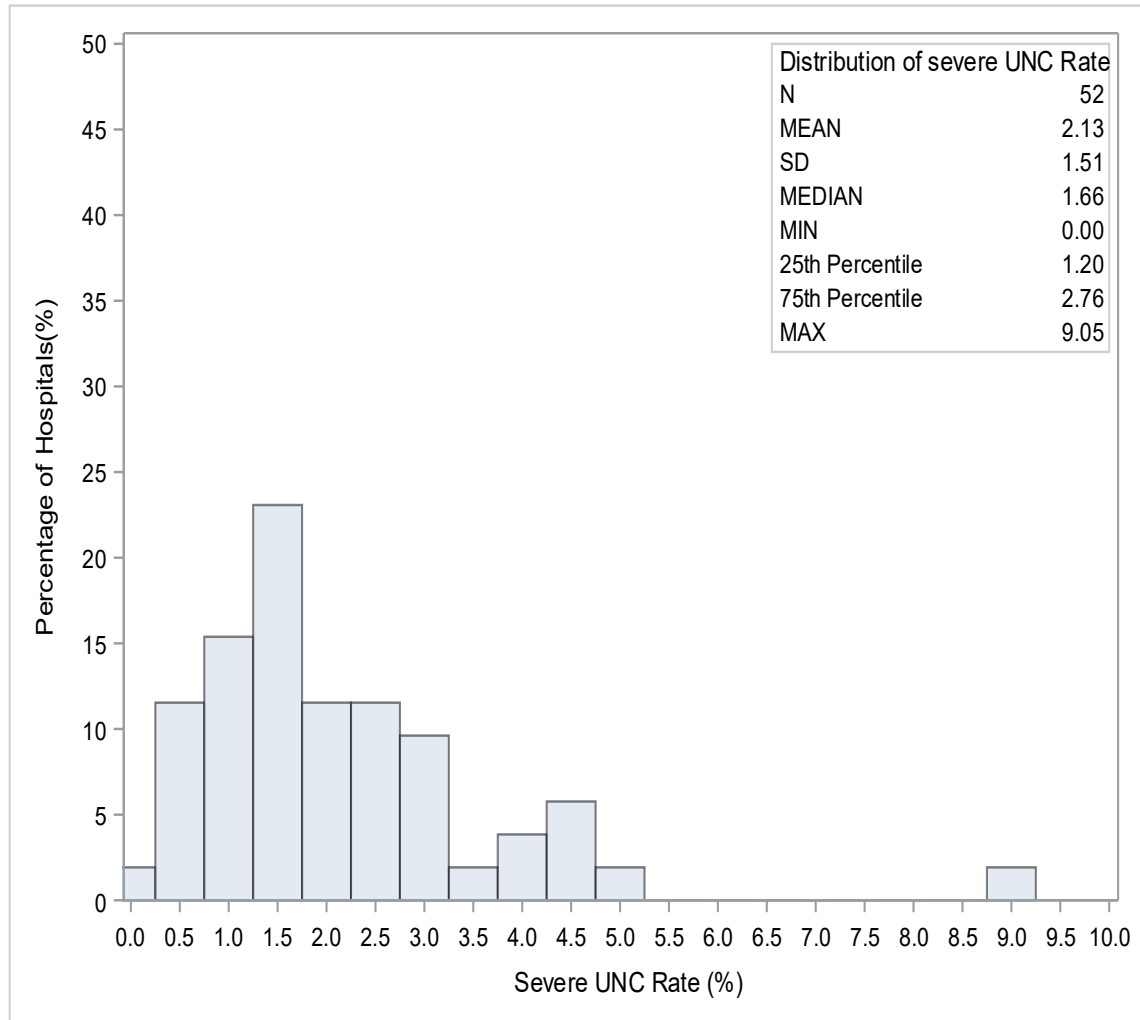
NICU Level (N)	Severe UNC	Total UNC
Level III-IV (117)	1.7%	3.0%
Level II (58)	2.4%	3.4%
Level I (74)	2.4%	3.0%
Critical Access (14)	2.5%	3.4%
University (6)	2.3%	4.6%

Mean rates among California hospitals

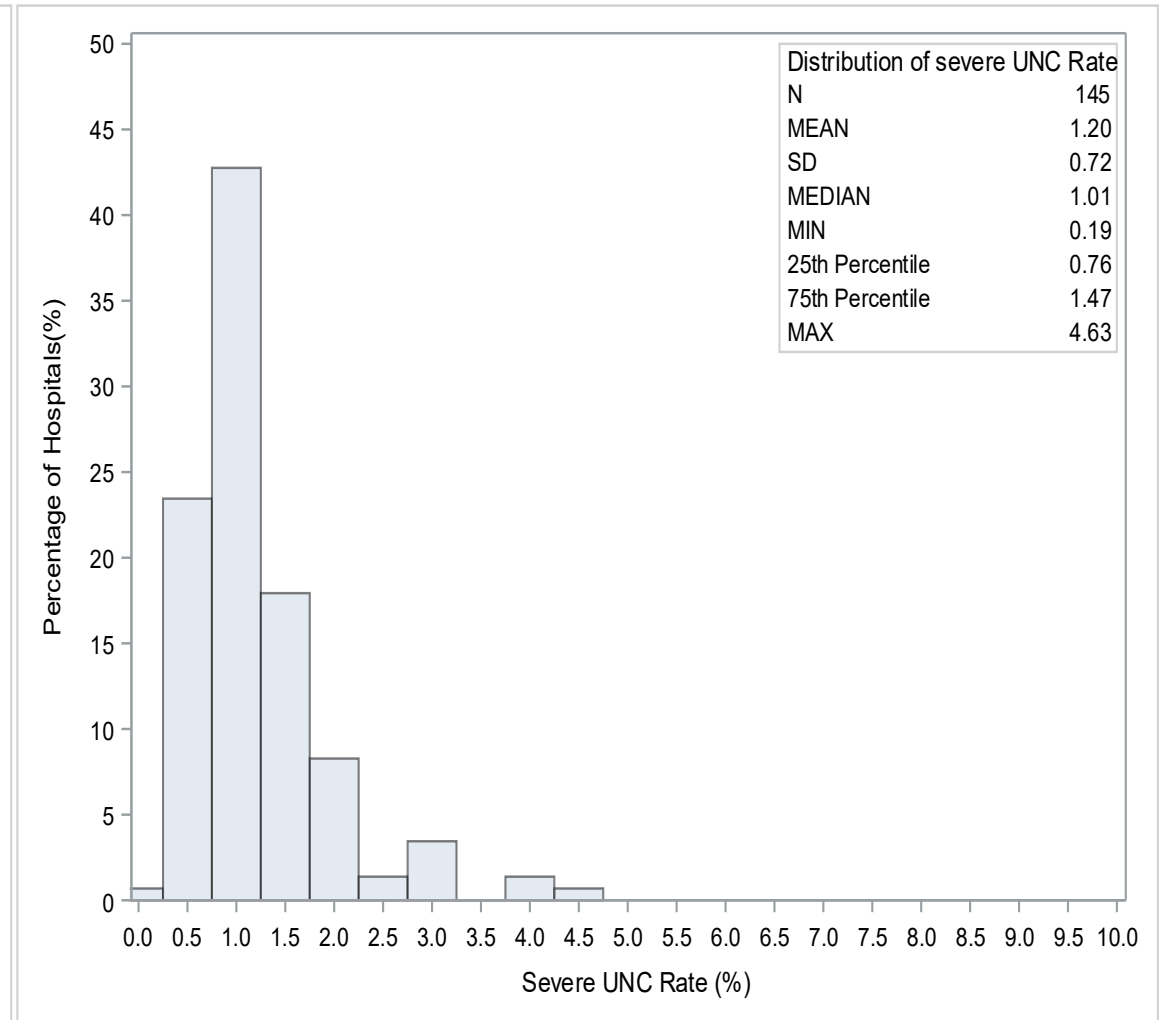


UNC rates in Percent or per 10,000?

Histogram of **severe UNC rate** in 197 California hospitals, 2022



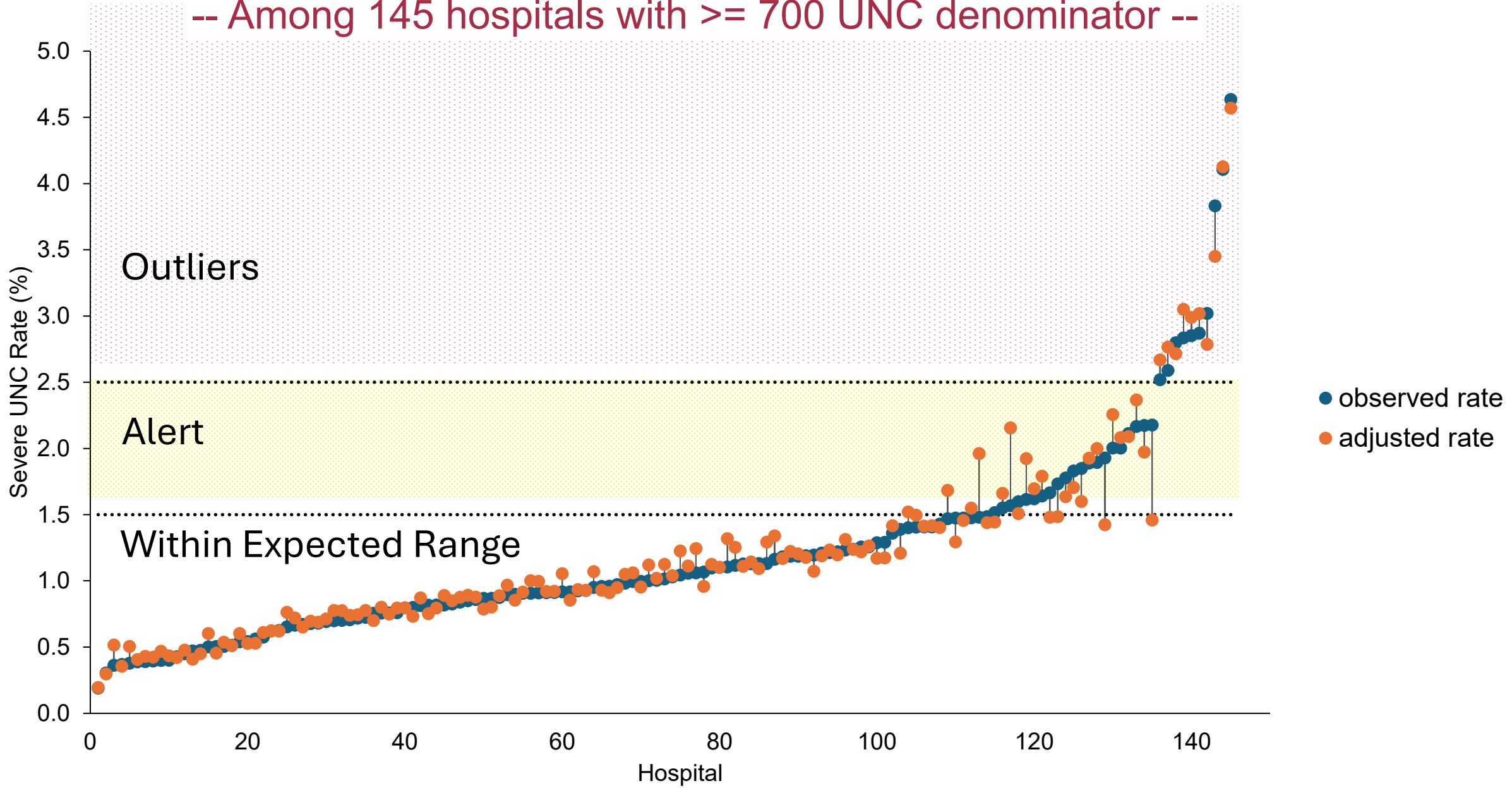
a) Among 52 hospitals with UNC denominator between 200 and 699



b) Among 145 hospitals with UNC denominator >=700

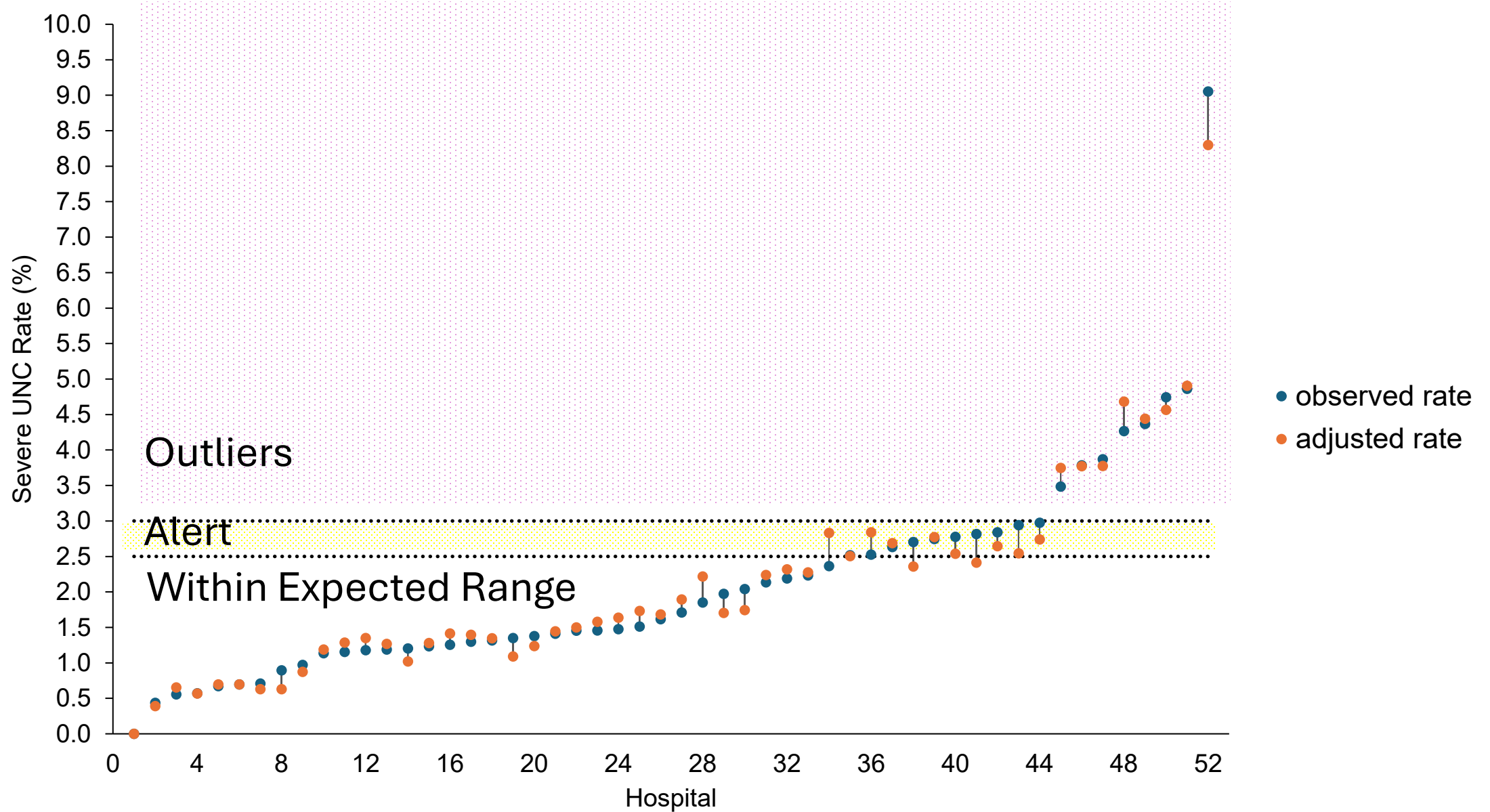
Observed and Risk-Adjusted Severe UNC Rate in 2022

-- Among 145 hospitals with ≥ 700 UNC denominator --



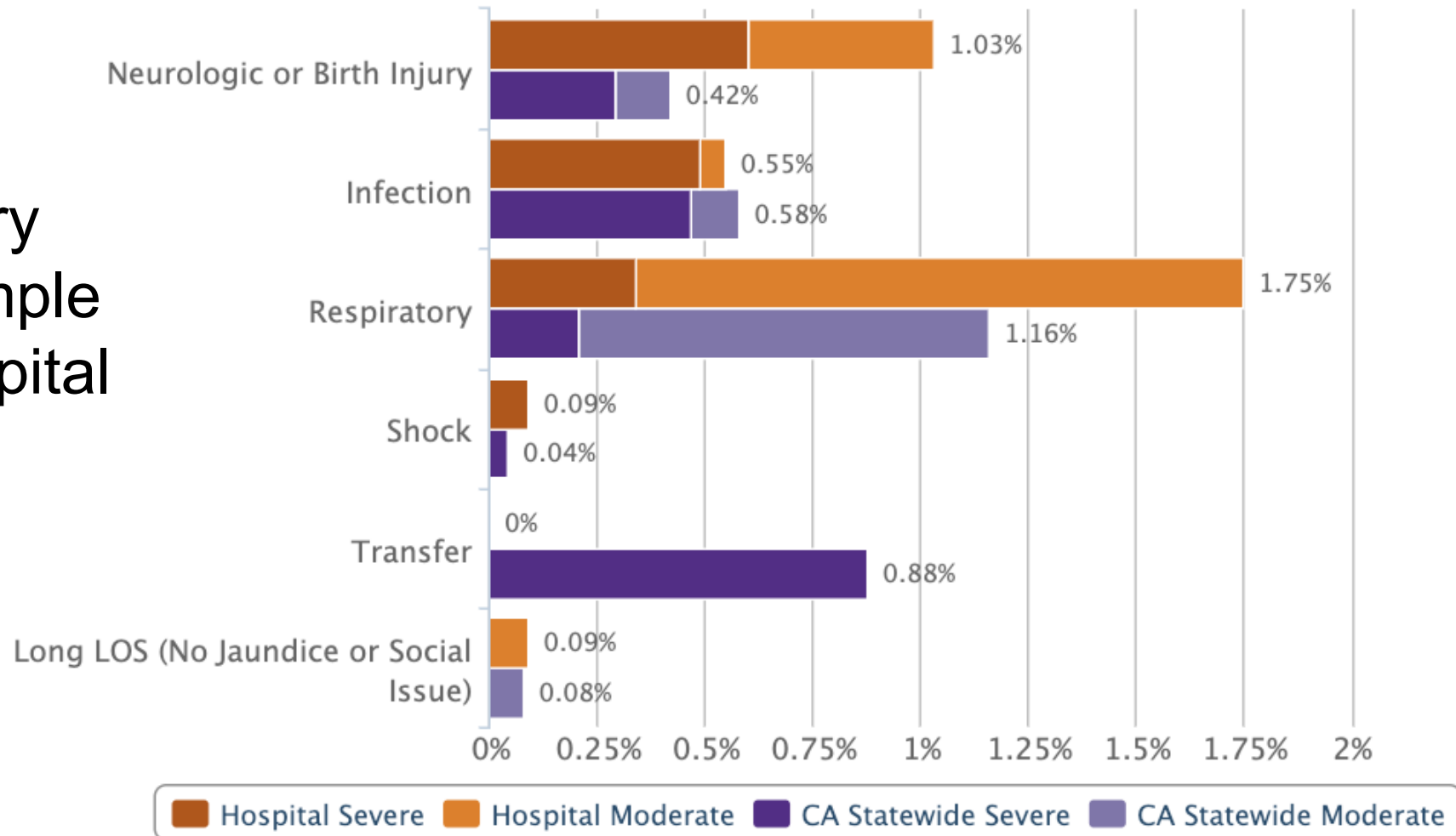
Observed and Risk-Adjusted Severe UNC Rate in 2022

Among 52 hospitals with UNC denominator b/t 200 and 699



UNC Analysis: What is Driving My Rate?

Percentage of all Term Newborns without preexisting conditions



UNC Category
Analysis : Example
University Hospital

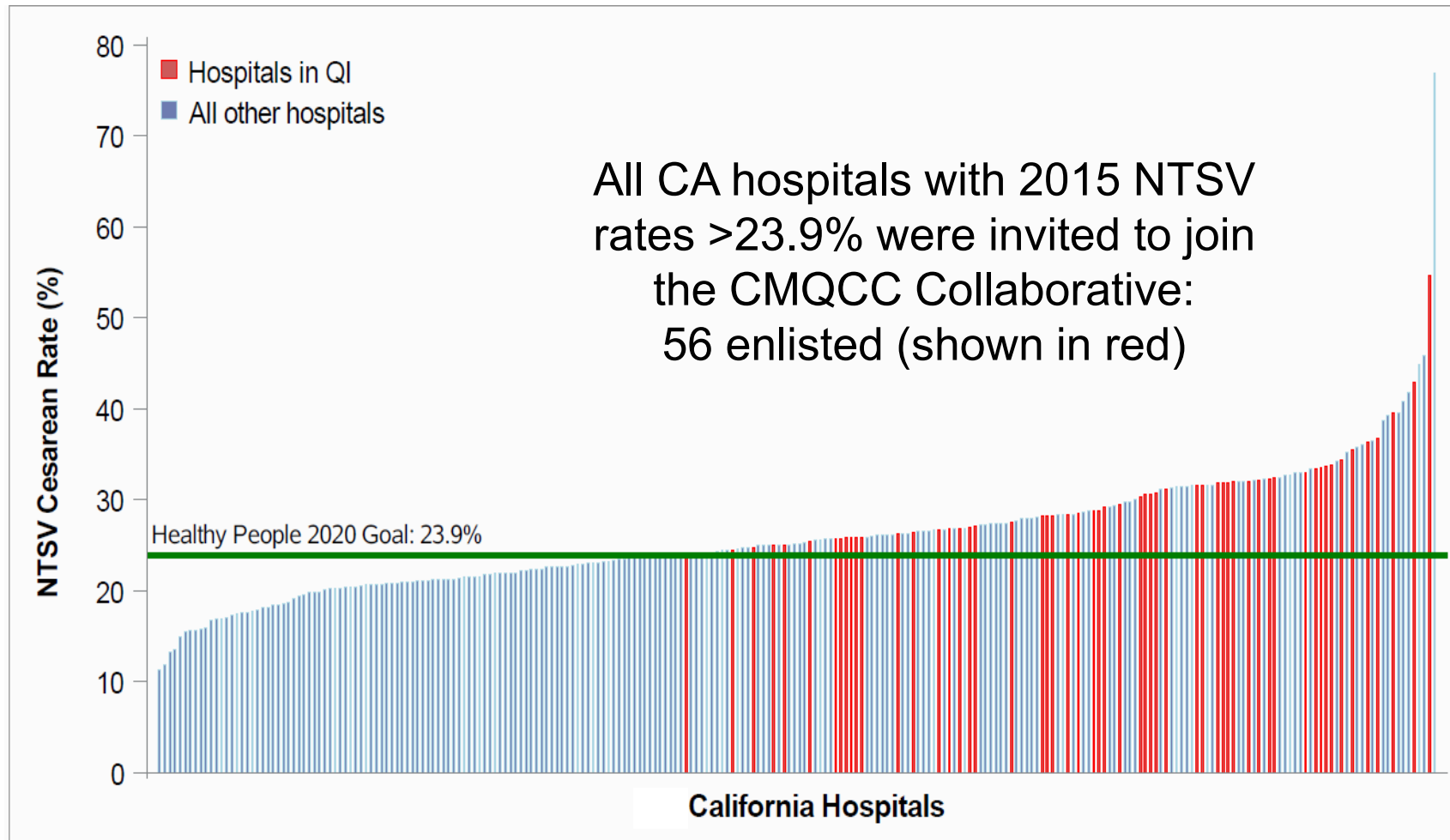


Examples of UNC QI Projects

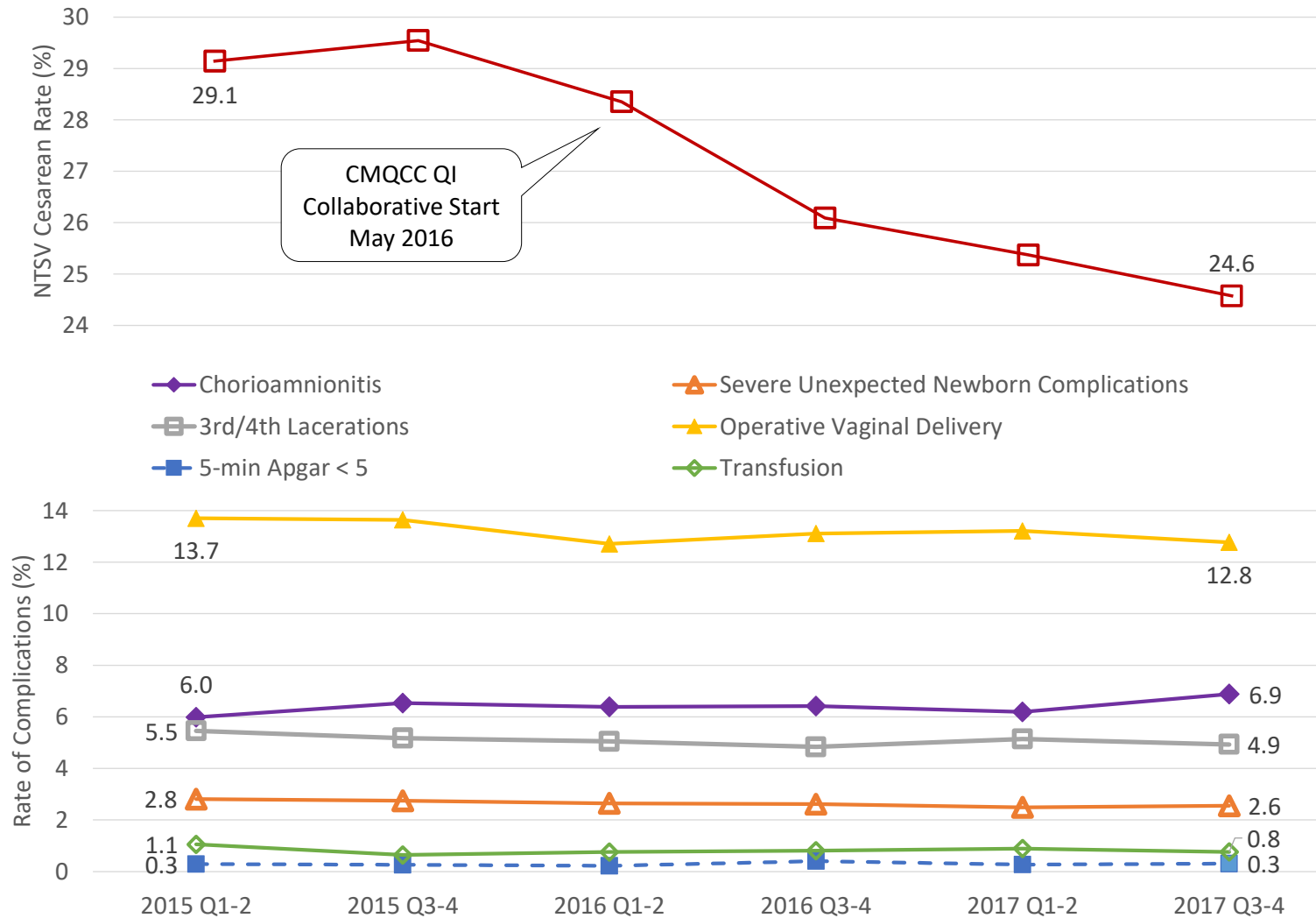
- Benchmarking for UNC categories leads to better understanding of where to work
- Revision of infection work-up protocols
- Improved L&D neonatal resuscitation protocols
- Second Stage Labor management protocols
- Education for forceps/vacuum best practices
- Respiratory morbidity due to elective early delivery
- Identification of cases for in-depth review
- Most important use is as balancing measure for OB intervention studies



Variation in NTSV Cesarean Rate among 243 CA Hospitals (2015)



Trendlines for NTSV Cesarean and Safety Measures Rates (6-month blocks)



Sensitivity Analysis

Hospitals with greatest decline in NTSV cesarean rate (N=19)

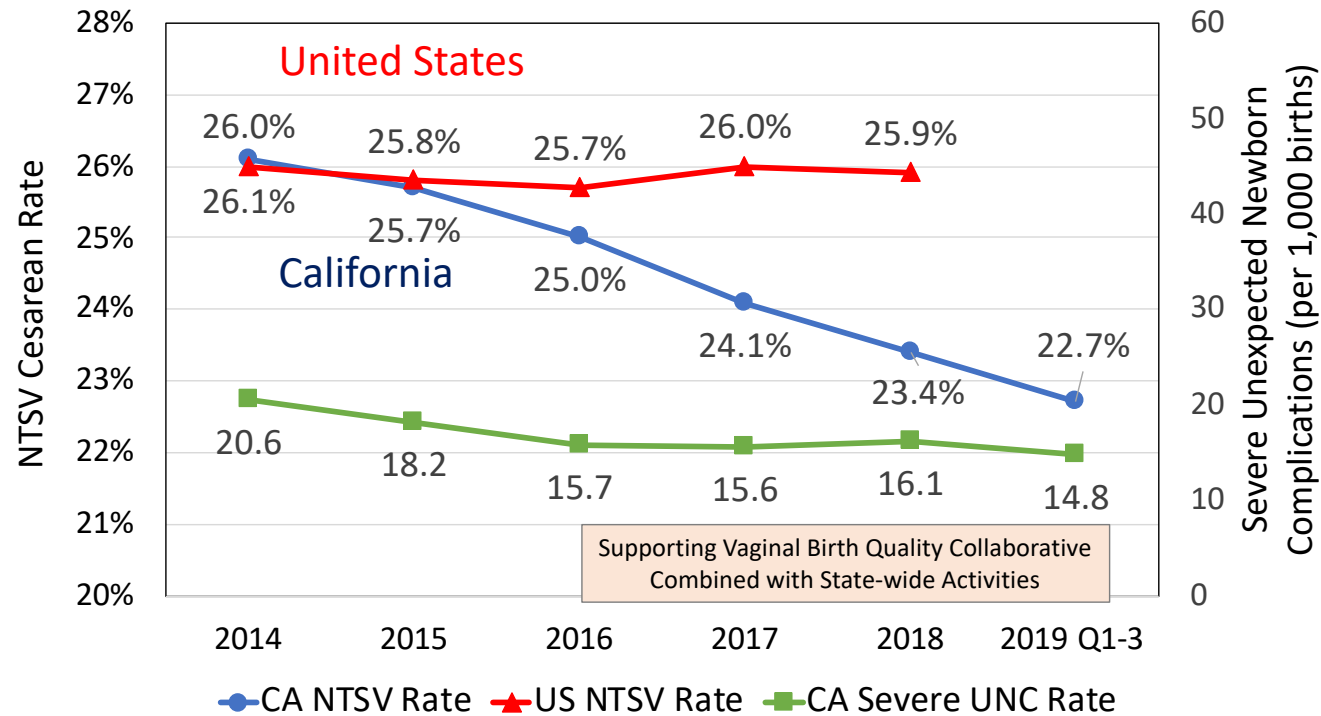
Top Tercile: Mean Hospital NTSV change: -10.9% points (range: -17.1 to -7.1)

Maternal and Neonatal Outcome Measures	2015 Rate N=8,666	2017 Rate N=7,982	unadjOR (95% CI)	adjOR* (95% CI)
NTSV Cesarean Rate	31.2%	20.6%	0.58 (0.54-0.62)	0.54 (0.50-0.58)
Chorioamnionitis	5.4%	4.9%	0.91 (0.79-1.04)	0.90 (0.78-1.04)
Transfusions	1.1%	1.1%	1.01 (0.75-1.35)	1.00 (0.74-1.35)
Severe Unexpected Newborn Complications	3.2%	2.2%	0.70 (0.55-0.89)	0.71 (0.55-0.92)
3rd/4th Lacerations among vaginal births	5.3%	4.9%	0.92 (0.78-1.08)	0.94 (0.79-1.11)
Operative Vaginal Delivery	14.4%	13.7%	0.94 (0.85-1.04)	0.95 (0.85-1.06)
5-minute Apgar Score < 5	0.33%	0.38%	1.12 (0.67-1.87)	1.16 (0.66-2.03)

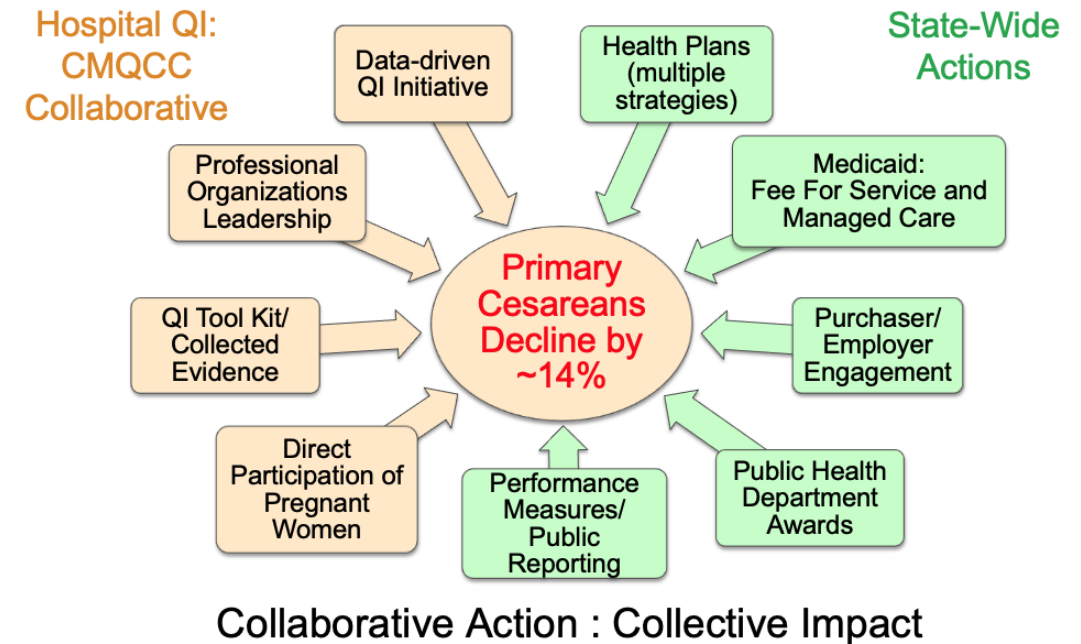
No Evidence For Concern

CMQCC Collaborative to Reduce Primary Cesarean Birth

First Birth Low-Risk (NTSV) Cesarean Rate



State-wide Initiative Activities



- Hospital level variation is dramatic for all OB metrics
- In 2014, hospital variation was extreme: 14% to 70%
- In 2020, variation still present but much more limited

Rosenstein MG, Chang S-C, Sakowski C, Markow C, Teleki S, Lang L, Logan J, Cape V, Main EK. Hospital Quality Improvement Interventions and Statewide Policy Initiatives and Rates of Nulliparous Term Singleton Vertex Cesarean Deliveries in California. JAMA 2021. Apr 27;325(16):1631-1639.

UNC Conclusions

- Reflects a patient/family viewpoint but also resonates with physicians
- Validated term baby outcome measure
- More variation than expected
- More improvement opportunities than expected
- Sensitive to both obstetric practice and neonatal care
- Able to drill-down and examine reasons for higher levels and for improvement opportunities
- Suitable for use as a balancing measure for Cesarean QI

Questions?

Please enter your questions in the Q&A box at the bottom of your screen.

Thank You!



Please send any questions to obgynsafety@acog.org



Advancing ob-gyn care for all.