

DEFINING AND IMPROVING VALUE IN PEDIATRIC AND NEONATAL CARE

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VP Research, MEDNAX

10/28/2018

Conflicts/FDA

- I have no conflicts of interested related to the talk.
- I will give examples of how off-label use of medications in the NICU is unsafe.

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Objectives

- Define the term health care value
- Explore problems with measuring value
- Discuss some of the measures of value
- Define 2 ways to improve value in health care

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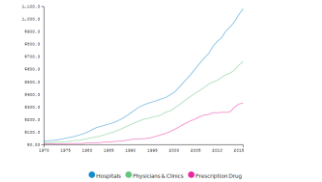
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The Peterson-Kaiser Health System Tracker
<http://www.healthsystemtracker.org/interactive/health-spending-explorer>
U.S. HEALTH EXPENDITURES 1970 - 2016

On Hospitals, Physicians & Clinics, Prescription Drug (U.S. \$ Billions)

U.S. \$ Billions

EMBED

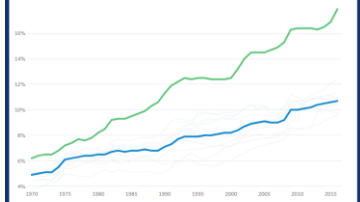


HOSPITALS, PHYSICIANS & CLINICS, PRESCRIPTION DRUG SPENDING BY ALL SOURCES OF FUNDS, 1970-2008

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Country comparison:

Total health expenditures as percent of GDP, 1970 - 2016



Excludes spending on structures, equipment, and accessories for medical research. Data on alcohol for the Netherlands in 1970 and 1971, Australia in 1970, Germany in 1980, and France from 1971 through 1974, 1976 through 1979, 1981 through 1984, and 1986 through 1989. These countries are 100% (2008) comparable averages for 1970-2016. Source: J. Hahn & J. C. Smith (2017) 'Designing Health Care and 2016 for the Netherlands'. Data for 2016 are estimated values. The 2016 US value was obtained from National Health Expenditure data.

Source: Kaiser Family Foundation analysis of data from OECD 2015, "OECD Health Data: Health expenditure and financing health expenditure indicators" (2015) <http://www.oecd.org/health/health-data/>

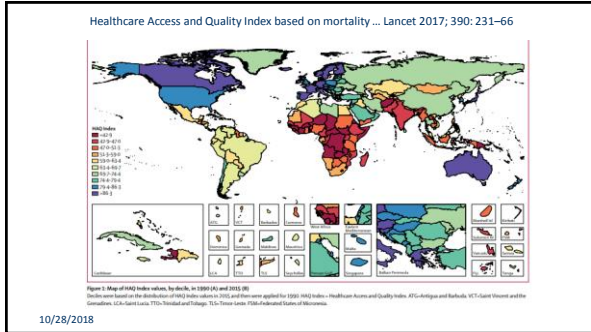
Private Equity
Health System Tracker

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MD

If this cost was associated with world class outcomes, it might be worth it, but US health care is not the best in the world.

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Medscape: What are your goals for healthcare in the United States? Interview with Dr. Berwick

- The **healthcare system we have simply cannot be sustained.**
- Create a healthcare system that is just, safe, infinitely humane, and that **takes only its fair share of our wealth**—that **engages only in work that actually improves the lives** of patients, families, and communities.
- **...Healthcare is a human right.** We are the only Western democracy that hasn't made it a human right.

MEDNAX

<http://www.medscape.com/viewarticle/851893>

October 15, 2015

www.medscape.com

Medscape: What are your goals for healthcare in the United States? Interview with Dr. Berwick

- We need to have a system that **focuses on patient-centered care**. Patients need to be able to experience **transparency, individualization, recognition, respect, dignity, and choice** in all matters.
- **...benefits of data.** All philosophies of improvement depend on having information.
- **Improvement requires this transparency**—turning the lights on—to support learning and to usher in productive changes.

MEDNAX

<http://www.medscape.com/viewarticle/851893>

October 15, 2015

www.medscape.com

Is the care we provide safe?

- “Using a weighted average of the 4 studies, a lower limit of **210,000 deaths per year was associated with preventable harm in hospitals.**
- **...the true number of premature deaths associated with preventable harm to patients maybe than 400,000 per year.**
- Serious harm seems to be 10- to 20-fold more common than lethal harm.”

James, J.T. A New, Evidence-based Estimate of Patient Harms Associated with Hospital Care. Journal of Patient Safety: September 2013 - Volume 9(3):p 122–128

Examples of Harm in the NICU

- Being admitted hypothermic
- E-Ferol
- Heparin and IVH
- Infusion of breast milk in IV
- Lipids being infused at hyperalimentation rate and hyperalimentation being infused at the lipid rate.
- ...

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Cost of Adverse Events/Medical Errors

EQUAL TO UP TO 45% OF HEALTH CARE SPENDING

Source: National Center for Policy Analysis

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Brilli RJ, Allen S, Davis JT. Revisiting the quality chasm. Pediatrics. 2014;133:763-765.

TABLE 1 IOM Domains Compared With National Children's Hospital Quality and Safety Strategic Plan Domains

NCH Domains	Do Not Harm Me	Cure Me	Treat Me With Respect	Navigate My Care	Keep Us Well
Goals	Eliminate preventable harm	Transform the outcome of 1 chronic or acute illness for each clinical service line	Transform the patient experience by reengineering how we interact with families	Improve throughput by improving access, discharge planning, and care coordination	Behavioral health initiatives, prematurity prevention, improved acute/chronic asthma care, Healthy Neighborhoods Healthy Families
IOM domains	Safety	Effectiveness	Patient centeredness Equity	Access Efficiency Timeliness Care Coordination	Access Care Coordination Effectiveness

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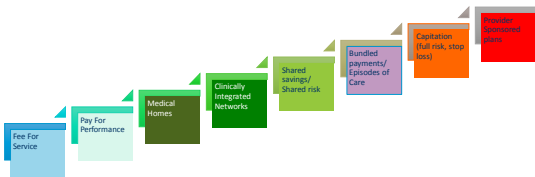
TRADITIONAL PAYMENT SYSTEM

- Providers/Hospitals are **typically are not compensated for producing value**. Instead, they are **rewarded for the volume** of services they provide
- THINGS HAVE AND ARE CHANGING
 - Pay for performance
 - Value based care
 - Accountable Care Organizations (ACOs)
 - ...



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Major Payment models in the U.S.- The Risk Escalator Model



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Resources required for value based programs

- Information Technology
 - Cyber-Security measures
 - EHR customization
 - Patient portal
 - Predictive analytics/modeling
 - Tele- and mobile health
- Human Capital
 - Higher number of non-MD providers
 - Population health management staff
 - IT staff: architecture, database, data warehouse, analysts



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What is value?

<http://www.merriam-webster.com/dictionary/value>

- Noun
 - the amount of money that something is worth : the price or cost of something
 - something that can be bought for a low or fair price
- Verb
 - to make a judgment about the amount of money that something is worth
 - to think that (someone or something) is important or useful



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Porter ME. What Is Value in Health Care? New England Journal of Medicine. 2010;363:2477-2481

- **Value = Outcomes/Costs** (Encompasses efficiency)
- Or maybe **Outcomes/What the health care team gets paid**
- Cost reduction without regard to the outcomes
 - Dangerous and self-defeating
 - False "savings"
 - The patient who dies reduces health care cost but no one would say that is a good outcome of a health care encounter or a health care system
- Outcomes (numerator)
 - Inherently condition-specific and multidimensional
 - No single outcome captures the results of care

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Porter ME. What Is Value in Health Care? NEJM. 2010;363:2477-2481

- Cost (denominator) = total costs of the full cycle of care for the patient's medical condition, not the cost of individual services.
- **To reduce cost, we may spend more on some services to reduce the need for others.**
- This is particularly true of **children as the cost of care is amortized over a lifetime.**
- Preventing premature birth and promoting normal neurodevelopmental outcomes can improve the quality of life and reduce cost of care.

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The perspective of value matters

- Patients
- Employers
- Payers
- Providers

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Problems

- Cost is always the sum of everything paid for that service (insurance payments, co-pays, interventions/medications deductibles, etc.)
- Costs are often reduced (or increased) without regard to outcome.
- Providers contracting with payers are constantly increasing or decreasing their costs with no change in their patient outcomes.
- Medications are prescribed that may increase harm (associated with a worse outcome) and cost.
- The patient may perceived that they received valuable care because they got the antibiotics they wanted but the opposite may be true. The over use of antibiotics promotes the emergence of resistant organisms and this effects everybody.

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The Value Equation's Components

Outcome Measures (Numerator)

How do we measure the quality of the care we provide in the NICU?

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Domains

- Delivered to defined **patient/s**, by a defined **provider/s** and must relate to one domain.
 - Process** - a health care service provided to or on behalf of a patient.
 - Outcome** - a patient's health state resulting from health care.
 - Access** - the patient's attainment of timely and appropriate health care.
 - Patient experience** - a patient report about observations of and participation in health care.



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Guidelines for Measurement

National Quality Measures Clearinghouse

- Quality of Care**
 - The degree to which health care services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge.
- Measurement**
 - Assigning a quantity to quality by comparing it with a criterion.



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Reliability vs Validity

- Reliability is the extent to which variation in the outcome measure is due to **variation in quality of care rather than random variation** due to the sample of cases observed
- Validity **is the accuracy** with which the outcome measure reflects the quality of care on average.
- Validity depends on the accuracy of calculations:** whether complete records are available and the accuracy of the data in the medical record.



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http://www.qualityindicators.ahrq.gov/Modules/PDI_TechSpec.aspx

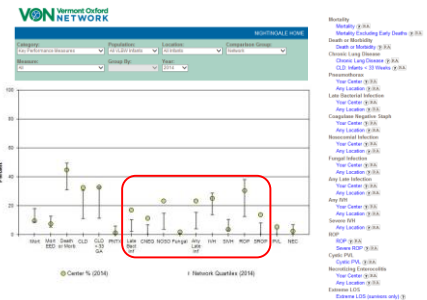
AHRQ Quality Indicators Home Modules Software News Resources FAQs & Support Actions

General Pediatric Quality Indicators Technical Specifications - Version 5.0, March 2015

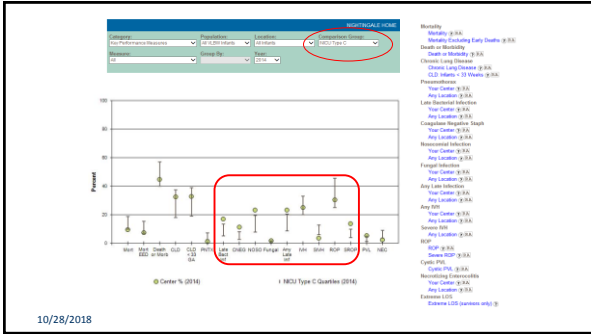
- All Pediatric Quality Indicators Technical Specifications, Version 5.0 (Zip File)
- All Pediatric Quality Indicators Technical Specifications, Version 5.0 (Zip File)
- PQI 01 Neonatal Sepsis Pneumothorax Rate
- PQI 02 Neonatal Mortality Rate
- PQI 03 Neonatal Blood Stream Infection Rate
- PQI 04 Accidental Puncture or Laceration Rate
- PQI 05 Pressure Ulcer Rate
- PQI 06 Related Surgical Item or Unretrieved Device Fragment Count
- PQI 07 Sepsis Pneumothorax Rate
- PQI 08 SACS-1 Pediatric Heart Surgery Mortality Rate
- PQI 09 SACS-1 Pediatric Heart Surgery Volume
- PQI 10 Postoperative Hemorrhage or Hemodynamic Rate
- PQI 11 Postoperative Respiratory Failure Rate
- PQI 12 Postoperative Sepsis Rate
- PQI 13 Postoperative Wound Dehiscence Rate
- PQI 14 Central Venous Catheter-Related Blood Stream Infection Rate
- PQI 15 Transfusion Reaction Count
- PQI 16 Catheter-Related Infection Rate
- PQI 17 Diabetes Short-term Complications Admission Rate
- PQI 18 Appendicitis Admission Rate
- PQI 19 Perforated Appendix Admission Rate
- PQI 20 Pediatric Safety for Selected Indicators
- PQI 21 Pediatric Quality Overall Composite
- PQI 22 Pediatric Quality Acute Composite
- PQI 23 Pediatric Quality Chronic Composite
- PQI Appendices

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Frame of Reference/Benchmark Comparison Group Matters



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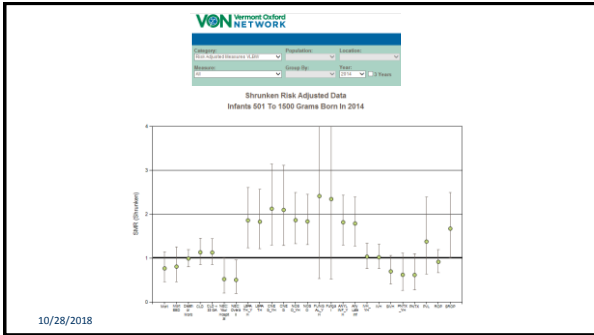
Risk Adjustment

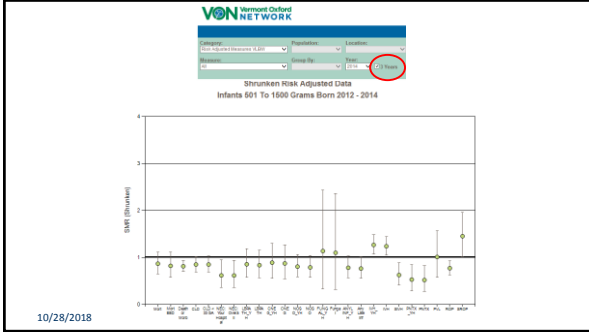
- ### Problems With the General Application of Any Model
- ▶ Standardized Rate: Observed outcome rate divided by the predicted rate
 - ▶ Inadequate sample size (but may be slow in identifying poor performers if we have to wait for adequate sample size)
 - ▶ Selection biases
 - ▶ Comparison group/benchmark
 - ▶ How the model is built
 - ▶ Neonatal care changes and the model must be recalibrated

- ### What is SMR (Shrunken)?
- ▶ "A shrunken standardized morbidity or mortality ratio (SMR) and its upper and lower bounds indicate whether your center has more or fewer infants with the outcome than would be expected given the characteristics of infants treated at your center. **It is calculated as observed/expected rate of the event being measured.**"
 - ▶ <https://nightingale.vtoxford.org/help/ISSLI/WebHelp/SMR.htm>

DOES RISK ADJUSTMENT WORK?
 Look at the next 2 slides.
 The data is from the same site and measured by the same group.
 What makes the difference?
 Why do the error bars and point estimates of the standardized outcomes change?

How do you want to be graded?
 How do you want your quality measured?





Cost (denominator)

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- Do we really know the cost of health care?
- Costs, charges and payments
 - Variable costs (salaries of clinicians, costs of supplies and medications)
 - Fixed costs (overhead expenses and cost of equipment, land and buildings)
 - Hospital charges are list prices for medical services
 - **List prices (charges) are not reflective of what patients/insurance actually pay.**
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- SIX CATEGORIES OF WASTE
- Overtreatment
 - Failures of care coordination
 - Failures in execution of care processes
 - Administrative complexity
 - Pricing failures
 - Fraud and abuse
 - **The sum of the lowest available estimates exceeds 20% of total health care expenditures.**
- Berwick DM, Hackbarth AD. Eliminating waste in us health care. JAMA. 2012;307:1513-1516
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Kaempf JW, Zupancic JA, Wang L, Grunkemeier GL. A risk-adjusted, composite outcomes score and resource utilization metrics for very low-birth-weight infants. JAMA Pediatr. 2015;169:459-465

Value = $\frac{\text{Benefit} - \text{Risk Adjuster} + \text{Mortality Deduction} + 100}{\text{Cost}}$

Benefit = 1
Summation of 8 Major VON Morbidity Rates Weighted Equally

Cost = Mean Total Hospital Length of Stay to Survivors (LOS₂₅)

Risk Adjuster: Derived From the Following Demographic Factors:
 Gestational Age
 Birth Weight (Small for Gestational Age)
 Inborn/Outborn
 Major Birth Defect
 Mode of Delivery
 1-Minute Apgar Score
 Birthorder
 Sex
 Maternal Race

Mortality Deduction: 100%-Mortality Excluding Early Death

The 8 major morbidities are as follows: chronic lung disease, grade 3 to 4 intraventricular hemorrhage, periventricular leukomalacia, stage 3 to 4 retinopathy of prematurity, any late infection, necrotizing enterocolitis, focal intestinal perforation, and discharge weight less than the 10th percentile. VON indicates Vermont Oxford Network.

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Kaempf JW, Wang L, Dunn M. Using a composite morbidity score and cultural survey to explore characteristics of high proficiency neonatal intensive care units. Arch Dis Child Fetal Neonatal Ed 2018.

Cultural, environmental and cognitive characteristics vary among NICUs perhaps more than traditional CQI methodology and PBPs, possibly explaining the inconstancy of VLBW infant morbidity reduction efforts.

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Kaempf JW, Wang L, Dunn M. Using a composite morbidity score and cultural survey to explore characteristics of high proficiency neonatal intensive care units. Arch Dis Child Fetal Neonatal Ed 2018.

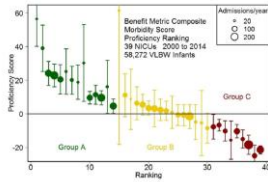


Figure 1 Thirty-nine NICUs ranked by the Benefit Metric composite morbidity score: high proficiency group A green circles significantly greater, group B yellow circles are not significantly different and lower proficiency group C red circles are significantly less than the group mean. NICU, neonatal intensive care unit; VLBW, very low birth weight.

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KEY DRIVERS FOR A SUCCESSFUL VALUE BASED PROGRAM



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What are some of the ways to decrease healthcare cost in the newborn care?

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Prevent Morbidities

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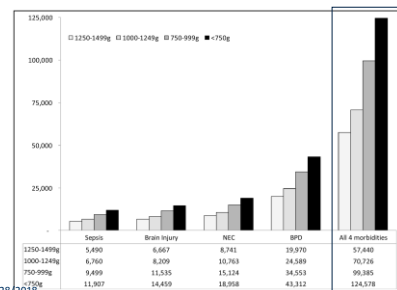
Johnson TJ. Cost of morbidities in very low birth weight infants. J Pediatr. 2013;162:243-249.

- 425 VLBW infants born alive between July 2005 and June 2009 at Rush University Medical Center.
- After controlling for birth weight, gestational age, and sociodemographic characteristics
 - *brain injury associated with a \$12,048 increase in costs;*
 - *necrotizing enterocolitis, with a \$15,440 increase costs;*
 - *bronchopulmonary dysplasia, with a \$31,565 increase;*
 - *and late-onset sepsis, with a \$10,055 (P < .001) increase.*

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Johnson TJ. Cost of morbidities in very low birth weight infants. J Pediatr. 2013;162:243-249.

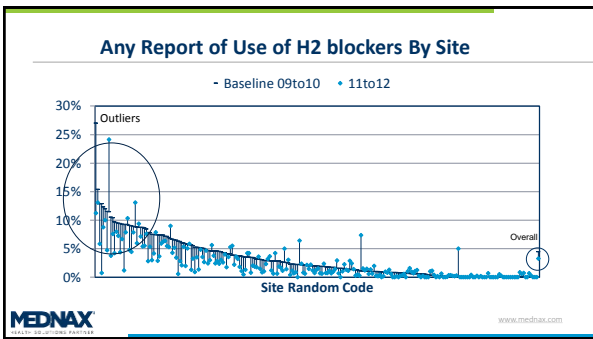
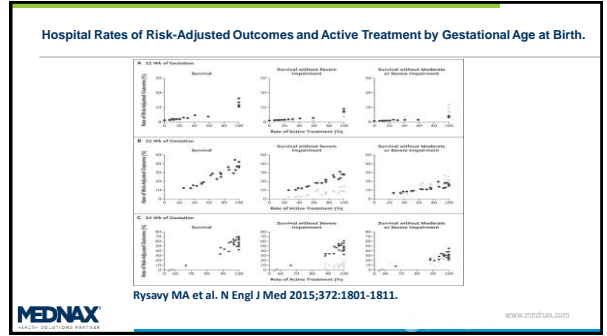


Important to remember that this is rare but the cost of rare events get payers attention.

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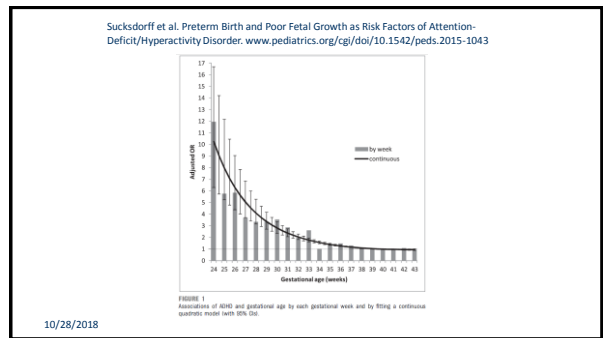
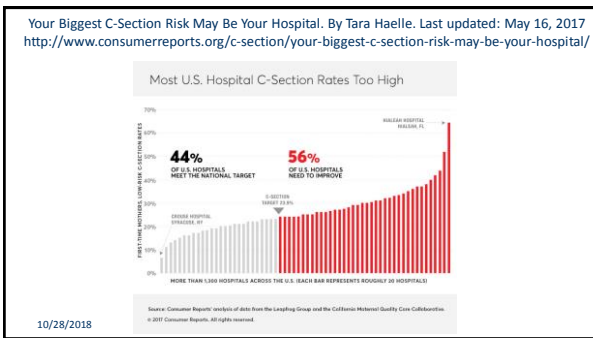
Reduce site variability in care and outcomes

Site variation is real; it is large and *it influences everything (cost and outcomes and patient satisfaction and families and ...)*



Reduce early delivery (Late Preterm/Early Term)

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Make Sure Antenatal Steroids Are Given

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Antenatal Corticosteroid Therapy Before 24 Weeks of Gestation: A Systematic Review and Meta-analysis. Park, C et al. *Obstetrics & Gynecology*. 127(4):715-725, April 2016.

CONCLUSION:
 The available data, all observational, show **reduced odds of mortality** to discharge in neonates born before 24 weeks of gestation who received antenatal corticosteroids and active intensive treatment.
Antenatal corticosteroids should be considered for women at risk of imminent birth before 24 weeks of gestation who choose active postnatal resuscitation

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Chawla S, et al. Association of Neurodevelopmental Outcomes and Neonatal Morbidities of Extremely Premature Infants With Differential Exposure to Antenatal Steroids. *JAMA Pediatr*. Published online October 10, 2016. doi:10.1001/jamapediatrics.2016.1936

- Observational cohort study, participants were extremely premature infants (birth weight range, 401-1000 g; gestational age, 22-27 weeks) who were born at participating centers of the NRN between January 2006 and December 2011.
 - 848 infants in the no ANS group
 - 1581 in the partial ANS group
 - 3692 in the complete ANS group

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Chawla S, et al. Association of Neurodevelopmental Outcomes and Neonatal Morbidities of Extremely Premature Infants With Differential Exposure to Antenatal Steroids. *JAMA Pediatr*. October 10, 2016. doi:10.1001/jamapediatrics.2016.1936

- Among the **no, partial, and complete ANS groups**, there were significant differences in the rates of:
 - **mortality (43.1%, 29.6%, and 25.2%, respectively)**
 - **severe intracranial hemorrhage among survivors (23.3%, 19.1%, and 11.7%),**
 - **death or necrotizing enterocolitis (48.1%, 37.1%, and 32.5%),**
 - **and death or bronchopulmonary dysplasia (74.9%, 68.9%, and 65.5%).**
- Death or neurodevelopmental impairment occurred in 68.1%, 54.4%, and 48.1% of patients in the no, partial, and complete ANS groups, respectively. Logistic regression analysis revealed that complete (odds ratio, 0.63; 95% CI, 0.53-0.76) and partial (odds ratio, 0.77; 95% CI, 0.63-0.95) improved outcomes.

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Antibiotic Stewardship

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Antimicrobial Exposure and NEC
 Yale cohort replicates association reported by Cotton et al.

Days on Antibiotics	OR for NEC (approx.)
1 to 2	1.2
3 to 4	1.6
5 to 6	2.0
7 to 8	2.4
9 to 10	2.8
> 10	3.2

Alexander. *J Pediatr*. 2011;159(3):392-7.

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Do not use things that do not work.

Campbell BT, Herbst KW, Briden KE, Neff S, Ruscher KA, Hagadorn JJ. Inhaled nitric oxide use in neonates with congenital diaphragmatic hernia. *Pediatrics*. 2014;134:e420-e426.

- Data were analyzed for 1713 neonates with CDH in 33 hospitals
- **Utilization varied dramatically (34% to 92%).**
- **>\$81 million in pharmacy charges.**
- The proportion of infants receiving INO as well as their duration of therapy increased significantly.
- **ECMO utilization and mortality did not change significantly during the study period.**
- Hospital-specific mortality rates did not correlate with INO therapy, ECMO utilization, or case volume.

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Campbell BT, Herbst KW, Briden KE, Neff S, Ruscher KA, Hagadorn JJ. Inhaled nitric oxide use in neonates with congenital diaphragmatic hernia. *Pediatrics*. 2014;134:e420-e426.

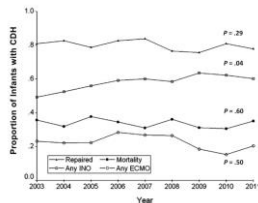


FIGURE 2 Trends in nitric oxide use, ECMO use, rate of repair, and mortality for 1713 infants with CDH at 33 PHIS hospitals, 2003 to 2011.

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Choosing Wisely in *Newborn Medicine*: Five Opportunities to Increase Value
Timmy Ho, MD, Dmitry Dukhovny, MD, MPH, John A.F. Zupancic, MD, ScD, Don A. Goldmann, MD, Jeffrey D. Horbar, MD, DeWayne M. Pursley, MD, MPH

1. Avoid routine use of antireflux medications for treatment of symptomatic gastroesophageal reflux disease or for treatment of apnea and desaturation in preterm infants.
2. Avoid routine continuation of antibiotic therapy beyond 48 hours for initially asymptomatic infants without evidence of bacterial infection.
3. Avoid routine use of pneumograms for predischarge assessment of ongoing and/or prolonged apnea of prematurity.
4. Avoid routine daily chest radiographs without an indication for intubated infants.
5. Avoid routine screening term equivalent or discharge brain MRIS in preterm infants.

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PEDIATRICS Volume 136, number 2, August 2015

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What is one of the simplest thing we can do?

Colaizy et al. Impact of suboptimal breastfeeding on the healthcare and mortality costs of necrotizing enterocolitis in extremely low birthweight infants. *Pediatr*. 2016; 175: 100–105

- In Monte Carlo simulation, current feeding of ELBW infants was associated with **928 excess NEC cases and 121 excess deaths annually**, compared with a model in which 90% of infants received $\geq 98\%$ MM.
- These models estimated an annual cost of suboptimal feeding of ELBW infants of \$27.1 million (CI \$24million, \$30.4 million) in direct medical costs, \$563,655 (CI \$476,191, \$599,069) in indirect nonmedical costs, and \$1.5 billion (CI \$1.3 billion, \$1.6 billion) in cost attributable to premature death.

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Engage in large collaboratives

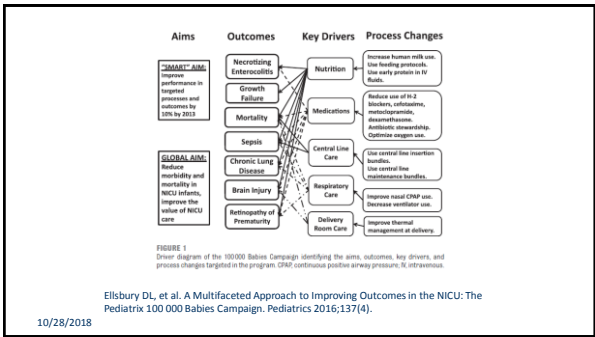
100,000 Babies Campaign

“Redesigning the Delivery of Neonatal Intensive Care”

A national quality improvement program designed to improve the outcomes of all critically ill newborns



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Concept	Kotter's 8-Step Process	100,000 Babies Campaign Steps
Prepare	1. Create Urgency	Provide outcome data and benchmarking highlight equity chain in neonatology Maintenance of certification
	2. Create a Guiding Coalition	Quality improvement leadership team Regional and local improvement champions
	3. Create a Vision	Build on previous success Emphasis on pragmatic and meaningful improvement
Implement	4. Communicate Vision	Quality Summits
	5. Remove Obstacles	Flexibility in participation Automated data collection and reports
	6. Enable Short-Term Wins	Include simple projects with immediate results
Manage	7. Build on Change	Center presentations to peers Spread of success
	8. Embed Change in Culture	Ongoing emphasis and recognition of improvement activity Ongoing infrastructure to support improvement work

FIGURE 2
Adaptation of the Kotter organizational change model to the structure of the 100,000 Babies Campaign.

Elisbury DL, et al. A Multifaceted Approach to Improving Outcomes in the NICU: The Pediatrrix 100 000 Babies Campaign. *Pediatrics* 2016;137(4).

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Quality Summit Attendance & CDW Utilization by Clinicians

Activity	2007	2008	2009	2010	2011	2012	2013
Quality Summit Attendance	263	331	447	414	425	456	468
CDW Unique Visitors	391	513	547	648	690	638	659
CDW Visits	1,626	2,568	3,274	4,190	4,094	4,049	4,579
CDW Reports Viewed	6,511	10,132	12,859	15,326	15,443	16,148	17,522

Increased...

- # of clinicians attending Quality Summits
- # of clinicians utilizing the CDW
- # of CDW visits
- # of CDW reports generated

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Cumulative Reduction in Morbidity and Cost

Observed vs Expected Morbidity (2008-2013, compared to 2007 baseline)	Cumulative Cost Savings* (2008-2013, compared to 2007 baseline)
324 fewer babies with severe IVH	\$3,904,000
800 fewer babies with NEC	\$12,352,000
745 fewer babies with BPD	\$23,516,000
3,272 fewer babies with late sepsis	\$32,900,000
	(total: \$72,672,000)

*Cost of morbidities in very low birth weight infants. Johnson TJ et al J Pediatr. 2013;162(2):243

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Cumulative Reductions in Mortality, Medications

Observed vs Expected Morbidity (2008-2013, compared to 2007 baseline)	Cumulative Cost Savings* (2008-2013, compared to 2007 baseline)
65,118 fewer days of H-2 blockers	???
1,885 fewer deaths (all BW)	???
842 fewer deaths (501-1500g)	???
1,815 MORE babies 501-1500g who survived without morbidity	???
Total \$\$: ????????????	

*Cost of morbidities in very low birth weight infants. Johnson T et al J Pediatr. 2013;162(2):243 www.mednax.com

Prevent the need for health care

Fix things right the first time (decrease readmissions)

Improve safety/Do not hurt your patient

David Casarett, M.D. The Science of Choosing Wisely — Overcoming the Therapeutic Illusion. 2016. NEJM 374:1203-5

➤ **“Therapeutic illusion”**

➤ When physicians believe that their actions or tools are more effective than they actually are, the results can be unnecessary, dangerous and costly care.

Vitamin E



Has anyone ever heard of E-ferol?
www.ferol.com

10/28/2018

Do You Remember E-Ferol? The Penalty for Selling Untested Drugs in Neonatology

- O'Neal/Jones & Feldman Pharmaceuticals began marketing E-Ferol in the fall of 1983 as a vitamin supplement.
- The product was never submitted for FDA approval. Physicians incorrectly assumed E-Ferol had been tested and approved for use by the FDA
- In 1984, E-Ferol **killed at least 38 newborns**
- iatrogenic disasters are often caused primarily by well-intentioned physicians using logical therapies which turned out to have unexpected, lethal side effects**
- On January 19, 1989, three defendants pleaded guilty and were sentenced to fines of \$130,000 each and 6-month jail sentences. **Legal settlements in 100,000,000 range.**



Let's Stop the Bleeding: Preventing Errors with Heparin Therapy. PA PSRS Patient Saf Advis 2006 Dec;3(4):31.

- Medication error that occurred in an Indiana hospital received nationwide publicity when three premature infants died as a result.
- The infants mistakenly received overdoses of heparin because the wrong strength was used to prepare flush solutions for umbilical lines.
- The error occurred when heparin 10,000 units/mL, 1 mL vials inadvertently were placed into a unit-based automated dispensing cabinet (ADC) pocket where heparin 10 units/mL, 1 mL vials were normally kept.
- While nothing can erase the grief experienced by the families and hospital workers in the wake of this tragic incident, it does serve as a reminder of the need to take a closer look at heparin utilization in our facilities.

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Barriers

- Inconsistency in team membership.
- **Lack of time.**
- Lack of information sharing.
- **Hierarchy.**
- Varying communication styles.
- **Presence of conflict.**
- Lack of coordination and follow-up.
- Misinterpretation of cues.
- Lack of role clarity.

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