

Administrative Data Based Tools for Pediatric and Neonatal Health Services and Outcomes Research: Risk-Adjustment

Corinna A. Haberland, MD, MS
Stanford University
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Introduction

- For any comparative use of AHRQ Quality Indicators (QIs), adjusting for underlying health status is crucial
- Paucity of methods available for pediatric measures
- Developed methods for both Pediatric QIs (PDIs) and Neonatal QIs (NQIs)

Pediatric QIs – Risk Adjustment - Development

- For the hospital level AHRQ PDIs – developed a method to adjust for four factors
 - Reason for Admission – using DRGs
 - Age and Gender
 - Comorbidities – developed de novo
 - Indicator specific categories

Pediatric QIs – Risk Adjustment - Development

- Comorbidity adjustment - Clinical Classification Software (CCS)¹ & 2001-2003 State Inpatient Data²
 - Clinical Review – CCS categories selected out
 - Empirical Analysis – Statistics Generated
 - Present on admission (POA)
 - Relative risks
 - Bias estimators
 - Clinical list and Empirical list compared - matching CCS categories were placed on an initial risk-adjustment list
 - List reviewed clinically again – appropriate CCS groupings added

¹Clinical Classifications Software (CCS) for ICD-9-CM, <http://www.hcup-us.ahrq.gov/toolssoftware/ccs/ccs.jsp>

²2001-2003 State Inpatient Data, Healthcare Cost and Utilization Project, Agency for Healthcare Research and Quality.

Pediatric QIs – Risk Adjustment - Current Application

- Adjustment regression model includes:

Pediatric QIs – Risk Adjustment - Current Application

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 - Age & Gender

Pediatric QIs – Risk Adjustment - Current Application

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 - Age & Gender
 - Comorbidities

Pediatric QIs – Risk Adjustment - Current Application

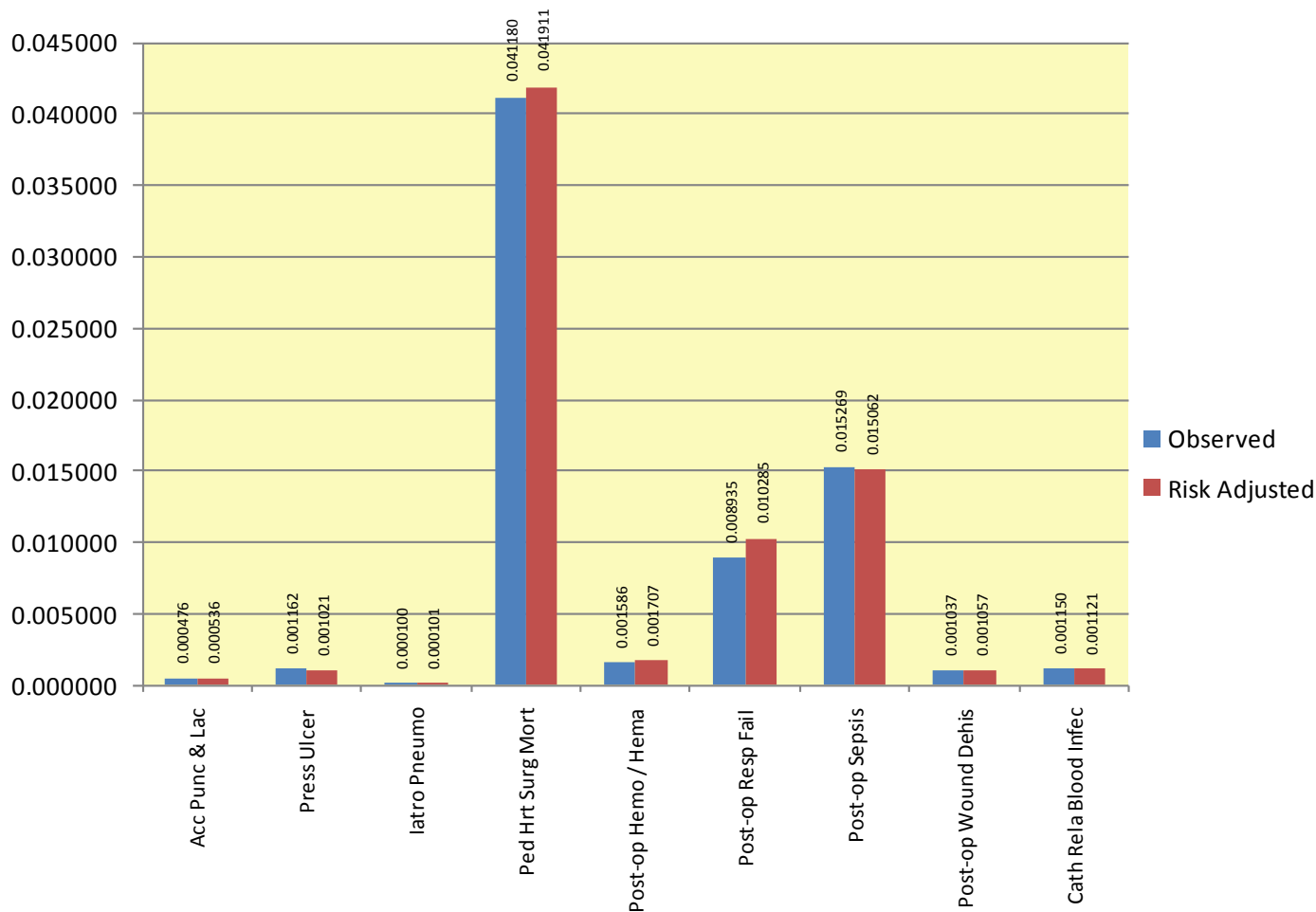
- Comorbidity Adjustment - Using Present on Admission (POA) data:
 - Determines whether the record has POA data
 - Identifies covariates
 - Calculate predicted value for covariate
 - When POA data are available – able to use actual comorbidity values
 - When POA not available – covariate values generated using comorbidity values and a POA propensity score

Pediatric QIs – Risk Adjustment - Current Application

- Adjustment regression model includes:
 - Reason for admission – DRGs
 - Age & Gender
 - Comorbidities
 - Indicator specific risk categories

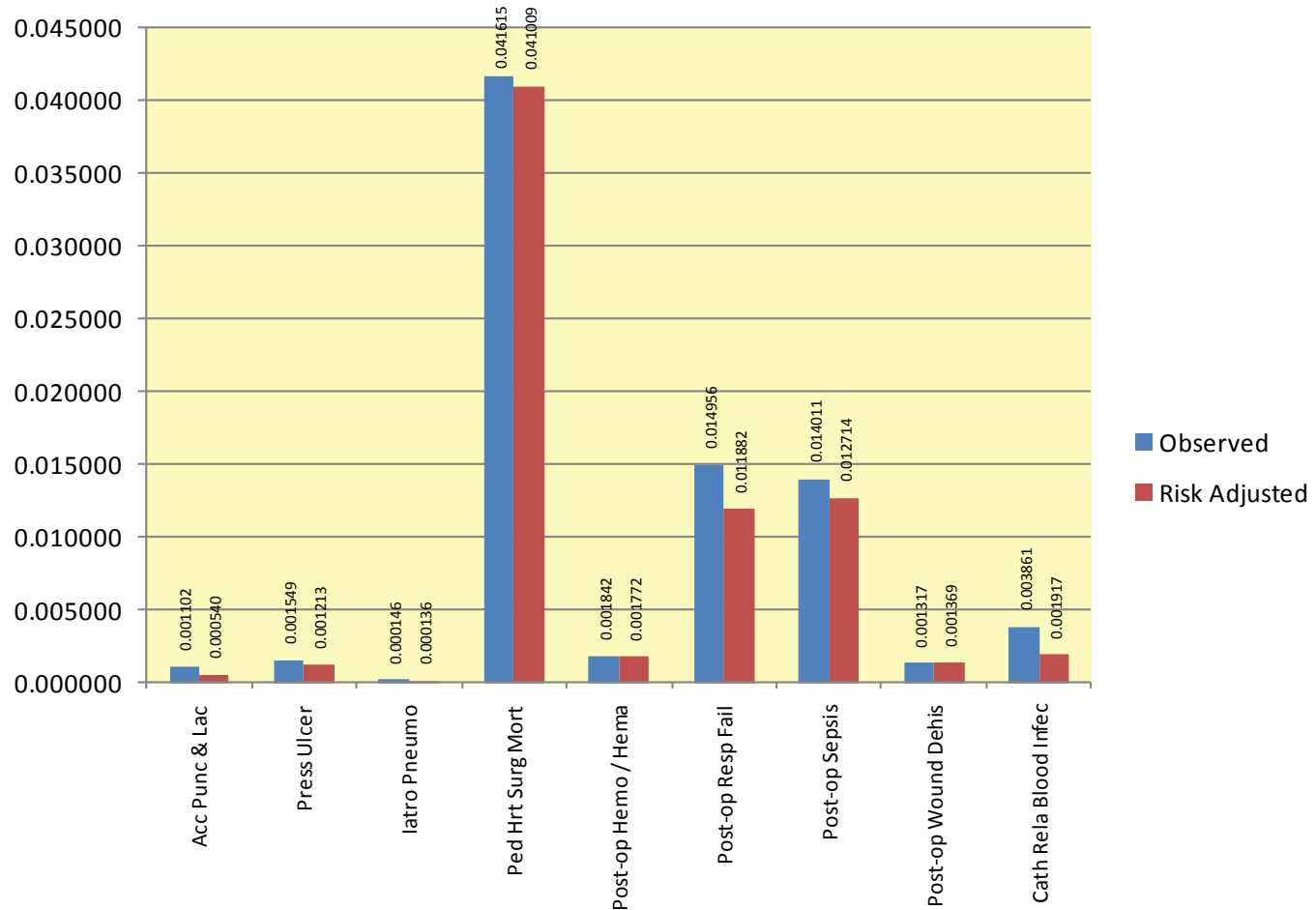
Pediatric QIs – Risk Adjustment – Results

Non-Children’s Hospitals – Overall Rates



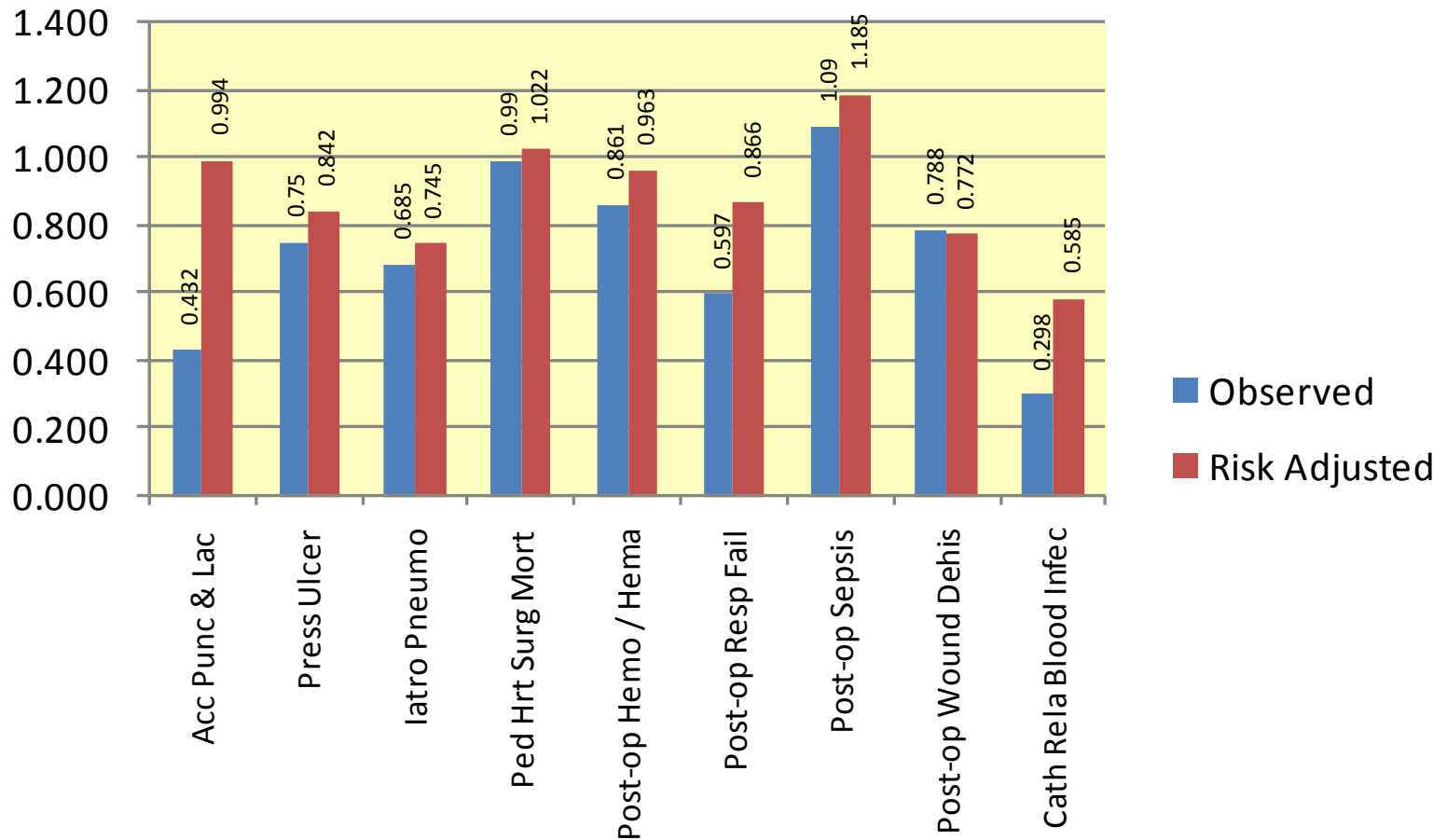
Pediatric QIs – Risk Adjustment – Results

Children’s Hospitals – Overall Rates



Pediatric QIs – Risk Adjustment – Results

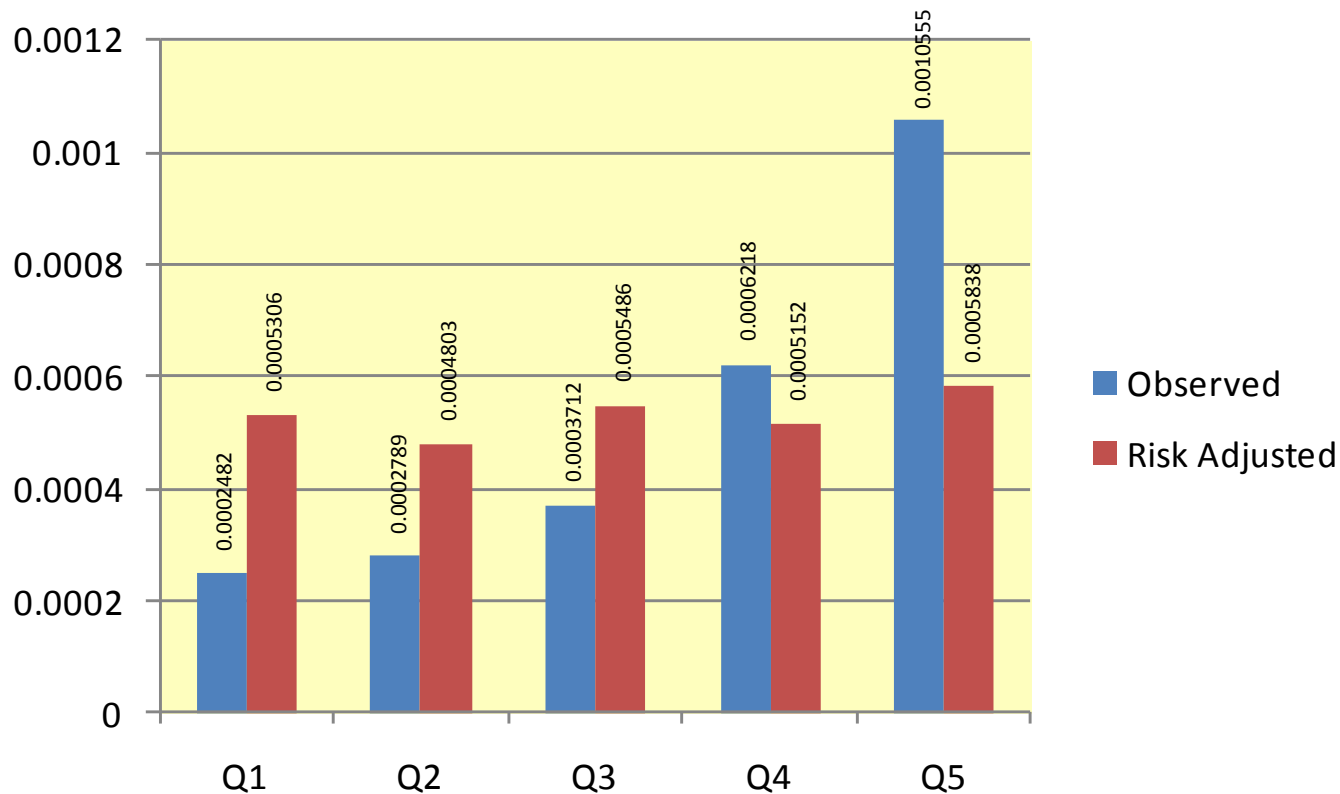
Non-Children’s vs. Children’s Hospitals – Ratios



Pediatric QIs – Risk Adjustment – Results

Children’s Hospitals – Rates by Hospital Volume

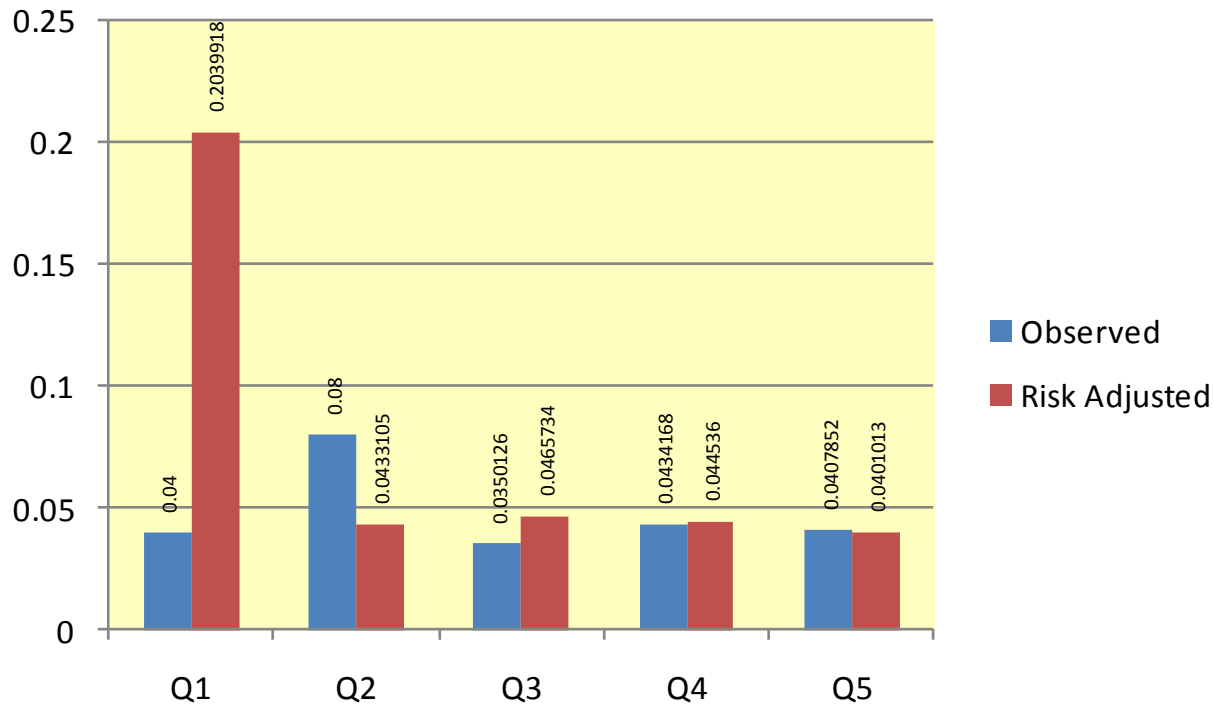
Accidental Puncture & Laceration



Pediatric QIs – Risk Adjustment – Results

Children’s Hospitals – Rates by Hospital Volume

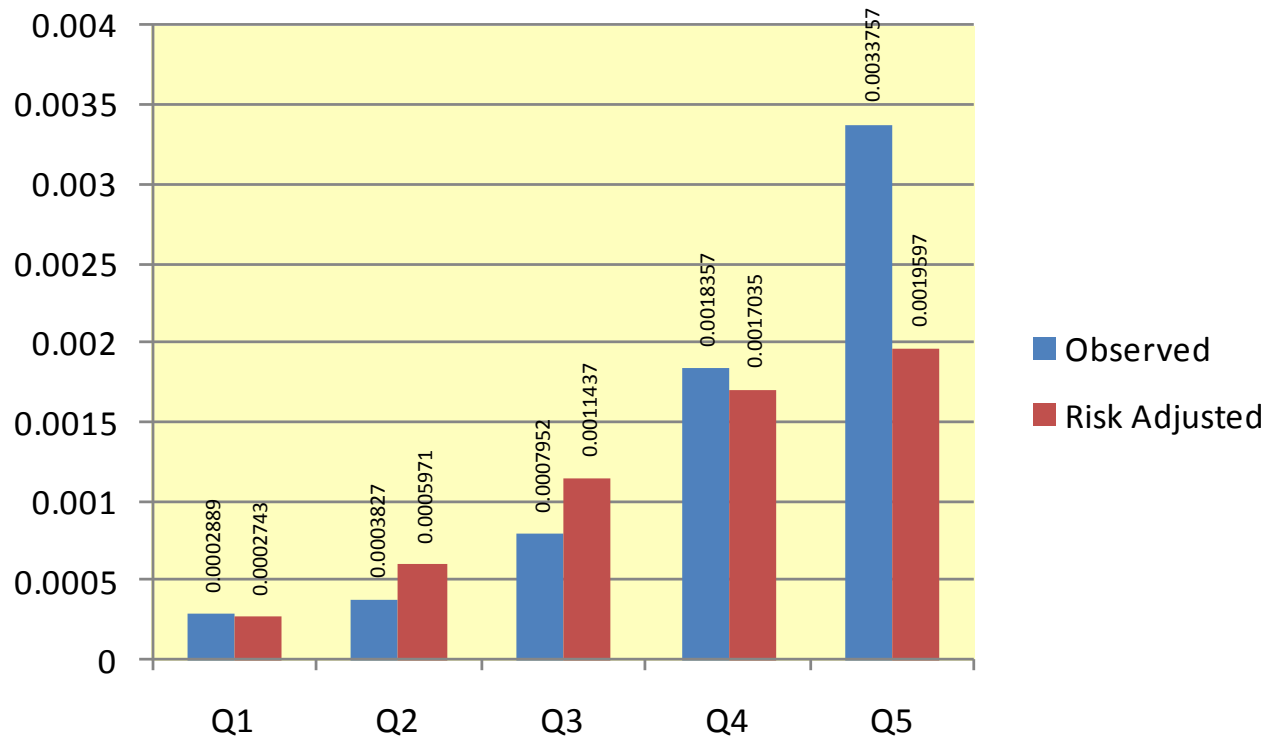
Heart Surgery Mortality



Pediatric QIs – Risk Adjustment – Results

Children’s Hospitals – Rates by Hospital Volume

Catheter Related Bloodstream Infections



Neonatal QIs – Risk Adjustment - Development

- Preliminary RA model included:
 - Birthweight
 - Gender
 - Multiple Gestation
 - Congenital Anomalies
 - Groupings derived by Phibbs, et al.¹
 - By organ system
 - Based on mortality rates

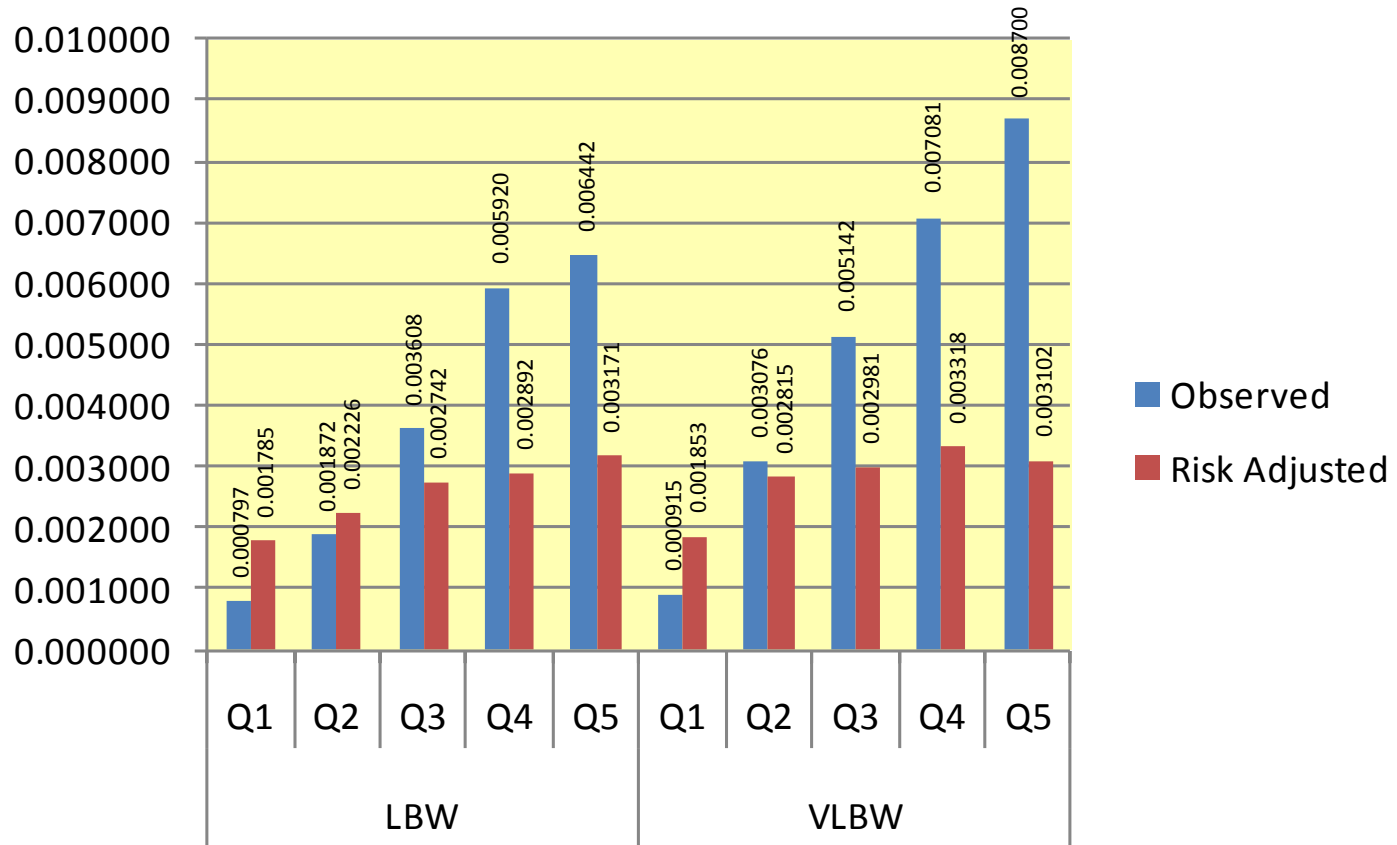
¹ Phibbs CS, Baker LC, Caughey AB, Danielsen B, Schmitt SK, Phibbs RH. Level and volume of neonatal intensive care and mortality in very-low-birth-weight infants. *New England Journal of Medicine*. 2007;356(21):2165-2175 & Supplement.

Neonatal QIs – Risk Adjustment - Current Application

- Current RA model includes:
 - Gender
 - Outborn / Inborn status
 - Birthweight
 - Gestational Age
 - Congenital Anomalies Groupings

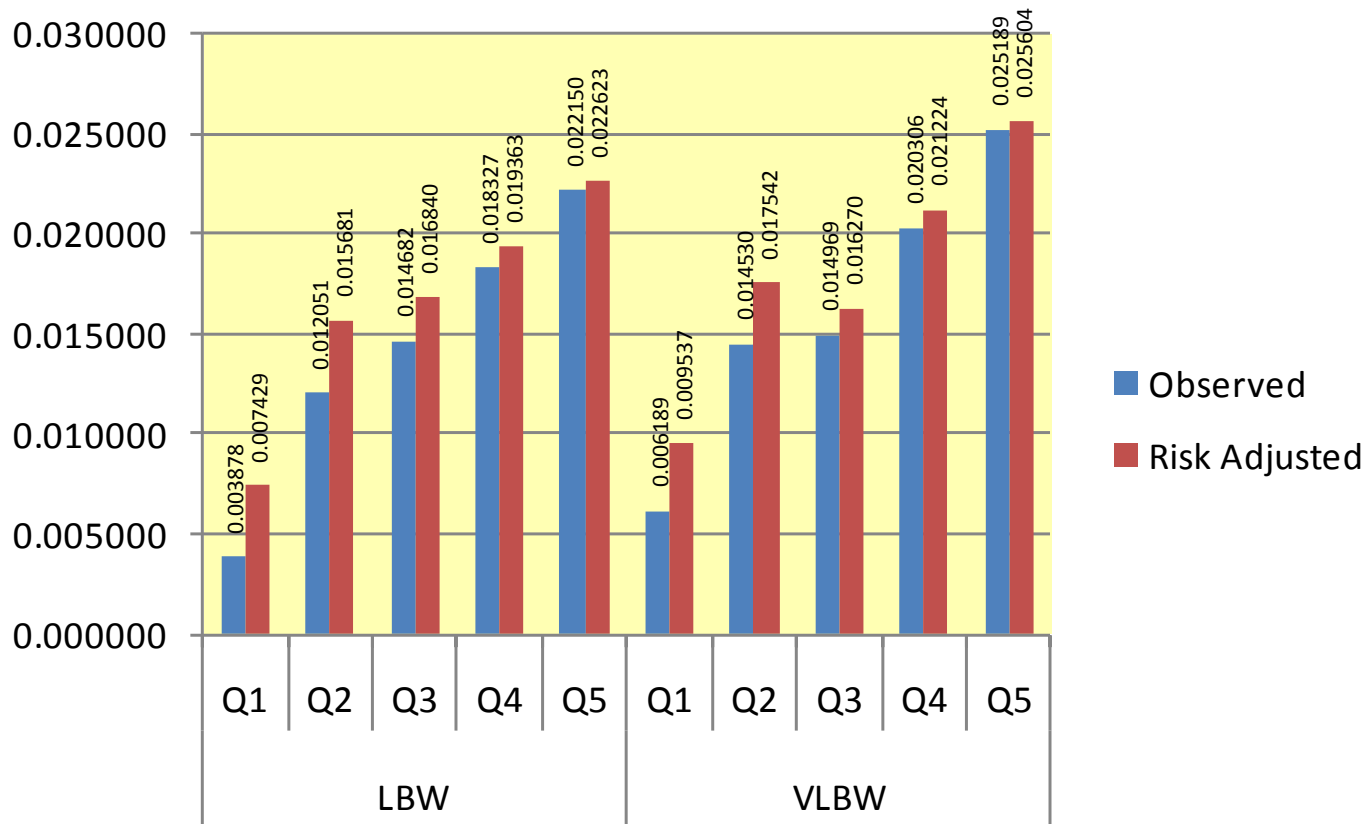
Neonatal QIs – Risk Adjustment - Results

Neonatal Mortality



Neonatal QIs – Risk Adjustment - Results

Neonatal Blood Stream Infections



Conclusions

- Risk adjustment methods for both QI sets:
 - Account for important clinical variations in patients
 - Attenuate differences in children's & non-children's hospital, and between volume quintile rates
 - Will better allow for comparisons of quality outcomes

Additional Slides

Statistic	Description	Strict Threshold	Loose Threshold
SID rate and RR	Observed rate and relative risk for CCS category in 2000-2003 SID.		
NY and CA SID rate and RR	Observed rate and relative risk for CCS category in 2000-2003 New York and California data only.		
Rate and RR given complication	Observed rate and relative risk, using NY and CA data, including only patients whose CCS triggering code was NOT POA		
Rate and RR given comorbidity RR (POA)	Observed rate and relative risk, using NY and CA data, including only patients whose CCS triggering code was POA	RR > 2	RR > 2
% CCS	Percent of indicator denominator represented by the CCS.	% CCS > 1 %	% CCS > 1%
% POA	Percent of the CCS that is present on admission.	% POA > 85%	% POA > 85%
Estimator Bias (EB)	Measure of bias due to unknown POA status. Ranges from 0 (no bias) to 1 (high bias).	EB ≤ 0.2	EB ≤ 0.3
Comparison Bias (CB)	Measure of bias using corrected RR and frequency of CCS / POA	CB ≤ 0.015	CB ≤ 0.03

*Each statistic was calculated for each CCS that appeared as a codiagnosis for each indicator.

From: Phibbs CS, Baker LC, Caughey AB, Danielsen B, Schmitt SK, Phibbs RH.
 Level and volume of neonatal intensive care and mortality in very-low-birth-weight infants.
New England Journal of Medicine. 2007;356(21):2165-2175 & Supplement.

Diagnostic Risk Group	ICD-9 Diagnosis Codes	N (1998-2000) and (% of all coded risks)
Gastrointestinal		
Abdominal wall defect	756.70, 756.79	986 (0.054)
Tracheoesophageal fistula	750.3, 750.4	365 (0.020)
Small bowel or upper GI anomalies		
(1) Anomalies NOS including pyloric stenosis	750.5, 750.7, 750.8, 750.9, 751.1, 751.5, 751.8, 751.9	745 (0.040)
(2)	751.5	903 (0.049)
(3) Volvulus or Intestinal Fixation Problem	560.2, 751.4	224 (0.012)
Meckel's Syndrome	751.0	67 (0.004)
Large Bowel		
(1) Atresia, etc.	751.2	647 (0.035)
(2) Hirschprung's	751.3	214 (0.012)
(3) Meconium obstruction	771.1	1479 (0.080)
Liver, bile duct, pancreas –		
(1) Biliary Atresia or Pancreatic Anomaly	751.61, 751.7	100(0.005)
(2) Bile, liver, pancreas	751.60, 751.69	246 (0.013)
Genitourinary		
Renal		
(1) Agenesis	753.0	434 (0.024)
(2) Polycystic	753.12, 753.14, 753.15	294 (0.016)
(3) Other cystic	753.10, 753.19	244 (0.013)
(4) Other anomalies	753.3, 753.4	430 (0.023)
Obstructions		
(1) High Obstruction	753.21, 753.22, 753.23	2154 (0.117)
(2) Low Obstruction	753.6, 753.7, 753.8, 753.9, 753.20	450 (0.024)
(3) Prune Belly, etc.	756.71	28 (0.002)
CNS		
Spina bifida, etc.		
(1) Spina bifida	741.00, 741.01, 741.02, 741.03, 741.90, 741.91, 741.92, 741.93, 742.59	441 (0.024)
(2) Encephalocele	742.0	86 (0.005)
Brain		
(1)	742.1, 742.4	1080 (0.059)
(2)	742.2, 742.3	757 (0.041)
(3)	742.8, 742.9	252 (0.014)

Pulmonary		
CDH	519.4, 553.3, 748.9, 750.6, 756.6	588 (0.032)
Airway	748.3, 748.9	933 (0.051)
Cyst, etc.		
(1)	748.4, 748.60	435 (0.024)
(2)	748.69, 748.8	126 (0.007)
Cardiovascular		
Aortic valve	746.3, 746.4, 424.1	216 (0.012)
Aortic arch		
(1)	747.10, 747.21, 747.29	436 (0.024)
(2)	747.11, 747.22, 746.81	135 (0.007)
HLHS	746.7	321 (0.017)
Endocardial fibroelastosis	425.3	149 (0.008)
Mitral valve		
(1) Stenosis	746.5	42 (0.002)
(2) Other mitral	424.0, 746.6, 746.84	436 (0.024)
Transpositions	745.10, 745.19, 745.12	360 (0.020)
Coronary/Myocard	746.85, 425.1	105 (0.006)
Common RV, etc.	745.3, 745.11, 745.0	450 (0.024)
Pulmonary valve – tricuspid		
(1)	746.01, 746.83, 746.2	325 (0.018)
(2)	746.09, 745.2, 746.1	693 (0.038)
Cushion, etc.	745.60, 745.61, 745.69	346 (0.019)
Pulmonary veins, etc.	746.82, 747.41, 747.42	177 (0.010)
Great vein	747.40, 747.49	94 (0.005)
Skeletal	756.50, 756.51, 756.55, 756.59	115 (0.006)
Chromosomal Syndromes		
(1)	758.3, 758.5, 758.89, 758.9, 759.89, 759.9	1484 (0.081)
(2)	759.7	107 (0.006)
(3) Conjoined twins	759.4	15 (0.001)
Other		
(1) Non-immune hydrops	778.0	385 (0.021)
(2) Hamartoses	759.6	34 (0.002)
(3) Congenital anemia	776.5	1846 (0.100)

Current NQI RA Congenital Anomalies Groupings

Diagnostic Risk Group	
1. Gastrointestinal	
756.70	Anomaly of abdominal wall, unspecified
756.79	Other congenital anomalies of abdominal wall
750.3	Tracheoesophageal fistula, esophageal atresia and stenosis
750.4	Other specified anomalies of esophagus
750.5	Congenital hypertrophic pyloric stenosis
750.7	Other specified anomalies of stomach
750.8	Other specified anomalies of upper alimentary tract
750.9	Unspecified anomaly of upper alimentary tract
751.1	Atresia and stenosis of small intestine
751.5	Other anomalies of intestine
751.8	Other specified anomalies of digestive system
751.9	Unspecified anomaly of digestive system
751.5	Other anomalies of intestine
560.2	Volvulus
751.4	Anomalies of intestinal fixation
751.0	Meckel's diverticulum
751.2	Atresia and stenosis of large intestine, rectum, and anal canal
751.3	Hirschsprung's disease and other congenital functional disorders of colon
771.1	Congenital cytomegalovirus infection
751.61	Biliary atresia
751.7	Anomalies of pancreas
751.60	Unspecified anomaly of gallbladder, bile ducts, and liver
751.69	Other anomalies of gallbladder, bile ducts, and liver
2. Genitourinary	
753.0	Renal agenesis and dysgenesis
753.12	Polycystic kidney, unspecified type
753.14	Polycystic kidney, autosomal recessive
753.15	Renal dysplasia
753.10	Cystic kidney disease, unspecified
753.19	Other specified cystic kidney disease
753.3	Other specified anomalies of kidney

Current NQI RA Congenital Anomalies Groupings

3. CNS	
741.00	With hydrocephalus, unspecified region
741.01	With hydrocephalus, cervical region
741.02	With hydrocephalus, dorsal (thoracic) region
741.03	With hydrocephalus, lumbar region
741.90	Without mention of hydrocephalus, unspecified region
741.91	Without mention of hydrocephalus, cervical region
741.92	Without mention of hydrocephalus, dorsal (thoracic) region
741.93	Without mention of hydrocephalus, lumbar region
742.59	Other specified anomalies of spinal cord, Other
742.0	Encephalocele
742.1	Microcephalus
742.4	Other specified anomalies of brain
742.2	Reduction deformities of brain
742.3	Congenital hydrocephalus
742.8	Other specified anomalies of nervous system
742.9	Unspecified anomaly of brain, spinal cord, and nervous system
4. Pulmonary	
519.4	Disorders of diaphragm
553.3	Diaphragmatic hernia
748.9	Unspecified anomaly of respiratory system
750.6	Congenital hiatus hernia
756.6	Anomalies of diaphragm
748.3	Other anomalies of larynx, trachea, and bronchus
748.9	Unspecified anomaly of respiratory system
748.4	Congenital cystic lung
748.60	Other anomalies of lung, anomaly of lung, unspecified
748.69	Other anomalies of lung, other
748.8	Other specified anomalies of respiratory system

Current NQI RA Congenital Anomalies Groupings

5. Cardiovascular	
746.3	Congenital stenosis of aortic valve
746.4	Congenital insufficiency of aortic valve
424.1	Aortic valve disorders
747.10	Coarctation of aorta (preductal) (postductal)
747.21	Other anomalies of aorta, anomalies of aortic arch
747.29	Other anomalies of aorta, other
747.11	Interruption of aortic arch
747.22	Other anomalies of aorta, atresia and stenosis of aorta
746.81	Subaortic stenosis
746.7	Hypoplastic left heart syndrome
425.3	Endocardial fibroelastosis
746.5	Congenital mitral stenosis
424.0	Mitral valve disorders
746.6	Congenital mitral insufficiency
746.84	Obstructive anomalies of heart, NEC
745.10	Complete transposition of great vessels
745.19	Transposition of great vessels, other
745.12	Corrected transposition of great vessels
746.85	Coronary artery anomaly
425.1	Hypertrophic obstructive cardiomyopathy
745.3	Common ventricle
745.11	Double outlet right ventricle
745.0	Common truncus
746.01	Atresia, congenital
746.83	Infundibular pulmonic stenosis
746.2	Ebstein's anomaly
746.09	Anomalies of pulmonary valve, other
745.2	Tetralogy of Fallot
746.1	Tricuspid atresia and stenosis, congenital
745.60	Endocardial cushion defect, unspecified type
745.61	Ostium primum defect
745.69	Endocardial cushion defects, other

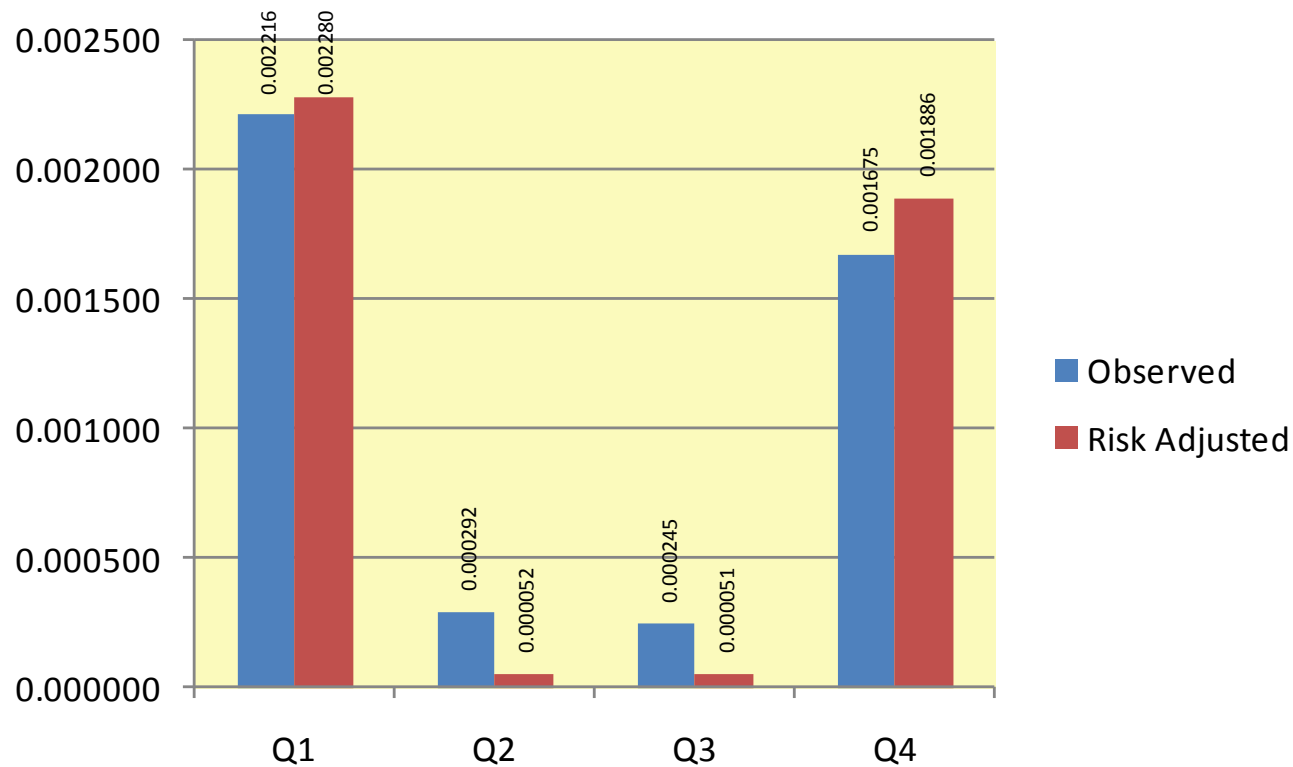
Current NQI RA Congenital Anomalies Groupings

6. Skeletal	
756.50	Osteodystrophy, unspecified
756.51	Osteogenesis imperfecta
756.55	Chondroectodermal dysplasia
756.59	Osteodystrophies, other
7. Chromosomal Syndromes	
758.3	Autosomal deletion syndromes
758.5	Other conditions due to autosomal anomalies
758.89	Other conditions due to chromosome anomalies, other
758.9	Conditions due to anomaly of unspecified chromosome
759.89	Other specified anomalies, other
759.9	Congenital anomaly, unspecified
759.7	Multiple congenital anomalies, so described
759.4	Conjoined twins
8. Other	
778.0	Hydrops fetalis not due to isoimmunization
759.6	Other hamartoses, NEC
776.5	Congenital anemia

Pediatric QIs – Risk Adjustment – Results

Children’s Hospitals – Rates by Hospital Volume

Pressure Ulcer



Pediatric QIs – Risk Adjustment – Results

Children's Hospitals – Rates by Hospital Volume

Post-Op Hemorrhage & Hematoma