International Quality Improvement Collaborative for Congenital Heart Surgery in Developing World Countries

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Cardiovascular and Critical Care Services
Boston Children’s Hospital
Assistant Professor of Pediatrics
Harvard Medical School

PCICS 12th Annual Meeting
December 11, 2016
Outline

• Introduce the development of the IQIC

• Describe components of IQIC

• Discuss strategies for continued learning and improvement

• Discuss outcome assessment
Vision & Mission

• Vision
  – To facilitate a collaborative of healthcare teams from around the world creating a culture of safety and quality for children undergoing congenital heart surgery

• Mission
  – To reduce mortality and major complications for children undergoing congenital heart surgery
Development of the IQIC
Steering Committee

Jan Christensen, MD, PhD
Department of Cardiovascular Surgery, University Hospital of Geneva
Humanitarian Association Coeurs pour Tous, Geneva, Switzerland

Aldo Castañeda, MD, PhD
UNICAR, Guatemala City, Guatemala

Kathy Jenkins, MD, MPH and Patricia Hickey, RN, PhD
Boston Children’s Hospital, Boston, MA

K.M. Cherian, MD
Frontier Lifeline Hospital and Dr. KM Cherian Foundation
Chennai, India

William Novick, MD
The William Novick Global Cardiac Alliance, Memphis, TN

Ms. Bistra Zheleva
Children’s HeartLink, Minneapolis, MN

R. Krishna Kumar, MD, DM, FACC, FAHA
Amrita Institute of Medical Sciences, Kochi, India

Nestor Sandoval, MD
Fundación Cardioinfantil de Bogotá, Bogotá, Colombia
History of the Project

2007
- 3rd GFHM: need for registry identified

2008
- Pilot sites selected, project aim identified, and database created
- Key driver diagram and QI learning established

2009
- 9 more sites enroll

2010
- 7th GFHM
- First audit trips
- 8 more sites enroll

2011
- Advanced nursing content added to QI learning
- 9 more sites enroll

2012
- 1st annual benchmarking report published using 2010 data
- 1st site-led webinar presentations

2013
- IQIC Learning Session & 9th GFHM
- 3 more sites enroll

2014
- IQIC Learning Session & 11th GFHM
- 5 more sites enroll

2015
- 9 more sites enroll

2016
- Quality report published in Pediatrics
- Development of cardiac catheterization component
- 2 regional learning sessions
- 5 more sites enroll

Advanced
nursing
content added
to QI learning

5th
GFHM
Participating Centers 2016

Pilot Sites

<table>
<thead>
<tr>
<th>Country/Location</th>
<th>Participating Centers</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNICAR, Guatemala City, Guatemala</td>
<td>National Children's Cardiac Surgical Center, Minsk, Belarus*</td>
</tr>
<tr>
<td>Clinica Medellin, Medellin, Bogota*</td>
<td>Armed Forces Institute of Cardiology, National Institute of Heart Disease, Rawalpindi, Pakistan</td>
</tr>
<tr>
<td>Frontier Lifeline Hospital, Chennai, India</td>
<td></td>
</tr>
</tbody>
</table>

*No longer enrolled
Cumulative Site Participation

47 sites in 22 countries enrolled
Strategies for Continued Learning and Improvement
Aim
Reduction in 30-day mortality associated with congenital heart surgery

Key Drivers

Safe Perioperative Practice

Reduction of Surgical Site Infections & Bacterial Sepsis

Team-Based Practice

Change Strategies

Utilize a surgical safety checklist to prompt and document evidence-based process measures (i.e., antibiotics given within 60 minutes of surgical incision)

Focus on hand hygiene for ALL clinical personnel in contact with patient care

Empowering nurses
 Evidence-based nursing practice
 Scripting nurses in ward and ICU on how to give reports
 Accurate 24hr total patient intakes and outputs
 Accurate daily recording of patient weight
 Effective Communication-SBAR

Boston Children's Hospital
Until every child is well

Harvard Medical School
Teaching Hospital
**QI Teams**

**India**
- Star Hospital
- Care Hospital
- Fortis Escorts Heart Institute*
- Public Health & Welfare Society Hospital
- RTIICS*
- G. Kuppuswamy Naidu Memorial Hospital
- Fortis Child Heart Mission
- Narayana Hrudayalaya*

**China**
- First Hospital of Lanzhou University*
- West China Hospital*
- FAHMKU*

**Brazil**
- HCor
- InCor
- HUFM
- Dr. Carlos Alberto Studart Gomes Hospital*
- HCRMRP-USP

**Russia**
- Research Institute for Complex Problems of Cardiovascular Diseases*
- Nizhny Novgorod Cardiac Surgical Center*

**Pakistan**
- Aga Khan University Hospital

**Afghanistan**
- French Medical Institute for Children

**Mexico**
- Instituto Nacional de Pediatria
- American British Cowdray Medical Center

**Malaysia**
- Institut Jantung Negara*

**Vietnam**
- Nhi Dong 1*

**Uganda**
- Uganda Heart Institute*

**Nicaragua**
- Salud Integral*

**Georgia**
- JoAnn McGowan Pediatric Cardiac Surgery Center

**Costa Rica**
- Hospital Nacional de Ninos

**AfIC (Pakistan)**

**UNICAR (Guatemala)**

**Shanghai Children’s Medical Center (China)**

**Frontier Lifeline Hospital (India)**

**UNIVERSITY HOSPITAL FG (Pakistan)**

**Mother and Child Health Institute* (Serbia)**

**Fundacion Cardiopadrenil (Colombia)**

**Hospital de Ninos (Argentina)**

**United Hospital (Bangladesh)**

**KDA Hospital & Medical Research Institute (India)**

**Hospital Garrahan (Argentina)**

**Hospital da Criança e Maternidade* (Brazil)**

*Partnered with NGO
Quality Improvement

- Monthly webinars based on QI strategies to reduce mortality and major complications
  - Webinars are created at the beginner, intermediate, and advanced level for each of the change strategies
  - IQIC sites evaluate the content and complete a needs assessment each year
- QI strategies reinforced by NGOs

<table>
<thead>
<tr>
<th>Learning Modules</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>April</th>
<th>May</th>
<th>June</th>
<th>July</th>
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<th>Sept</th>
<th>Oct</th>
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<tr>
<td>Advanced Nursing</td>
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<td></td>
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<td>6-Apr</td>
<td>11-May</td>
<td>15-June</td>
<td>27-July</td>
<td>14-Sept</td>
<td>5-Oct</td>
<td></td>
<td></td>
<td>21-Dec</td>
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<tr>
<td>Team-Based Practice</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>12-Oct</td>
<td>16-Nov</td>
<td>14-Dec</td>
<td>14-Dec</td>
<td></td>
</tr>
<tr>
<td>Reducing Infections</td>
<td>6-Jan</td>
<td>10-Feb</td>
<td>16-Mar</td>
<td>23-Mar</td>
<td></td>
<td></td>
<td>13-July</td>
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<tr>
<td>Safe Perioperative Practices</td>
<td></td>
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<td></td>
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<td></td>
<td>4-May</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>How to Read Benchmarking Report</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>23-Sept</td>
</tr>
</tbody>
</table>
2016 Webinars

Team-Based Practice
- “Ventilator Management Strategies and Suctioning in Pediatric Cardiac Patients” - 12 October
- “Healthy Work Environment and Teamwork” - 16 November
- “Train to Retain the ICU Nurses: Part 1”
- “Management of Ventricular Septal Defect with Severe Pulmonary Hypertension” - 14 December

Reducing Infections
- “Preventing Health Care Associated Infections: Creating a Culture of Infection Prevention”
- “Preventing Bloodstream Infections and Performing Root Cause Analysis”
- “Preventing Ventilator Associated Pneumonia and Developing a Dental Prevention Program”
- “Preventing Surgical Site Infections and Urinary Tract Infections”
- “Laboratory Report Interpretation and Antibiotic Stewardship”

Advanced Nursing
- “Care of the Neonate with CHD: Postoperative Concerns”
- “Bereavement and Supporting Families and staff in the Cardiac Intensive Care Unit”
- “Nutrition”
- “Nutrition Program: Feeding Regime for Undernourished Patients”
- “Heart Sounds”
- “Parent Presence During Resuscitation and Invasive Procedures”

Safe Perioperative Practices
- “Arterial Blood Gas Management”
- “Advanced Perfusion and Nursing Considerations”
- “Implementation of a Surgical Safety Checklist for Congenital Cardiac Surgery and Hand-off (I-PASS)”
- “Postoperative Arrhythmia Management in Pediatric Congenital Heart Surgery”

Administrative
- “Understanding Your Benchmark Report”
New Content in 2015/2016

“Care for the Adult with Congenital Heart Disease”

“Preventing Infections: Oral Health Promotion as an Infectious Risk Reduction Strategy for Pediatric Cardiac Patients”

“Arterial Blood Gas Management”

“Management of Open Sternum Patients in Congenital Heart Surgery”

“The Pre-Bypass Checklist”

“Care of the Neonate with CHD: Postoperative Concerns”
QI Competition
11th Global Forum on Humanitarian Medicine in Cardiology and Cardiac Surgery
Geneva, Switzerland
2016 Latin America Regional Learning Session
2016 Asia Pacific Regional Learning Session
Data Registry
Cumulative Number of Surgical Procedures

n= 59,467
Green Light Sites

Percent of Sites Included in Aggregate

- 2010: n = 2686
- 2011: n = 4263
- 2012: n = 8646
- 2013: n = 7861
- 2014: n = 8686
- 2015: n = 10728
RACHS-1 Risk Categories

Least Complex

1. ASD Surgery
2. VSD Surgery
3. Aortic Valve Replacement
4. Truncus repair
5. Ebstein < 30 days
6. Norwood for HLHS

Most Complex

PDA > 30 days
TOF repair
Fontan
Arterial Switch & VSD
Truncus with arch repair

Cases of congenital heart repair < 18 years are eligible for RACHS-1
Premature or < 30 days PDAs, Transplant surgeries are excluded from RACHS-1
Benchmarking Report

International Quality Improvement Collaborative for Congenital Heart Surgery in Developing World Countries

Annual Data Report 2015
Outcome Assessment:
2015 Aggregate Results
Surgical Procedures by RACHS-1 Risk Category
Patient Age at Surgery

Median age at surgery 1 year
(range 0-66 years)

Pediatric Health Information System (PHIS) (2015)
50 Free-standing Children’s Hospitals*

<table>
<thead>
<tr>
<th>Age</th>
<th>Percentage</th>
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</thead>
<tbody>
<tr>
<td>≤ 30 days</td>
<td>24.8%</td>
</tr>
<tr>
<td>31 days to &lt; 1 year</td>
<td>32.6%</td>
</tr>
<tr>
<td>1 to 17 years</td>
<td>42.6%</td>
</tr>
</tbody>
</table>

*Inclusion: Congenital Heart Surgery, Age <18 years, Eligible for RACHS-1
# Patient Characteristics

<table>
<thead>
<tr>
<th></th>
<th>Number</th>
<th>Percent</th>
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</thead>
<tbody>
<tr>
<td>Male</td>
<td>5906</td>
<td>55.1%</td>
</tr>
<tr>
<td>Prematurity</td>
<td>589</td>
<td>5.8%</td>
</tr>
<tr>
<td>Major Non-Cardiac Structural Anomaly</td>
<td>295</td>
<td>2.8%</td>
</tr>
<tr>
<td>Major Chromosomal Abnormality</td>
<td>702</td>
<td>6.6%</td>
</tr>
<tr>
<td>Major Medical Illness</td>
<td>1477</td>
<td>13.8%</td>
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</table>

<table>
<thead>
<tr>
<th></th>
<th>Number</th>
<th>Median</th>
<th>Range</th>
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</thead>
<tbody>
<tr>
<td>Weight (kg)</td>
<td>10718</td>
<td>8.7</td>
<td>(0.7, 110)</td>
</tr>
<tr>
<td>Oxygen Saturation (%)</td>
<td>10498</td>
<td>95</td>
<td>(8, 100)</td>
</tr>
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</table>
## RACHS-1 Risk Adjustment Model
(2010-2015 Aggregate Data)

<table>
<thead>
<tr>
<th>RACHS-1 Risk Category</th>
<th>Odds Ratio</th>
<th>95% Confidence Interval</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.0</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>2</td>
<td>3.1</td>
<td>(1.7, 5.4)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>3</td>
<td>9.6</td>
<td>(5.4, 17.0)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>4</td>
<td>12.1</td>
<td>(6.6, 22.2)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>5+6</td>
<td>51.7</td>
<td>(24.7, 108)</td>
<td>&lt;0.001</td>
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<table>
<thead>
<tr>
<th>Age at Surgery</th>
<th>Odds Ratio</th>
<th>95% Confidence Interval</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤30 days</td>
<td>4.3</td>
<td>(3.2, 5.8)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>31 days to &lt;1 year</td>
<td>1.9</td>
<td>(1.5, 2.3)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>1-17 years</td>
<td>1.0</td>
<td>---</td>
<td>---</td>
</tr>
</tbody>
</table>

| Prematurity            | 1.0        | (0.7, 1.5)              | 0.87   |
| Major Non-Cardiac Structural Anomaly | 2.5       | (1.7, 3.7)              | <0.001 |
| Multiple Cardiac Procedures | 1.0       | (0.8, 1.2)              | 0.81   |

**ROC**
C statistic for this model is 0.770
Standardized In-Hospital Mortality Ratio

2011 (14 sites), 2012 (24 sites), 2013 (25 sites), 2014 (24 sites), and 2015 (28 sites) versus 2010 benchmark (13 sites)

Standardized mortality rates are shown with 95% confidence intervals

Risk-adjusted in-hospital mortality is lower in each of the five years 2011 through 2015 relative to 2010, and has decreased since 2012.
In-Hospital Mortality Rate by RACHS-1 Risk Category

** Unadjusted Mortality Rate in U.S.: 2.9%
PHIS 2015, 50 free-standing children's hospitals
# Risk Factors for Infection
## 2010-2015 Aggregate Data

<table>
<thead>
<tr>
<th></th>
<th>Odds Ratio</th>
<th>95% Confidence Interval</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RACHS-1 Risk Category</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1.0</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>2</td>
<td>2.5</td>
<td>(1.5, 4.0)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>3</td>
<td>4.2</td>
<td>(2.6, 6.9)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>4</td>
<td>5.4</td>
<td>(3.2, 9.2)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>5+6</td>
<td>10.5</td>
<td>(5.1, 21.7)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td><strong>WHO Weight/BMI for Age Percentile</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>&lt;5th percentile</td>
<td>1.6</td>
<td>(1.3, 2.0)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>≥5th, &lt;15th percentile</td>
<td>1.2</td>
<td>(0.9, 1.7)</td>
<td>0.20</td>
</tr>
<tr>
<td>≥15th percentile</td>
<td>1.0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Any Preoperative Procedure</strong></td>
<td>2.0</td>
<td>(1.5, 2.5)</td>
<td>&lt;0.001</td>
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<tr>
<td><strong>Major Non-Cardiac Structural Anomaly</strong></td>
<td>2.1</td>
<td>(1.4, 3.1)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td><strong>Major Chromosomal Abnormality</strong></td>
<td>2.0</td>
<td>(1.5, 2.7)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td><strong>Major Medical Illness</strong></td>
<td>1.1</td>
<td>(0.8, 1.4)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td><strong>Oxygen Saturation &lt;85%</strong></td>
<td>1.4</td>
<td>(1.1, 1.7)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td><strong>ROC</strong></td>
<td></td>
<td></td>
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<tr>
<td>C statistic for this model is 0.769</td>
<td></td>
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</table>
Adjusted Major Infection Ratio

2011 (14 sites), 2012 (24 sites), 2013 (25 sites), 2014 (24 sites), and 2015 (28 sites) versus 2010 benchmark (13 sites)

Standardized infection rates are shown with 95% confidence intervals

Risk-adjusted major infection is lower in each of the five years 2011 through 2015 relative to 2010, and has decreased since 2013.
Major Infection Rate by RACHS-1 Risk Category

![Graph showing major infection rate by RACHS-1 risk category.

- Category 1: 1.1% with a range of 0 to 10.
- Category 2: 3.3% with a range of 0 to 10.
- Category 3: 7.2% with a range of 0 to 10.
- Category 4: 12.5% with a range of 0 to 27.
- Category 5+6: 27.0% with a range of 0 to 27.]
Reducing Mortality and Infections After Congenital Heart Surgery in the Developing World
*Pediatrics,* originally published online October 13, 2014;
DOI: 10.1542/peds.2014-0356

The online version of this article, along with updated information and services, is located on the World Wide Web at:
http://pediatrics.aappublications.org/content/early/2014/10/08/peds.2014-0356
International Society of Adult Congenital Heart Disease Cardiac Care Associate Research Award

“Adult Congenital Heart Disease in the Developing World”

Dorothy (Disty) Pearson, Curt Daniels, Kimberlee Gauvreau, Kathy Jenkins, Paul Khairy

Toronto ACHD Symposium, 5 June 2015
Manuscripts in Progress

Postoperative infections (resubmission in progress)
  – Lead author: Dr. Amitabh Sen
    Amrita Institute of Medical Sciences, Kochi, India

Transposition of the great arteries (resubmitted)
  – Lead author: Dr. David Schidlow
    Children’s National Medical Center, Washington, DC

Tetralogy of Fallot
  – Lead author: Dr. Nestor Sandoval
    Fundación Cardioinfantil, Bogotá, Colombia

Single ventricle
  – Lead author: Dr. David Schidlow
    Children’s National Medical Center, Washington, DC
Feedback from Sites on IQIC Experiences

“We have lately been performing complex procedures in congenital heart disease and Rheumatic Heart disease. The gradual, monitored, recovery of the patients compels us to say a big ‘Thank you’ to IQIC”

“From Latin America Regional Learning Session, “I guess there is always room for improvement, but I think it was a great opportunity to share the experiences with other site members. We even created a chat that will help us in a more regional level.”

“By participating with the IQIC learning session understood more about the pediatric care and how patient care related with quality improvement.”

“Thank you so much for this opportunity and all IQIC efforts into helping us provide great care!”
Feedback from Sites on IQIC Experiences

“Next week I will present...about IQIC and HNCA quality improvement results during 2012-2013 and 2014. It is going to be a great experience; been involved on such a wonderful program, that at the end we are offering good results decreasing mortality and we need now to improve on infection rate. Last week we organized on CICU a workshop on hand hygiene....Thank you again to support our Team with all the work IQIC Team does”
CINCO MOMENTOS DEL LAVADO DE MANOS

ANTES DEL CONTACTO CON EL PACIENTE

ANTES DE REALIZAR UNA TÉCNICA ASÉPTICA

DESPUÉS DE LA EXPOSICIÓN CON FLUIDOS CORPORALES O RIESGO DE CONTACTO CON LOS FLUIDOS

DESPUES DEL CONTACTO CON EL AMBIENTE CERCANO AL PACIENTE

Agua, jabón y acción evitamos infección.
Infrastructure Assessment Survey

Aim: Describe the current state of infrastructure for congenital cardiac surgery among IQIC sites

Status: Revising from feedback from pilot program at 3 IQIC sites to send to full Collaborative
Next Steps

- Infrastructure assessment survey
- Evaluation of ACHD outcomes
- Full collaborative learning session at WCPCCS 2017
- Develop improved risk adjustment model for IQIC cases (RACHS-Plus)

![RACHS-Plus Risk Adjustment Model]

RACHS-Plus Risk Adjustment Model

<table>
<thead>
<tr>
<th>RACHS-1 Risk Category</th>
<th>Odds Ratio</th>
<th>95% CI</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.0</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>2</td>
<td>4.2</td>
<td>(1.3, 13.7)</td>
<td>0.02</td>
</tr>
<tr>
<td>3</td>
<td>8.1</td>
<td>(2.0, 30.0)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>4+5+6</td>
<td>13.1</td>
<td>(7.7, 46.5)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Age at Surgery</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤ 30 days</td>
<td>3.3</td>
<td>(1.9, 5.6)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>31 days to &lt; 1 year</td>
<td>1.7</td>
<td>(1.1, 2.5)</td>
<td>&lt; 0.008</td>
</tr>
<tr>
<td>1 to 17 years</td>
<td>1.0</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>Prematurity</td>
<td>1.6</td>
<td>(0.8, 3.1)</td>
<td>0.18</td>
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<tr>
<td>Major Non-Cardiac Structural Anomaly</td>
<td>2.0</td>
<td>(0.8, 4.9)</td>
<td>0.12</td>
</tr>
<tr>
<td>Multiple Cardiac Procedures</td>
<td>2.0</td>
<td>(1.4, 3.0)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Oxygen Saturation &lt; 90%</td>
<td>3.0</td>
<td>(2.1, 4.4)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Major Chromosomal Abnormality</td>
<td>2.4</td>
<td>(1.3, 4.6)</td>
<td>0.006</td>
</tr>
<tr>
<td>Nutrition Appearance (Maincursed or Enacicated)</td>
<td>1.4</td>
<td>(1.0, 2.1)</td>
<td>0.005</td>
</tr>
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</table>

ROC: C Statistic for this model is 0.808

Taken from 2010 audited data.
Future Innovations and Initiatives

• Develop Catheterization Laboratory Registry
• Role of the Physician Assistant
• Incorporate End of Life Care webinars
Conclusions

• IQIC has allowed developing congenital heart surgical programs to understand outcomes compared to peers

• Adoption of interdisciplinary educational and quality improvement strategies has resulted in significant reductions in risk-adjusted mortality and infection

• Use of multiple forums to disseminate relevant skills and knowledge, with reinforcement from NGOs, have improved care among participating programs

• This strategy can reduce global disparities in access to life-saving procedures
Thank You!

Follow IQIC on Twitter: @IQICforCHD   Like IQIC on Facebook: www.facebook.com/IQICforCHD