NICU Length of Stay Initiative: Lessons Learned

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In the beginning:

I have this great idea!

C.O.P.E. can lower LOS in the NICU by 8 days! I only need $10K!

What’s your idea?

Dr. Brilli, Make it happen!

Dr. McCleod, Make it happen!

You gotta be $#!^ing me!

(Spring 2009)
Benefits of COPE

Cost Savings / Decreased Length of NICU Stay for Infants
- 4 day shorter length of NICU stay for preterms 26-34 weeks
- 8 day shorter length of NICU stay for preterms under 32 week

Improved Parent Outcomes
- Less stress in the NICU
- Stronger beliefs/confidence in their ability to care for their preterm infants
- More developmentally sensitive interactions with their preterm infants
- Less depression and anxiety symptoms during and after NICU stay

Greater satisfaction with the NICU stay
Higher readiness for their infant's discharge from the NICU
How can I reduce NICU LOS with only one intervention?

You Can’t!
Lesson # 1

• You must understand your data!
  • What does your population look like?
  • What factors contribute to long length of stay, and which factors can you impact?
  • What is a long length of stay?
  • Where are the data to answer these questions?
Two Populations Contribute to LOS

What is a long LOS?
What are the contributing factors to a long LOS?
What is the Average LOS?
# Why are infants hospitalized longer than 37 weeks CGA?

<table>
<thead>
<tr>
<th>Not Statistically Significant VON Data</th>
<th>Statistically Significant* VON Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Admit by DOL 3 or DOL 7</td>
<td>Lower EGA</td>
</tr>
<tr>
<td>Race</td>
<td>Inborn</td>
</tr>
<tr>
<td>Hispanic ethnicity</td>
<td>No Antenatal Steroids</td>
</tr>
<tr>
<td>No PNC</td>
<td>Male Gender</td>
</tr>
<tr>
<td>Delivery Mode</td>
<td>PDA</td>
</tr>
<tr>
<td>Multiple Gestation</td>
<td>PDA Ligation</td>
</tr>
<tr>
<td>HFV</td>
<td>Severe ROP/ ROP Surgery</td>
</tr>
<tr>
<td>RDS</td>
<td>Other Surgery</td>
</tr>
<tr>
<td>Steroids for BPD</td>
<td>Pneumothorax</td>
</tr>
<tr>
<td>Indocin therapy for PDA</td>
<td>GI Perforation</td>
</tr>
<tr>
<td>NEC</td>
<td>Congenital Malformation (Gastroscchisis)</td>
</tr>
<tr>
<td>NEC Surgery</td>
<td>CONS Sepsis</td>
</tr>
<tr>
<td>PVL</td>
<td>Oxygen at 36 weeks CGA</td>
</tr>
<tr>
<td>Fungal Sepsis</td>
<td>NAS</td>
</tr>
<tr>
<td>Late Bacterial Sepsis</td>
<td>* Items in red could be influenced by QI team</td>
</tr>
<tr>
<td>IVH</td>
<td></td>
</tr>
<tr>
<td>Home O2/monitor</td>
<td></td>
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</tbody>
</table>
Where do we start?

Start with engaged staff!
Lesson # 2

• Start with something that already is of interest to the staff, and has a physician and nurse champion!
  • COPE
  • Neonatal Abstinence Syndrome
  • Gastroschisis
  • Feeding failure
  • Palliative Care
How do I organize the QI work?

Decide on a QI methodology
Lesson # 3

• Choose a QI infrastructure!
  • Model for Improvement
  • Six-sigma/Lean
  • Toyota Production System
  • FOCUS-PDSA
What are we trying to accomplish?

How will we know that a change is an improvement?

What change can we make that will result in improvement?

Model for Improvement

Act  Plan

Study  Do
Repeated Use of the PDSA Cycle

**Hunches**

**Theories**

**Ideas**

**Changes That Result in Improvement**

**Implementation of Change**

**Wide-Scale Tests of Change**

**Follow-up Tests**

**Very Small Scale Test**

**DATA**

**APSD**

**APSD**

**APSD**

**APSD**

**APSD**

**APSD**
PDSA Cycles for Testing

Why Test?

- Increase your belief that the change will result in improvement
- Document how much improvement can be expected from the change
- Learn how to adapt the change to conditions in the local environment
- Evaluate costs and side-effects of the change
- Minimize resistance upon implementation
Lesson # 3

• Choose a QI infrastructure!
  • Model for Improvement
  • Six-sigma/Lean
  • Toyota Production System
  • FOCUS-PDSA

• Create a specific SMART aim and a key driver diagram
# Worksheet for Creating a SMART Aim Statement

<table>
<thead>
<tr>
<th>Specific</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>What is the goal or intent. Precisely and concisely describe what is to be achieved. It MUST focus on achieving only ONE thing.</strong></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Measurable</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>There is a direct relation between the increase and the decrease of a measure and the attainment or loss of the goal. Recommend: Start the Aim Statement with Increase/Decrease…then describe the object of what is to be measured</strong></td>
<td><strong>There are means with which to measure and monitor progress over time (to take, collect, and record the measurement)</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Actionable</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>The team can take action to overcome any known barriers to achieving the proposed measurable results</strong></td>
<td><strong>The ‘HOW’ of achieving this goal in NOT part of the Aim Statement (this would restrict other plausible solutions)</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Realistic</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Given the resources available, it is within the teams ability to achieve, control, or influence the Aim’s attainment</strong></td>
<td><strong>There is no significant that will compete with the time, attention or ability to achieve the goal</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Timely</th>
<th></th>
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</thead>
<tbody>
<tr>
<td><strong>The goal has a target date. If timeline is beyond 6 months there are interim Milestones. Recommend: …achieve intent by a specified date</strong></td>
<td><strong>There is nothing that should compete with the time and attention needed to achieve the goal</strong></td>
</tr>
</tbody>
</table>
Key Driver Diagram

• This Learning Structure helps everyone on the team from the physician to the housekeeper understand the approaches, recommendations, and processes that have to be followed to reach the goal.

• The diagram identifies and spells out acceptable practice for providing care and creates a common language that everyone is expected to follow.

• Without these interventions, you are less likely to achieve the goal.

• To the left of the key drivers are the components of “how” you will get there.

• Using a diagram like this as a visual can help to focus staff and management on the important and necessary things for reaching a positive outcome.

Global Aim & Key Drivers

**Global Specific Aim**

Reduce ALOS for all infants admitted to Main Campus Neonatal Services from a baseline* of 42.4 days to 28.4 days by **Sept 30, 2010**.

Balancing measures
- Mortality rate
- Readmission rate
- ED visit rate

**Key Drivers**

- Team Communication
- Care of ELBW Infants
- Care of NAS patient
- Care of Gastroschisis
- Care of lethal anomaly

**Design Changes/Interventions**

- Weekly meetings
- Monthly meetings
- QI Companion

- Establish small baby team
- Develop sub-aim with KDD & interventions

- Establish NAS QI Team
- Develop KDD with interventions

- Establish Gastroschisis Team
- Develop sub-aim with KDD & interventions

- Engage palliative care group
- Develop sub-aim with KDD & interventions

*Average LOS from Jan-Sept 2009
Aim & Key Drivers for SBP

**Specific Strategic Aim**

Reduce ALOS for infants ≤ 27 Weeks EGA admitted to Main Campus Neonatal Services from a baseline* of 95.5 days To 90.5 days by December 31, 2010.

**Key Drivers**

- **QI Team Communication**
- **Parent Empowerment**
- **Severity of illness on admission**
- **Feeding Failure**
- **Inadequate nursing documentation**

**Design Changes/Interventions**

- Weekly meetings
- Monthly meetings
- QI Companion
- Implement C.O.P.E. in SBP
- P.E.E.P. all main campus units
- Parent education complete before DOD
- Eliminate hypothermia (done)
- Standardize management of the PDA (MCSCA and RMH)-done
- Minimize surgical ligation
- Establish Feeding Failure Team-6/10
- Standardize feeding regimen-
- Conduct weekly feeding rounds-6/10
- Monitor feeding milestones
- Spread to C4 from J4- in progress
- Survey doctors for expectations
- Standardize Nursing documentation

**Balancing measures**

- Mortality rate
- Readmission rate
- ED visit rate

* Average LOS from Jan-Sept 2009
That is great, but how do I know when I have actually improved?

Look at your data
Lesson # 4

- Use charts and graphs to visualize your data

Run Chart

Waiting Time for Clinic Visit

Frequency Plot

Distribution of Wait Times

Pareto Chart

Clinic Wait Times > 30 days

Scatterplot

Relationship Between Long Waits and Capacity
Lesson # 4

• Use charts and graphs to visualize your data
• Understand variability using annotated statistical process control charting
  • Improved Visibility into Process & Outcomes
    • What kinds of problems are most prominent?
    • How is our performance changing over time?
    • What impact have our actions or interventions had?
All Processes Vary!

Common Cause Variation

Unavoidable variation inherent in the system. This will affect numbers of medication errors, falls, BSIs, etc. (within limited ranges). The amount of variation depends upon the system’s current characteristics, but a certain amount will always exist.

The point-to-point ups and downs in common cause variation are RANDOM. They do not have particular causes. Looking for cause is generally futile. And attributing a cause, however tempting that may be, is risky at best and can lead to misdirected efforts.

Common cause variation on a control chart is what generally appears between the control limits (with the exception of certain “special cause” patterns).
All Processes Vary!

Special Cause Variation

Variation that is not an inherent part of the system or process. It will generally arise from specific circumstances. Examples of potential special causes are:

- Faulty Materials or Equipment
- Unusually High/Low Patient Volume or increase/decrease in the proportion of high-risk patients.
- Unusual Staff Shortage
- Sudden Influx of New Staff
- Non-standardized practices (e.g., differences across shifts).

Special cause is indicated on a control chart by points outside the control limits or by certain patterns, for which we have several “rules of thumb” for recognizing.
When do you have special cause variation?

1 data point > 3 \( \delta \) from centerline
9 point in a row, above or below centerline
6 points in a row, all increasing or decreasing
2 of 3 points > 2 \( \delta \) from center line
15 points in a row within 1 \( \delta \) of centerline
Specific Aim: Reduce ALOS for infants < 27 Weeks EGA admitted to Main Campus Neonatal Services from a baseline* of 95.5 days to 90.5 days by December 31, 2010

Historical Mean and Control Limits from Jan-Aug 2009

Special Cause Variation (9 points at or below centerline)
Lesson # 4

• Use charts and graphs to visualize your data

• Understand variability using annotated statistical process control charting.

• When you find special cause variation, investigate its cause.
Impact of COPE/PEEP on Neonates admitted to Small Baby Pod

SBP LOS 12/08/08-10/26/10 Survivors

Dates of Admission
Impact of Feeding Program on LOS for infants < 32 weeks PMA without Surgical Problems of Congenital Anomalies
Specific Aim: Reduce ALOS for all infants admitted to Main Campus Neonatal Services from a baseline of 42.4 days to 28.4 days by Sept 30, 2011.
Balancing Measure for Specific Aim: Reduce ALOS for all infants admitted to Main Campus Neonatal Services from a baseline of 42.4 days to 28.4 days by Sept 30, 2011.

P Chart of All Deaths

Tests performed with unequal sample sizes
Montly Discharges from the NCH NICU (Jan 2009-April 2011)
APR-DRG Mortality Risk for Neonates admitted to Main Campus Neonatal Services

Xbar-S Chart of Risk of Mortality

Tests performed with unequal sample sizes
Lesson # 4

- Use charts and graphs to visualize your data
- Understand variability using annotated statistical process control charting.
- When you find special cause variation, investigate its cause.
- Track a balancing measure to make sure something untoward is not happening.
More on Lesson # 4

Use the right control chart to track your data
Mortality for all infants admitted to the NICU at RMH

P Chart of Mortality at RMH

Tests performed with unequal sample sizes
Mortality for all infants admitted to the NICU at RMH

G Chart of RMH Deaths

UCL = 282.695
CL = 70.300
LCL = 0.000
Lesson # 5

• When you find something that works to improve a process, spread the learning to another area!
Aim & Key Drivers for NAS

**Specific Aim**
Reduce LOS of main campus NAS patients from 31 to 24 days by December 31, 2010

**Key Drivers**
- Nursing Assessment
- Nursing Documentation
- Weaning Protocol
- Maternal Management

**Design Changes / Interventions**
- Education re patient assessment and scoring
- Compliance Monitoring
- Develop alternative Weaning protocol
- Collaborate with OBGYNs
LOS Data for Main Campus NAS Patients

Specific Aim: Reduce LOS of main campus NAS patients from 24.1 to 18 days by Sept 30, 2011

- Methadone Weaning Protocol
- NAS Task Force Convened
- Failed Morphine weaning protocol
- Surgical infant required opioid for pain control; began weaning DOL13
- IUGR infant required only 6 days of morphine but prolonged W/U for hypoglycemia
LOS Data for GMC NAS Patients

NAS Patients Discharged from GMC October 2009- January 2011

LOS (Days)

Black circle = Methadone wean
Blue triangle = Morphine wean

Methadone Protocol

Morphine Protocol

2009 2010 2011

Nationwide Children’s Hospital™
Lesson # 6

• Be careful of “before” and “after” comparison
Aim & Key Drivers for Gastroschisis

**Specific Aim**
Reduce LOS of uncomplicated Gastroschisis patients from 44 to 34 days by Sept 30, 2010

**Key Drivers**
- Guideline
- Feeding Delays
- Pain Management
- Discharge Preparation

**Design Changes / Interventions**
- Revise Guideline
- Obtain surgical support
- Monitor guideline use & explain Variances
- Surgical attending round 2x/wk
- Develop Feeding Plan per Jadcherla et al
- Standardized post-op protocol
- Implement protocol
- Develop & Implement Parent Road Map (Similar to COPE & PEEP)
Specific Aim: Reduce LOS of uncomplicated* Gastrochisis patients from 44 to 34 days by Sept 30, 2011

* Excludes premature infants < 34 weeks PMA and any infant with multiple surgeries (e.g. stenosis or atresia repairs)
Specific Aim: Reduce LOS of uncomplicated* Gastrochisis patients from 44 to 34 days by Sept 30, 2011

* Excludes premature infants < 34 weeks PMA and any infant with multiple surgeries (e.g. stenosis or atresia repairs)
Lesson # 7

• When you introduce a “test of change,” monitor compliance.
Gastroschisis Timeline Review
First Infant on Protocol

LOS = 44 days
## Lesson # 8

- **Track the performance of the teams**

<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>Team has been formed; target population identified; baseline measurement begun.</td>
</tr>
<tr>
<td>1.5</td>
<td>Team is meeting, discussion is occurring. Plans for the project have been made.</td>
</tr>
<tr>
<td>2.0</td>
<td>Team actively engaged in development and discussion, but no changes have been tested.</td>
</tr>
<tr>
<td>2.5</td>
<td>Components of Change Package being tested but no improvement in measures. Data on measures are being reported.</td>
</tr>
<tr>
<td>3.0</td>
<td>Initial test cycles have been completed and implementation begun for several components. Evidence of moderate improvement in process measures.</td>
</tr>
<tr>
<td>3.5</td>
<td>Some improvement in outcome measures, process measures continuing to improve, PDSA cycles on multiple components of the Change Package.</td>
</tr>
<tr>
<td>4.0</td>
<td><strong>Evidence of sustained improvement in outcome measures, halfway toward accomplishing all of the goals. Plans for spreading the improvements are in place.</strong></td>
</tr>
<tr>
<td>4.5</td>
<td>Sustained improvement in outcome measures, 75% of goals achieved, spread to a larger population has begun.</td>
</tr>
<tr>
<td>5.0</td>
<td>Major change in all areas of the Change Package has occurred, all goals of the AIM have been accomplished, outcome measures at national benchmark levels, and spread to another department is underway.</td>
</tr>
</tbody>
</table>
Lesson # 9

• For big QI projects, you need senior leadership on board.
NICU LOS Reduction Project

Results to Date

1. Overall ALOS for main campus NICU has decreased 7 days from 42 to 35 days.
2. ALOS for infants < 27 weeks EGA admitted to main campus NICU has decreased 10 days from 95-85 days.
3. ALOS for main campus NAS patient has decreased 7 days from 31 to 24 days. ALOS for NAS patients at offsite nurseries has decreased to < 20 days.
4. ALOS for infants with uncomplicated gastroschisis has decreased ~ 9 days from 44 to 35 days.
5. Over 4,000 unnecessary patient days have been avoided since June 2010.
6. The estimated financial impact of the project to date is in excess of $6,000,000.
Aim & Key Drivers for Intestinal Injury

**Strategic Aim**
Reduce the incidence of NEC in infants ≤ 1500 g Birth weight from 7.4% to 3.8%* by December 31, 2012

**Key Drivers**
- Feeding Protocol
- Transfusion Policy
- Restrict feeds
- Engagement by referring Hospital NICU/SCNs

**Design Changes / Interventions**
- Feed according to protocol
  - Feed mothers own milk or Donor breast milk exclusively
  - Perform oral care with EBM
- Avoid routine transfusions for Hb > 7 g/dL
- Hold feeds during transfusion
- Meet with medical directors of all Referring NICU/SCNs to obtain Agreement to feeding protocol and Transfusion guidelines

* NEC @ NCH, 7.4%
CHCA Lower quartile, 3.8%