Use of Quality Improvement Methodology to Improve the Safety of Intravenous Infusions in a Pediatric Rheumatology Practice at a Tertiary Care Children’s Hospital

Pai-Yue Lu, MD
J Taylor, M El-Hallak, DW Moser, KA Sikora, T Moore, JV Ranz, J Thomas, G McIntyre-Patton, JL Huggins, TV Ting

Cincinnati Children’s Hospital Medical Center (CCHMC)
Division of Pediatric Rheumatology
Cincinnati, OH

Disclosures

• I have no relevant financial relationships to disclose

References

Clinical Data Published in a Scientific Journal:

An Infusion Incident

• A patient received the incorrect medication:
  – Abatacept was given instead of tocilizumab

A Precursor Event

• Upon review of the incident, it was deemed a “precursor” event
• The following system failures were identified:
  – Infusion was scheduled last minute
  – Scheduled infusion was not communicated to appropriate providers
  – Previous “signed and held” orders for abatacept were present in the computerized order entry system (Epic)
  – No expiration date for signed and held orders
  – Confusion by bedside nursing staff regarding medication names

Intravenous Infusions in Pediatrics

• Safe administration of intravenous (IV) infusions in pediatric patients is a complex process
• Medication errors and medication-related potential adverse events occur more often in children compared to adults
  – Weight-based dosing
  – Dilution of stock solutions
  – Patient’s communication level
  – Pediatric physiology and ability to handle variations in medication dosages
A Computerized Order Entry System

- Reduction of medication error rates is conflicting
- New forms of error arise
  - Duplication error
  - Drop-down menu selection error
  - Keypad entry error
  - Order set error

Our Institution

- Cincinnati Children’s Hospital Medical Center is a free-standing tertiary care children’s hospital
  - Inpatient capacity fluctuates around 350 patients at any one time
- The Division of Pediatric Rheumatology has over 5,000 ambulatory patient visits a year

IV Infusions We Prescribe

- Eight providers prescribe IV infusions
  - Infliximab
  - Abatacept
  - IVIG
  - Tocilizumab
  - Methylprednisolone
  - Cyclophosphamide
  - Pamidronate
  - Rituximab
- Infusions administered at 4 different sites

Patients Receiving Infusions in September 2011 (n = 76)

- Infliximab (n=25)
- Abatacept (n=20)
- IVIG (n=15)
- Tocilizumab (n=10)
- Methylprednisolone (n=6)
- Cyclophosphamide (n=2)
- Pamidronate (n=1)
- Rituximab (n=1)

- Average number of infusions scheduled monthly has increased from 39 to 62

Objectives

- Global Aim:
  - To develop a significantly improved process where all IV infusions are given in a planned and safe manner, eliminating care delays and patient safety concerns while maximizing patient safety and provider satisfaction

- SMART Aim:
  - To achieve a zero percent error rate on all IV infusion orders by May 2012

Methods

- Developed a multidisciplinary rheumatology improvement team led by clinical fellows:
  - 2 attendings
  - 1 nurse practitioner
  - 2-3 fellows
  - 2 nurses
  - 1 clinical service representative (CSR)
- Meetings occurred on a weekly to monthly basis
**KEY DRIVER DIAGRAM**

**KEY DRIVERS**
- Provider awareness of infusions
- Patient and family awareness of infusion process
- Standardization and centralization of documenting infusion medications and doses
- Appropriate transcription of infusion orders into Epic
- Communication amongst clinic, patient, and infusion units
- Appropriate scheduling of infusions

**SMART AIM**
- To achieve a zero percent error rate on all IV infusions by May 2012

**GLOBAL AIM**
- Improve rheumatology patient safety

**INTerventions**
- Improve communication between clinical service representatives, nursing, and physicians
  - Reliability Level: 1
- Development of a patient monitoring tool
  - Reliability Level: 1
- Further development of master order sheets and order sets in Epic
  - Reliability Level: 2
- Collaboration with Epic
  - Members to set an expiration date on infusion orders
  - Reliability Level: 2
- Development of a system to monitor infusion frequency and catch overdue infusions
  - Reliability Level: 2/3

---

**FMEA: Order Preparation and Entry for Rheumatology Infusions**

1. Standards method to find recent weight
2. Increase vigilance
3. Prompts to alert providers
4. Back-up call provider
5. Provider contacted if scheduling non-standard
6. Nurse emails providers
7. Provider reviews master, edit, or updates orders, places in "To Act" tray
8. Follow reviews orders
9. Orders placed in Epic by fellow
10. New Epic order set
11. Back-up providers assure with order entry
12. Weight not updated

---

**PDSA (Plan-Do-Study-Act) Cycle**

**Plan**
- Infusion order set updated
- Master orders updated

**Do**
- Infusion order set updated
- Master orders updated

**Study**
- Infusion order set updated
- Master orders updated

**Act**
- Infusion order set updated
- Master orders updated

---

**Where are we now?**

- **Order Entry**
  - Continue to work on improving our process
  - Institution-wide change: signed and held orders expire after 90 days

- **Scheduling**
  - Generation of encounter reports
  - Development of a tracking system
Summary

- Analysis of a precursor event encouraged us to step up quality improvement initiatives for IV infusions in our patients and led to an institutional change
- Tools: process flow map, key driver diagram, FMEA’s, PDSA’s, Pareto charts
- Preliminary data (run charts) and future directions

Lessons Learned

- Quality improvement allows for systematic evaluation of processes and errors and guides implementation and tests of change
- One precursor event is capable of inciting change on an institutional level
- Improving safety is a gradual process and continued monitoring and re-evaluation is essential

Acknowledgements

Providers
Jennifer Huggins, MD
Janalee Taylor, CNP
Tracy Ting, MD, MSc

Fellows
Moussa El-Hallak, MD
David Moser, DO
Keith Sikora, MD
Patricia Vega-Fernandez, MD

Clinic Nurses
Terry Moore, RN
Julie Ranz, RN

Clinical Services
Judy Thomas, CSR

Infusion Nurses
Grace McIntyre-Patton, RN
Patti Mercurio, RN

References

Clinical Data Published in a Scientific Journal:
Types of Events

- **SERIOUS SAFETY EVENT**: Any unanticipated event involving death, life-threatening consequences, or serious physical or psychological injury.
- **PRECURSOR EVENT**: An event that did reach the patient but resulted in minimal or temporary harm.
- **NEAR MISS**: An event that almost happened, but the error was caught by one last error detection barrier.

Infusions at CCHMC as of October 2011

<table>
<thead>
<tr>
<th>Infusion</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infliximab (n=28)</td>
<td>34</td>
</tr>
<tr>
<td>Abatacept (n=21)</td>
<td>26</td>
</tr>
<tr>
<td>IVIG (n=15)</td>
<td>18</td>
</tr>
<tr>
<td>Tocilizumab (n=12)</td>
<td>14</td>
</tr>
<tr>
<td>Methylprednisolone (n=5)</td>
<td>6</td>
</tr>
<tr>
<td>Cyclophosphamide (n=1)</td>
<td>1</td>
</tr>
<tr>
<td>Pamidronate (n=1)</td>
<td>1</td>
</tr>
<tr>
<td>Rituximab (n=0)</td>
<td>0</td>
</tr>
<tr>
<td>Total (n=82)</td>
<td>100</td>
</tr>
</tbody>
</table>
Methods

- Performed process flow mapping of the IV infusion system, including scheduling, communication among staff and providers, and order entry.
- Gathered data on the existing process.
- Conducted Failure Mode and Effects Analyses (FMEA)

Methods

- Monitored order errors.
- Performed Plan-Do-Study-Act (PDSA) cycles, which focused on 4 areas of change concepts:
  - improved work flow
  - improved communication
  - process standardization
  - building reliability