Residency Project Pearls

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THE IMPACT OF IMPLEMENTING A β-LACTAM ALLERGY GUIDELINE AT A LARGE ACADEMIC MEDICAL CENTER

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CONFLICTS OF INTEREST

The speaker and authors of this study have no actual or potential conflicts of interest

RUMC POST-GUIDELINE STUDY

• Setting
  – Rush University Medical Center
    • Chicago, IL
  – 664-bed Academic Medical Center
  – Intensive care units
    • Medical: 24 beds
    • Cardiac: 28 beds
    • Surgical: 22 beds
    • Neuroscience: 28 beds

OBJECTIVES

• Recognize the true cross-reactivity between penicillins, cephalosporins, and carbapenems in β-lactam antibiotics.

• Identify patients with reported β-lactam allergies who can safely tolerate β-lactam antibiotics

BACKGROUND

• β-Lactam class - most commonly reported medication allergies\(^1\)
  – 10% of patients report an allergy to penicillin\(^2\)

• 80-90% of reported PCN allergies:
  – Negative PCN skin test suggesting PCN tolerance.\(^2\)

• If PCN skin test positive → Likely IgE mediated → Life-threatening

**Types of Reactions**

<table>
<thead>
<tr>
<th>Type I: IgE-Mediated</th>
<th>Type II: Cytotoxic (IgG, IgM-complement)</th>
<th>Type IV: Cellular/delayed (T lymphocytes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe</td>
<td>Hemolysis, thrombocytopenia, neutropenia, or interstitial nephritis</td>
<td>- Contact dermatitis - Delayed non-urticarial rashes</td>
</tr>
<tr>
<td>- Immediate (&lt;1 hr)</td>
<td>- Rash, urticaria, angioedema, bronchospasm</td>
<td>- Serum sickness - Fever, rash, urticaria, lymphadenopathy, and arthralgias - Onset 7-14 days</td>
</tr>
<tr>
<td>- Delayed onset (1-72 hrs)</td>
<td></td>
<td>- SJS, TEN, drug fever</td>
</tr>
<tr>
<td>Non-Severe</td>
<td>Type III: Immune complex (IgG, IgM immune complex)</td>
<td>Idiopathic</td>
</tr>
<tr>
<td>- Rash, urticaria, angioedema</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Penicillin Skin Test**

- Gold standard for ruling out IgE-mediated reactions
  - Negative predictive value: 97-99%
- Safe, with minimal discomfort
- Rapid: Less than one hour
- Drawbacks
  - Costly
  - Requires special technique

**CROSS-REACTIVITY**

- Cephalosporins
  - Historically: 10% reaction risk if allergic to PCN
    - 2/5 major reports were from the 1970's
    - Contaminated with trace amounts of PCN
    - Not PCN skin tested
  - Cross-reactivity risk ~2% when adjusted for reports prior to 1980.

- Carbapenems
  - Limited data
  - Presumed high due to structural similarity to PCN
  - 1988 study:
    - 20-40% correlation
  - 2014 systematic review:
    - 854 PCN allergic patients → Cross-reactivity < 1%

**B-lactam Chemical Structure**

- Share a four-membered cyclic amide (lactam)
CLINICAL IMPLICATIONS

- Patients with penicillin allergies are more likely to:
  - Receive broad spectrum antibiotics
  - Experience antibiotic resistance
  - Greater drug toxicity
  - Suboptimal therapy
  - Higher costs


RUMC DATA

- Prevalence of reported β-lactam allergies
  - 5806 of 93,854 (6.2%) patients admitted from 1/2011 to 12/2014

- Reported allergens

<table>
<thead>
<tr>
<th>Allergen</th>
<th>Prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penicillin</td>
<td>67.7%</td>
</tr>
<tr>
<td>Cephalosporins</td>
<td>(13.7%)</td>
</tr>
<tr>
<td>Carbapenems</td>
<td>(9.4%)</td>
</tr>
<tr>
<td>Aztreonam</td>
<td>(0.2%)</td>
</tr>
</tbody>
</table>

OF PATIENTS WHO REPORT ALLERGY TO β-LACTAM ANTIBIOTICS, WHAT PERCENTAGE IS EXPECTED TO SAFELY TOLERATE THESE ANTIBIOTICS?

A. > 90%
B. 60 – 80%
C. 20 – 40%
D. < 10%

A PATIENT ALLERGIC TO PENICILLIN IS _____% LIKELY TO REACT TO CEFTRIAXONE.

A. ≥ 50%
B. 15-25%
C. 10%
D. ≤ 5%

ADDRESSING THE PROBLEM

- What we know
  - Prevalence of true type 1 allergy: low
  - Cross-reactivity of PCN and β-lactams: low
  - PCN skin test reliable, but widespread use impractical
RUMC GUIDELINE

Figure 1. β-Lactam Allergy Practice Parameter Algorithm (Adapted from UI Health)


Non Type I Possible Type I Type I

GRADE CHALLENGE

• Cautious administration of medication to patient who is unlikely to be allergic
• Choose antibiotic with dissimilar side chain
• Process

Which of the following patients is the best candidate for a ceftriaxone graded challenge?

<table>
<thead>
<tr>
<th>Patient</th>
<th>Allergy</th>
<th>Reaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Penicillin</td>
<td>Nausea and Headache</td>
</tr>
<tr>
<td>B</td>
<td>Penicillin</td>
<td>Rash</td>
</tr>
<tr>
<td>C</td>
<td>Penicillin</td>
<td>Anaphylaxis and hives</td>
</tr>
<tr>
<td>D</td>
<td>Penicillin</td>
<td>Rash, but tolerated ceftriaxone during previous admission</td>
</tr>
</tbody>
</table>
GUIDELINE OBSTACLES

- Staff awareness and compliance
- Ambiguity in classifying type of allergy
- Increased liability and apprehension of reaction
- Ordering and preparation
- Requirement to consult Allergy and Immunology (A&I) prior to graded challenge attempt

GUIDELINE IMPLEMENTATION

Interdisciplinary Collaboration

Mass Education

Guideline Improvement

June 2015

Operational Initiatives

March 2016...

PROMOTING GUIDELINE USE

- Interdisciplinary collaboration
  - Allergy and Immunology (A&I)
  - Infectious Diseases (ID)
  - Nursing

PROMOTING GUIDELINE USE

- Education
  - House‐staff
    - ID Grand Rounds
    - Internal Medicine Noon Conference
  - Pharmacy
    - Pharmacy Grand Rounds
  - Nursing
    - In‐services provided to different units

PROMOTING GUIDELINE USE

- Operational Initiatives
  - Order‐set development and optimization
    - November 2015
  - Technician instructions for IV preparation
    - On‐going. Ex Ceftazidime added in March, 2016
  - Infusion pump library update
    - November 2015

GRADED CHALLENGE ORDER SET
**Graded Challenge Order Set**

- Nursing instructions
- Built-in prn orders
- Nursing
  - New Protocol - Graded Challenge
  - Follow-up Care - Graded Challenge

**Promoting Guideline Use**

- Guideline Improvements
  - Removing A&I consult requirement for graded challenges
  - Elucidating definition of allergy type
  - Redesigning of β-Lactam Side Chain Chart

**RUMC Post-Guideline Study**

- Purpose
  - Assess β-Lactam Allergy guideline implementation and impact of educational interventions
- Outcomes
  - Primary Endpoint
    - Number of Graded Challenges
  - Secondary Endpoint
    - Use of broad-spectrum antibiotics
      - (vancomycin, levofloxacin, clindamycin) and aztreonam
    - Use of β-Lactams

**Results**

- Types of Allergies
  - Pre-guideline
    - Jun – Dec 2014
    - N=200
    - Non-Type 1: 28%
    - Type 1: 39%
    - Possible Type 1: 34%
  - Post-guideline
    - Jun – Dec 2015
    - N=200
    - Non-Type 1: 36%
    - Type 1: 34%
    - Possible Type 1: 31%

- Results
  - Number of Graded Challenges
    - Jan – Mar 2015: 0
    - Apr – Jun 2015: 1
    - Jul – Sep 2015: 2
    - Oct – Dec 2015: 3
    - Jan – Mar 2016: 6

- Results
  - Primary Outcome
    - 12 Graded Challenges
      - 7 of 12 → Jan – March 2016
        - 6 of last 7 without A&I consult
      - With the exception of 1 patient, all were able to safely tolerate graded challenge
        - Deviation from protocol
      - Allergy documentation updated to allow future use of tolerated agent
RESULTS

- Secondary Endpoints
  - Use of broad-spectrum antibiotics

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Jun - Dec 2014 (N=200)</th>
<th>Jun - Dec 2015 (N=200)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Composite Use of Broad Spectrum Use</td>
<td>196 (98%)</td>
<td>187 (94%)</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Eszopiclone</td>
<td>79 (40%)</td>
<td>53 (27%)</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Levetiracetam</td>
<td>81 (41%)</td>
<td>77 (39%)</td>
<td>0.79</td>
</tr>
<tr>
<td>Clindamycin</td>
<td>101 (51%)</td>
<td>110 (55%)</td>
<td>0.53</td>
</tr>
<tr>
<td>Aztreonam</td>
<td>12 (6%)</td>
<td>4 (2%)</td>
<td>&lt;0.05</td>
</tr>
</tbody>
</table>

- β-Lactam Use

<table>
<thead>
<tr>
<th>Year</th>
<th>Non Beta-Lactam</th>
<th>Beta-Lactam</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>35%</td>
<td>65%</td>
</tr>
<tr>
<td>2015</td>
<td>48%</td>
<td>52%</td>
</tr>
</tbody>
</table>

CONCLUSION

- Implementation of a β-Lactam allergy guideline at a Large Academic Medical Center
  - Complex, multifaceted process
  - Requires
    - Strong collaboration
    - Education
    - Ongoing process improvement

CONCLUSION

- Ongoing Process
  - Protocol/operational improvements
  - Team education by pharmacists
  - Inter-professional collaboration
  - Next steps...
    - Multi-annual, retrospective review ➔ Patient outcome focus

CONCLUSION

- Developing a β-Lactam Allergy Guideline is a must in order to increase use of β-Lactam antibiotics in penicillin-allergic patients

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- Mary Tobin, MD
- Sarah Won, MD, MPH
REFERENCES


Preferences for Patient Medication List Structure to Optimize Utilization

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"The speaker has no actual or potential Conflict of Interest in relation to this presentation."

Objectives

- Identify barriers to medication list utilization for physicians and other healthcare professionals
- Describe preliminary pilot data on understanding patient utilization of their medication list

Limitations to Medication List Utilization

- Patient
  - Communication and understanding
  - Limited medication self-management

- Provider
  - Time
  - Lack of confidence
  - Patient utilization
  - Accuracy

Medication Errors

- ≥ 6 medications can lead to medication errors1
  - Regimen complexity decreases adherence2
- The Joint Commission: 2008 National Patient Safety Goals3-4
  - Prioritized medication reconciliation
  - Patients should be provided with a medication card with a list of all medication
  - 48-98% of medication lists contain discrepancies3

Limitations to Medication List Utilization

- Patient
  - Communication and understanding
  - Limited medication self-management

- Provider
  - Time
  - Lack of confidence
  - Patient utilization
  - Accuracy

Literature Review: Provider Perspective

<table>
<thead>
<tr>
<th>Author</th>
<th>Objective</th>
<th>Study Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rahmerer et al.</td>
<td>General practitioners’ perspective</td>
<td>Prescribers feel responsible only for their own prescriptions</td>
</tr>
<tr>
<td>Leonhardt et al.</td>
<td>Interventions can improve medication list accuracy</td>
<td>Medication list accuracy improves with both patient and provider involvement</td>
</tr>
</tbody>
</table>

References


Literature Limitations

- How can providers utilize the medication list to improve communication?
- What aspects of the medication list are utilized for patient care activities?
- Do all healthcare providers utilize the same information from the medication list?
- What variations exist between different healthcare providers?

Pilot Study

- Survey conducted at Dreyer Medical Clinic and Midwestern University
  - Patients
  - Healthcare professionals
    - Physicians
    - Nurses
    - CMAs
    - Pharmacists
  - Patient focus group
    - Patient insight into medication utilization and contents

Pilot Study

<table>
<thead>
<tr>
<th>Healthcare Professionals</th>
<th>Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>(n=24)</td>
<td>(n=41)</td>
</tr>
<tr>
<td>List used to know:</td>
<td>Survey</td>
</tr>
<tr>
<td>Which medications</td>
<td>Use list to know indication</td>
</tr>
<tr>
<td>When medication taken</td>
<td>Preferred contents:</td>
</tr>
<tr>
<td>Preferred contents:</td>
<td>- When to seek care</td>
</tr>
<tr>
<td>Brand/generic</td>
<td>- Directions</td>
</tr>
<tr>
<td>Indication</td>
<td>Focus Group</td>
</tr>
<tr>
<td>Prescriber</td>
<td>Format of medication list could be improved</td>
</tr>
<tr>
<td>Date medication started</td>
<td></td>
</tr>
<tr>
<td>Allergies/intolerances</td>
<td></td>
</tr>
</tbody>
</table>

Survey Expansion

- Improve Survey
  - Question wording
- Single Clinic Site
  - Outpatient health professionals only
- Sample Size
  - Few physician responses with pilot study

Primary Aim

- Primary Aim 1
  - Determine how physicians utilize medication lists generated by the electronic health record (EHR)
  - Hypothesis
    - Medication lists are not being utilized to the fullest potential

Primary Aim

- Primary Aim 2
  - To identify physician desired content and formatting of an optimal medication list in order to assist in defining a standard
  - Hypothesis
    - Desired content will vary among physicians; however, it is anticipated common themes in design will emerge
Study Methods

- Study Design
  - Cross-sectional Survey
  - Physicians
    - Email distribution of survey
  - Distributed throughout Illinois

Criteria

Inclusion
- Active Illinois license
- Email listed within database provided by 3rd party affiliate of American Medical Association

Exclusion
- Unable to complete survey in English

Survey Procedures

- Estimated sample size: ~5000 physicians
  - Completion rate: 24%
  - Anticipated completed: 1200 surveys
- Incentive
  - 1 of 3 $10 gift cards

Survey

- Estimated time to complete: 5-10 minutes
  - Revisions incorporated based on pilot study results
- Demographics
- Section 1: Medication list utilization
  - Which
  - When
  - How
  - Why
- Section 2: Preferred medication list characteristics
  - 13 Questions:
    - Brand/generic
    - Prescriber
    - Adverse effects
    - Efficacy
  - Start date
  - Date of next refill
  - Start date
- Section 3: How medications are arranged
  - Alphabetical
  - Indication
  - Time of day
  - Start date
Statistical Analysis

- Descriptive statistics

Results

### Characteristics of Survey Respondents

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Male, (%)</th>
<th>n=18</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average age, years</td>
<td>52</td>
<td></td>
</tr>
<tr>
<td>Average years in practice</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White, (%)</td>
<td>61</td>
<td></td>
</tr>
<tr>
<td>Black, (%)</td>
<td>5.6</td>
<td></td>
</tr>
<tr>
<td>Asian, (%)</td>
<td>22.2</td>
<td></td>
</tr>
<tr>
<td>Hispanic, (%)</td>
<td>11.1</td>
<td></td>
</tr>
<tr>
<td>Area of Practice</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internal Medicine, (%)</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>Family Practice, (%)</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>Specialty, (%)</td>
<td>72</td>
<td></td>
</tr>
</tbody>
</table>

Results

#### What type of information do you gain from medication lists provided by patients?

<table>
<thead>
<tr>
<th>Why patients take medications</th>
<th>n=18</th>
</tr>
</thead>
<tbody>
<tr>
<td>How patients take medications</td>
<td></td>
</tr>
<tr>
<td>When patients take medications</td>
<td></td>
</tr>
<tr>
<td>Which medication prescribed</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number of Responses</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Results

#### Likert Scale Response

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>n=18</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medication allergies</td>
<td>2.89</td>
</tr>
<tr>
<td>Indication</td>
<td>2.72</td>
</tr>
<tr>
<td>Intolerance to medications</td>
<td>2.72</td>
</tr>
<tr>
<td>Start date of medication</td>
<td>2.72</td>
</tr>
<tr>
<td>Reasons of discontinuation of previous medications</td>
<td>2.72</td>
</tr>
<tr>
<td>Medication generic name</td>
<td>2.61</td>
</tr>
<tr>
<td>Anticipated duration of therapy</td>
<td>2.61</td>
</tr>
<tr>
<td>Prescribing provider</td>
<td>2.61</td>
</tr>
<tr>
<td>Medication brand name</td>
<td>2.44</td>
</tr>
<tr>
<td>How medication is taken</td>
<td>2.44</td>
</tr>
<tr>
<td>When medication is taken</td>
<td>2.44</td>
</tr>
<tr>
<td>Goal of therapy</td>
<td>2.39</td>
</tr>
<tr>
<td>History of previous medications</td>
<td>2.39</td>
</tr>
<tr>
<td>Next refill date</td>
<td>2.34</td>
</tr>
</tbody>
</table>

* Likert scale response of 1 indicates Not at all helpful, 2 Somewhat helpful and 3 Very helpful

Limitations

- Low response rate
- Limited external validity
  - Limited to those listed within registries
- Survey not validated
- Response bias
- Physicians only

Future directions

- Increase survey distribution
  - Other healthcare professionals
  - Patients
    - Partner with Illinois Medication Safety Coalition
- Create optimized, standardized medication list
  - Determine outcomes with various medication list formats
  - Recommend changes to EHR providers
Research Lessons

- Survey as a research tool
  - Survey question writing
  - Sample size
  - Survey distribution method

- Creating a line of research
  - Importance of pilot data
  - End goal vs “next steps”

Which of the following is a barrier for provider utilization of medication lists?

A. Lack of time to verify accuracy of the medications on the patient’s medication list.
B. Understanding of the electronic health record functions, resources and capabilities.
C. Patient utilization of medication cards to provide an accurate medication list.
D. Patients often have an abundance of medication self-management and adherence.

Which of the following statements is correct?

A. Pilot data to date shows no improvements are necessary for patient medication lists.
B. Patient focus group data demonstrates areas for improvement including formatting of the medication list.
C. An initial pharmacist survey demonstrated that pharmacist most prefer for medications to be listed chronologically.
D. There is an abundance of literature assessing how patients and providers are currently utilizing medication lists.

Acknowledgements

- Jill S. Borchert, PharmD, BCPS, BCACP, FCCP
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- Midwestern University Chicago College of Pharmacy

References

- Chae SY, Chae MH et al. The patient medication list: can we get patients more involved in their medical care? J Am Board Fam Med. 2009;22(7):489.
- The speaker and authors of this study have no actual or potential conflicts of interest.
**Learning Objectives**

- Describe lean methodology processes and how they can be applied to pharmacy workflow.
- Identify factors specific to the inpatient pediatric setting that can contribute to increased medication waste.

**Background**

- Studies estimate 20-30% of medications are wasted on average at a healthcare institution.

- Given the increasing costs of healthcare, a multi-faceted approach including an efficient dispensing workflow is necessary to reduce waste.

**Project Background**

What causes medication waste?

- Potential modes of waste can occur between time of preparation of medication to time of administration:
  1. Provider could change the dose
  2. Change the route of administration
  3. Drug could be discontinued
  4. Patient could be discharged

  The longer the period of time between time of preparation to time of administration, the more potential for waste.

**Background**

- Waste potential is especially pertinent in the pediatric population.

- Majority of pediatrics dosing is weight-based and thus medications prepared are patient-specific doses:
  - Require individual drawing up in pharmacy
  - Drawn up drug cannot be re-used
  - Short expiration

- Pediatric patients’ weight and fluid status are more frequently changing, often requiring dose adjustments.

**Approximately what percentage of dispensed medications from an inpatient pharmacy are later wasted?**

- A. 0% - 10%
- B. 10% - 20%
- C. 20% - 30%
- D. 30% - 40%

**Methods of getting the medication to the floor:**

- **Just-in-time Dosing:** Each medication dose is dispensed from pharmacy right before scheduled administration time.

- **Automated Dispensing Cabinets:** Medications are stocked on nursing unit and released at administration time of order.

- **Cart-fill/Batch:** Scheduled medications are prepared and delivered in batches in advance based on scheduled due times.
Which of the following is a disadvantage of “just-in-time” preparation?

A. Increased amounts of expired medications on the floor
B. Can result in delays getting the medication to the floor
C. Often requires keeping high amounts of inventory on hand to supply large batches
D. Increased amount of medications being wasted

Study Objective

➢ To construct a multiple-batch medication preparation schedule in the pediatric setting and evaluate its impact on medication waste outcomes

Study Design

- **Post-implementation case study**
- **Study Setting:** Rush University Medical Center Pediatric Satellite
- **Study Period:** Pre-intervention: 07/2015 – 10/2016; Intervention: 12/2015
- **Inclusion Criteria:** All pediatric oral and IV medications prepared in the batch

Methods

- **Step 1:** Analysis of current data and resources to determine an optimum new batching schedule
- **Step 2:** Implementation of new batching schedule
- **Step 3:** Analysis of post-implementation data collection

Rush University Medical Center:

- 664 bed tertiary care academic medical center located in Chicago
- Pediatric pharmacy section within a large hospital that serves only the pediatric floors
- Floors covered:
  - Peds Psych – 15 beds
  - PICU – 18 beds
  - Gen Peds – 22 beds
  - Mother/Baby – 23-34 beds
  - Labor & Delivery – 10 beds
  - NICU – 60 beds

Methods – Step 1: New Batch

- An optimum batching schedule was determined based upon the following data points retrieved from EPIC
  - Medication ordering times
  - Medication administration times
- Current workflow and resources were also taken into account to determine feasible schedule
Pre-Implementation Workflow

- Pediatric satellite open from 7:00 - 20:30
- 7:00 - 15:30: AM pediatric pharmacist and AM pediatric technician
- 12:00 - 20:30: PM pediatric pharmacist and PM pediatric technician
- Rounding generally occurs from 08:00-12:00
- Consult services round in afternoon

Pre-Implementation Workflow

- Pre-implementation: one batch for pediatric medications that need to be compounded
- Batch prints at noon with all oral and IV pediatric medications that are scheduled for 24 hour period
- High potential for waste

Batch Prints
Meds Prepared and Delivered
5PM – 4:59PM (next day)

Pre-Implementation Workflow

- Peak administration times: 9AM, 9PM

Administration Times for Medication Orders Per Each Hour of Day

Methods – Step 2: Implementation

- Implemented a 10-day pilot with the new batch on weekdays only
- Updated technician and pharmacist workflows
- Education and training for affected groups
  - Pharmacy Technicians
  - Pharmacists

Methods – Step 3: Post-Implementation

- Primary outcome: Percentage of batched medications being wasted per day
  - Waste: defined as medications that were discontinued before being given, data from EPIC
- Secondary outcomes:
  - Reasons for discontinuation
  - Medications/classes that were discontinued
  - Times of discontinuation
**Results – Primary Outcome**

Total Number of Medications in Batch Made vs Wasted

- Post-Intervention vs. Historical Data

<table>
<thead>
<tr>
<th>Month</th>
<th>% Wasted Medications (average)</th>
</tr>
</thead>
<tbody>
<tr>
<td>December Pilot</td>
<td>13.01%</td>
</tr>
<tr>
<td>October</td>
<td>14.96%</td>
</tr>
<tr>
<td>September</td>
<td>14.87%</td>
</tr>
<tr>
<td>August</td>
<td>15.20%</td>
</tr>
<tr>
<td>July</td>
<td>15.10%</td>
</tr>
</tbody>
</table>

% of Medications Wasted Per Day
- Ranged 5% - 20%
- Average = 13%

**Pilot Results**

Post-Intervention (2 Batches) vs. Pre-Intervention (1 Batch) Workflow
Range: 2–4% difference

- Discontinuation Reasons

<table>
<thead>
<tr>
<th>Reason</th>
<th># Meds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unknown Reason</td>
<td>28</td>
</tr>
<tr>
<td>Patient Discharged</td>
<td>24</td>
</tr>
<tr>
<td>Dose Change</td>
<td>23</td>
</tr>
<tr>
<td>Frequency Change</td>
<td>23</td>
</tr>
<tr>
<td>Therapy Completed</td>
<td>20</td>
</tr>
<tr>
<td>Error</td>
<td>18</td>
</tr>
<tr>
<td>Re-ordered</td>
<td>15</td>
</tr>
<tr>
<td>Route Change</td>
<td>13</td>
</tr>
</tbody>
</table>

- Most common classes: diuretics, anti-hypertensives, steroids, and antibiotics

- ~1/3 of discontinued doses were discontinued 3 hours or less before the due time
- Most common discontinuation periods of time for wasted medications were 8-9AM and 4-7PM
Challenges/Limitations

- Small sample size
- Fluctuating number of doses
- Only estimating waste based on medications discontinued early - many other forms of waste
- Feasibility of “ideal” batch times
- Inability to separate PO batch from IV batch
- Labor cost was not collected

Conclusion

- Implemented a two-batch workflow which resulted in a 2-4% decrease in medication waste and an associated relative reduction in cost of ~14%
- For our institution, inefficiencies in process and increase in technician/pharmacist work time outweighed medication waste reduction with this workflow
- Collected data used to determine future approaches to reduction in waste

Future Directions

- Target IV only
- High-cost medication classes
- Frequently adjusted medication classes
- Adjustment in batch times
- Standardized dosing
- Expanding use of Automatic Dispensing Cabinets

Advice for Future Implementers:

- Important factors to consider:
  - Pediatric bed census
  - Current batch size
  - Current number of returns/wasted medications
  - Number of available technicians
  - IT ability
  - High cost waste
- Daily evaluation once implementation is started

Acknowledgements

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- Jessica Jacobson, PharmD, BCPS
  Clinical Pharmacist, Pediatrics
- Kristen Welsh, PharmD, BCPS
  Clinical Pharmacist, Pediatrics

References

Questions for Panel?

Supporting Literature

**STUDY:** Effects of a new sterile product preparation and delivery process on operational efficiency and cost

- **Pre-implementation:** preparing ~853 doses per day using two batches; wasting 26% of meds in every batch
- **Post-implementation:** increased to four batches a day
- Reduction of wasted medications from 26% to 18% resulting in a 28% reduction of total cost of waste


Advice for Future Implementer:

- **Potential benefits of multiple batches:**
  - Less first doses will need to be made, as they will just default to part of the batch
  - Better allocation of technician time during in-between batch hours
  - Less potential for medication errors because possibly incorrect doses not being sent up 24 hours in advance and staying in Pyxis until removed

- **Potential disadvantages of multiple batches:**
  - Lack of efficiency in terms of doubling up on set-up, preparation, delivery, checking times
  - Single dose vials (<24 hr expiration): may be better to draw up all doses at once instead of use multiple vials
  - Drawing up from extended-use batched bags may limit cost savings, no need for new vial every time

Pilot Results

- 1/3 of discontinued doses were discontinued 3 hours or less before the due time
- Most common discontinuation periods of time for wasted medications were 6-9AM and 4-7PM
Background

- **Just-in-time Dosing:** Each medication dose is dispensed from pharmacy right before scheduled administration time
  - **Advantage:** minimize waste, minimize expired medications on floor
  - **Disadvantage:** time intensive and labor intensive

- **Automated Dispensing Cabinets:** Medications are stocked on nursing unit and released at administration time of order
  - **Advantage:** time and labor efficient, no delay in medication
  - **Disadvantage:** need for increased stock, expired meds, limited meds

- **Cart-fill/Batch:** Scheduled medications are prepared and delivered in batches in advance

Supporting Literature

**STUDY:**
- **Hospital setting:** 205-bed children’s center, ~1850 doses/day
- **Pre-Implementation:** One Batch
- **Post-Implementation:** Three Batches
- **Results:**
  - Waste reduction: 28.7% per batch → 19.7% per batch
  - Net annual savings: $97,940
- **Conclusion:** 3 batches reduced waste; greater than 3 batches per day would not be cost-effective due to increased labor costs