From Big Data to Big Knowledge – Optimizing Medication Management
Session 157, March 7, 2018
Dave Webster, RPh MSBA, Associate Director of Pharmacy Operations, URMC Strong
Maria Schutt, EdD, Director Education & Optimization Services, BD
Conflict of Interest

David Webster, RPh, MSBA
Has no real or apparent conflicts of interest to report.

Dr. Maria Schutt, EdD
Has no real or apparent conflicts of interest to report.
Maria Schutt is an employee of BD
Agenda

1. Learning Objectives
2. Setting the Stage: Health System Profile
3. The Medication Availability Challenge
4. Practice Improvement Methodology
5. Inventory Optimization Analytics
6. University of Rochester Medical Center Optimization Case-study
7. Recommendations
Learning Objectives

• Define the challenges of inventory management with a focus on reducing medication waste across a health system

• Utilize analytics tools, national benchmarking and machine learning algorithms to target automatic dispensing cabinets (ADC) medication waste reduction

• Describe a business improvement plan to target medication waste reduction from ADCs

• Measure, monitor, and evaluate data to adjust program to maximize results

• Develop, define and execute a comprehensive action plan to reduce medication waste in ADCs using national benchmarking and predictive analytical tools
University of Rochester Medical Center (URMC)

Rochester, New York

Strong Memorial Hospital
- 839 beds
- >100% occupancy
- Quaternary care
- Level 1 trauma
- Pediatric hospital
- Oncology hospital/Infusion centers (on and off-site)
- Off-site emergency services center
- Off-site ambulatory surgery center
- Off-site sterile compounding center
- 340B Eligible

Highland Hospital
- 261 beds
- >100% occupancy
- Acute care
- Active emergency department
- Known for:
  - Nationally ranked geriatrics program
  - Orthopedic surgery
  - Region’s leading gastric bypass program
  - Comprehensive women’s services
  - 340B (Rural Referral Center)

Regional Community Hospitals
- FF Thompson (125 beds)
- Jones Memorial Hospital (70 beds)
- Noyes Memorial Hospital (67 beds)
- Several contractual relationships with other community based hospitals and clinics

Ambulatory Sites
- Medical clinics/primary care
- Specialty Pharmacy Services
- Contract Pharmacy Services
- 10 licensed ambulatory pharmacies
- Home Infusion Pharmacy Services
Highland Pharmacy Model

• Total Doses Dispensed: 
  ~6,600 doses/day
• Total Doses Dispensed ADCs: 
  ~5,900 doses/day
36 ADC units; 20 Anesthesia units
• Override Rate: 1.7%
• ADC Replenishment: Once Daily
• 340B Facility
• Cartfill for patient specific orders
Strong Pharmacy Model

- Total Doses Dispensed
  ~18,000 doses/day
- Total Doses Dispensed ADCs:
  ~7,900 doses/day
- 124 ADC units; 63 Anesthesia units;
- Override Rate: 2.5%*
  *Inpatient + ED + PACUs
- ADC Replenishment: 2-3 times daily
- 340B Facility
- Cart fill for patient specific orders
Polling Question!

How do you manage/adjust your facility’s ADC PAR levels?

1. Review/adjust when prompted
2. Review/adjust annually
3. Review/adjust monthly
4. Review/adjust daily/weekly
Polling Question!

Generally, how often do you replenish your ADCs?

1. Less than once daily
2. Once daily
3. Twice daily
4. Three times or more daily
Pharmacy Dispensing Models: Highland and Strong Hospitals

73,632,000 …data messages per year for ADCs
Dispensing Data Transactions

12,113,516,199 (12 billion)
…data messages for ADCs
…2234 Facilities

Patient encounters (1,224,139,122) (1.2 billion)
“In essence, a well-planned and implemented medication management system supports patient safety and improves the quality of care by doing the following:

- Reducing variation, errors, and misuse
- Using evidence-based practices to develop medication management processes
- Managing critical processes to promote safe medication management throughout the organization
- Standardizing equipment and handling processes, including those for sample medications, across the organization to improve the medication management system
- Monitoring the medication management process for efficiency, quality, and safety” - Excerpt from The Joint Commission
# Medication Availability Challenge

Most hospitals face these challenges…leading to these problems……creating a sizable impact...

<table>
<thead>
<tr>
<th>Medication is out of stock</th>
<th>Excessive inventory</th>
</tr>
</thead>
<tbody>
<tr>
<td>at the medication dispensing machine</td>
<td>is stocked in automated dispensing cabinets to ensure medication availability SLA’s</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Inefficient workflow &amp; productivity</th>
<th>Inefficient workflow &amp; productivity</th>
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</thead>
<tbody>
<tr>
<td>due to interruptions and distractions</td>
<td>due to interruptions and distractions</td>
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</table>

<table>
<thead>
<tr>
<th>Low hospital staff satisfaction</th>
<th>Increased cost</th>
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<tbody>
<tr>
<td></td>
<td>due to inefficient workflow</td>
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</tbody>
</table>

Frequent refills creates **long wait times for nurses and extra work**

Picking cycle in pharmacy does not correspond to demand on floors

**Increased cost** due to Expired and wasted medication and bloated inventory on hand

On average, **>2,400 hours** of time each year is consumed by nursing calls to pharmacy in a 350 bed hospital

20 minutes to track down each missing medication

Pharmacy staff spends **3-4 hours/day** on purchasing, receiving and stocking meds

On average, **~20% of ADC pockets** have not been accessed in 6 months

On average, **6-7%** of pharmacy inventory spend is wasted

An average hospital loses **$150k every 3 months** from expired medications

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Practice Improvement Methodology

**PRACTICE ASSESSMENT & SUCCESS PLAN**
- Site-Specific Success Plan
- Guiding Principles & Operational KPI’s

**EDUCATION SERVICES & CORE COMPETENCIES**
- Training Plan, Workshops, & Certifications
- Success Community & User Group Access

**INTEGRATED ANALYTICS & BENCHMARKS**
- PAR Optimization & Workflow Analytics
- National Pharmacy Benchmarks

**IMPROVEMENT & ADOPTION SUPPORT**
- Practice Improvement Platform
- Optimization Specialist Support

**EDUCATE – ADOPT – OPTIMIZE**
Utilizing Data, Analytics and Benchmarking to Optimize

GUIDING PRINCIPLES
(Practice, process, feature usage)

1. Defines a process, policy, or setting and the associated compliance metrics to track performance
2. Measure of the customer's process, typically at a site or IDN level

KEY PERFORMANCE INDICATORS (KPI)

A
B
C

SYSTEM LEVEL OUTCOMES

Financial, efficiency, or patient safety metrics

Example

<table>
<thead>
<tr>
<th>KPI</th>
<th>Practice, processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>y=f(x)</td>
<td></td>
</tr>
</tbody>
</table>

Stock-out Percentage

Medication Availability

Refill Frequency
Discrepancy Mgmt.
PAR level Mgmt.
Cycle Counts
## Guiding Principles and Established KPIs

### Guiding Principles

<table>
<thead>
<tr>
<th>Guiding Principles</th>
<th>Key Performance Indicators</th>
</tr>
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<tbody>
<tr>
<td>Refill Frequency</td>
<td>Stock-out percentage</td>
</tr>
<tr>
<td></td>
<td>Vend-to-Refill ratio</td>
</tr>
<tr>
<td>Nursing Inventory Counts</td>
<td>Remove - Pulling Practice</td>
</tr>
<tr>
<td></td>
<td>Remove - Override</td>
</tr>
<tr>
<td>Pharmacy Inventory Counts</td>
<td>Witness Override</td>
</tr>
<tr>
<td>Outdates</td>
<td>Blind stock-outs per station</td>
</tr>
<tr>
<td>Witness on Emptying</td>
<td># of pockets w/out vend greater than policy days</td>
</tr>
<tr>
<td>Return Bin</td>
<td>Average removed outdates per station</td>
</tr>
<tr>
<td>Destock</td>
<td>Doses dispensed from Pyxis MedStation</td>
</tr>
<tr>
<td>Standard Stock</td>
<td># of medications greater than 2 loads and unloads</td>
</tr>
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<td></td>
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</tbody>
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### RATIONALE

**Regulations & Guidelines**

**White Papers**

**Device Generated Data**

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# of medications greater than 2 loads and unloads
Data Science Approach

- **Goal:** Understand the relationship between KPIs and Guiding Principles
- **Foundation for “smart recommendation engine”**
- **Benchmarking data:** >300 health systems, 330 million dispensed doses/year

**Data Science Approach:***

- **Features extracted from health system data**
- **Build predictive models using multiple techniques**
- **Optimal model(s) identified through testing and evaluation**
- **Identify top variables that predict KPIs**
Why Optimize?

HIGHLAND

- ADCs integral to the dispense model; 89% of all doses dispensed from ADCs
- Physical constraints impose challenge on distribution and need for efficient processes
  - No pneumatic tube system
  - Size-constricted medication rooms limit ability to add storage capacity for medications
  - Maximize resources involved in refill process
  - Improve vend-to-refill ratios
- Budgetary constraints

STRONG

- Waste Expired Medications from ADCs
  - Business Improvement Plan (BIP) for waste reduction
  - Funding FTE to oversee process
- Inefficiencies: Focus on Replenishment Process
  - Maximize use of resources involved in refill process
  - Improve vend-to-refill ratios
  - Create process for managing changes in PAR levels
- Stock-outs: Rates increasing, not meeting goals
  - Goal of eliminating predicted stock-outs
  - Improve nursing satisfaction
  - Improve time-to-refill (service recovery)
Why Optimize?

Medication cost volatility continues to drive focus on cost reduction strategies, including inventory management.
Initial Challenges and Considerations

- Adjusting PAR levels and reports required
- Data integrity
- Cost of file integration from EMR to ADC
Optimization Goals at Highland

**Adopt** guiding principles in refill process for ADCs

**Maintain** stock-out rate

**Maximize** availability of medications from ADCs

**Vend-to-Refill Ratio**
Optimize Vend-to-Refill ratio, work toward one major device replenishment per day

**Stock-out Rate**
Maintain a stock-out rate at or below one percent

**Dispense % from ADCs**
Target 90%+ dispenses from ADCs
Optimization Business Improvement Plan - Highland

1. Optimize Device Inventory
   - Adjusted min/max (via report analysis)
   - Move most-refilled medications to larger pockets in the ADC
   - Add pockets specifically for highest-use medications

2. Planning for One Refill per Day
   - Analyze department workflow and resources

3. Avoid Nurse-Tech Workflow Conflicts
   - Identify time of most frequent vends
Knowledge Check: True or False?

Medication inventory across a health system is becoming more important due to rising medication costs and health system complexities.

True!
Inventory Optimization Results at Highland

Through change in process, Highland shifted Vend/Refill from 8.7 to 10.5

Source: URMC Medication Dispensing Data: Aug 2015 – Aug 2017
Inventory Optimization Results at Highland

Changes eliminated ~80 refills of ADCs daily

Source: URMC Medication Dispensing Data: Aug 2015 –Aug 2017
Inventory Optimization Results at Highland

<table>
<thead>
<tr>
<th>Mar 2016</th>
<th>Aug 2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.8%</td>
<td>0.9%</td>
</tr>
<tr>
<td>STOCK-OUT RATE</td>
<td>STOCK-OUT RATE</td>
</tr>
</tbody>
</table>

Initial Focus: Maintain stock-out rate below 1%

March 2016

<table>
<thead>
<tr>
<th>Initial Focus:</th>
<th>85%</th>
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</thead>
<tbody>
<tr>
<td>Improve dispense %, particularly in the ED</td>
<td></td>
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</table>

Aug 2017

| 89% |
| DISPENSE FROM ADCs |
**Optimization Goals at Strong**

**ADOPT** Destock feature on ES into waste reduction process

<table>
<thead>
<tr>
<th>Expiring inventory</th>
<th>Reduce expiring inventory in ADCs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inventory carrying cost</td>
<td>Reduce level of inventory in ADCs</td>
</tr>
<tr>
<td>Stock-out</td>
<td>Reduce or maintain stock-out rate</td>
</tr>
</tbody>
</table>

**OPTIMIZE** medication availability in ADCs

Dedicated resource for **active** inventory management

- Moving product from low use to high use areas with **Destock** feature
- Using reports to identify soon-to-expire medications
- Identify highest risk medications (short expiration date)
Waste Reduction Plan at Strong

TOTAL EXPIRED MEDICATIONS 2015

REDUCTION IN EXPIRED MEDS

Identify Baseline

Create Goal

Develop BIP

Source: URMC Medication Dispensing Data: Aug 2015 – Aug 2017
2017 represents \( \sim 70\% \) reduction in waste compared to baseline year for inpatient/ED units

Source: URMC Medication Waste Data: January 2016 – November 2017
Inventory Optimization

Perform PAR level optimization to reduce stock-outs and waste at least 1x quarter

~3,200 recommendations for medication-locations accepted or modified...

Changed PAR levels on 4,000 medications on Standard stock

- Leveraging usage data in chart to look over previous 30, 60, 90, 120, and 365 days
- Consider whether medication should be on standard stock in the first place
- Realized significant inventory carrying cost hiding in standard stock inventory
Inventory Optimization Results at Strong

Avg. Removed Outdates per Station nearly halved

Stock-out rate drops by >50%

Vend / Refill ratio almost doubles

Source: URMC Medication Dispensing Data: June 2015 – Aug 2017
For over 3,200 medications, stock out rate has improved **266%**

Source: URMC Medication Dispensing Data: June 2015 – Aug 2017
Inventory Optimization Results at Strong Source: URMC Medication Dispensing Data: Jan 2017 – Sep 2017

Doses on hand in ADCs have decreased 9.8%

Primarily attributable to **standard stock optimization**
lowering the carrying cost $200,000+
Inventory Optimization with Analytics at Strong

Inventory Optimization
Analyze delivery process and inefficiencies

Targeted Medical/Surgical floor receiving 3 times daily replenishment to ADCs (~130 beds)

Analyzed data, maximized PAR levels, focused on avoiding conflicts in delivery time

• Goal of once daily delivery
• Maximize vend-to-refill ratio
• Avoid negative impact on stock-out rate
Inventory Optimization Results at Strong

Once Daily Delivery

**NUMBER OF POCKETS REFILLED DAILY**

49.3 (Pre - Implementation (3 Deliveries per Day))

41.3 (Post - Implementation (One Delivery Per Day))

**DAILY REFILL TIME (MIN) 5TH FLOOR**

59 (Post - Implementation (3 Deliveries per Day))

Stock Out Rate 5th Floor

Dec-16 | Jan-17 | Feb-17 | Mar-17 | Apr-17 | May-17 | Jun-17 | Jul-17 | Aug-17 | Sep-17 | Oct-17 | Nov-17 | Dec-17

0.00% | 0.05% | 0.10% | 0.15% | 0.20% | 0.25% | 0.30% | 0.35%

Once Daily Delivery
Knowledge Check!

Inventory optimization drives deeper insights into cost and waste reductions based on:

A. Analysis and benchmarking of drug costs, utilization, and KPIs
B. Formulary standardization
C. Assessment of clinical impact
D. Purchasing and packaging logistics
Recommendations

• Understand your goals and metrics

• Improve practice as the basis for inventory optimization

• Dedicate resources (inventory management and IT)

• Data integrity and price file integration

• Long term plan (remember optimization is ongoing)
Knowledge Check!

Achieving inventory optimization requires continuous data driven monitoring and adjustment of inventory levels based on:

A. Patient demand
B. Purchasing procedures
C. Hospital staff workflows
D. All of the above
Questions?

Dave Webster, RPh MSBA
Associate Director of Pharmacy Operations
University of Rochester Medical Center
Dave_Webster@URMC.Rochester.edu

Dr. Maria Schutt, EdD
Director, Education Services and Optimization
BD Medication Management Solutions
Maria.schutt@bd.com

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