Optimizing the Supply Chain of Medical Devices
A Shared SaaS Platform for Suppliers and Providers

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Outline

- **Background**
- The PPI Supply Chain
- The WaveMark System
- Analysis of the Hospital Inventory Subsystems
- Wrap-up
About WaveMark - Background

- Founded in 2003

- Vision
  Improve the quality of patient care by optimizing the quality and efficiency of the healthcare supply chain and clinical workflow

- Mission
  Deliver innovative solutions to improve patient safety, regulatory compliance, and reduce costs by providing workflow optimization and supply chain visibility for the healthcare industry and medical device suppliers

- Focus on Physician Preference Items (PPI)
**Physician Preference Items (PPI)**

- **PPI are a category of medical devices**
  - Consumable high value devices
  - $100 to $20,000 in cost
  - Not commodity products
  - Can influence the outcome of the treatment
  - Around 40% of total hospital supplies expenses
  - $80M is not unusual
  - Mix of purchased and consigned products

- **Examples:**
  - Pacemakers, Stents, Balloons, ICDs, Heart valves
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Consumer Packaged Goods (CPG) Supply Chain

- Mature and very advanced supply chain
- Generally low margin products
- Point of Sale data
- Strong profit optimization
- Focused and dedicated supply chain resources
Medical Devices (PPI) Supply Chain

Manufacturing → Distribution Center → Hospital Inventory → Patient

Physical Product Flow

Information Flow

Sales Rep
Trunk Stock
Problems with PPI Supply Chain

- No medium for information to flow back from the hospital
- Highly inaccurate inventory and usage information

### Suppliers
- Lack of visibility – information on consumption is not available
- Labor intensive manual counts are needed
- Poor consignment management

### Hospitals
- Overstocking and product unavailability
- Expirations and write-offs
- Missed charge capture and clinical documentation
Easy Fix? Reproduce CPG?

- The underlying dynamics for PPI are different
- Different drivers influence the supply chain - The primary objective is patient care

- What is needed is a holistic rethinking of the problem
  - Right System
  - Right Incentives

- Why now?
  - A big push towards cutting costs out of healthcare
  - A series of technologies are now available: RFID, Cloud Computing, and Mobility
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The WaveMark Solution

- A Multi-Component approach

- The overall system:
  - Provides full product lifecycle visibility: Point of Manufacture → Point of Use
  - Consists of SaaS software, on-premise software, and RFID hardware

- Components of the system address localized needs with standalone value – this key for adoption
The WaveMark Solution – High Level Components

- WaveMark Core (SaaS) (Visibility and Analytics layer)
- WaveMark DC (Manufacturing and DC)
- WaveMark Mobile (Field Mobility Transactions)
- WaveMark CIMS (Inventory and Usage)

Manufacturing → Distribution Center

Hospital Inventory → Patient

Sales Rep Trunk Stock
The WaveMark Solution – Detailed Components

- Analytical Layer
- Visibility Layer
- Operational Layer

WaveMark Core - A Shared SaaS Platform
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The PPI Environment

- High value products
- Extensive product lines
- Low par levels and low turn for each SKU
- Product availability is critical to patient safety
- Rapid product expirations
- A mixture of consigned and purchased inventory
- Absent or error-prone perpetual inventory systems
- New product introductions are common
- Clinicians manage PPI (lack of dedicated staff)
A Picture is Worth a Thousand Words

- 130 Products, 80 SKUs
- This product is expired
- Out of stock
- This product is recalled
Problems

- Problems can be divided into three categories:

  - Patient Safety
  - Financial (hard dollars)
  - Operational and Efficiency
Patient Safety Problems

- Using an expired product on a patient
- Using a recalled product on a patient
- Product unavailability
- Incorrect or incomplete clinical documentation
Financial Problems (hard dollars)

- Inventory overstocking
- Product write-offs from expiration and obsolescence
- Product loss and inventory shrinkage
- Missing charge capture
- Pricing disadvantage
- Suboptimal consignment management
## Operational and Efficiency Problems

- Inefficient internal processes with expensive/scarce resources
- Time consuming/inaccurate inventory audits and counts
- Time consuming searches for recalled products
- Regulatory audits finding expired products in inventory
- Highly manual processes
Analyzing the Hospital Problem – As a System

- A holistic view
- Identifying the relationships and interactions between the various components of the system
- We created a qualitative systems dynamics model to understand the problems of inventory management and usage capture
System Dynamics (Qualitative Model)

- Human Error: recording usage
- Human Error: recording receipts/returns/etc...
- Loss and Shrinkage

Errors in Inventory
System Dynamics (Qualitative Model)

- Overstocking Inventory
- Recalled Product in Inventory
- Expired Product in Inventory
  - Potential for Using Recalled Products on a Patient
  - Potential for Using Expired Products on a Patient
  - Regulatory Audit Problems
  - Product Write-offs

Potential for Product Unavailability for a Patient

- Human Error: recording usage
- Human Error: recording receipts/returns/etc...
- Loss and Shrinkage

Errors in Inventory
Focus on the Root Cause
So then... what is wrong with inventory?

- Humans can’t count!
- Inventory systems are transactional by nature
  - You count what goes in
  - You count what comes out
  - All you know is that you’re wrong. By how much?
In other words...

- Current thinking implemented by transactional systems

\[
\text{Inventory}_{t_1} = \text{Inventory}_{t_0} + \sum_{t_0 \rightarrow t_1} \text{Transactions}
\]

- Our premise is that

\[
\text{Inventory}_{t_1} \neq \text{Inventory}_{t_0} + \sum_{t_0 \rightarrow t_1} \text{Transactions}
\]

...and systems need to be designed accordingly
WaveMark’s Solution Using RFID

- RFID is an enabling technology for a new paradigm
  - It starts with faster, more accurate, and orientation indifferent data capture that does not require line of sight
  - This enables alternative paradigms and new systems thinking
- The system is built from the ground up using this technology - the focus is on exception management

RFID is not used as merely an alternative data capture method
RFID Inventory

- RFID is used to read inventory as a primary read
- RFID smart cabinets are deployed in the hospital
  - Power connectivity
  - Network connectivity
- Cabinets read their inventory periodically (every 20 minutes) and report it to a central database
- Inventory is always 99.99% accurate
Products are Tagged and Registered
WaveMark RFID Cabinet – HFx1500 Series

- Antennas built into shelves read RFID tags
- RFID tagged products
- Cabinet requires Ethernet and power connectivity
- CPU is stored in base of cabinet
Deployed WaveMark RFID Cabinets
RFID Transactions Record Usage

- RFID transactions complement the RFID inventory management
- Transactions handle product use and reverse logistics
- Transactions are performed on RFID POS Stations
The Resulting System

- A system that:
  - Reads inventory accurately
  - Allows the recording of transactions
  - Alerts promptly on missing transactions and allows corrections

- The new equation

\[
\Delta \text{Transactions} = \sum_{t_0 \rightarrow t_1} \text{Transactions}
\]

Alert ! and Correct ✓ in Real-time
Breaking the Feedback Mechanisms
New System Dynamics Emerge (Qualitative Model)
New System Dynamics Emerge (Qualitative Model)

1. RFID System
2. Accurate Product Usage Capture
3. Accurate Inventory
4. Alerts on Missed Transactions
5. Real-time reconciliation of missed transactions
6. More Staff Time
7. Reduced time to search for missing products
8. Usage Pattern Analysis
9. Optimized Par Levels
10. Automated Ordering
11. Optimal Inventory Levels
12. Product Availability

Positive Feedback Loop:
- Accurate Product Usage Capture → Accurate Inventory → Alerts on Missed Transactions → Real-time reconciliation of missed transactions → More Staff Time → Usage Pattern Analysis → Optimized Par Levels → Automated Ordering → Optimal Inventory Levels → Product Availability → Accurate Product Usage Capture
New System Dynamics Emerge (Qualitative Model)

- Accurate Product Usage Capture
- Real-time reconciliation of missed transactions
- Accurate Inventory
- Alerts on Missed Transactions
- More Staff Time
- Reduce time to search for missing products
- Usage Pattern Analysis
- Optimized Par Levels
- Automated Ordering
- Optimal Inventory Levels
- Expiration Management
- Reduced Expiration Write-offs
- Product Availability
- RFID System
New System Dynamics Emerge (Qualitative Model)

- Reduced Product Cost
- Better Consignment Negotiation
- Optimized Bulk Buy Decisions
- Reduce time to search for missing products
- Accurate Charge Capture
- Accurate Clinical Documentation
- Accurate Product Usage Capture
- Real-time reconciliation of missed transactions
- More Staff Time
- Usage Pattern Analysis
- Optimized Par Levels
- Product Availability
- Automated Ordering
- Optimal Inventory Levels
- Expiration Management
- Reduced Expiration Write-offs
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- Accurate Inventory
- RFID System
The WaveMark Solution – Detailed Components

Operational Layer

Visibility Layer

Analytical Layer

- WaveMark Core - A Shared SaaS Platform
Recap of the Solution

- PPI supply chain optimization through inventory and usage visibility:
  - A SaaS platform for data sharing and process coordination between suppliers and hospitals
  - Accurate inventory and usage capture - An RFID based inventory management system for hospitals
  - Standalone-capable subsystems that add localized value
    - Hospitals
    - Supplier Manufacturing and DC
    - Supplier Sales Reps
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Next Session

- SaaS multi-tenancy
  - Shared schema with selectively shared data
- SaaS+
  - A SaaS system with hardware components – Complexities and Challenges
- Running a network of RFID nodes
- Regulatory requirements
Now, or later at
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