From big data to results:

Accelerating and sustaining medication inventory optimization

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Instead of extracting data from multiple sources, we wanted to have one source for managing the inventory adjustments and that's really BD HealthSight™ Inventory Optimization.[1]

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Abstract

Hospitals have traditionally been labor-intensive organizations with a supply chain component, but they are evolving into more integrated, supply chain-centric entities. As this paradigm shifts, it is critical for hospitals to manage costs. By using advanced analytics, the University of Rochester Medical Center ("URMC") realized a significant reduction in stock-out rates (a 266% reduction at one facility for targeted medications), a reduction in expired waste from Automated Dispensing Cabinets (a 66% reduction at one facility), as well as decreased inventory carrying costs. By reducing up to three-times-per-day drug delivery to devices down to one, URMC also made great strides in mitigating staff frustration and confusion, resulting in improved efficiencies in pharmacist and technician workflows related to inventory replenishment.

URMC initially achieved its results through multi-system report generation and analysis, then maintained and improved efficiencies further with BD HealthSight™ Inventory Optimization, a supply chain-driven analytics solution that delivers outcomes-driven workflow recommendations to optimize on-hand inventory, minimize waste, reduce stock-out events, and drive prioritization. BD HealthSight™ Inventory Optimization has replaced most report generation and manual calculations with automated inventory analysis and intelligent recommendation processes. Whether you are an informaticist, pharmacy technician or frontline staff, the analytics tool is designed to optimize inventory management workflows to enable you to provide the best patient care possible by having the right medication at the right place at the right time.

## About University of Rochester Medical Center / Strong Memorial Hospital and Highland Hospital

Founded respectively in 1925 and 1889, Strong Memorial Hospital ("Strong"), an 886-bed facility and Highland Hospital ("Highland"), a 261-bed facility, are nonprofit community hospitals affiliated with URMC in New York. Both Strong and Highland are accredited by the Joint Commission.

Challenges in medication inventory management

Drug costs represent a significant portion of hospital supply expenses, which, in turn, comprise on average 15% of total hospital expenses per year but can range as high as 40% in some cases.[2] Despite a consolidation wave that would have typically generated bargaining power, hospitals still struggle with cost containment due in part to rising drug costs. In 2018, they spent an average of 18% more in supply chain operations, processes and product use than necessary — a 10% increase from 2017.[3]

"Inefficient inventory management often results in negative cost implications across multiple departments in a hospital, including increased holding costs, waste of product and waste of valuable time for critical healthcare workers,"[4] said David Webster, RPh, MSBA, Director of Acute Care Pharmacy Operations, Assistant Professor of Clinical Community and Preventive Medicine, University of Rochester Medical Center / Strong Memorial Hospital.

93%
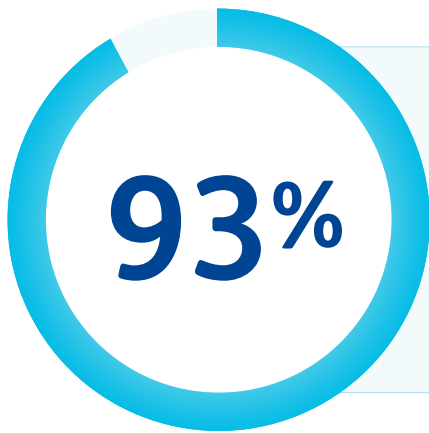
of materials managers state their health system organizations suffer from poor inventory control technology and processes that typically result in overstocking, high supply and labor costs, and frustrated nursing staff, who may spend an average of 34% of their time on supply-related tasks such as locating drug products.[5] These factors reflect a significant need for effective inventory control methods to keep costs contained.

> With BD HealthSight™ Inventory Optimization, we can reduce the labor involved in managing inventory. We can reallocate that labor to other patient care tasks, helping to drive efficiencies so we can spend time on adding value, particularly around cost-reduction strategies.[6]

David Webster, RPh, MSBA

Medication inventory management at URMC

Although Strong and Highland are within the URMC healthcare system, they have different methods of managing pharmacy inventory. Strong, having a more "hybrid" dispensing model, opts to nearly split the number of doses dispensed daily between its Automated Dispensing Cabinets ("ADCs") and central pharmacy. Conversely, Highland holds a more "decentralized" model, wherein most of its pharmacy doses are dispensed and stored in ADCs. Key data metrics for both hospitals are displayed below in **Table 1**.

Table 1

Key data metrics: Strong Memorial Hospital and Highland Hospital - 2019

	Strong	**Highland**
Doses dispensed per year, ADCs	5,030,765	
Data messages transferred to/from ADCs per Year	73,632,000	
Percentage of doses dispensed from Pyxis ADCs	49% (Hybrid)	89% (Decentralized)
Percentage of doses dispensed from Central Pharmacy	51%	11%
Average doses dispensed/day	18,200	5,500
Number of doses dispensed daily from ADCs	8,900	4,900

Optimizing ADC inventory to improve efficiencies and achieve goals

A look at the effort and coordination required for manual inventory management

The case for Highland Hospital

As an example of challenges identified by many hospitals, Highland faced notable physical and financial constraints imposed on the medication distribution system. The response was to identify initiatives to improve efficiencies in its current inventory management processes. Highland aimed to achieve three main goals:

1	2	3
Improve vend:refill ratio	**Maintain low stock-out rate**	**Grow decentralized inventory model**
Target was 10:12 and one major replenishment per day	**Target was ≤1%**	**Target was ≥ 90% dispensed by ADCs**

Highland achieved positive results toward meeting these goals as indicated in **Table 2**.

Table 2: Highland Hospital results from manual optimization

Impact	Pre-Manual Optimization (prior to March 2016)	Post-Manual Optimization (2017)
Vend:Refill Ratio	8.7	10.5
Stock-out Rate	0.8%	0.9%
% Dispense from Pyxis	85%	89%
Replenishment Model	2-3 per day	1 per day
Overall Overrides (Safety)	2.8% (July 2016)	1.7%

Figure 1 below illustrates the vend:refill impact of the optimization tool from May 2016 through August 2017. The goal of reaching a ratio of 10:12 was achieved, allowing for more vends before requiring replenishment of ADC pockets.

Figure 1

Vend:refill ratio for Highland pre- and post-optimization

Through change in process, Highland shifted vend:refill from 8.7 to 10.5
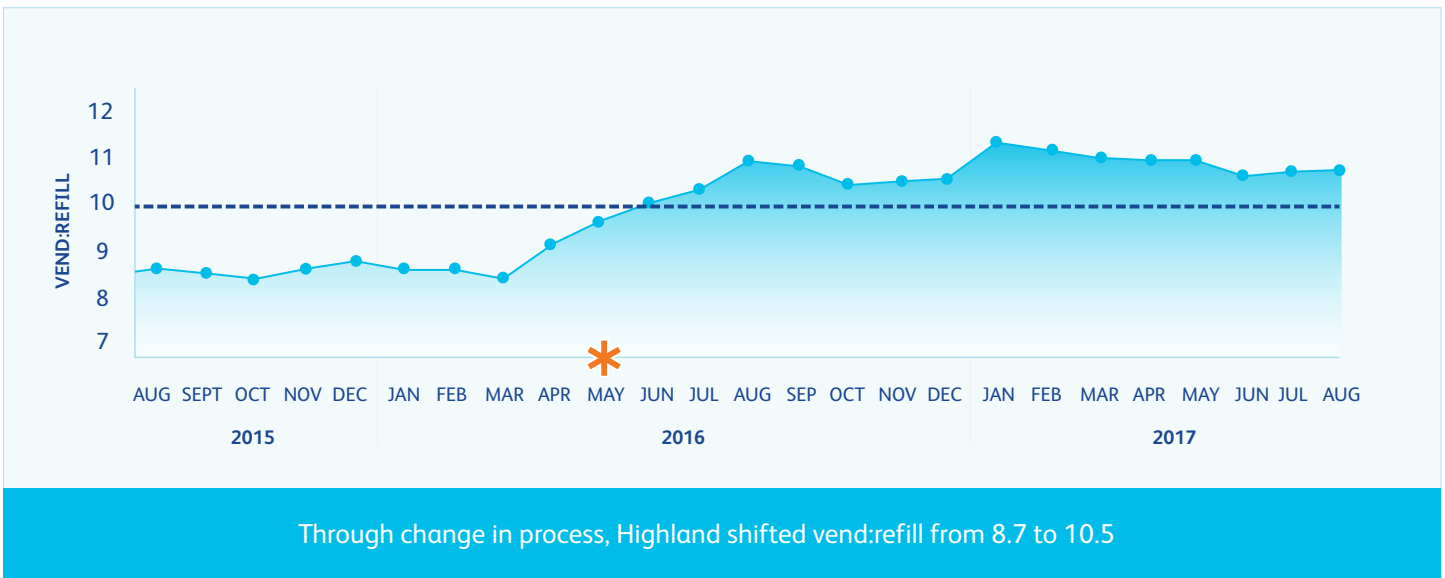
Although the stock-out rate did increase slightly, it remained below 1%. The percentage dispensed from BD Pyxis™ MedStation™ ES improved to just under the goal of 90%, with a focus on improving stock availability in the Emergency Department. As can be seen in **Figure 2**, the change in the replenishment model from multiple times per day to once **resulted in a significant decrease in workload**, eliminating the need for refilling approximately 80 pockets per day.

Figure 2

Vend and refill trends following optimization

Changes eliminated ~80 refills of ADCs daily
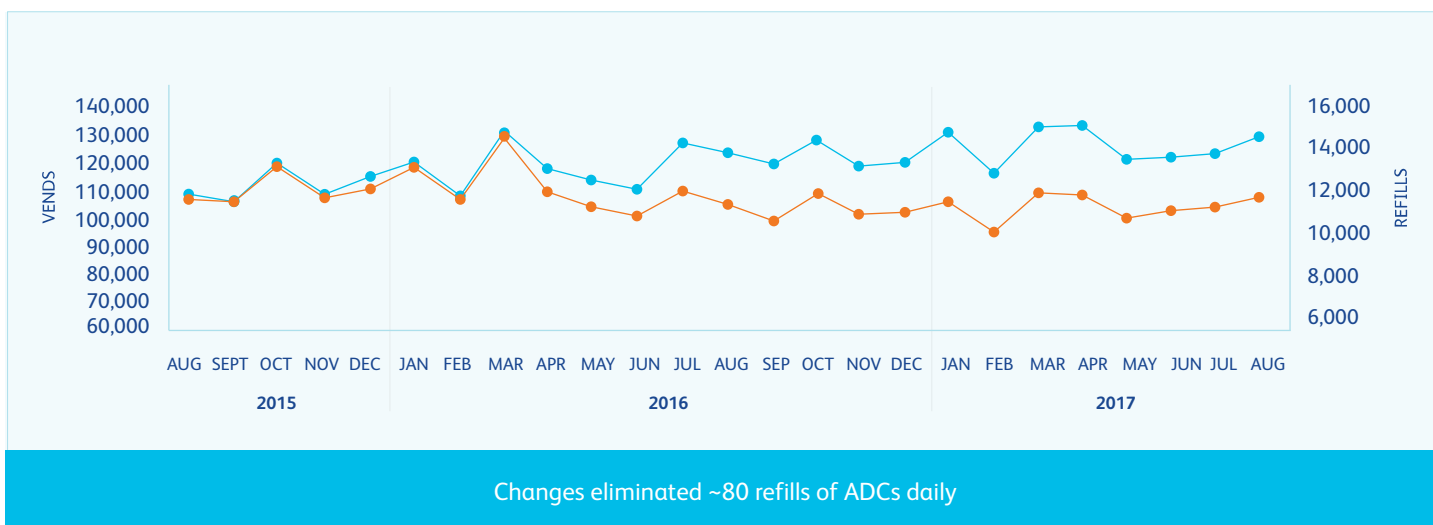
Although managing overrides was not a part of the defined goals, override rates are a known medication safety concern, as lower rates can improve medication safety by ensuring that a pharmacist reviews and verifies overrides prior to medication access. As a result of evaluating inventory and adjusting override settings, **the overall override rate dropped by almost 40%.**

It required significant effort to manage these changes and optimizations through a manual process, including generation of multiple reports, frequent updates to ADC cabinets, and modifications to Periodic Automatic Replenishment (PAR) values on the server, etc. As a result, URMC funded a full-time position at Highland to focus on future optimization projects, such as prioritizing reductions in waste, mitigating expiration, and continuous PAR management. This would also help facilitate implementation of an automated tool to continue to drive these efficiencies.

The case for Strong Memorial Hospital

Along with the successes realized at Highland, URMC established additional goals at Strong as it proceeded towards automation across both hospitals:

1

Decrease expiring inventory in BD Pyxis™ MedStation™ ES ADCs in patient care areas — target was a $150,000 net reduction in expired waste per year (including cost of 1 FTE Pharmacy Technician)

2

Optimize and reduce inventory levels in BD Pyxis™ MedStation™ ES ADCs — target was an overall reduction in inventory costs across ADCs

3

Reduce or maintain stock-out rate — target was ≤1%

Similar to Highland, Strong achieved positive results toward meeting these goals as indicated in **Table 3**.

**Table 3**: Strong Memorial Hospital results from manual optimization

Impact	Pre-Manual Optimization (prior to 2017)	Post-Manual Optimization (2017)
Decrease in Expired Waste	$347,000/year	$120,589/year
Inventory Cost ADCs	$959,689 (Apr-Jun 2017)	$755,936
Stock-out Rate	1.2%	0.7%
Replenishment (5th Floor)	3 per day	1 per day
Overall Overrides (Safety)	2.5%	2.4%

To address the challenge of waste due to expiring medications, URMC utilized reports from its EMR and from BD Knowledge Portal for BD Pyxis™ Medication Technologies to identify soon-to-expire medications and move medications from low-use to high-use areas using the destock function. Using these methods, **URMC achieved a 65% reduction in waste compared to the baseline year, a cost reduction of approximately $226,000 in 2017.**

As a second goal, adjusting stock levels and reducing PARs where indicated resulted in **reducing cabinet inventory costs by over $200,000**. This was an additional effort to the reduction in expired waste performed by manually reviewing pockets and inventory not utilized at a frequency indicated by the current stock level. See **Figure 3**.

Figure 3

Doses and inventory costs in ADC cabinets for Strong Memorial Hospital pre- and post-optimization
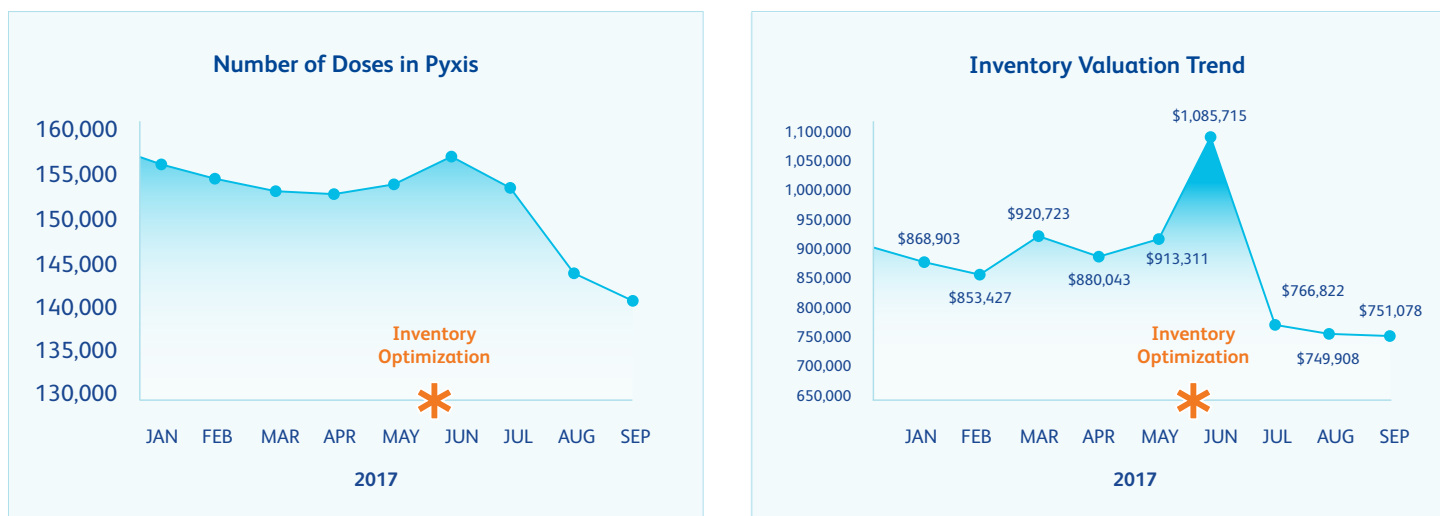
Stock-out rates through this process decreased significantly overall, reflecting a greater than 40% reduction. If examining only targeted medications and pockets, the impact on stock-out rates was dramatically decreased by 73% as illustrated in **Figure 4**.

Figure 4

Stock-out rates pre- and post-optimization for targeted medications (June 2015 – August 2017)

Although not part of the specifically defined goals, Strong also piloted a once daily replenishment model on one medicine floor of the hospital which contained five patient care units. In concert with the inventory optimization, the number of pockets refilled dropped by 16%, and the **time to refill the entire floor dropped from an average of 59 minutes to 32 minutes**; the stock-out rate on this floor did not change significantly and remained <0.3%.

Looking at the safety features related to maintaining low override rates, the overall rate decreased slightly during this optimization as well from 2.5% to 2.4%.

Similar to Highland, managing these changes and optimization for a manual process required a labor-intensive effort, demanding the involvement and the coordination of multiple resources.

<div style="background:#00b0e6;color:#fff;padding:4px;display:inline-block">**THE AUTOMATED PROCESS**</div>

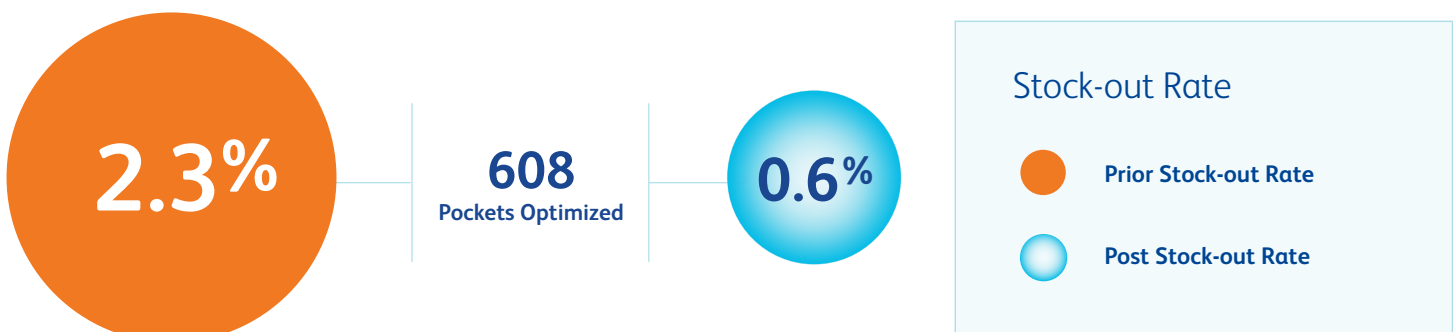# How BD HealthSight™ Inventory Optimization would sustain and expand these results

The case for Highland Hospital

The initial improvements in 2017 justified the efforts focused on inventory management and created a case for ongoing optimization with an automated tool. After implementing BD HealthSight™ Inventory Optimization, Highland was able to **significantly reduce stock-out rates to 0.4% in 2020 from 0.9% in 2017**. For the pockets that were targeted for optimization by BD HealthSight™ Inventory Optimization, there were a total of 608 pockets optimized from 2017 through January 2020 with a **reduction in the stock-out rate for those specific pockets from 2.3% to 0.6%**, as reflected in **Figure 5** below.

One can estimate labor savings in the pharmacy by assuming it takes approximately 10 minutes to respond and refill an isolated stock-out on a patient care unit, with this **reduction saving an additional 12,899 stock-outs or approximately 2,150 hours of labor over this time frame**. The pharmacy was able to maintain a once daily replenishment schedule for most areas, which resulted in an overall decrease in the number of routine refills.

Figure 5

Stock-out rate change at Highland Hospital for optimized inventory with use of BD HealthSight™ Inventory Optimization (January 2017 – January 2020)

Although the vend:refill ratio has declined and the percentage dispensed from ADCs remains relatively unchanged at a little below 90%, continued use of the BD HealthSight™ Inventory Optimization analytics tool and recent post-pandemic stabilization will continue to target these goals.

## The case for Strong Memorial Hospital

Similarly, the implementation of BD HealthSight™ Inventory Optimization resulted in further reductions of stock-out rates at Strong. The overall stock-out rate for all medications **dropped from 0.7% in 2017 to 0.5% in 2019 and more recently to 0.4% in 2020**.

From 2017 through January 2020, there were 4,414 pockets adjusted, yielding a reduction in the stock-out rate of over 50% for these targeted medications, down to 0.26% from 0.57%, as can be seen in **Figure 6** below. This **resulted in avoidance of what would have been an additional 23,326 stock-outs** if not optimized, **equating to approximately 3,888 additional labor hours to manage.**

Figure 6

Stock-out rate change at Strong Memorial Hospital for optimized inventory with use of BD HealthSight™ Inventory Optimization (January 2017 – January 2020)*

*<1% of PAR adjustments took place prior to 2017

0.57% — **4,414** Pockets Optimized — **0.26%**

Stock-out Rate

● **Prior Stock-out Rate**
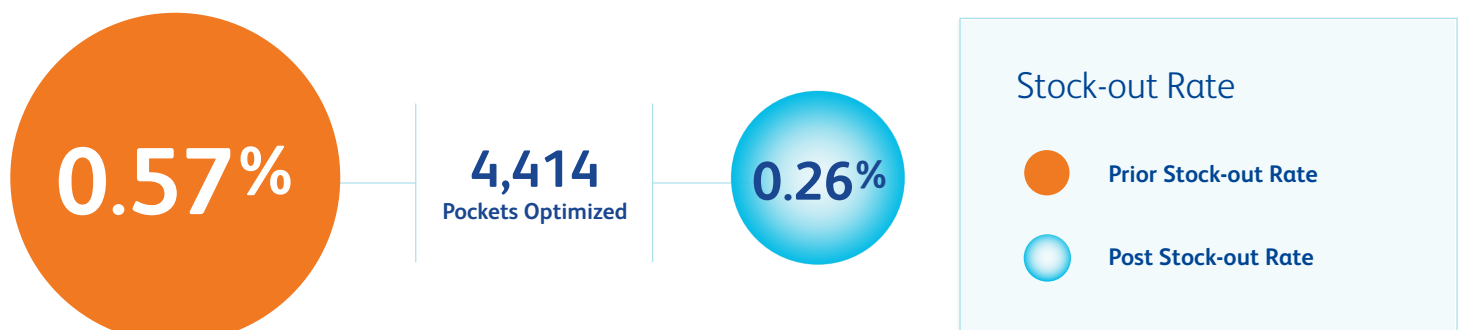
● **Post Stock-out Rate**

Beyond the Initial Goals

Initial impacts of these changes were not restricted to costs and key performance indicators (KPIs)— nursing, pharmacist and technician workflows were also positively impacted. The significant stock-out reductions demonstrated helped improve nursing satisfaction and trust in the ADC system, and the reduction in workload to manage deliveries in select areas by decreasing from multiple deliveries a day to once a day has had a positive impact on pharmacy operations as well. "And of course, we want to reduce frustration. We all know stock-outs frustrate nursing; they frustrate pharmacy. They can create patient care and patient safety issues,"[7] said Webster.

While URMC realized positive results with the use of manual methods before implementing BD HealthSight™ Inventory Optimization, there remained significant burdens pertaining to time required to complete tasks. At Strong, this included approximately 0.5 FTE to compile the data needed to adjust inventory levels. Manual tasking at both hospitals was replaced with automation between the BD Pyxis™ MedStation™ ES server and BD Pyxis™ MedStation™ ES, and the **time spent going to each machine for optimization purposes was reduced**. Furthermore, the need to automate was only part of the decision to implement the solution. **Operating with a single source for managing inventory adjustments through BD HealthSight™ Inventory Optimization** equally influenced the buying decision.
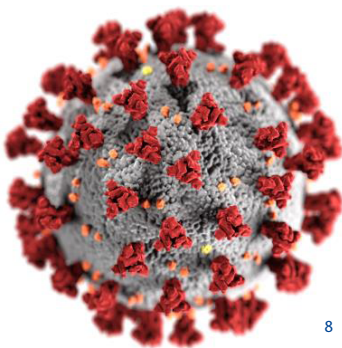
During the COVID-19 pandemic period from March to September 2020, use of BD HealthSight™ Inventory Optimization surged. As units were repurposed, **machines relocated multiple times, and medications dynamically shifted,** the emphasis on actively managing inventory has never been greater. Even through these changes and challenges, the **stock-out rates at both Highland and Strong have remained well below the initial target of ≤1%, measuring at 0.4% and 0.5%, respectively.**

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> What was very valuable during COVID was the ability to access real-time data, assess medication stocks, and adjust PAR levels based on the type of patient moving into those ICUs and Non-ICU areas.[9]
>
> **David Webster, RPh, MSBA**

Due to its adaptability and sustainability, BD HealthSight™ Inventory Optimization can play a significant role in handling fluctuating, often daily, inventory needs such as ADC-level adjustments used to align inventory as patient demands shift. Not only did the solution help hospitals prepare for the influx of COVID-19 cases, it also helped them to readjust PAR levels and overall inventory so that they could more effectively treat patients hospitalized at the present day, not the COVID-19 patient population of the past. With visibility into the cabinets, hospitals are afforded the opportunity to see what medications they need to adjust or load/unload into the ADCs, a true advantage over a manual alternative approach.

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While we didn't see the patient surge at the numbers we were expecting from New York City, which was a blessing, we were ready. And BD HealthSight™ Inventory Optimization is part of the reason we were ready.[10]

David Webster, RPh, MSBA

Implementation

URMC noted how simple it was to integrate BD HealthSight™ Inventory Optimization into current practice — it did not require significant IT involvement and utilized the hospitals' data and current interfaces. Additionally, the application drove prioritization and optimization opportunities, creating an accessible tool which allowed transferring this work from tasks managed by specialists to frontline staff as a part of daily workflow. This freed up valuable FTE(s) to be reassigned to other functions such as managing cost reduction or consolidating inventory optimization, as well as providing support to multiple hospitals.

Lasting positive impact

For both Highland and Strong, implementing BD HealthSight™ Inventory Optimization resulted in immediate reductions in cost and manual effort, measurable and sustained improvement in key performance indicators for inventory management, and the ability to redeploy staff to other priority initiatives.

As the analytics solution continues to evolve and offer new capabilities, URMC will expand its use to drive cost-effective inventory management across its growing ADC footprint, as well as identify and capitalize on opportunities for enterprise-wide inventory optimization.

About BD

BD is one of the largest global medical technology companies in the world and is advancing the world of health by improving medical discovery, diagnostics and the delivery of care. The company supports the heroes on the frontlines of health care by developing innovative technology, services and solutions that help advance both clinical therapy for patients and clinical process for health care providers. BD and its 65,000 employees have a passion and commitment to help enhance the safety and efficiency of clinicians' care delivery process, enable laboratory scientists to accurately detect disease and advance researchers' capabilities to develop the next generation of diagnostics and therapeutics. BD has a presence in virtually every country and partners with organizations around the world to address some of the most challenging global health issues. By working in close collaboration with customers, BD can help enhance outcomes, lower costs, increase efficiencies, improve safety and expand access to health care. For more information on BD, please visit bd.com.

About BD HealthSight™ Inventory Optimization

BD HealthSight™ Inventory Optimization automates the process of adjusting PAR levels by delivering dynamic, predictive analytics and outcomes-driven workflow recommendations, empowering clinicians and pharmacists to take meaningful action to optimize on-hand inventory, minimize waste, and reduce stock-out events. Through a bi-directional interface with BD medication management technologies, our solution enhances your pharmacy operations and helps secure for you the assurance you may need to get the right medication to the right place at the right time. BD HealthSight™ Inventory Optimization promotes Connected Medication Management across the enterprise and is part of the larger BD HealthSight™ Analytics portfolio.

Learn more about how BD HealthSight™ Inventory Optimization promotes Connected Medication Management to optimize inventory across your organization.

Get Started

https://www.bd.com/en-us/offerings/brands/healthsight

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