**Title and Authors:**

# Impact of a pharmacy inventory analytics tool on labor and medication availability

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**Introduction:**

Automated Dispensing Cabinets (ADCs) have allowed health-system pharmacies to increase efficiency and reduce cost through decentralization of inventory.[1] While technology has increased visibility to these metrics, many health-systems struggle to find the correct balance between higher inventory Periodic Automatic Replenishment (PAR) quantities in ADCs, which correlate to increased inventory carrying costs, and medication stock-outs, representing supply exhaustion.[2] This can be explained by the observation that most pharmacies have access to more inventory data than they have the personnel to review it.[1] PAR adjustments through predictive inventory optimization analytics aims to close this gap by automating recommendations to increase medication availability, while reducing labor requirements necessary to maintain drug carrying costs.

**Objectives:**

The primary objective of this study is to review the impact of a predictive Inventory Optimization Analytics (IOA) software on labor savings and stock-out percentage by reviewing data across a variety of health-system sizes and geographic locations, while also leveraging quantitative data assumptions to estimate labor impacts resulting from the use of the software.

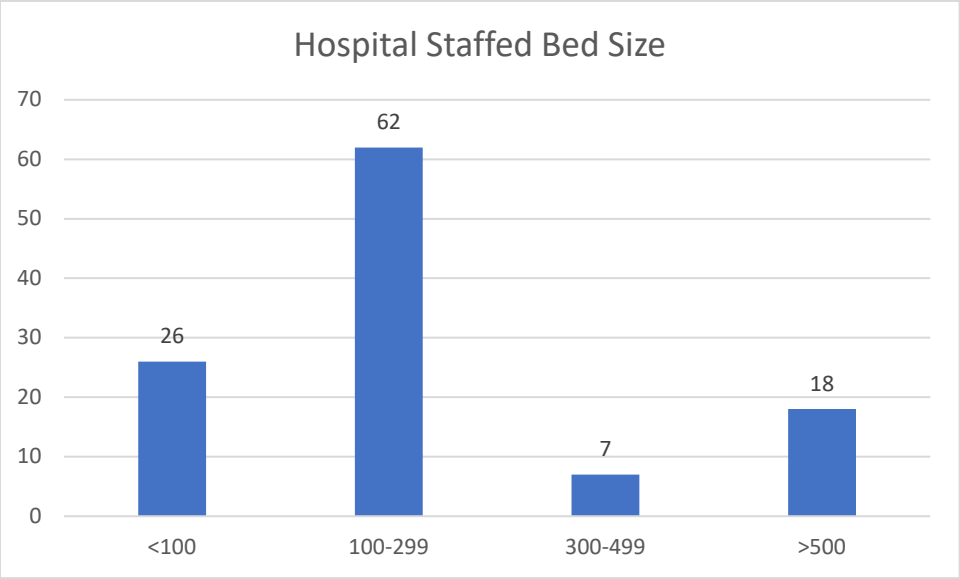
**Materials and Methods:**

A retrospective database analysis was performed on facilities pre- and post-implementation of the predictive IOA software. The study period ranged from November 2016 through August 2020 and included 113 available facilities across 36 integrated delivery networks (IDNs). All data were aggregated and de-identified. Stock-out percentages of medications impacted by the analytics software were calculated using data extracts from the IOA software[*]. Variables used for calculations included pre- and post-implementation vends and pre- and post-implementation medication stock-outs. A stock-out was defined by any instance where a medication pocket reached zero inventory. The data were normalized (weighted) to adjust the stock-out percentage to account for total vends in both the pre- and post-intervention data, rather than assuming dispensing was equal across all facilities. A sensitivity analysis utilizing ADC[†] dispensing data was also performed to determine what impact the intervention had on total facility stock-out percentage.

Total accepted PAR change recommendations were obtained via data extraction from the BD IOA software[*]. Results were stratified to align the first month of recommendation acceptance across all facilities. Descriptive statistics were used to analyze the data for both total recommendations and stock-out percentage, and student t-tests were used to compare pre and post data. A two-sided alpha level of 0.05 was used for all statistical tests. Extrapolation of accepted PAR recommendation data was used to

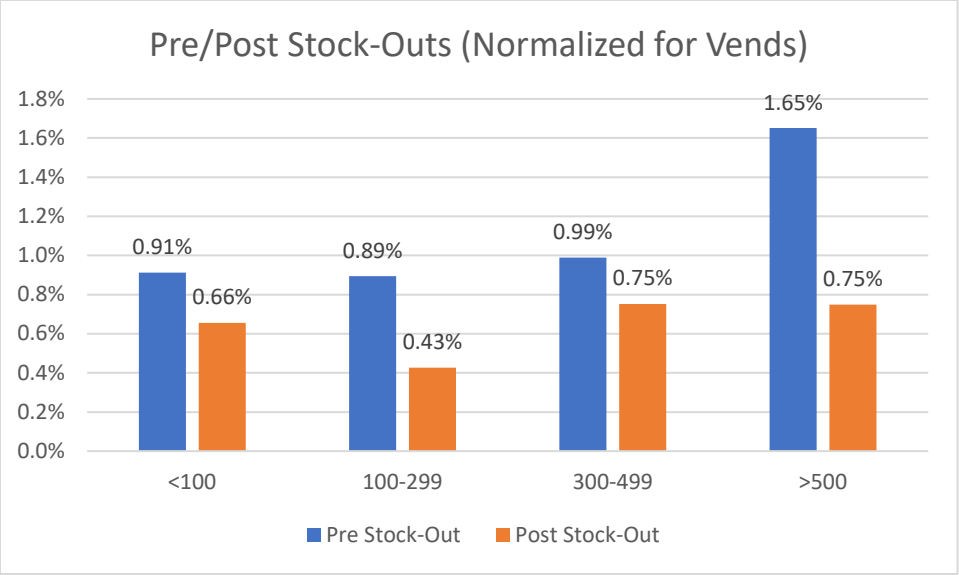
[*] BD HealthSight™ Inventory Optimization Software
[†] BD Pyxis™ Medication Knowledge Portal

estimate an average labor savings. Internal workflow testing was completed to determine average labor time spent on setting and adjusting PAR levels per ADC.[3] This resulted in a range of one to three minutes per accepted recommendation. Financial savings were calculated based on the median pharmacy technician salary of $16.32 per hour, as reported by the Federal Bureau of Labor Statistics.[4]

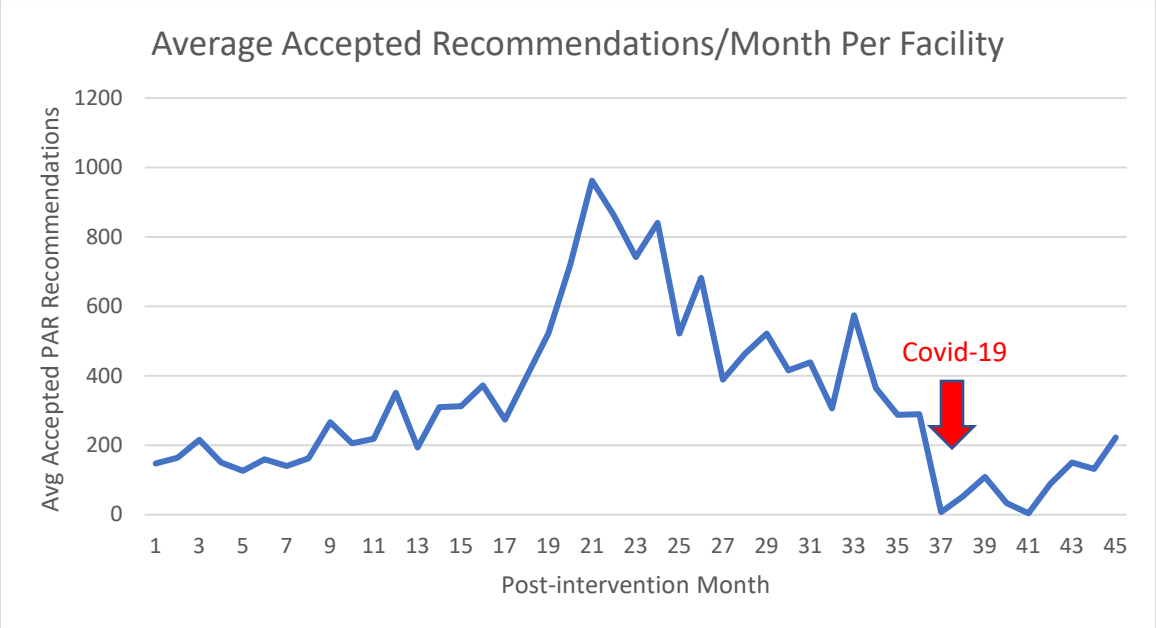



Results:

- The average stock-out rate of medications adjusted by the IOA software for all facilities was 2.66% (Standard Error (SE)=0.63% ) prior to accepting automated PAR recommendations. Post-acceptance stock-out rate was 0.71% (SE=0.10%). This represented a statistically significant decrease of 73% (p= 0.003). When weighting for vends, pre-acceptance stock-out rate was 1.3% and post-acceptance stock-out rate was 0.67%, or a 48% relative reduction in stock-out percentage.
- Total facility stock-out percentage over the same period resulted in a pre-recommendation acceptance stock-out percentage of 0.93% (SE=0.04%) and post-recommendation acceptance stock-out percentage of 0.86% (SE=0.17%). This represented a 7.5% relative reduction in total facility stock-out percentage (p= 0.10)
- On average, 231 automated PAR change recommendations (SE=18 ) per month were accepted by each facility. This result trended upwards as facility size increased. This resulted in an average labor savings of 46-139 technician hours per year, with a projected financial valuation of $754-2,262 per year.




| Average Recommendation Acceptance per month by bed size | | | | |
|---|---|---|---|---|
| Bed size | <100 | 100-299 | 300-499 | 500+ |
| Mean | 29 | 93 | 208 | 552 |
| Median | 14 | 89 | 34 | 553 |
| Standard Error | 7 | 11 | 81 | 57 |
| Total months studied | 23 | 43 | 11 | 45 |



**Conclusions:**

This study demonstrated an appreciable decrease in stock-out percentage for medications where a PAR change recommendation was provided by a predictive IOA software. This result was consistent in all facility population subgroups and was robust when weighting for vends per recommendation. In addition to reducing repercussions of stock-outs, such as ad hoc trips necessary to replenish supply, this study also showed a labor savings associated with the software's potential to reduce manual PAR adjustments. Combining these metrics illustrates a possible reduction in overall labor hours spent performing inventory management, which is increasingly important as health-systems debate the best use of limited human resources.

**Limitations:**

The primary stock-out percentage only corresponds to medication PAR levels altered by the predictive inventory optimization analytics software, therefore not accounting for medications stored outside of ADCs. The number of medication vends utilizing the software versus vends not associated with software utilization is unknown, potentially impacting results for total facility stock-out percentage. This analysis did not account for other potential confounders that could have impacted stock-out % or associated labor, such as practice or policy changes.

The time study utilized to extrapolate labor savings only considered time spent running reports and physically making changes in the ADC enterprise server[‡]. The time spent analyzing reports to obtain PAR change recommendations was not considered, thus likely underestimating the total labor impact of using an IOA software. Future research may be useful to address the relationship between optimal IOA software utilization and total facility stock-out percentage.

**References:**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3. REF-18229 Time impact of PAR changes in Pyxis™ medication technologies
4. REF-18287 "Pharmacy Technicians : Occupational Outlook Handbook." U.S. Bureau of Labor Statistics, U.S. Bureau of Labor Statistics, 1 Sept. 2020, www.bls.gov/ooh/healthcare/pharmacy-technicians.htm.


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[‡] BD Pyxis™ MedStation ES Server

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