



Measuring, evaluating, and improving medication distribution process and performance metrics in an inpatient pharmacy:

**The value of medication tracking,
on-time delivery,
and pharmacy analytics.**

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Background:

Utilization of defined processes and performance metrics, in pharmacy distribution, is an essential component of continuous quality improvement, and has the potential to profoundly impact patient care. Process improvement methods, in the healthcare setting, such as Lean Production and Six Sigma have grown in popularity in recent years, particularly within hospital pharmacy settings. While the merits of these tools have been well documented in the manufacturing setting, effective application of these methods within inpatient pharmacy settings are arguably in the early development stages. Additionally, when compared to other industries, the ability to *quickly and efficiently* measure, analyze, and apply process and performance data is a relatively novel concept within the field of inpatient pharmacy operations.

Current Limitations in Tracking Data in the Inpatient Pharmacy

Although many organizations use data under the guise of process improvement, true real-time, accessible, actionable data usage is the exception rather than the norm. Data collection and analysis in the inpatient pharmacy setting is often a manual process requiring a tremendous amount of resources to collect and report data in an impactful manner. Limitations in collecting valuable and available data may lead to misaligned or surrogate measures, thus significantly impairing the achievement of optimal performance.

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Medication turnaround time is a frequently cited process metric and is defined as the interval that elapses from the time a medication order is generated to the time the medication is administered to a patient¹. This process measurement can play an important role in quality patient care as a number of studies have shown improved outcomes with timely medication administration.

Pharmacy's direct involvement in this process improvement can be divided into two measurable processes. The process of order fulfillment includes the time elapsing from order request to product check by pharmacist. The second process consists of medication delivery to the patient care area, represented by time elapsed from departure of medication from the pharmacy until delivery to patient care area. Additional process categories may include order transcription, order verification, filling of medication orders, product check by a pharmacist, medication delivery, as well as staging between process steps. Although medication turnaround time, in its entirety, is well defined, the individual component processes are highly variable and influenced by a wide variety of factors.

Many studies have been published regarding overall medication turnaround, and pharmacy processing time. Most of these studies have evaluated the cause and effect relationship between implementation of an advanced technology into a process and a specific endpoint such as overall handling time, cost savings, and patient safety improvements^{2, 3, 4}. The prevailing theme throughout the studies that evaluate turnaround time is that a reduction in turnaround time, either in the aggregate or specific segments, is viewed to be a positive outcome. Conversely, traditional thinking tends to view increases in turnaround time as a negative performance indicator. One major drawback of many studies involving medication turnaround time is the inclusion of automated dispensing cabinet (ADC) dispense data. The immediate availability of the medication from an ADC tends to decrease turnaround time for aggregate dispenses and masks the true turnaround time for central dispensing. This becomes an even greater issue as the proportion of ADC dispenses to central pharmacy dispenses increases.

There is currently minimal information available focusing on the evaluation of the entire medication turnaround time process in terms of each individual process components. Recently, a study conducted at the Cleveland Clinic evaluated both cycle and turnaround times with regards to process improvements⁶. The majority of published studies focus solely on process based metrics, including cycle and turnaround time. The value of turnaround time measure and process capability should not be minimized, however, effective use must be caveated. Specifically, the assumption of “faster is better” cannot be exclusively accepted as a sole indicator for performance. For example, there may be little value in rapidly preparing a medication in less than 15 minutes when it is not due for 4 hours. In fact, rapid preparation hours before the due time may increase waste and associated costs if the medication order is modified during that timeframe. Utilizing a tailored, site specific “just in time” model for production may be an optimal approach.

On-Time Delivery as a Performance Metric:

When applying Lean Production methods to the inpatient pharmacy, considerations must be made for major differences in products and service expectations when compared to other industries. While most manufacturing companies focus on the production of a limited number of line items, inpatient pharmacy product output could be in thousands. Additionally, products in the manufacturing industry often have completion goals based on entire product lots, while inpatient pharmacy products completion targets, or due time, can be specific to each and every medication. Little emphasis has been placed on linking process evaluation to measurable performance metrics, including correlation of turnaround time to “on time” medication delivery or customer satisfaction. Solely evaluating turnaround time does not reflect inherent process decisions that may increase efficiency. Additionally, evaluating performance purely on turnaround time does not factor in differing customer or patient demand for the medication. To illustrate this point consider the need to dispense 100 first

dose medications with differing due times. Applying an average process time to medications with different priorities is not fully indicative of performance.

Poor performance, i.e., late deliveries, also contributes to the incidence of missing medications and numerous calls from nursing to determine medication location.

Published evidence has suggested that missing medications may represent nearly 3% of total pharmacy volume dispensed, equivalent to over 200 missing medications per day in one organization.⁷

Assuming an average cost of \$5 per missing medication, a conservative estimate, this represents over \$300,000 lost annually for a 448 bed facility.

Untimely medication delivery and missing medications may also increase nursing time away from the bedside, resulting in a reduction in nursing satisfaction. Additionally, although it has not been clearly quantified in the literature, missing medications and untimely medication delivery may cause unnecessary delays in patient treatment, leading to adverse patient outcomes.

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There is no clear information defining what serves as an appropriate medication turnaround time, therefore knowing process turnaround times may limit process understanding and only serve as surrogate of the true system performance. As a result, on-time delivery may serve as a more accurate measure of system performance. Ensuring the right medication is at the right location at the right time is critical to optimal patient care.

Integrating Technology to Optimize Performance:

Real-time tracking of pharmacy processes and performance, similar to what occurs in other industries, provides the capability to *quickly and efficiently* measure, analyze, and apply process and performance data.

To manage and continuously improve pharmacy product processing and delivery, pharmacy administrators must have visibility into the specific processes. Despite evolving technology in the hospital pharmacy environment, few technology solutions have provided complete visibility into process flow. Real-time tracking of pharmacy processes and performance, similar to what occurs in other industries, provides the capability to *quickly and efficiently* measure, analyze, and apply process and performance data within the field of inpatient pharmacy operations. Ideally, a technology

solution should track not only medication location through the process but also track critical information regarding workflow, productivity, and efficiency and provide real-time feedback regarding performance.

Implementation of Medication Tracking and Process Management Software, PharmTrac.PD, resulted in a 64% improvement in on-time delivery.

In Spring 2012, in an effort to more effectively monitor pharmacy processes, track medications, and improve operational performance, Wake Forest Baptist Medical Center (WFBMC) implemented PharmTrac.PD. PharmTrac.PD is a mobile, barcode enabled, medication tracking and process management solution that provides insight into inpatient pharmacy process and performance. The interactive user interfaces provide a platform that can drive optimal workflow and performance through communication with the end user. WFBMC is a tertiary care academic medical center located in Winston-Salem,

NC. The Department of Pharmacy currently services 1056 acute care rehabilitation, long-term, and psychiatric beds. The implementation was primarily focused on first doses, intravenous doses, and other compounded patient-specific products. The goal of implementation of the barcode enabled medication tracking and process management solution were to collect baseline data, and later improve performance and process metrics, specifically improving on-time delivery, thus reducing consequences of late deliveries, including missing medications and associated calls from nursing staff. WFBMC conducted a baseline assessment of performance and process metrics and found that approximately 62% of medications were delivered late. Post implementation of PharmTrac.PD, WFBMC recognized a significant improvement in process turnaround time but more importantly, in on-time delivery. During the first 3 months after implementation, on-time delivery improved significantly.

Figure 1: OnTime Delivery Following Implementation of Technology Solution

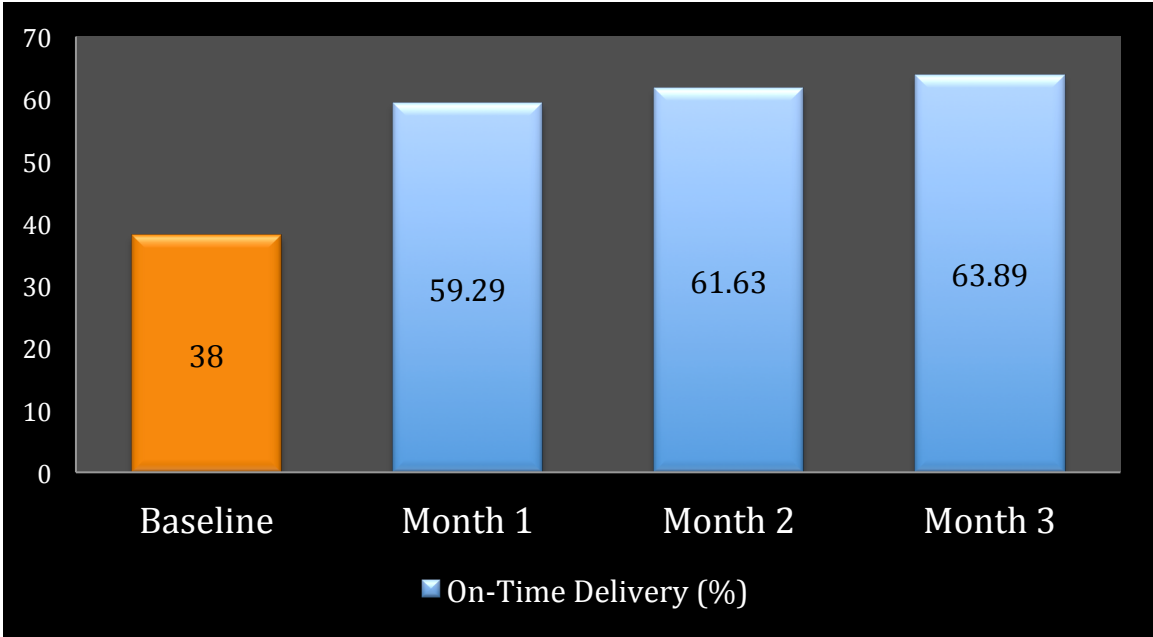


Figure 2: OnTime Delivery and Late Delivery Following PharmTrac

	On-time delivery (percentage of total deliveries) (baseline 38%)	Late Delivery (percentage of total deliveries)	Percentage improvement in late delivery (baseline 62%)
Month 1	59.19	40.81	50
Month 2	61.63	38.37	53
Month 3	63.89	36.11	56

More impressively, these improvements occurred without any active process improvement efforts directed at performance during the implementation and first 90 days post implementation. This relatively immediate improvement likely occurred as the result of creating a more defined workflow around the technology solution, thus creating greater awareness to process consistency.

Improvements were also recognized in process turnaround time for each step, e.g., preparation, pharmacist product check, and product delivery. Additionally, the technology solution provided insight into delivery methods which can be used to identify the most resource efficient method of delivering to various areas throughout the hospital or to reallocate resources or staff for delivery purposes. Considering costs associated with missing medications or late deliveries, improvements in on-time delivery can dramatically impact costs and reduce waste.

Delivery Methods identified through technology solution:

Delivery method	Percentage
Staff delivery	50.94%
Pneumatic tube delivery	49.06%

Analytics – Harnessing the Power of Data

Although business intelligence systems have become more commonplace in healthcare, the availability of real-time, available, and usable data in inpatient pharmacy continues to be elusive. Performance improvement methods often incorporate retroactive data analysis, which as previously stated is historically laborious, time intensive, and often, inexact. Proactive analytics and real-time data visualization in inpatient pharmacy supports proactive decision-making and allows pharmacy administrators to better understand current pharmacy operations, and to predict future performance based on data. Through a web-enabled portal, PharmTrac.PD provides real-time, usable metrics about core pharmacy operations, presented as interactive dashboards and reports. Data can be integrated from other systems such as pharmacy information systems or carousel systems to provide expanded insight into pharmacy process and performance.

Proactive analytics and real-time data visualization:

- supports proactive decision-making
- provides a better understanding of current pharmacy operations
- can be used to predict future performance

Summary

Mobile, barcode enabled medication tracking and process management software provides a valuable tool in improving pharmacy product preparation and delivery processes and performance. Implementation of this technology has been shown to improve pharmacy operational processes and performance significantly within only 90 days. Through integration of real-time data analytics and workflow management tools, data is transformed into actionable information that can drive more effective, more efficient decision making in the inpatient pharmacy and can be leveraged to improve and predict performance in the future.

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