Pharmacy Dashboard: An Innovative Process for Pharmacy Workload and Productivity

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ABSTRACT

Background: Innovative approaches, including LEAN systems and dashboards, to enhance pharmacy production continue to evolve in a cost and safety conscious health care environment. Furthermore, implementing and evaluating the effectiveness of these novel methods continues to be challenging for pharmacies.

Objective: To describe a comprehensive, real-time pharmacy dashboard that incorporated LEAN methodologies and evaluate its utilization in an inpatient Central Intravenous Additives Services (CIVAS) pharmacy.

Methods: Long Beach Memorial Hospital (462 adult beds) and Miller Children's and Women's Hospital of Long Beach (combined 324 beds) are tertiary not-for-profit, community-based hospitals that are served by one CIVAS pharmacy. Metrics to evaluate the effectiveness of CIVAS were developed and implemented on a dashboard in real-time from March 2013 to March 2014.

Results: The metrics that were designed and implemented to evaluate the effectiveness of CIVAS were quality and value, financial resilience, and the department's people and culture. Using a dashboard that integrated these metrics, the accuracy of manufacturing defect-free products was ≥99.9%, indicating excellent quality and value of CIVAS. The metric for financial resilience demonstrated a cost savings of \$78,000 annually within pharmacy by eliminating the outsourcing of products. People and value metrics on the dashboard focused on standard work, with an overall 94.6% compliance to the workflow.

Conclusion: A unique dashboard that incorporated metrics to monitor 3 important areas was successfully implemented to improve the effectiveness of CIVAS pharmacy. These metrics helped pharmacy to monitor progress in real-time, allowing attainment of production goals and fostering continuous quality improvement through LEAN work.

Key Words— CIVAS, compounded sterile products, dashboard, LEAN, management, metrics, pharmacy, productivity, workload

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Medication safety, diminished quality of health care services, and excess waste, coupled with shrinking reimbursements, are current challenges that have prompted leaders of health care organizations to redesign many aspects of hospital operations and processes to improve health care delivery and minimize waste. LEAN systems thinking is one popular concept that has been adopted with varying degrees by many industries worldwide to improve processes and minimize waste.¹ It fosters

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a culture for continuous quality improvement that has been effective in improving many organizations. In health care, LEAN can be defined as “an organization’s cultural commitment to applying the scientific method of designing, performing, and continuously improving the work delivered by teams of people, leading to measurably better value for patients and other stakeholders.”^{2(p75)}

LEAN systems thinking has become popular in health care over the last decade. Through the LEAN concept, management tools have been established to (a) organize work areas using 5S techniques (sort, simplify, sweep, standardize and sustain),³ (b) decrease inventory drug costs with a 2-bin replenishment system,⁴ and (c) improve workflow to support a product-driven process by eliminating steps with minimal value in enhancing productivity.⁵ Recently, LEAN management dashboards have been developed to provide a visual representation of data showing key performance metrics to foster LEAN work.^{6,7}

Operational dashboards are intended to provide managers and leaders a quick visual tool based on collected data to monitor the completion of work in their departments.⁸ The dashboard can help them quickly uncover any potential problems and take immediate action to help improve the department’s performance.⁸ There are no standard, set metrics displayed on every dashboard because they are intended to be tailored to the user’s needs, but operational dashboards typically involve metrics pertaining to inputs, outputs, outcomes, efficiency, and effectiveness (including quality).⁸ Although dashboards cannot be all-encompassing on levels of performance, they can be utilized to help make objective business decisions.^{8,9}

One such dashboard was created and implemented by the University of California Los Angeles (UCLA) neurosurgery department.⁶ This dashboard focused on 3 priorities: quality and safety, patient satisfaction, and efficiency and utilization. The constant display of these metrics aided management in making critical decisions that directed departmental change.

One pharmacy-related dashboard was created by the University of Michigan, in collaboration with the clinical information and decision support services, to analyze drug cost and usage trends throughout the hospital.⁷ The dashboard has allowed hospital management to formulate strategies to decrease drug expenditures and react to emerging trends in a more immediate fashion.

The utilization of dashboards in other areas of pharmacy are limited and not well documented in the literature. The purpose of this study was

to create, implement, and evaluate the utility of a pharmacy dashboard for the inpatient Central Intravenous Additives Services (CIVAS) at 2 inpatient community-based hospitals.

METHODS

Long Beach Memorial Medical Center and Miller Children’s and Women’s Hospital in Long Beach, California, are hospitals integrated into a not-for-profit, community-based health care system. Long Beach Memorial Medical Center is an adult hospital with a total of 462 total beds, 61 of which are beds for the intensive care unit (ICU). Miller Children’s and Women’s Hospital has a combined 324 pediatric and women’s beds, including 93 neonatal and 20 pediatric ICU beds. Both hospitals are currently serviced by one CIVAS pharmacy. This study was approved by the institutional research review board as an exempt application.

LEAN has been an integral part of a quality improvement program for the CIVAS pharmacy since 2009. In 2013, a pharmacy dashboard was created and implemented to track and enhance all of the LEAN processes that were previously completed. Prior LEAN processes done in 2009 included projects that created and defined standard work, helped develop a system to triage labels by due time, established and implemented par levels (or minimum stock levels for re-ordering medications and supplies), and balanced workflow and workload by shifting work from the day to the evening. A 5S was completed in 2010 to reorganize supplies and medications to improve inventory management and create standards for medication and equipment location. Early in 2012, another rapid process improvement project was undertaken to move from a 24-hour production cycle with 1 to 2 deliveries per day to 4 production and delivery cycles per day for both hospitals. Also, a small-scale daily management system was created to track production and waste of medications returned to CIVAS from the floors. Finally in 2013, production cycles were increased again from 4 to 6 adult and 7 pediatric cycles a day. Also, the pharmacy dashboard (which incorporated and monitored the results from this previous LEAN work) was created and implemented in CIVAS. The period for this study incorporated dashboard data from March 2013 to March 2014.

The operational dashboard implemented in CIVAS was created using basic data-entering software that could generate graphs. The graphs were printed on a weekly or monthly basis (depending on the metric) for display on a corkboard near the pharmacy’s

central area, allowing for easy viewing during daily huddles/meetings. Initial development of the graphs and data tracking took approximately 60 hours. Maintenance was less difficult; it took approximately 8 hours a week of the CIVAS supervisor's time. This included time for data gathering from the various paper data recordings by staff, graph generation, and time for the standard work audits performed by management daily.

The metrics for the CIVAS dashboard align with 3 of the organization's 6 overall strategic goals: (1) quality and value, (2) financial resilience, and (3) people and culture (Figure 1). The metrics for quality and value include on-time production, consistent turnaround times on STAT (or urgent) orders, and defect-free production tracking. For financial resilience, the productivity metrics include cost savings by eliminating outsourcing, and the tracking of drug and supply expenditures. The metrics for people and culture are compliance with standard work tasks and recognition of staff participation in workflow decisions displayed on an idea board that showcases continuous quality improvement.

All data were collected anonymously from staff by using tally marks to indicate the data points. These tally marks were compiled by the CIVAS manager and put in an electronic format for display on the dashboard. Any data collected from management observation were also collected anonymously and entered by management for display using nonspecific shift labels.

Figure 1. The 3 categories and their metrics on the pharmacy dashboard.

Quality and Value

Collection of these data was prospectively conducted by on-staff pharmacists as part of a quality improvement project. Between the 2 hospitals, there were 7 pediatric cart fill deliveries and 6 adult cart fill deliveries per day. To assess timeliness of completion and delivery of the cart fills to both of the hospitals, the pharmacist simply added a checkmark to a chart to indicate whether the delivery was leaving on time or late. The chart was located near the delivery cart to help the pharmacist remember to document this metric. The information was compiled by pharmacy administrators monthly as the percentage of cart fill deliveries that were fulfilled and delivered on time.

STAT intravenous (IV) turnaround times were recognized early in the LEAN management system as an area for improvement. Although specific data pre-implementation were not available, recording of this metric allowed the department to track improvements in turnaround times due to proposed and implemented changes in the IV workflow done specifically around processing STAT orders. Consistent turnaround times on STAT orders were collected for 1 week in a month. The time from printing of the label through production and verification of a STAT order was recorded, in minutes, by the pharmacist on a tally sheet. That week's data were again compiled, graphed, and displayed on the dashboard monthly.

Defect-free production was defined as the accuracy of the products made without any errors. Capture and correction of these errors occurred (1) externally by nurses and satellite pharmacists or (2) internally by pharmacists directly involved in the production of the medication. External data were recorded in real time when an error escaped CIVAS and was discovered either by a satellite pharmacy or at bedside. Internal errors or "good catches" were also recorded in real time. When a CIVAS pharmacist discovered an error in a product that was made in the cleanroom, the error was recorded by the discovering pharmacist on a dry-erase (and thus reusable) tally sheet indicating the type of error caught. The categories included expiration date error, wrong drug, wrong concentration, wrong volume, and wrong diluent/base solution. Numbers of good catches and types of errors were then transcribed daily by a technician to a monthly tally sheet. The supervisor of CIVAS finally compiled these data onto the dashboard after each week in a graph form. The external defects that escaped CIVAS were also anonymously recorded on a tally sheet by management and graphed monthly with percent defect-free production by the CIVAS supervisor.

Financial Resilience

The financial resilience portion of the dashboard incorporated daily and monthly recordings of metrics. Productivity was represented on the dashboard by the ratio of units of service per hours worked. Units of service were collected daily from a specific technician shift that was assigned the task of compiling the workload for printed labels and drug production (including total parenteral nutrition bags, bulk products, and on-hand injections) for the pharmacy satellites. Each of these activities was weighted based on difficulty and time spent to complete the product. Then, that unit of service number was divided by the number of employee hours worked that day. This final quotient was compiled and presented to management on a biweekly basis (although it could be viewed daily if desired) and graphed on the dashboard, with the budget ratio provided by hospital administration based on the previous year's data.

The amount of dollars spent on outsourced medications was also displayed in this portion of the dashboard. It was updated by management annually from 2012 to 2014. Finally, drug and supply expenditures were compiled and displayed by management monthly on the dashboard as well.

People and Culture

The third category on the dashboard, people and culture, was partly driven by 2 specific Gallup workplace survey statements: I know what is expected of me at work, and I have received recognition or praise for doing good work.¹⁰ In an effort to improve the score for these 2 statements, the compliance rate with standard work tasks in different work shifts was assessed by management daily. Initially, a standard work document was created for each technician shift, often with edits by the technicians themselves. Each technician was assigned to a shift, and the team within that shift was responsible for making decisions on workflow. The document clearly defined tasks and the amount of time associated with each task that was specific to each shift. Technician engagement in creation and presentation of the standardized work processes helped ensure consistency in completion of the task to manufacture high-quality products. After the completion of the standard work documents, random audits were conducted by the supervisor for CIVAS daily. Compliance with the standard work was monitored and the data posted on the dashboard.

Another metric for people and culture was used to evaluate and encourage idea generation for continuous improvement of CIVAS workflows. Metrics for quality

and value, financial resilience, and standard work were analyzed and discussed at a 15-minute daily huddle meeting that was mandatory for all CIVAS staff and leaders. The staff and management team were constantly challenged to identify ways to improve workflows and add safety measures to ultimately improve all metric data collected on the dashboard. Individuals would present ideas in huddle, and these ideas were briefly discussed among the group. Personnel were then selected and assigned by the group to determine the feasibility of the ideas and the likelihood of implementation. Participation in idea generation and implementation were tracked by CIVAS management and recorded on the dashboard monthly to recognize individual's contribution for continuous improvement work. Everyone shared the responsibility for evaluating and potentially improving the idea as well as implementing it. Department celebrations occurred when metrics improved. After successful implementation of an idea, a new challenge was then selected as a target goal for LEAN's cycle for continuous quality improvement.

RESULTS

The CIVAS pharmacy that provided the IV medications to both the adult and pediatric hospitals has been open 18 hours daily from 05:30 to 23:30, 7 days a week. Three 10-hour shift pharmacists staffed CIVAS per day; they also operated an oral liquid and tablet pharmacy area with data that were not included here. Nine, 8-hour shift technicians covered CIVAS per day on Mondays through Fridays. Weekends were flexed down with only 7 CIVAS technicians per day. This resulted in 472 technician and 210 pharmacist work hours weekly. The CIVAS pharmacy produced an average of 8,000 IV doses weekly and approximately 34,667 IV doses monthly.

Quality and Value

The evaluation of on-time production and delivery demonstrated 99% to 100% attainment of metrics during the 10 months from April 2013 to March 2014 (Figure 2). STAT turnaround times were reduced from an estimated average of 20 minutes to as little as 6.4 minutes over the first year after dashboard implementation (Figure 3).

The accuracy of defect-free production was $\geq 99.9\%$ for all months during the study period, with 100% attainment in September 2013. This incorporated both internal and external correction of any errors. The internal errors detected and corrected by

Figure 2. On-time production cycles by month.

Figure 3. STAT (or immediate) intravenous order turnaround time by month.

pharmacists directly involved in the production process are presented in **Figure 4**. The internal defects that were rectified by the pharmacist during the initial production process decreased dramatically over time, with a decrease from 193 to 13 errors between March and November 2013. Notably, while 193 errors were corrected internally for March 2013, this represented less than 0.1% of the total unit of production each month. Expiration date was the most common type of error caught internally over the study period (**Table 1**).

Financial Resilience

The mean actual productivity, at approximately 0.45 hours worked per unit of service, was consistent with the budgeted amount (**Figure 5**). By using LEAN methods, CIVAS was able to increase the number of production and delivery cycles multiple times. The increased number of cycles resulted in deliveries that were more reactive to changing physician orders; this

Table 1. Type and frequency of internal errors identified and corrected by pharmacists

Type of internal errors	No of errors (%)
Incorrect expiration date	208 (37.1)
Incorrect volume	152 (27.1)
Incorrect concentration	83 (14.8)
Incorrect drug	63 (11.3)
Incorrect diluent/base solution	54 (9.6)

saved staff time, because they did not need to constantly remake products, and decreased waste from discontinued medications. The time saved allowed CIVAS to increase the capacity for workload, which resulted in the department being able to eliminate the outsourcing of products. In fact, the amount spent for outsourcing products was about \$78,000 in 2012, \$30,000 in 2013, and \$0 in 2014. The annual

budget for both drugs and supplies was \$550,000. The actual expenditures for drugs and supplies were fairly consistent each month, accumulating to the budgeted annual amount by January 2014 (Figure 6).

People and Culture

The overall compliance rate with standard work tasks in different work shifts was 94.6%. At the beginning of the study period, variations in the compliance with standard work were detected (Figure 7). One hundred percent compliance was achieved in 3 of the 13

months. The idea board consistently had input from 14 different pharmacists and pharmacy technicians. Most of these ideas were related to the standard work tasks that ultimately improved the quality and value metrics (Table 2).

DISCUSSION

Since the implementation of the pharmacy dashboard, CIVAS operation and productivity have been enhanced, as demonstrated by steady and sustained improvements in metric data. Within the quality and

Figure 4. Internal errors identified and corrected by pharmacists.

Figure 5. Pharmacy productivity in hours worked per unit of service by month.

Figure 6. Drug and supply expenditures by month.

Figure 7. Compliance with standard work tasks.

Table 2. Some workflow issues and solutions identified and implemented by Central Intravenous Additives Services (CIVAS) pharmacists, technicians, and managers

Issues identified	Solutions proposed and implemented
STAT orders pile up and are not being completed as quickly as they could be	Create an escalation matrix so that other shifts can be pulled away from their work to help with compounding STATs
Both CIVAS and Miller Children's staff delivering around 16:00	Decrease duplicate work by having Miller Children's staff deliver all meds ready by 16:00
Wrong base volume	Circle the volume on the IV bag with sharpie for a double-check
Expiration dating printed on some labels, not others	Make a list for IT of orders that do not print with an expiration
STAT labels sometimes get mixed up in batch cart fill print outs	Get a new "STAT only" printer and put a roll of labels with a red border on them to help distinguish STAT versus routine

Note: IT = information technology; IV = intravenous; STAT = immediate.

value category, on-time production was consistently at a high level; thus, limited time was used to brainstorm and work to improve this metric. Since improvement was unnecessary, this metric may be removed from the dashboard, or only periodically evaluated, to reduce the need for recording time and analysis.

In addition to the on-time production categorized as a metric for quality and value on the dashboard, STAT IV turnaround times improved significantly from the estimated baseline. For example, a yellow bin system for STAT labels was implemented the same month as the dashboard was created, which likely contributed to the decrease from an estimated 20 minute baseline turnaround time. In April 2013, a suggestion was made by staff to add a designated STAT printer with a red-bordered label to ensure that a STAT label would not be misplaced among non-urgent labels. Users of computerized physician order entry (CPOE) had to choose this STAT printer instead of the default IV printer in order for the red-bordered labels to be utilized. An escalation matrix was also brainstormed and designed to redirect work when there were too many STAT labels for one technician to handle during the month of May 2013.

The percent of defect-free production continues to be an important metric to show quality. Defect-free production relates to no external errors being caught or discovered by staff external to the pharmacy department. The initial goal of 100% defect-free production, achieved in September 2013, was a great opportunity for staff and management to celebrate the success that was realized through the dashboard implementation.

The data on internal errors detected in CIVAS were a critical focus area for generating ideas from staff. In the initial months of data collection, expiration dating errors were identified quickly. Through discussions at staff meetings, it was discovered that not all labels had expiration dates preprinted from the CPOE program. In response to this omission, pharmacists typically added the dates after production. To prevent this error, records of labels without preprinted expiration dates were collected and sent to computer super-users to add into the CPOE program. Meanwhile, awareness was heightened on the issue, and technicians vigilantly checked for expiration dates to help decrease the amount of these types of internal errors.

Another area of focus for internal errors was wrong volumes. Staff presented the solution of circling the volume on the IV bag with a marker to indicate

the completion of a technician double-check before final verification by the pharmacists. This appeared to decrease the frequency of this type of error.

Financial resilience metrics were more challenging to improve quickly. Although the results were displayed in real time, it was difficult for pharmacy management to make certain cost-saving decisions. For example, based on the previous day's units of service versus hours worked data, management could decide to reduce the work hours for staff to thereby supplement the difference. While this furlough technique is challenging to implement, it remains an option for CIVAS to improve the productivity metric when workload is down.

The metric of cost savings from outsourced products was easily realized. Workload was adjusted to allow time for this extra production. To create this capacity, production cycles were changed through LEAN methodologies in early 2014 from 4 to 8 cycles a day for pediatrics and from 4 to 6 cycles for adults. The resulting production batches were much smaller, and therefore they required less technician time to fill per cycle. Because of these more frequent fills, each batch was also more reactive to changes in patients' therapies made by physicians. This limited the amount of wasted products that were either discontinued or changed and returned to the pharmacy. However, this also decreased the units of service for the department. With the readjusted workload, staff members were able to internally produce the formerly outsourced items, including patient-controlled analgesia drips, narcotic drips, and cardioplegic solutions. These changes have resulted in significant savings of over \$5,000 per month for the department without changing staff time. Although the units of service have not significantly changed, the department savings in dollars have been realized.

Metrics for cumulative expenses also showed an area for improvement. Plans are currently underway to create a technician position for inventory management. It will be interesting to evaluate for changes in this metric once this position is realized. A point to consider related to costs is the added expenses associated with drug shortages and the decision to acquire these medications at a premium cost from secondary markets. This information can be teased out of this metric to better quantify the additional expenses of acquiring these high-cost medications, and this is a consideration for display in the future.

The final category on people and culture focused on 2 pertinent Gallup poll statements. To improve these scores and ensure consistent, high-quality work, the standard work process was created for each technician shift. The standard work processes held everyone accountable to the same steps and essentially the same time frame to complete the work. It has streamlined processes so that all technicians and pharmacists can complete work in the same way and produce the same quality product each time. Recording for compliance to the standard work has been tedious, but certainly worthwhile. The audits showed a continued increase in compliance with all standard work activities over the first 6 months of the study period. When variances were detected by management through the audits, real-time coaching occurred and time was spent in department meetings to reinforce the standard process. Frequently, these meetings resulted in opportunities to discuss and revise the standard work. Through this process, many staff members became engaged in the discussions and generated effective ideas. Staff felt the value of their contributions as changes to standard work were improved.

Limitations of this study included missing data for on-time production due to a lack of recording at each delivery. This may have resulted in uncertainty of these data. The audit process for STAT IV workflow was implemented with the dashboard and thus prior data were unavailable, preventing a true view of the impact of all the changes made to the STAT process. The assumed baseline was an educated guess agreed upon by the investigator and the manager of CIVAS as a representation of how long an average STAT dose took from printing to delivery of the completed IV product. Additionally, pharmacists using CPOE did not always select the STAT printer with the red border, potentially resulting in slower STAT turnaround times if a few of these products were mislabeled. The escalation matrix developed for decreasing STAT turnaround times was not always followed due to issues with minimal staffing around lunch breaks, which could have also resulted in longer average turnaround times. Additional limitations to the defect-free production metric involved recording fatigue of internal errors. When the process was new, more pharmacists were excited about the recordings, but as time went on, it is possible that fewer recording of errors caught were made due to a lack of emphasis on the process. Finally, it is possible that not all external errors were caught or made known

to CIVAS staff for recording, which possibly led to a falsely high defect-free production rate.

CONCLUSION

The dashboard has been a valuable tool for both management and staff in improving the productivity of the CIVAS pharmacy. It has identified multiple areas for improvement. Trends have been easier to display on the dashboard, which helped staff to visualize results from changes to workflow. This system, with its focused metrics, should continue to be revised to maximize documenting accurate and real-time data. Furthermore, areas where further improvements are limited may be eliminated to allow for generation and collection of new metrics.

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