Implementation of Three Times Daily Small Volume Parenteral (SVP) Processing Using Lean Methodology

Phuoc Lynsey Le, PharmD; Dominick Bulone, PharmD; Akta Patel, PharmD, BCPS; Glenn Oettinger, PharmD; Dennis Delisle, MHSA, PMP

Department of Pharmacy, Thomas Jefferson University Hospital, Philadelphia, PA

CLINICAL IMPORTANCE

- Small volume parenteral (SVP) medications are batch-processed once daily at a 900+ bed academic medical center
- Labels are printed 36 hours before medications are due and prepared and delivered for a 24-hour period
  - Therapy changes, discontinuations or patient transfers lead to increased rework, missing doses, and ultimately waste
- Lean methodology was originally developed as a production philosophy and quality system with an emphasis on problem solving, partnership, and process improvement[1-3]
  - The Lean philosophy emphasizes the continual identification and elimination of waste in order to maximize value[1]
- Lean has been used in healthcare with great success[4-5]

PURPOSE

The purpose of this project was to evaluate the SVP process and identify opportunities for improvement

- Current process was redesigned using Lean Thinking and associated tools
- SVP processing was increased to three times daily to minimize waste, improve workflow, and decrease overall drug expenditure

METHODS

- Develop project charter to establish the scope and goals by 4 institutional Lean Leaders and 1 Lean Master
- Form SVP improvement team consisting of pharmacy administrators, pharmacists, and technicians
- Engage stakeholders and front-line staff to identify potential issues and barriers to project implementation through Voice of Customer (VOC) interviews (Table 1)

Table 1. VOC Questionnaire

1. Why are we doing this project?
2. What is the ultimate goal?
3. What is your role in achieving that goal?
4. What will success look like?
5. What are the barriers you foresee?
6. How can we overcome those barriers?

- Map current and future state SVP processes using value stream mapping and defining pharmacist and technician roles and responsibilities
- Reorganize SVP work and storage areas using the Lean 5-S methodology (Sort, Store, Shine, Standardize, and Sustain)
- Create documentation tools and standard operating procedures to address staff concerns
- Distribute electronic communication to all pharmacy and nursing personnel prior to implementation
- Provide 24-hour on-call support by the Lean team for 2 weeks post-go-live
- Analyze hospital-wide purchasing and billing data for targeted high-cost medications

RESULTS

VOC Interviews

Table 2. The VOC indicated the following opportunities for improvement:

Establish consistent staff coverage in the SVP area for all shifts
Create a checklist of responsibilities per shift
Develop optimal par levels for each medication
Create a call-out plan
Reorganize the physical work space
For nurses, the primary objective was to receive medications from the pharmacy on time to avoid delays in administration

Value Stream Mapping

Trained Lean leaders went to the "Gemba" (place where the work is completed) to map the SVP process pre- and post-implementation. Value stream mapping is a method of identifying waste within a process by examining each step to determine if it is value-adding or non-value adding. In Lean methodology, value-adding is defined as something 1) the customer is willing to pay for, 2) done right the first time and 3) changes the good or service physically[2]. These three criteria were assessed for every process step. Non-value adding activities were eliminated to create the future state workflow.

Figure 1. Mapping Current State SVP Process

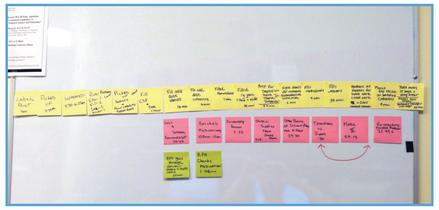
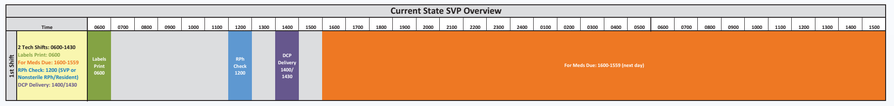


Figure 2. Mapping Future State SVP Process

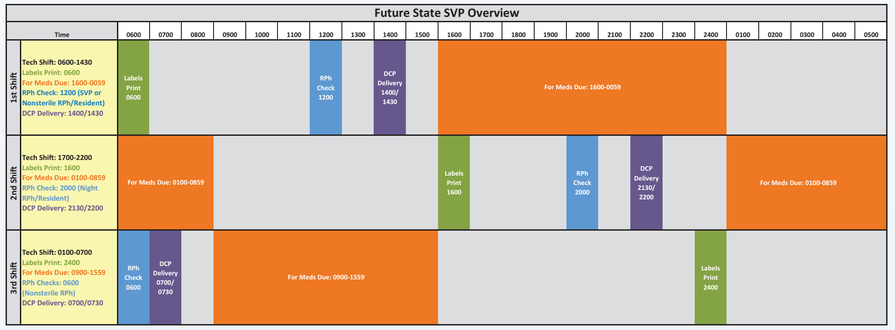
With once daily SVP processing, labels printed 36 hours prior to the medication being due leading to unnecessary work, rework and waste as patients' clinical status may change in the interim and orders get changed or discontinued. Additionally, these changes affect other processes, such as workflow on the decentralized pharmacies (DCPs), resulting in nurses calling for missing doses.

Figure 3. Schedule of the Current State SVP Process



With the redesigned three times daily SVP processing, no more than one dose of a medication is dispensed for most products, minimizing extra-processing and rework. The medications dispensed were a more accurate reflection of the patients' current medication profile.

Figure 4. Schedule of the Future State SVP Process



Flow

The concept of flow stipulates that products should move smoothly from process to process without waiting or waste. Flow may be a physical matter such as re-aligning machinery in a factory or through using a 5S methodology (Sort, Store, Shine, Standardize, and Sustain)[2].

Institutional 5S experts were brought in to assess how we could reorganize the SVP workspace to optimize flow. Figure 5 illustrates the SVP area pre- and post-5S. Lastly, par levels were established to implement a pull system whereby products are batched only when needed.

Figure 5. SVP Area: Pre-(left) and Post-5S (right)

Metrics

Purchasing and billing data for five high cost medications, consisting of amphotericin B, daptomycin, micafungin, acetaminophen IV and tigecycline were evaluated pre- and post-implementation (Table 3). The purchasing data was converted to purchased billing units (BUs). The billed BUs were divided by the purchased BUs to obtain a billing ratio. A billing ratio of 1 implies we are billing for the exact amount of medication we purchased. The pre- and post-implementation billing ratios were compared. A higher billing ratio post-implementation suggests increased charge capture and/or decreased drug waste. The billing ratios (column I) for amphotericin B, daptomycin, micafungin and acetaminophen IV increased post-implementation from 0.82 to 1.2, 0.79 to 0.8, 0.97 to 1.03 and 0.72 to 0.96, respectively. The billing ratio for tigecycline remained the same at 0.99 pre- and post-implementation.

Table 3. Average Monthly Purchasing and Billing Data Pre- and Post- Implementation

	A	B	C	D	E	F	G	H	I
Drug	Billing Unit (BU)	Purchased (P) BU	Price per BU	Total Purchased Amount (B x C)	Billed (B) BU	Total Billed Amount (E x C)	Difference (F - D)	Net Difference (Post - Pre)	Ratio B/P BU
Amphotericin B Pre	50 mg	575	$50.55	$29,066.25	471	$23,809.05	($5,257.20)	$9,630.48	0.82
Amphotericin B Post		353	$60.74	$21,441.22	425	$25,814.50	$4,373.28		1.2
Daptomycin Pre	1 mg	153333	$0.55	$84,333.15	120545	$66,299.75	($18,033.40)	($3,908.00)	0.79
Daptomycin Post		180000	$0.60	$108,000.00	143431	$86,058.60	($21,941.40)		0.8
Micafungin Pre	1 mg	32813	$0.77	$25,266.01	31713	$24,419.01	($847.00)	$1,579.72	0.97
Micafungin Post		34556	$0.71	$24,534.76	35588	$25,267.48	$732.72		1.03
IV APAP Pre	10 mg	165867	$0.11	$18,245.37	119334	$13,126.74	($5,118.63)	$4,118.91	0.72
IV APAP Post		224400	$0.12	$26,928.00	216069	$25,928.28	($999.72)		0.96
Tigecycline Pre	50 mg	134	$71.62	$9,597.08	159	$11,387.58	$1,790.50	$325.12	0.99
Tigecycline Post		132	$81.37	$10,740.84	158	$12,856.46	$2,115.62		0.99

Column H shows the net monetary difference between pre- and post-implementation. Amphotericin B, micafungin, acetaminophen IV and tigecycline demonstrated a monthly net gain of $9,630; $1,580; $4,119; and $325, respectively (total net gain = $11,746/month).

DISCUSSION

- Billing ratio for amphotericin B is greater than 1 post-implementation because stock purchased prior to go-live was used and billed for the period *following* the change in SVP production.
- Daptomycin showed a monthly net loss of $3,908 because the cost of drug increased from $0.55 to $0.60/BU post-implementation. Additionally, since the drug is supplied as daptomycin 500 mg single-use vials and is dosed by weight, odd doses would result in wasting the remainder of a vial.

CONCLUSION

Utilizing Lean Thinking and associated tools, the once daily SVP process was successfully redesigned to three times daily production. Although batching was not completely eliminated, we were able to break down the process into smaller batches to reduce waste.

An annual cost-saving of $140,952 was observed with 4 out of 5 high-cost drugs that were monitored. This amount may be higher if other high volume SVP products (i.e., vancomycin, piperacillin/tazobactam, cefazolin, etc.) were taken into consideration. Due to logistical challenges, we were not able to measure the number of missing doses pre- and post-implementation. Anecdotally, however, pharmacy staff reported that there were fewer missing medication calls from nurses with the three times daily SVP production.

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DISCLOSURES

Phuoc Lynsey Le, Dominick Bulone, Akta Patel, Glenn Oettinger, and Dennis Delisle have nothing to disclose concerning possible financial or personal relationships with commercial entities that may have a direct or indirect interest in the subject matter of this presentation.