OPTIMIZATION OF WORK PROCESSES FOR INPATIENT PHARMACY AUTOMATION SYSTEM (IPAS)

IE3100R/IE3100M Systems Design Project (AY2017/2018) | Department of Industrial Systems Engineering and Management

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ABSTRACT: As Singapore embraces technology and automation, this has resulted in both efficiency gains at the expense of more complex workflows and processes. The IPAS system which serves to distribute medication from the central pharmacy to intermediate distribution units using a "push" strategy. However, given the limited number of manpower, the pharmacy technicians are constantly under heavy time pressure to fulfill daily rounds and top-ups due to potential inefficiencies from both the man and the machine. As the labour supply tightens and the demand ever increases, the hospital thus aims to boost productivity by reducing the time spend during the IPAS process, minimizing recorded medicine discrepancies, reducing the number of stockouts occurring and decreasing any possible waste within the process itself.

OBJECTIVES

1) Reduce total required man hours (IPAS)

3) Reduce return rates in medication (AMC)

2) Reduce stock out of medications (AMC)

4) Identify other waste within the process(IPAS)

Data analysis and root cause analysis are done for all four objective. However, due to a lack of data on returns, and the heavy influence of human behaviour on discrepancy rates, accurate measurement of objective 3 and 4 becomes difficult. Hence, objective 1 and 2 will be discussed with more details.

SKILL SETS

Lean Six Sigma
Made use of DMAIC framework to study the issue of man-hours wastage through define, measure, analyse, improve and control phases.

Data Analysis
Analysed AMC event report to identify interruptions, stock-outs and the pattern of non-pharmacy activities.

Human Factors Engineering
Conducted observational studies to identify potential issues. Proposed the idea of pre-sorting of returned items to reduce operation time for PTs.

Programming
Made use of VBA coding to perform simulation and test the performance of the newly formulated par levels.

1. PROCESS OVERVIEW – OBSERVATION STUDIES

Inpatient Pharmacy Automation System

Process	**Production & Loading**	**Preparation for Top Up**			**AMC Refill**	
					Sign-in	Scan Barcode	Verify Count	Refill	Check Expiry
Activity	Prep medication draw + cut + scan + load	Unload	Picking and Bundling	Find manual medication	**Medcart Refill**	
					Scan Patients' Barcode	Refill	Sort Returns	Return Back to AMC & CP(Central Pharmacy)

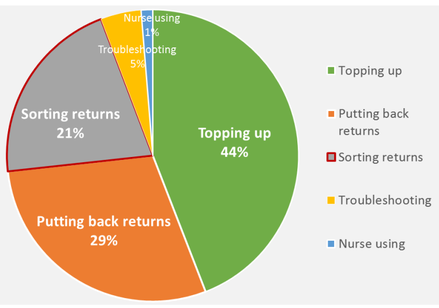
2. MAN HOUR REDUCTION

Benchmarks and Quantitative Analysis

Bottleneck Analysis

Machine Utilization = 100%
The machine is working non-stop during unloading

Technician's Utilization ≈ 80%
The number of PTs working on picking and bundling varies depending on perceived workload



Pie Chart – Medcart Refill (Time Motion Studies)

- **44.1%** of time is spent topping up Medcart.
- **55.9%** of the time is spent handling returns.
- **21%** of time is spent sorting returns despite not being the main purpose of the process.

Return Bins - Medcart Refill

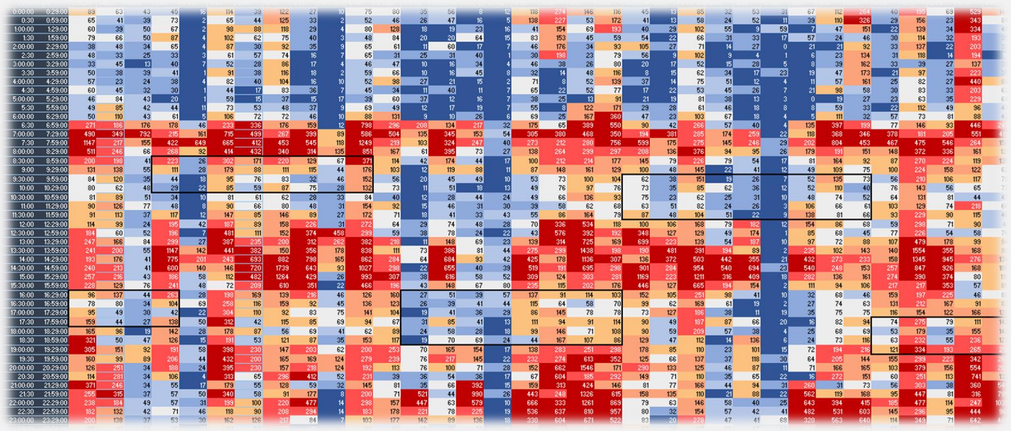
Disorganized refill bins potentially causing longer time required to sort items

Return bin in AMC Preparation room


Unsorted mix of medication

Interruptions

- Switch of AMC account sign-in within 5 minutes is identified as an interruption.
- 875 interruptions in the month of Aug 2017.



Heat Map

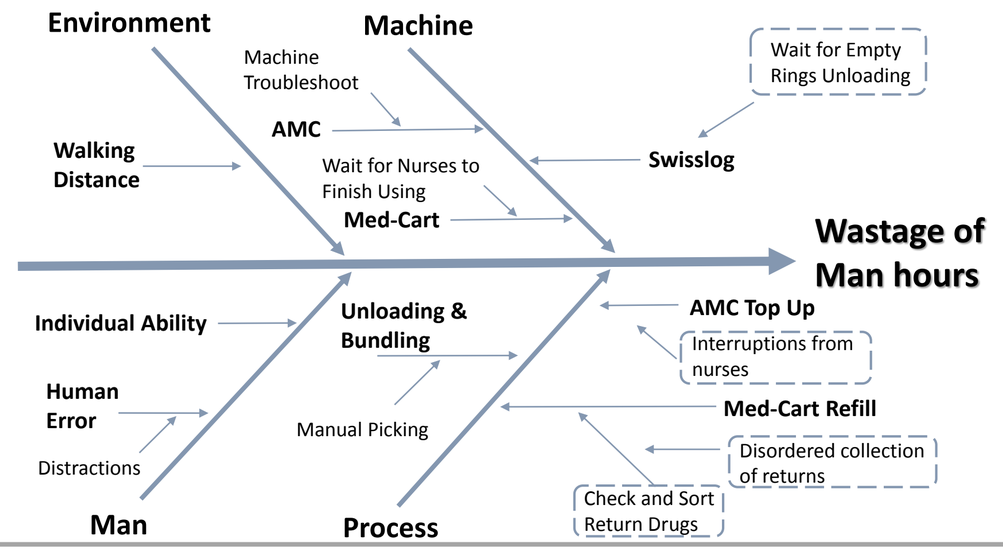
- To visualize the frequency of nurses log in throughout a day
- To identify possible improvements on refill scheduling
- High traffic timeslots occur during 0630 – 0900 and 1200 – 1600 for majority of the wards

3. MAN HOUR REDUCTION

Root Cause Analysis

Interview with Pharmacy Technician

- Nurse interruptions during Refill period
- Long wait time for machine to unload medication



4. STOCK-OUT REDUCTION

Benchmarks and Quantitative Analysis

6230 stock-out counts in Aug 2017

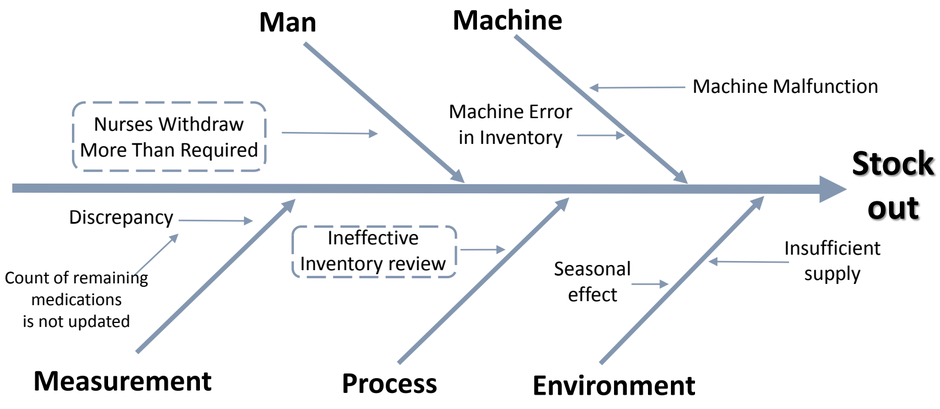
Review period formulation and calculation does not account for standard deviation of demand

Calculated no apparent correlation to medicine discrepancies

5. STOCK-OUT REDUCTION

Root Cause Analysis

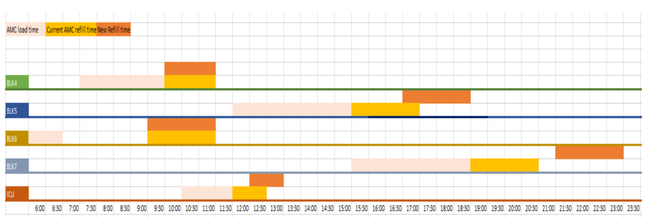
- Nurses tend to withdraw more to save time
- Inventory management occurs once every year



6. RECOMMENDATIONS & FORECASTED IMPROVEMENTS

Scheduling

- Reschedule AMC top up activity to avoid clashes with nurse's operation based on the trend identified by heat map



✓ Reduce potential interruptions

Interruptions	Reduced by 11%

✓ Man-hours saving of 46 minutes per day

Empty Rings

- Add a filter in the system to exclude manual items in the machine job list

✓ Save time for machine unloading medications and hence improve PT's efficiency

Machine Unloading Time	Reduced by 30%

✓ Machine time and man-hours saving by 3.8 hours per day

Par Value

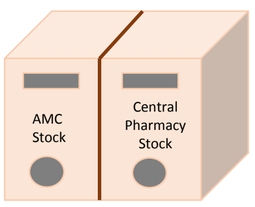
- Adjust MIN and MAX value
- Min = μ + 2.58*σ — Sample mean and standard deviation of withdrawals every 3 days; Z-value which covers 99% withdrawals
- Max = 2*Min

	Med ID	Med Desc	Transaction Date	Transaction Time	remove	max	min	current value before trigg	current value after refi	trigger before refill tim	trigger after refill tim	stock out
2	0004-04-	Loratadine 10mg (Clarityne) 10 mg Tablet				13	7		4		1	0
3	0004-04-	Loratadine 10mg (Claritynе) 10 mg Tablet	02/10/2017	23:37:57	1			12	12	0	0	0
4	0004-04-	Loratadine 10mg (Claritynе) 10 mg Tablet	03/10/2017	14:02:40	1			11	11	0	0	0
5	0004-04-	Loratadine 10mg (Claritynе) 10 mg Tablet	08/10/2017	21:54:30	1			10	10	0	0	0
6	0004-04-	Loratadine 10mg (Claritynе) 10 mg Tablet	17/10/2017	16:05:57	1			9	9	0	0	0
7	0004-04-	Loratadine 10mg (Claritynе) 10 mg Tablet	18/10/2017	22:45:24	1			8	8	0	0	0
8	0004-04-	Loratadine 10mg (Claritynе) 10 mg Tablet	20/10/2017	05:49:20	1			7	7	0	0	0
9	0004-04-	Loratadine 10mg (Claritynе) 10 mg Tablet	28/10/2017	08:35:27	1			6	6	0	0	0

✓ Reduce the stock-out rates

Stock Outs	Reduced by 74%

Return Bins



- Redesign the layout of return bins which will be pre-separating returned items into AMC stock and Central Pharmacy stock

✓ Reduce human errors and time spent on sorting.

Sorting Time	Reduced by 60%

✓ Man-hours saving of by 11.8 hours per day

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