Healthcare Needs Technology More than Ever: A Comparative Analysis of Healthcare Supply Chain Management Models in a General Hospital in Singapore

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Introduction

Singapore healthcare system is at par with developed health systems and is known to employ/evaluate latest technological advances in logistics to improve efficiency. It also suffers a double whammy of tight labour market as well as ageing workforce, justifying a constant need for improvement in supply chain efficiency.

We aim to simulate the supply chain models for manual and technologically integrated processes using value stream maps and probabilistic modelling to compare these processes in terms of labour man hours, total costs as well as productivity in a general hospital in Singapore.

Methods

Setting: Study was conceptualised during re-location of a 355 bed general hospital to newer premises within Singapore with an increased capacity of 700 beds. Study duration was 1.5 years and data collection was performed from Sep 2014 to Sep 2015.

Study Design and Methods

Probabilistic Model of hospital supply chain management was created for manual and technologically integrated processes as part of operations research under the institutional quality improvement exercise.

Results

Table 1: Comparison of hospital supply chain process: Manual versus RFID and AGV

System Resource Requirements	Manual	RFID	AGV
		Total service points (9100)	
		Process	
Inventory Check	manual	RFID enabled 2 bin replenishment system	manual
Order Generation	With current hospital information system	New hospital information system linked to RFID	With current hospital information system
Order Picking	Manual	Manual	Manual
Order Delivery			
• **Transport**	Manual Trolley	Manual Trolley	AGV, AGV trolley (+ few Manual trolleys)
• **Replenishment**	Manual	Manual	Manual
Total Man-hours required to serve all areas/service points*	282 hours	187 hours	265 hours
Number of Staff required**	**55**	**38**	**53**

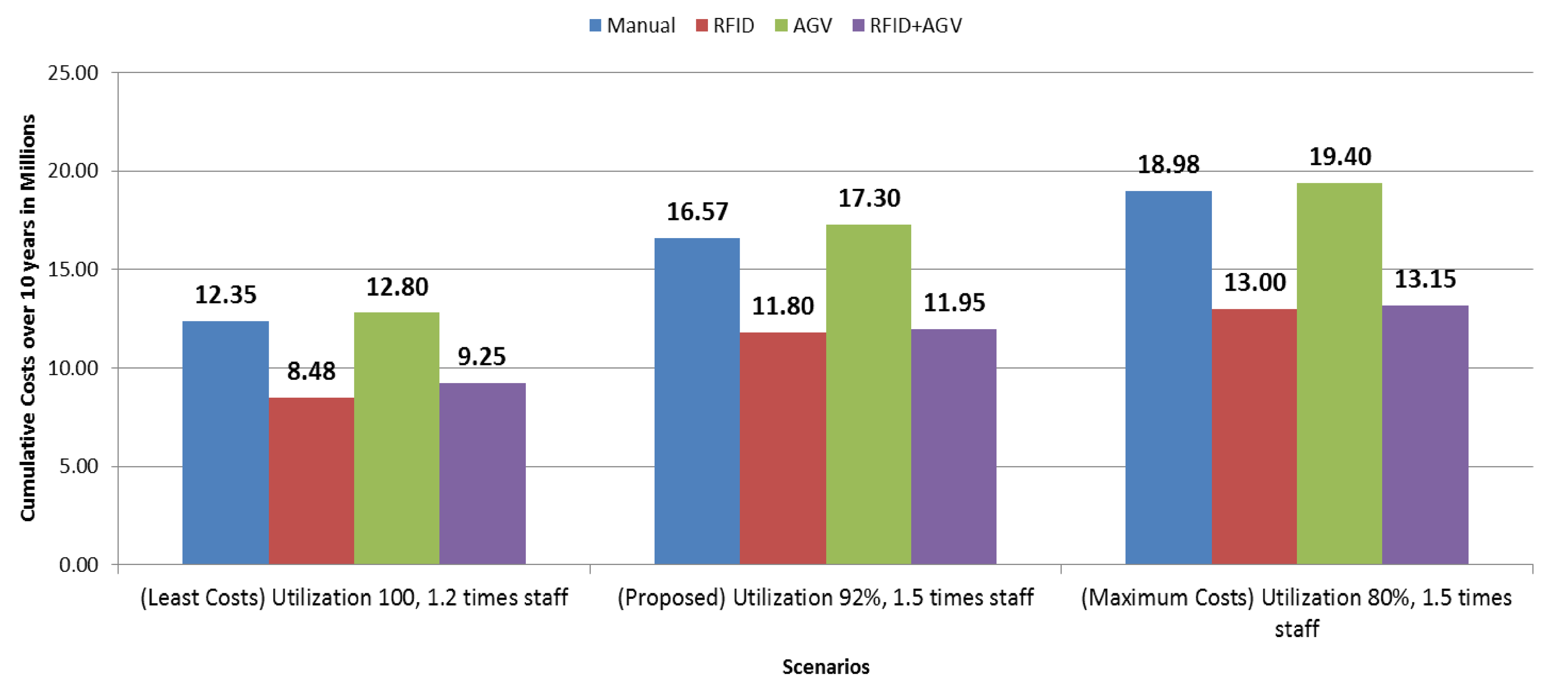
***based on value stream maps, **based on probabilistic modelling.**

Table 2: Comparison of Total Expenditure between the Manual and Automated Processes

System Resource Requirements	Manual	RFID	AGV
Manpower			
Cost of required staff (Annual salary package)	16,501,600	11,401,100	15,901,600
Equipment			
Trolleys and maintenance	71,600	49,500	319,100
AGV system + Maintenance	0.00	0.00	1,084,100
Other requirements			
Hospital Information system linked to RFID	0.00	198,800	0.00
Hospital Information system linked to RFID (Maintenance)	0.00	151,700	0.00
TOTAL	16.5 M USD	11.8 M USD	17.2 M USD
	Service points (9100)		
Multi-factor Productivity*(MFP) [Total Daily Output/ Total Daily Input] Total output calculated as service points, while total input calculated as total daily costs in USD.	9100/4540.1 Service points per USD =2.0	9100/3229 Service points per USD = 2.8	9100/4726.8 Service points per USD = 1.9
Change in MFP as compared to Manual process	**Baseline**	**2.8/2.0 = +40%**	**1.9/2.0 =-5%**

*OECD Manual for measuring productivity; all prices reflected in USD

Comparison of Cumulative 10 year costs based on assumptions: Best Case-Worst Case



Model	Total Amount (10 years)	Range* in Million USD	Manpower Requirement (Range)
Manual	$16.5 M	12.3M- 18.9M	55 (41-63)
RFID (automated inventory check)	$11.8M (-4.7M)	8.5M- 13.0M	38 (27- 42)
AGV (Automated Transport/Delivery)	$17.3M (+0.8M)	12.8M- 19.4M	53 (38- 60)
RFID+AGV	$11.9M (-4.6M)	9.2M- 13.1M	34 (25- 38)

*Range: Based on Best Case- Worst Case Scenario; all prices in USD

Conclusions

Healthcare is a complex system and healthcare administrators are often faced with tight budgets. Justification for technology adoption should be brisk, well debated, well studied and widely shared to allow rapid up-scaling of best practices. Optimising supply chains within healthcare settings helps minimize manpower dependency and costs. However, prior to adopting a specific intervention, the unique characteristics of the healthcare setting should be considered.

This study emphasises on the need for similar operational research into healthcare supply chains to identify key determinants to cost saving and improving efficiency, both locally and regionally.

References

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