A PRELIMINARY EXAMINATION OF THE DEPLOYMENT OF LEAN AND REVERSE LOGISTICS WITHIN THE PHARMACEUTICAL SUPPLY CHAIN (PSC) UK

Marina Papalexi[1], Liz Breen[2], David Bamford[1], Nicoleta Tipi[1]
University of Huddersfield Business School[1]
Bradford University School of Management[2]

Introduction

The pharmaceutical industry operates globally, generates a massive amount of income and affects almost everyone in the developed world (Davis, 2010). Specifically, medication is produced and prescribed in large volumes every year, for example over 100 tonnes of the top three compounds medications are prescribed in the UK each year (Xie and Breen, 2012). Furthermore, pharmaceutical prescription represents the highest non-staff revenue cost in the UK National Health Service (NHS) (Savage et al, 2006). This high cost is the reason why there has been pressure on the NHS, and generally on healthcare organisations, to keep a tight rein on their drugs spending. The annual drugs bill in the UK is approximately £10 billion, which equates to about 10% of NHS expenditure, having risen 3.5% a year between 2007 and 2011 (McKee, 2012). Despite the fact that the drug industry has agreed to £12bn NHS bill cap, to keep the bill for more expensive branded medicines flat for two years (Boseley, 2013), in this era of austerity there is an immense focus and accountability for funds spent within the NHS.

Hospital pharmacies are looking for cost saving, waste elimination and better services through improving their Supply Chain Management (SCM) (AT Kearney, 2009). It is believed that they can minimise waste and maximise patient satisfaction and wellbeing by managing not only the forward components but also the reverse components of the logistics process (Jamali et al., 2010). The application of improvement tools and methods such as Lean thinking is considered necessary in order that the dominant causes of waste and the management practices that trigger waste in PSC are identified (Holden, 2011).

This paper presents a preliminary examination of the deployment of lean and reverse logistics within the PSC. The authors believe that the Lean Philosophy can be applied to recognise process variations and identify explicit causes of waste.

Literature review

The complexity of modern markets, and demand for products and services in combination with the continuing development of technology make supply chains a popular choice for investigation by a number of researchers (Dobbs et al., 2011). Major supply chain disruptions can significantly reduce the stock market value of a company (Mustaffa and Potter, 2009). The challenge, therefore, for those involved in managing supply chains is not only to manage the forward components of the logistics process in order to minimise waste and maximise consumer satisfaction and wellbeing but, increasingly, to manage and improve the reverse components as well (Pokharel and Mutha, 2009). In other words, the need for the re-use or recycling of unwanted stock has become a major issue in many industries (Rupnow, 2007) such as: electronic waste (Lau and Wang, 2009); computer (Kumar and Putnam, 2008); paper (Pati et al., 2008); and packaging material (Skinner et al., 2008).

Reverse supply chain management (RSCM) is defined as the effective and efficient management of the series of activities required to retrieve a product from a customer in order to either dispose of it or recover value (Defee et al., 2010). The research on reverse logistics has tended to focus on automobiles, metal scraps, sales packaging material, waste paper recycling (Kumar and Putnam, 2008; Skinner et al., 2008). However, in recent years, research on reverse logistics in the pharmaceutical industry has begun to be reported. A representative example is that of Aurora Health

Care Pharmacy, which keeps returns at less than 2% of its total inventory despite stringent regulations related to expiration dates, manufacturer recalls and proper disposal of drugs (Morton, 2006). Nevertheless, academic researchers and practitioners believe that pharmaceuticals are different and they cannot be treated like other commodities (Savage et al, 2006). The reasons for this sentiment appear to be the level of regulation in the product production, storage, distribution, consumption and the complexity of the fabric of this supply chain (Porter and Teisberg, 2006).

Lean is defined as an improvement philosophy that focuses on continually improvement of a process by removing waste, increasing efficiency and providing higher quality product or service (Brandao de Souza, 2009). Lean was originally applied in the industrial sector; however in recent years there have been significant interventions in other areas including healthcare (Lodge and Bamford, 2008). It has met with great success in healthcare organisations across the world from hospitals in the USA (Savary and Crawford-Mason, 2006), Australia (Bem-Tovim et al., 2007) and the UK (Fillingham, 2007), in both the acute (Joosten et al. 2009) and community settings (Grove et al. 2010).

Holden's (2011) review of lean applications in Accident and Emergency department shows that lean can contribute to decreases in waiting times, length of stay, and the proportion of patients leaving without being seen. Similar results have been reported by Kelly et al. (2007), in their project, where an emergency department was analysed and redesigned using lean principles. Moreover, research indicates that Lean implementation resulted in reduced lead-time (Al-Araidah et al., 2010), clinical errors (Raab et al., 2006), inappropriate procedures (Van Lent et al., 2009) and enhanced patient and staff satisfaction (Dickson et al., 2009).

The literature has revealed that Lean applications have been more applied in physical health service settings, focusing on the improvement of patients flow. Moreover, at present there is weak tangible evidence on how Lean can influence other healthcare services such as the delivery of medicines.

Description of the challenge

One of the growing concerns in the pharmaceutical industry is related to the particular characteristics of medicines; drugs can be converted into dangerous or useless products for consumers due to their short expiration dates (Cherrett et al., 2012). Moreover, the disposal of expired/unwanted medication can be very costly and harmful to the environment. Therefore, hospital pharmacies concentrate on innovative programmes to reduce waste and costs, while improving quality of services (Odier, 2010). The UK Department of Health produced a series of guidelines on best practice waste management to help healthcare organisations deal with these kind of issues (DoH, 2012). In addition to this, Xie and Breen (2012), in their research, designed a green community Pharmaceutical Supply Chain (PSC) that reduces preventable pharmaceutical waste and effectively disposes of inevitable pharmaceutical waste, using a cross boundary green PSC approach that requires every participant in the PSC to take environmental practices.

Outside the area of community pharmacies hospitals concentrate on innovative programmes to reduce waste and costs, while improving the quality of services (Odier, 2010). However, there is a need for further research to identify the root causes of waste within the PSC. Consequently, the aim of this research is to gain a better understanding of wastage in the PSC and to assess how Lean and reverse logistics can improve the delivery of medicine. To structure the investigation two research questions (RQs) were developed:

RQ1: What are the root causes of medicine waste in a hospital pharmacy in the UK?

RQ2: What is the impact of Lean thinking on medicines waste reduction?

The research methods

The research study adopted a qualitative approach; the methodology was designed to analyse qualitative data, to identify and understand the causes and potential solutions. This data was

collected via a series of site visits and one-to-one interviews with key pharmacy professionals within the NHS. Questions were formulated and grounded in academic theory and professional practice and were reviewed and revised post the initial pilot site visits/interviews. A total of 10 pharmacists from 4 hospitals were interviewed in a semi-structured manner. Each interview lasted approximately 50 minutes. Participants were asked a series of questions focusing on current practices in hospital pharmacies and the PSC, current measurement of waste, and the benefits/potential of reverse logistics application.

A case study approach (Yin, 2008) was adopted to gather and assess the data in order to have a better insight of the PSC in the NHS. The case study focuses on the drug delivery process within the NHS. In particular, it describes the delivery of medicines from the hospital pharmacy to wards and vice versa.

Findings

The application of Lean thinking within the case study has provided the opportunity to establish the current state of operational processes within not only the forward components but also the reverse components of the defined pharmaceutical logistics process, identifying the root cause of the waste. According to the respondents the main waste identified was at ward level in hospitals as the ward staff, have to manage their own stock of medicines and deal with patients as well and hence have limited time to focus on stock related issues. This is also not an essential part of their nursing role and therefore they are not trained to effectively manage stock rotation hence stockpiling and obsolescence occurs It is worth mentioning that a hospital pharmacy supplies approximately £30 million pounds of medication per annum of which £36,000 per annum (£3,000 per month) is returned and reused (Respondent A).

From the collated primary research the following is an indication of the set-up and physical distribution of the PSC:
Hospital pharmacies tend to order the majority of items five days per week, twice a day. However, order frequency will depend upon the type of product and how often it is needed. For example, some stock is received twice a week, such as the large bags of fluids, some of them might do next day delivery and others can only deliver on a specific day. Therefore, there are ten or eleven deliveries from each wholesaler per week. The stores departments are tasked with having no more than two weeks stock (an average). However, there are some lines/types of medicines that might only be used once a year - but they have to be kept (just in case). On the other hand to offset and balance it out, another line/type of medicine may only have one or two days stock. This described strategy is based upon actual usage figures within the hospital pharmacies.

With this system, there is a potential risk regarding the storage of medicines due to their short expiration dates. Pharmacists do stock checked the whole stored supply during the year, but the expiry date check should happen every month; formal systems and procedures prompt them to annotate on the medicine packaging/box that it is going out of date. However, there tends to be an agreement between the Co-operative and the hospital pharmacy where if the hospital pharmacy discovers a short dated item, it can swap it with the Co-operative that they might use it more frequently and vice versa (Respondent B).

Hospital Pharmacies supply the wards with one week of stock in order to be able to treat patients in a timely manner. It has been observed that the majority of the medicines ‘wasted’ occur on the patient wards. One reason appears to be that staff there does not manage their stock correctly. Formally the wards have to stock check their own supplies; they are required to check the expiry date to make sure they are not giving out-of-date medication. Another problem reported during the research is that discharge medication is commonly issued to the wards but the patient has left before the medication is ready. However, these medicines can be returned back to pharmacy and re-used.

In one hospital pharmacy approximately £3,000 per month of stock is re-used from this method, a positive action. Unfortunately a negative impact is that the pharmacists have already labelled the medicines and dispensed them (all of which takes time), then of course they have to put them back into the stock system. On the other hand there are some medicines that cannot be re-used, for example, in order that antibiotic syrups are ready for consumption, water has to be added and if that happens they must be taken within seven days otherwise they become unusable. In addition to this, medication that is issued by, for example, a community pharmacy of another hospital is not allowed to be reused. This is guidance from the General Pharmaceutical Council (Respondent A); their rationale being that the quality of those medicines cannot be attested regards source and control. Furthermore, it was reported that some medicines might be unlabelled and according to the guidance from the General Pharmaceutical Council, they cannot be used until they have been correctly identified.

In the patient wards there are Pharmacy Returns Boxes. These are grey lockable boxes to put the leftover or unusable medicines in. Subsequently these boxes are returned back to the pharmacy where the medicines that can be reused are separated from those that have to be destroyed. Unfortunately at this point most pharmacies do not collate the data from the returns. Additionally, there are Yellow Bins in each ward for 'dropped' medication, for example, some injections need to be wasted because only the 1ml of the 5ml that one ampoule contains, is needed and the rest of it cannot be reused. Therefore, the Yellow Bins include products that have to be physically incinerated.

Figure 1 illustrates the perceived process map of drug delivery in the NHS. The arrows show the forward logistics process and the dashed arrows the way that items can be reused or destroyed.

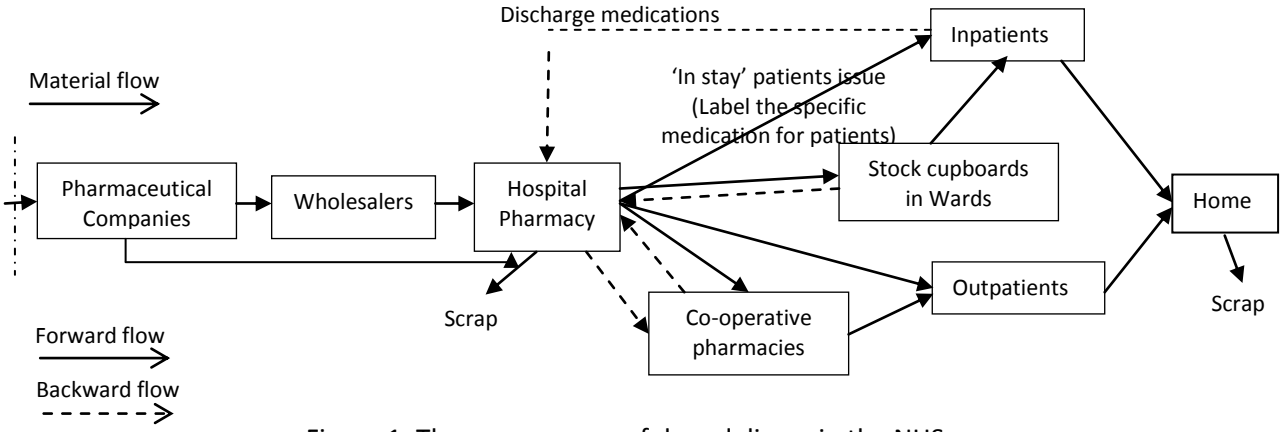

Figure 1: The process map of drug delivery in the NHS

As can be seen from the above figure:

- The hospital pharmacy receives its supplies of medicines from wholesalers and Pharmaceutical Companies
- The medication comes in the 'back door' of the pharmacy and then it is booked into its stores
- There are different sort of supply routes:
  Inpatients
  1. On the wards, there is stock cupboards with medication which is not patient specific i.e. paracetamol
  2. Medication for a particular patient; pharmacists label medication for patient issue which is used during the In Stay and when patients return home
  3. Discharged medication: medicines that are going to be used by patients when they are back home

  Outpatients
  4. Outpatients receive their medication from the Co-operative/community pharmacies

Discussion

In this paper hospital pharmacies and the way that they supplies medication within hospitals have been used as a case study to have a better understanding of the delivery process. Furthermore, the application of Lean thinking within the case study was considered necessary in order to begin the establishment of the current state of operational processes and to identify the root cause of the waste. The drug delivery process map revealed a high number of process wastes occurring within pharmacies. These are summarised in Table 1.

Duplication	• Discharged medication has been issued to the wards when patients have already left –approximately £3,000 per month of stock is re-used from this method • Separation of the medicines that can be reused by those that have to be destroyed
Waiting	• Labelling the medicines
Defect/Error	• Unlabelled medicines • Inappropriate packaging of medication
Inappropriate processing	• Wards do not manage their stock properly • Discharged medication has been issued to the wards when patients have already left ▪ The medication was issued by another hospital and is not allowed to be reused (General Pharmaceutical Council guidance)
Unnecessary inventory	• Some medicines need to be stored according to national guidance, i.e. the antidotes for poisoning • On the wards, the stock cupboards contain more items than it is required / recorded • The periodic lack of adequate storage capacity
Unnecessary motion	• Nurses ask for required medication

Table 1: Operational process wastes identified within a hospital

Analysis revealed that the root cause of operational process wastes appear to stem from not following agreed procedures. For example, there is supposed to be a three monthly stock check of expiry dates; when these do not occur then the products are more likely to unknowingly expire. A solution to this problem may be found by applying the Kanban, one of the main tools of the lean philosophy (Brandao de Souza, 2009). Research suggests that the application of this tool can help the pharmacists to manage their stock correctly and also eliminate waste (Papalexi, 2010). Papalexi (2010) suggested a group of cooperative pharmacists that their organisation can store 56.8% fewer products and spend 71.8% less money, by adopting the kanban system.

Another equally important cause of waste is unnecessary stock holding. In other words, employees on the wards do not realise the actual value of the stock kept in the ward cupboards. They tend to request more products than they need; operating a 'just in case' not 'just in time' system. As a result, these items can expire and not be available when actually needed. A series of seminars and facilitated workshops is often the answer to this problem. Hazen et al. (2014) highlight the need for training and education of key stakeholders to embrace a more holistic food supply chain. This data can actively inform the supply and replenishment of medicines; the ability to predict provides an ability to control (Bamford, 2010).

A series of seminars and facilitated workshops may also contribute to improving reverse logistics processes. In particular, it would be an opportunity for the key stakeholders of the internal PSC to be aware of what items can be reused-recycled or have to be destroyed. As a result, this knowledge could reduce the waste associated with duplication, decreasing the workload of the pharmacists.

Poor communication between the stakeholders does increase the level of wastage. Better communication between pharmacists and doctors can minimise the amount of discharged medication prepared without reason. Furthermore, communication tends to be one of the main factors that impact upon managing returns (Breen, 2006). Drummond-Hay and Bamford (2009) suggest that successful improvements are subjected to an agreement that everyone within an organisation should work in one direction. Moreover, the waste occurring by not using medicines that have been issued by another hospital may be reduced; perhaps some national consultation with the General Pharmaceutical Council could contribute to a solution for this particular problem. Seddon and Caulkin, (2007) highlighted that the services measured by central government often demonstrated little improvement.

In conclusion, analysis of the management related causes led to the structure of a classification of factors affecting pharmaceutical waste. These are presented in Table 2.

Supply Chain Management	**Quality Control**
Planning and information flow	Product Specifications
Availability and inventory management	Shelf-life management
Job design	Packaging and labelling

Table 2: Classification of causes of medication waste

The first includes issues related to supply and the second to quality of medication. This classification has been adopted by Mena et al. (2014) who identified the dominant causes of waste and the operational issues within food networks.

Supply chain management is associated with data quality and impact the availability of products (Hazen et al., 2014). Regarding the pharmaceutical supply chain within hospitals, planning and information flow are weak due to poor communication between the providers of healthcare services; a fact that influences the availability of medicines. Furthermore, weaknesses related to quality and process control has also been observed within the pharmaceutical logistics process. The data analysis revealed that issues related to product specifications, shelf-life management, packaging and labelling have been reported.

Conclusion

This research began with the development of an understanding of wastage in pharmaceutical supply chain. In particular, the paper focused on the medication delivery process within the NHS. The study has demonstrated that by using Lean thinking, the current state operational processes can be established within the forward and reverse supply chain logistics, identifying the root causes of waste. A series of improvement solutions were identified which focused on improving stock management, data quality and communication between the providers of healthcare services.

The main limitation of this research was the timeline available to investigate this particular research area. As a result, with the time limitation, only 10 pharmacists were interviewed and certain figures were collected. To remain focused, this research focused on the distribution of medicines within NHS without taking into account the whole PCS. In addition, the research based exclusively in the UK and might have missed important causes of waste that are not prevalent in this country. Therefore, there is scope for further research in this area. Additional work can be completed on a broader analysis of the PSC, including the stakeholders such as pharmaceutical companies or wholesalers. Moreover, the

expansion of this research into other countries could lead to a better insight of the PSC and the root cause of waste occurring.

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