Chapter 7
An Analysis on Supply-Chain-Related Adverse Events

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ABSTRACT

This chapter presents an investigation on supply-chain-related adverse events and patient safety in healthcare. Based on site visits and phone interviews with six healthcare providers, material handling and administrative processes are determined in a typical healthcare supply chain. Then a simulation model is developed to determine correct product validation practices and procedures for maximum patient safety. Benefits of standard product identifying technologies and automated validation systems are also explored to minimize workflow interruptions. Different scenarios are compared for patient safety, care delay, and system efficiency. The results show that validation points during PAR picking or bedside product administration, and warehouse picking operations provide optimal overall system performance. The results also indicate that standard product-identifying technologies and automated validation systems significantly impact the efficiency of supply chain.

INTRODUCTION

In healthcare, patient safety is defined as freedom from accidental injury and error as failure of a planned action to be completed as intended or use of a wrong plan to achieve a goal (Donaldson *et al.*, 2000). Issues that try to minimize the occurrence and influence of adverse events while maximizing recovery from them are considered as a measure of patient safety. In the context of this study, an adverse event is considered as an injury or harm caused by medical management or intervention rather than by a disease or condition of a patient and are responsible for harm (Donaldson *et al.*, 2000). A number of studies classify adverse events in different ways. At a very high level they are non-preventable adverse events, such as a first-time allergic reaction to a drug and preventable adverse events, such as a wrong dose of a medicine administered to a patient. Even though non-preventable adverse events have greater potential of

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morbidity and mortality, preventable adverse events offer better opportunities to improve patient safety. These opportunities include identifying them, analyzing their courses, and taking corrective actions to reduce the reoccurrence of similar events (Sasou & Reason, 1999).

Errors and other relevant terms in the healthcare literature are also important to further understand and categorize adverse events. Typically, medical errors are the occurrence of failures in the process of care that do not necessarily harm patients. Near misses are unplanned events that do not result in injury but have the potential to do so. An example of no harm or minor harm is administering an extra strength drug by mistake and an example of a serious injury and even death is performing a surgical procedure on a wrong patient (Ginsburg *et al.*, 2009). Active errors typically occur when a patient interacts with nurses. Examples of active errors include infections due to contaminated instruments or medical devices, using expired or recalled instruments, devices, or drugs, catheter acquired infections (Attarian, 2008), and using an instrument or device for functions other than as intended due to misidentification. Latent errors include system defects such as poor design, incorrect installation, faulty maintenance of equipment, poor purchasing decisions, and inadequate staffing (Thomas *et al.*, 2000). Latent errors and active errors are main causes of adverse events that typically harm patients and causes injuries or damages.

Associate Among many types, supply chain related adverse events are one of the major patient safety issues in healthcare that are caused by inventory discrepancy and performance deficiencies in identification, medication, recall, return, and outdate processes and protocols of medical instruments, devices, and drugs at the provider level. The U.S. Food and Drug Administration (FDA) reports that a considerable number of medical instrument and device related adverse events occur each year due to unreliable identification and problem reporting systems in supply chain. Equipment related incident rates are as high as 16% of the procedures (Guédon *et al*. 2016). Similarly, studies on medication errors report that the error rates are as high as 7.45 per 1,000 patient days with voluntary reporting to 560 per 1,000 patient days with daily routine observation of prescriptions (Garrouste-Orgeas *et al.*, 2012).

In addition to identification and medication errors, there are other issues that impact patient safety and quality of care. Product misplacement and mispicking during replenishment processes as well as shrinkage and transaction errors are major sources of inventory discrepancy that lead to product stockouts, delayed care, and emergency replenishment in the supply chain operations (Opolon, 2010). Performance deficiencies and problems in recall, return, and outdate management are significant drivers for supply chain related issues as well that effect patient safety in healthcare.

The objective of this study is to investigate the impact of supply chain related adverse events on patient safety by means of increased patient risk, delayed care, and insufficient product availability. The attention is given to supply chain related product administration errors in healthcare, especially during identification and medication processes, in addition to inadequate and disorganized recalled, outdated, and incorrect product administration procedures. This study also focuses on different methods to minimize these events by incorporating several product validation points in the system and using standard product/ location identifying technologies and automated validation systems.

BACKGROUND

Healthcare supply chain processes can be considered in two broad categories; material handling processes and administrative processes. Typical material handling processes within each category are depicted in Figure 1. Note that these processes are representative of most healthcare supply chain operations, there