COVID-19 Utilising an automated medication inventory management system for emergency crash carts during the COVID-19 pandemic

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ABSTRACT

The high acuity of patients with COVID-19 during the pandemic in the city of New York correlated with an increased incidence of cardiac arrests and other emergent resuscitation scenarios requiring life-sustaining treatment. A spike in the utilisation of emergency crash cart medications was to be expected. The department of pharmacy at SUNY Downstate Health Sciences University optimised the use of an automated medication inventory management system with radio-frequency identification to assess usage and turnover of emergency crash carts; improve efficiency and turnaround times for crash cart dispatches; track drug consumption; and manage ongoing medication shortages during the peak of the COVID-19 pandemic. By capitalising on the utility and functionality of technology and automation, the institution was able to keep pace with acute patient care demands to prevent gaps in pharmaceutical care and medication management during emergency responses.

KEYWORDS: automation, health information technology, clinical pharmacy information systems, hospital inventory, COVID-19

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Introduction

The city of New York became the initial epicentre of the COVID-19 outbreak in the USA. Hospitals and health-systems in immediate and surrounding areas had to quickly prepare for the incoming surge of patients with COVID-19. At the time, not much information was known regarding SARS-CoV-2. However, it was clear that SARS-CoV-2 could spread rapidly throughout communities and patients with COVID-19 could develop critical illness and suffer from various life-threatening disease manifestations and multi-organ dysfunction.

During the peak COVID-19 period in the city of New York, the University Hospital of Brooklyn at SUNY Downstate Health Sciences University, a tertiary care urban academic medical centre, was declared a designated COVID-19 only treatment facility by the governor of New York state. With a rapid influx of high acuity patients, an increase in cardiac arrests and other emergent resuscitation scenarios requiring life-sustaining treatment was to be expected, as was seen in other countries affected by the pandemic.[1,2] Notably, the hospital primarily cared for an urban, underserved population with a high prevalence of cardiovascular comorbidities, which may have put these patients with COVID-19 at even higher risk for experiencing a cardiac arrest.[3] Thus, this stressed the importance of optimal supply chain management, including the availability of resources, equipment and medications for patient care.

The department of pharmacy routinely managed the deployment of 42 adult emergency crash carts, and was tasked with developing action and monitoring plans to ensure adequate supply and efficient workflows to accommodate the increased incidence of cardiac arrests and emergency responses. Herein, we describe the use of an automated inventory management system (AIMS) using radio-frequency identification (RFID) technology to improve the process of restocking, dispatching and tracking emergency crash carts and drug inventory during the COVID-19 pandemic.

Automated inventory management system

The AIMS (Kit Check, Alexandria, USA) was adopted by the University Hospital of Brooklyn for improved inventory management of crash carts and emergency medication trays. The AIMS involves the individual labelling of each medication with an RFID-enabled tag, which allows wireless electromagnetic fields for automatic identification and data capture (AIDC). When crash carts are physically brought back to the AIMS' scanning station, wireless tagging for AIDC can immediately identify which trays require restocking of specific medications; detect the presence of inventory discrepancies and expired drugs; and track logistical information (such as drug consumption, lot numbers and location). The collected data is then automatically uploaded

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into the cloud-based software, allowing the AIMS to aggregate previous utilisation data over a specific time period. At the point of contact, the user can analyse factual data and make informed inventory management decisions.

Assessing emergency crash cart usage and turnover

In order to forecast emergency crash cart usage during the pandemic, historical data was gathered and analysed via the AIMS to assess baseline turnover. As expected, the majority of usage was in critical care, emergency medicine and stepdown units. In preparation for the surge of patients with COVID-19, the hospital initially doubled its critical care and stepdown capacity. Thus, it was anticipated the crash cart dispatch rate would double, at a minimum. By utilising this initial data, it was justifiable to dedicate an additional pharmacist and pharmacy technician resources to crash cart restocking, verification, deployment and inventory tracking.

As the COVID-19 pandemic unfolded in the city of New York, it was deemed necessary to further increase hospital capacity for patients requiring intensive care, due to the acuity and complexity of the disease and its associated manifestations. Reported data generated via the AIMS showed a rapid rise in emergency crash cart turnover, with an increase of approximately four-fold at the peak of the pandemic when compared with pre-pandemic usage. During April 2020, each active crash cart in circulation was, on average, used and re-deployed approximately three times (Fig 1). The aggregated data also justified the acquisition of additional backup emergency crash carts and trays for storage within the hospital's disaster stockpile, for distribution into active circulation, if required.

With the halting of elective surgical procedures and other non-critical treatments and services to limit the spread of SARS-CoV-2, the department of pharmacy used tracking information from the AIMS to locate additional emergency crash carts throughout the institution. Crash carts not being utilised or those stored in temporarily closed areas were quickly centralised and re-deployed to acute inpatient units, emergency room areas and newly-opened treatment spaces with the highest demand and fastest turnover. The decision-making process involved interdisciplinary discussions among physicians, pharmacists, nurses and senior hospital leadership.

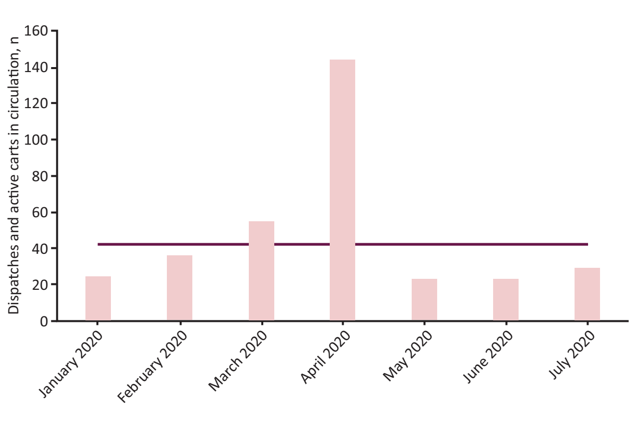

Fig 1. Emergency crash cart dispatches.

Improving efficiency and turnaround times

Technology involving RFID and AIDC has been shown to significantly decrease turnaround times for restocking and verifying crash cart contents when compared with manual processing.[4] By capitalising on these functionalities, the department of pharmacy was able to safely and efficiently manage the constant turnover of emergency crash carts, even during the peak of the COVID-19 pandemic.

The emergency crash carts at SUNY Downstate Health Sciences University contain two full medication trays. Internal data from the AIMS showed a median processing time for tray 1 was 38 seconds (interquartile range (IQR) 11–83) and tray 2 was 35 seconds (IQR 11–94), resulting in an average total processing time of 73 seconds. The processing time starts from the initial logging scan of a used medication tray, includes the full restocking process by a pharmacy staff member, and ends with the final completion scan. The utilisation data of the specific tray(s) of the crash cart is also automatically and instantaneously uploaded into the cloud-based software. When compared with anecdotal manual processing times of greater than 10 minutes, this resulted in significant time-savings.[4,5] The time saved using automation technology proved to be extremely valuable during the pandemic, allowing pharmacy personnel to attend to other labour-intensive operational and clinical patient care tasks.

Managing drug shortages and drug consumption

Prior to the pandemic, critical drug shortages were already impacting hospitals and health-systems. COVID-19 resulted in additional strain and pressure on all phases of the supply chain, as the demand for critical care and emergency medications skyrocketed. Examples include sedatives, neuromuscular blocking agents and drugs utilised in advanced cardiovascular life support (ACLS).[6,7] Since many of these aforementioned medications are stored in emergency crash carts and needed as part of life-sustaining treatments, optimal supply chain management and data tracking were crucial to prevent gaps in pharmaceutical care.

By utilising analytics regarding item-level consumption from the AIMS, it was feasible to track usage of specific medications via rapid data generation, allowing the pharmacy department to implement timely inventory management strategies and adjust periodic automatic replacement (PAR) levels in the crash cart as needed. In addition, the utilisation data allowed for modification of supplementary stock in automated dispensing cabinets, in the event of a prolonged resuscitation requiring quantities of emergency medications exceeding what was located within crash carts. The primary focus was on injectable medications commonly utilised in ACLS scenarios, such as epinephrine, calcium chloride and sodium bicarbonate. As forecasted, the usage of these medications during the peak of the COVID-19 pandemic increased dramatically, most notably with epinephrine (Fig 2). This information prompted frequent communication with drug suppliers and distributors to project inventory needs and to ensure adequate medication availability throughout the pandemic.

Discussion and conclusion

For institutions exploring the adoption of similar automation and technology, additional considerations include management of controlled substances and barriers to implementation. While

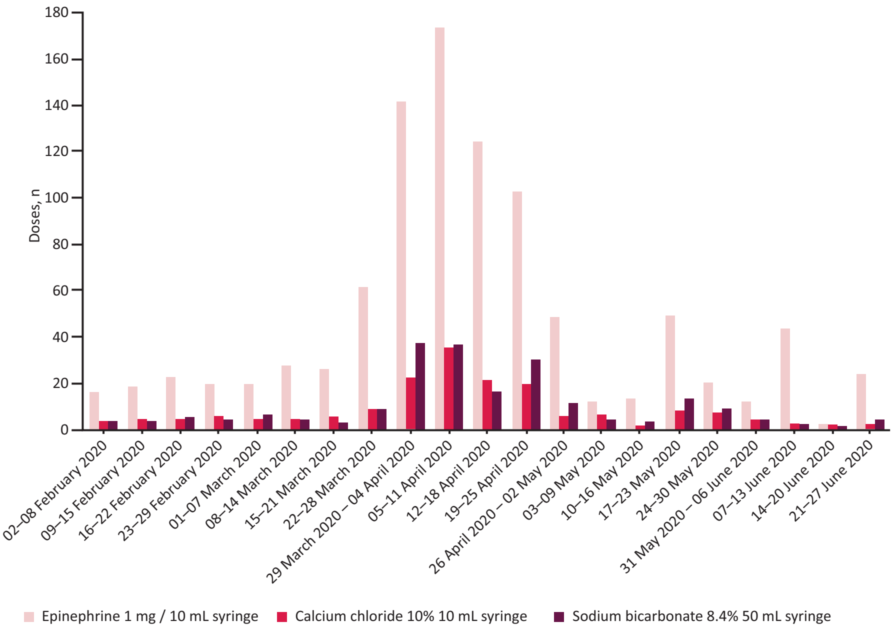

Fig 2. Weekly consumption of emergency crash cart medications.

the emergency crash carts at the University Hospital of Brooklyn did not contain any controlled substance medications, the RFID tracking technology could theoretically be applied to these drugs as an additional anti-diversion technique, assuming they do not interfere with one's regulatory requirements and institution-specific policies and procedures. Barriers to adoption may include, but are not limited to, adequate and timely training of staff; electromagnetic interference with RFID technology; acquisition and maintenance costs; and difficulty in quantifying the return on investment.[8] It is recommended to discuss these important considerations among an interdisciplinary team, including representation from organisational and senior leadership.

The use of an AIMS for emergency crash carts proved to be a vital component when preparing for and managing the surge of COVID-19 patients requiring resuscitation for cardiac arrests or other emergent clinical situations. While RFID technology is not new to healthcare, the automation functionalities allowed for improved efficiency and processing times of emergency crash cart contents during the peak of the pandemic, and provided rapid data generation capabilities to assist in the development and implementation of timely inventory and drug shortage management tactics. ■

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