# Case Study



# Automation to Improve Antibiotic Administration and Inventory Management

RIVERSIDE METHODIST HOSPITAL, A PART OF THE OHIOHEALTH SYSTEM, is a not-for-profit community hospital licensed for 1,100 beds, with an average daily census of 700 patients. Riverside has a strong neuroscience presence in central Ohio, with a 19-bed neurocritical care unit, a 25-bed stroke/neuro unit, and a 15-bed rehab



unit, as welll as a dedicated, 26bed unit with private rooms for spinal surgery patients. Over 3,200 spinal surgeries were performed in 2006.

Appropriate timing of antibiotics around surgeries has been a topic of nationwide interest. The CDC published guidelines for prevention of surgical site infections in 1999. In 2002, the CDC and the CMS initiated the National Surgical Infection Prevention project, highlighting the importance of choosing appropriate antibiotics based on the type of surgery, administering the preoperative prophylactic antibiotic dose within 60 minutes prior to incision, and discontinuing

postoperative prophylactic antibiotics within 24 hours of the operation's conclusion.

### **The Challenge**

After our pharmacy computer system change in September 2004, we noticed that the first doses of certain postoperative antibiotics were not consistently being sent from the pharmacy to the spinal surgery unit. This was likely caused by a processing glitch and resulted in prolonged times between the preoperative prophylaxis dose and the first postoperative dose. The delay in initiation also prolonged the patients' length of stay, causing throughput problems on this high-turnover unit and negatively affecting patient satisfaction – both for patients awaiting discharge, as well as those waiting in the PACU for transfer to the spinal unit. Additionally, we experienced a slight increase in postoperative infections.

With these circumstances in mind, we began measuring the times of pharmacy order entry, patient arrival on the spinal unit, and scheduled administration and actual administration of the first antibiotic dose. In February of 2005, we conducted a one-week survey of these parameters in all postoperative patients with antibiotics ordered and admitted to the spinal unit. We found that 59% of first postoperative antibiotic doses were late, with an average delay of 1.9 hours.

Pre-made 1-g cefazolin IV piggybacks – the most commonly prescribed postoperative prophylactic antibiotic doses for spinal surgeries – were most often late, possibly because of a computer glitch that counted the PACU stock as the first dose, resulting in a missing "actual" first dose. Looking exclusively at these doses, 79% were given late, and an additional 16% required rework, suggesting that "later" doses were utilized for the first dose. The rework suggested that even if the first dose was given on time, extra doses requested by nursing after the first dose administration implied that "later" doses were utilized for the first dose. The additional work required of nursing and pharmacy was problematic and frustrating for all involved. The delayed antibiotic doses, prolonged patient stays, bump in infection rate, reworked doses, and staff frustration indicated a need for process improvement.

## **Process Improvements**

While efforts were made to define and remedy the computer glitch, other alternatives were sought to improve the timeliness of postoperative antibiotic delivery to the spinal surgery unit. Riverside had been utilizing Pyxis MedStations for nursing unit medication control since 1990. A few areas in the hospital used the Pyxis Remote Manager system, a software module and locking system that allow a medication refrigerator to act as a "drawer" in a MedStation unit, thus improving medication storage and revenue control. Also, because the system includes a refrigerator, it allows us to store medications that require refrigeration directly on the nursing unit. In the emergency department, a Remote Manager is used to provide timely access and inventory control for tetanus/diphtheria vaccine. For revenue control, expensive pre-made Aggrastat (tirofiban) IV solutions were stored and billed via Remote Manager in the cardiovascular intervention unit.

Pharmacy had already conducted a pilot with the Remote Manager system on a general surgery floor that was having similar difficulties with postoperative antibiotics. The initial results were positive, and ultimately, we obtained 24 additional Remote Manager systems and refrigerators. The MedStation units were added to the pharmacy department's MedStation server, and then installed on the nursing floors.

Using a pharmacy computer system 90-day usage query, we compiled the numbers of various antibiotics ordered for patients on specific nursing units. This data was then sorted by the number of doses of particular antibiotics used per 24-hour period. To ensure that the nursing units would not run out, the antibiotic stock was adjusted to approximate a 36-hour supply, should there be a delay in our projected refilling of the stock every 24 hours. After about two months, we found that our antibiotic ordering and inventory levels decreased. Our previous batching of IV antibiotics and delivery to the nursing units left stock idle if the drug was discontinued or the patient was discharged before it was picked up again by pharmacy. Using the stock refrigerators allowed us to reduce the amount of "floating" stock not in use on the nursing units. The pharmacy inventory was adjusted to add as many commonly used, pre-made IV antibiotics as possible, in order to take advantage of the





One of Riverside Methodist Hospital's antibiotic dispensing stations

extended stability dating. This action, in addition to our stock level adjustments, led to less wastage of outdated antibiotics.

The Remote Manager system went live on the spinal unit in July 2005. Once a pharmacist has entered the order for the antibiotic into the pharmacy system, it crosses the interface into the Pyxis profile, allowing medications in the patient's profile to be accessed from the MedStation. At this point, the nurse accesses the patient's pro-

file, chooses the antibiotic ordered, and retrieves it from the now unlocked refrigerator. The dose is then administered to the patient. Nursing immediately expressed a great deal of satisfaction with their improved access to postoperative antibiotics and their ability to administer doses in a timely manner. Additionally, patients could be discharged on time, addressing our throughput concerns.

#### **Results**

In order to more formally assess the impact of the new system, we conducted a second one-week survey in November 2005. Great improvements were seen in the percentage of on-time first doses. (See Figure 1.) Only four of 58 patients were prescribed antibiotics not stored by the Remote Manager, streamlining processes for both pharmacy and nursing. At the time of this second survey, Riverside used paper MARs printed after the patients' postoperative orders were completed by the PACU pharmacist or at nursing's request. Of the late or missed doses that occurred, five were caused by the MARs being printed late – even after the first dose was due.

In early 2006, Riverside went live with the McKesson AdminRx bar coded medication administration platform, which includes an electronic MAR (EMAR). To determine if this technology would further improve the timeliness of postoperative antibiotic administration, a third one-week survey was done on the spinal surgery unit. For 51 patients with postoperative antibiotics, 90% of the first doses were given on time, a further improvement from the 78% in the second survey.

Nursing satisfaction was enhanced with the addition of the Remote Manager system and EMAR. EMAR prompts nurses to administer doses and allows them to easily determine when the first postoperative dose is due. Less work and rework is required from pharmacy, as doses are now available on the spinal unit at all times. Patient throughput concerns were also resolved. Our infection rate did not show any significant trends throughout this process. Surgical site infections are multi-factorial in etiology, and other factors could have influenced the rate of infection in the spinal surgery patients. A hospital-wide initiative was undertaken to reduce surgical infections and included improving hand hygiene on the nursing units, washing of the surgical site with a recommended antiseptic, and examination and improvement of surgical factors, such as air flow, traffic patterns, and sterilization techniques. That said, improved antibiotic availability on the nursing units justified the continued use of the Remote Manager system, especially in our critical care units, where timing of antibiotics can be crucial for a patient's survival. The implementation of these two technologies at Riverside led to improved on-time administration of postoperative antibiotics with a number of benefits for patients, nursing, and pharmacy staff. ■



Lorrie L. Burns, PharmD, has served as a clinical pharmacist for Riverside Methodist Hospital's Neuroscience Center for 19 years. She received her BS in pharmacy from Ohio Northern University and her PharmD from the Ohio State University.

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