

# IMPROVED ADMINISTRATION OF ANTIBIOTICS CrossMark

## IN THE EMERGENCY DEPARTMENT: A PRACTICE IMPROVEMENT PROJECT

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**Problem:** Although consensus exists among experts that early intravenous antibiotic therapy has an impact on patient mortality, the medical literature includes little information about ensuring that the patient receives the complete dose. At our emergency department, it had become standard clinical practice to administer antibiotics with primary pump tubing and an infusion pump. Clinical pharmacy staff identified this practice as a cause for concern, because at least 20 mL (up to 40%) of the dose volume remains in the tubing. This practice improvement project was aimed at improving the administration of antibiotics by programming a secondary infusion to ensure the complete dose would be administered.

**Methods:** A multidisciplinary educational intervention was initiated consisting of one-on-one instruction with each emergency nurse ( $n = 103$ ) at the department's annual Skills Sessions, distribution of educational tip sheets, and reinforcement of the proper procedure at the patient's bedside. Emergency nurses were

educated via simulation regarding correct secondary pump programming, using smart pump technology.

**Results:** Surveys indicated that 8% of emergency nurses used secondary tubing along with a smart pump to administer antibiotics before the intervention, compared with 96% after the intervention ( $P < .0001$ ).

**Implications for Practice:** This project demonstrates that our educational intervention improved awareness of the need to administer the entire antibiotic dose and adherence to the use of secondary tubing along with smart pump technology to administer antibiotics.

**Key words:** Smart pump technology; Secondary; Emergency; Antibiotic; Education; Skills

Administration of complete doses of antibiotics is pivotal in the care of patients with infections. For example, a number of studies show that in the presence of septic shock, each hour of delay in achieving complete administration of antibiotics is associated with a measurable increase in mortality.<sup>1</sup> Although consensus exists among experts that early intravenous (IV) antibiotic therapy has an impact on patient mortality, the medical literature includes little information about

ensuring that patients receive complete doses of antibiotics. Once the antibiotic is ordered, providers may not realize that nursing administration techniques can influence whether the complete dose is delivered. Emergency nurses may not have considered the impact of how the IV tubing is set up and the volume of medication that can be lost in the tubing.

### Description of the Problem

At our urban, level II, academic emergency department, which serves 95,000 people annually, it had become standard clinical practice to administer antibiotics with primary pump tubing. A consequence of this practice was that at least 20 mL of the dose volume remained in the tubing. A majority of first-dose antibiotics are beta-lactam antibiotics, which are administered in a total volume of 50 mL; therefore, patients were receiving only 60% of their first dose of antibiotics. When using primary pump tubing in conjunction with smart pump technology (SPT), the infusion automatically stops when it senses air in the tubing, resulting in undelivered medication. To minimize this issue, emergency nurses should use the secondary pump tubing and program the antibiotic as a secondary infusion. This

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practice ensures that when the secondary infusion is complete, the infusion pump automatically reverts back to the primary infusion, which then flushes the rest of the secondary infusion in at a programmed rate. After discussion with the ED pharmacist and the ED nurse educator, this issue was identified as a patient safety and practice improvement opportunity for emergency nurses to encourage best practices related to IV administration and to better utilize the existing SPT.

## Barriers

Perceived barriers to following best practices related to IV administration were identified. Emergency nurses likely were unaware that a 40% loss of antibiotic occurs with administration of antibiotics via primary pump tubing. Many nurses had the perception that the secondary tubing and pump programming required more time to set up. We also noticed a lack of knowledge related to secondary pump programming.

## Available Knowledge

We performed a search of the English-language literature on SPT and best practices related to IV administration techniques. This literature search was conducted using the MEDLINE (Medical Literature Analysis and Retrieval System Online) database from January 2005 through January 2014. Key words used included “smart pump technology,” “IV administration AND medication safety,” and “container overfill AND entire dose.” A total of 15 studies were retrieved. Studies that focused on the use of smart pumps and on IV administration techniques used to deliver the entire dose were obtained. Most of the studies and articles reviewed pertained to utilizing SPT and organizational initiatives to intercept and prevent errors due to incorrect programming or incorrect calculation of doses or infusion rates. This focus aligned with the results from the 2011 Institute of Safe Medication Practices (ISMP) Medication Safety Self-Assessment for Hospitals, which is a partnership between ISMP, the American Hospital Association, and the Health Research and Educational Trust that represent data submitted by almost 1700 hospitals.<sup>2</sup> We concluded that many studies exist that are related specifically to infusion pump technology, including incorrect programming of smart infusion pumps and underutilization of the SPT data.

The more recent literature we reviewed does address understanding and managing IV container overfill and potential dose confusion, but its focus is on pharmacy

preparation, admixture practices, and chemotherapy.<sup>3</sup> We did find that the ISMP best practice recommendation for infusions included nursing education to “Infuse entire contents for full dose.”<sup>3</sup> We found minimal research on our specific practice improvement issue of addressing the medication left in the tubing and correct tubing setup and programming for primary and secondary infusions.

## Specific Aim

Our primary aim was to assess the impact of a practice improvement project that used a multidisciplinary educational intervention to improve nursing adherence to use of secondary tubing and SPT to administer antibiotics. This process ensures that the patient receives the entire dose of prescribed antibiotic, every time.

## Methods

This study was conducted as a practice improvement project after the literature review. It was conducted over a 5-month period from February to June 2014. A flowchart demonstrating the process is provided in [Figure 1](#).

The ED nurse educator, in conjunction with an ED pharmacist and medication safety nurse, developed a multidisciplinary educational intervention consisting of one-on-one instruction with each emergency nurse at the department’s annual Skills Sessions, distribution of educational tip sheets, and reinforcement of the proper procedure at the patient’s bedside.<sup>4</sup> Furthermore, secondary pump tubing was stocked in additional areas in the emergency department, making it more readily available and increasing the likelihood that it would be used.

At the Skills Sessions, which were facilitated by the ED nurse educator, the emergency nurses ( $n = 103$ ) were required to demonstrate the proper programming of primary and secondary medications. Subject matter experts on the use of SPT were present for mentoring and troubleshooting. SPT nurses provided tip sheets, and the ED nurse educator provided a case study. The case study included an order typically seen by nursing staff that would simulate the need to set up and program the infusion pump for a primary carrier fluid and a secondary medication. The tip sheet ([Figure 2](#)) provided reinforcement of the proper programming steps. During this time, emergency nurses were educated on the necessity and safety of delivering antibiotics via the infusion pump, utilizing SPT’s safety software, and the rationale for secondary setup and

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