Managing medication use in the operating room is challenging for any hospital, whether it is a 700-bed urban teaching hospital or a 100-bed rural community hospital. In addition to the unique issues each facility faces, there is the common challenge of ensuring necessary access to medication without sacrificing the control required to ensure regulatory compliance, medication security, and patient safety. There remains a delicate balance between providing convenient, flexible, and timely medication access and these increasingly complex and stringent medication control mechanisms.

At the University of Maryland Medical Center (UMMC), Baltimore, we constantly strive to achieve that optimum balance between access and control. Success in meeting this goal depends upon prudent employment of technology, executing well-conceived operational policies and procedures, and maintaining effective relationships with key stakeholders.

Role of Technology
Implementing computerized prescriber medication order entry (CPMOE) at UMMC has resulted in significant medication safety improvements. Though the OR is not within the scope of our CPMOE program, the use of order sets, one of CPMOE’s hallmark features, was translated to support safe medication practices in the perioperative process. We make transplant induction order sets available, which comprise the medications used for organ transplantation: immunosuppressant agents, antibiotics, and induction agents. The transplant team is thus able to simply choose the necessary medications based upon the type of transplant being performed. Post operative order sets are also available. These order sets are customized according to the type of surgery performed and serve to prompt the physician to continue antibiotics post operatively, a measure crucial for infection prevention.

The use of automated dispensing cabinets (ADCs) in the OR supports medication control and access therein. With an ADC in each suite, anesthesiologists and nurse anesthetists retrieve medications directly from the cabinet, avoiding the inconvenience and delay associated with requesting and retrieving medications from the OR pharmacy. The ADCs track the medications that are withdrawn, generate patient charges, and produce valuable reports. For example, the core replenishment report is utilized daily for restocking any medications that have been depleted from the cabinet. In addition, a monitoring report is generated daily, allowing for managerial review of technician activity to ensure the ADCs are checked monthly for expired medications. The report indicates which medications have been checked and by whom.

Operational Policies
Our operational policies and procedures demonstrate our commitment to safe medication practices. These policies and procedures include appropriate packaging of hazardous products, the provision of medications in surgery-specific kits, and the development of a nurse-friendly labeling system. For example, glutaraldehyde, a carcinogenic agent and hazardous material, is used during cardiac surgery to wash pericardial tissue and valves. In the past, our nurses lacked a safe method for dispensing and disposing of this product. To protect the surgical staff, the pharmacy agreed to package the product in one mL aliquots, allowing the surgical team to request the exact amount required for each surgery. Pharmacy technicians now package glutaraldehyde from a bulk container into individual aliquots within a chemotherapy glovebox. The nurses appreciate this change as they can simply order the proper amount of aliquots from the pharmacy, and the bulk bottles are no longer stored in the cardiac suite.

We are also able to provide some medications to the OR nurses via secure medication kits. Each medication kit is designed to meet the needs of a specific type of patient; for example, we prepare general
The importance of properly labeling the basins used in the sterile field during surgery cannot be understated as the basins can be easily confused.

OR kits, neuro-surgery kits, pediatric nursing kits, and others. The kits are double-checked by a pharmacist or a pharmacy technician, who signs the check sheet and secures the kit with a red lock. The kit-check process includes checking each item’s expiration date and documenting on the check sheet any medications set to expire within six months. OR pharmacy personnel dispense the kits to the nurses and collect any used kits for reprocessing. Using a sign-out sheet, the nurses indicate the kit’s planned destination, allowing for easy monitoring of each kit’s location. In addition, a charge sheet accompanies each kit, ensuring complete and accurate billing.

The importance of properly labeling the basins used in the sterile field during surgery cannot be understated as the basins can be easily confused. For example, a basin containing an antibiotic mixture, such as bacitracin for irrigation, can easily be mistaken for a basin containing normal saline. Just as medications can be confused, the basins can also be confused, underscoring the need for appropriate labeling. Our pharmacy department provides OR nurses with standard medication labeling nomenclature, which mimics the nomenclature used in the Cerner Millennium Pharmnet computer system and in the Omnicell ADC system employed at UMMC.

In addition to promoting safe medication practices, the OR pharmacy dispenses pre-mixed medications and mixes patient-specific medications in the pharmacy to avoid common medication preparation errors. Items that are distributed as pre-mixed, or pharmacy-mixed preparations include antibiotics, such as vancomycin and ciprofloxacin; and irrigations, such as bacitracin and clindamycin. Items are also prepared upon request, such as ropivacaine for the On-Q pumps. Additionally, the pharmacy provides medications in pre-filled syringes for anesthesia use, including rocuronium, succinylcholine, methadone, and fentanyl. Providing these medications in pre-filled, properly labeled syringes reduces the potential for error that could result from an omitted label or an incorrectly labeled syringe.

To reduce the potential for errors when ordering and preparing chemotherapeutic agents—particularly errors resulting from illegible handwriting and inappropriate deviations from standard protocols—pharmacy created preprinted order forms for a majority of the standard protocols. The physicians access the catalog through the hospital’s intranet, select and print the required form, and adjust the contents if appropriate. When a chemotherapy agent is needed during surgery, these forms ensure consistency of approach between the OR pharmacy and the oncology satellite pharmacy, where our chemotherapy medications are prepared. This system provides many of the same safety features of CPMOE for chemotherapy orders.

**Management Philosophy**

Instituting and maintaining successful medication management processes in the OR pharmacy requires developing excellent interdisciplinary relationships. At UMMC, the OR-suite ADCs are effective because of the collaborative efforts between pharmacy staff and anesthesiologist, Dr. David Schreibman. His support was key in implementing the program and is essential to the continuous improvement of the program. The recent opening of a new OR suite underscores the impact of effective working relationships on operational success. The new area is remote from the existing OR area, which presents unique medication management challenges, such as ensuring communication and collaboration, and timely delivery. However, the same multi-disciplinary cooperation that contributed to a successful opening now contributes to ongoing success. This multi-disciplinary cooperation includes the involvement of charge nurses, nurse managers, and participation in perioperative quality council meetings.

**Future Direction**

The pharmacy is continuously searching for ways to improve its services. Goals include expanding the medications available to anesthesia in pre-filled, labeled syringes, and refining ADC processes to better serve the anesthesia practitioners. Our technology bent, operational policies and procedures, and management philosophy of establishing effective relationships provide a solid foundation for continuous medication safety improvements in the OR.

Meagan Rushe, PharmD, is the manager of the shock trauma and operating room pharmacy satellites at the University of Maryland Medical Center, where she began her career as a clinical pharmacist. Meagan received her doctor of pharmacy degree from the University of Pittsburgh School of Pharmacy in April 2007.