

Case Study



Zebra works with Brigham and Women's Hospital to Improve Patient Safety

Challenge: Throughout the U.S., almost one in five medication doses administered in hospitals is given in error, according to a recent *Archives of Internal Medicine* study. As a pioneer in patient safety, the Boston-based Brigham and Women's Hospital (BWH) wanted to decrease those odds by creating an automated safeguard for preparing and administering prescription medications. BWH concluded that bar code scanning was the optimal system to improve safety and accuracy at all points. An effective system would require an individual bar code label on all prescription medications, however, only about half of the pharmaceuticals shipped to the hospital were marked with unit-of-use bar codes.



When BWH was planning its systems, the U.S. Food and Drug Administration (FDA) was considering a new rule to require unit-of-use bar code pharmaceutical labeling. The hospital didn't wait for the FDA to require bar code labels on individual medications, and it did not rely on its suppliers to provide them. Instead, the hospital relied on printers from Zebra Technologies to produce individual two-dimensional (2-D) bar code labels for more than 3.5 million pharmaceuticals per year.

Solution: BWH implemented a system using bar code scanning to track and record pharmaceuticals from the time they are processed in the pharmacy until they are administered to the patient. Bar codes are also applied to patient wristbands, employee ID badges, prescription orders and lab samples to facilitate automated tracking and error-free information recording.

"There are all kinds of labels used in the pharmacy, laboratories, and on medications at the patient bedside," said Bill Churchill, director of pharmacy services at BWH. "We rely on bar codes to make our operations highly accurate, so we need to make sure the printers are reliable and always available."

Physicians enter medication in a computerized system that records the time of the order and the time it is received and reviewed in the pharmacy. Pharmacists check the order on the computer, then print a bar coded prescription sheet that a pharmacy technician uses to prepare and fill the order. Before orders are released, bar codes on the medication are scanned, along with the order sheet, to ensure the medications dispensed correspond to the order.

When orders and stock medications are released from the pharmacy for delivery, the bar codes are scanned, automatically updating the records system. Physicians, nurses and pharmacists can check the status of orders at any time from computers throughout the hospital, which has a wireless LAN in place so information is updated and available in real time. Medication bar codes are scanned to record their receipt, and scanned again when they are removed from storage. Employees scan their own bar code ID badges during each medication transfer to automatically create a chain-of-custody record.

To administer medication, the nurse scans a bar code on the patient ID wristband then scans the bar code label on the pill, vial or IV bag. The computer validates that the right medication, in the right dose and form, is being given to the right patient at the right time.

"What we have is a fully integrated tracking and control system. Bar coding makes our operations as accurate as possible," said Churchill.

Labeling each individual pill, vial, and IV bag with a bar code was a major undertaking. Approximately 50 percent of pharmaceutical products used at BWH are not packaged with individual bar code labels. Those that are often have only the national drug code (NDC) number encoded, which is insufficient for BWH's information needs.

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To ensure all its pharmaceuticals were bar coded with complete information, BWH set up what is believed to be one of the first complete hospital-based drug repackaging center. The center labels approximately 3.5 million items annually. Brigham and Women's encodes the NDC plus lot number and expiration date in a Data matrix 2-D symbology label produced on a Zebra printer.

"We wanted to make sure we had all the information in the bar code to help us do our jobs more accurately," said Churchill. "A two-dimensional bar code allowed us to capture detailed information in the smallest space available, increasing our knowledge of each medication beyond what a linear bar code could offer."

The FDA has required manufacturers to label all pharmaceutical products dispensed in hospitals with a unit-of-use bar code by 2007. However, the rule may not reduce BWH's relabeling needs, because the FDA is requiring only the NDC to be encoded (lot codes and expiration dates were recommended but not required) using a linear symbology, which precludes data matrix.

Data matrix symbols can encode up to 3,116 numeric or 2,335 alphanumeric characters, which is significantly more than traditional linear bar codes (for example, common UPC symbols encode 12 numeric characters). Data matrix symbols have no fixed size and can be very compact, which is one of the main reasons hospital planners chose the symbology. BWH encodes an NDC number, lot code and expiration data in a symbol less than a half-inch square.

The density of data encoded in such a small space requires high quality, precision printing. BWH uses a Zebra industrial label printer, which maintains high quality in high volume operations. The Zebra thermal printer has native support for Data matrix symbology and an optional 300 dpi resolution printhead, which is well suited for producing compact, high quality symbols.

"You need a high quality printer to encode two-dimensional bar codes small enough to put on a one milliliter vial," said Churchill.

Data matrix bar codes are also used on wristbands to encode the patient's name, attending physician, admission date and date of birth. Encoding the wristband information satisfies HIPAA privacy requirements and complies with the Joint Commission on Accreditation of Healthcare Organizations' (JCAHO) National Patient Safety Goal (NPSG) for positive patient identification.

Because the hospital reads the bar codes with imagers, rather than laser scanners, it is easier to read the symbols when they are applied to curved surfaces such as vials or patient wristbands. BWH reports excellent scan rates.

Results: The bar-coding system has prevented errors when prescriptions are entered, filled and dispensed. Bar code data entry and computerized controls also provide accurate, up-to-date records that improved Brigham and Women's pharmaceutical tracking and inventory management.

"We have seen a dramatic improvement in error reduction in the pharmacy since the bar coding systems were put in place," said Churchill. "For example, overages in filling prescriptions have just about been eliminated. However, the most exciting piece of our systems is the ability to reduce medication administration errors. If you look at what is reported in the literature, you can expect a 60 to 80 percent reduction in medication administration errors through bar coding. That is very much in line with what we're observing."

"In the future, a two-dimensional symbology will give us tremendous opportunities to innovate further. One potential application is coding IV pumps with information such as the patient's ID, weight, concentration of the medication, and more," said Churchill. "Such detailed data requires a two-dimensional bar code."

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