Implementation Guide for the Use of **Bar Code Technology in Healthcare**

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Implementation Guide
for the Use of

Bar Code Technology in Healthcare

HIMSS®

230 E. Ohio St., Suite 500
Chicago, IL 60611

ISBN: 0-9725371-2-0

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Preface

The pressures of governmental regulatory and legislative actions as well as financial incentives created by payers and powerful purchasing groups are forcing providers to examine technologies that have proven track records in other industries. Bar codes clearly fall into the category of a well-known, well-understood technology with a proven record of success for more than a quarter of a century in multiple industries outside of healthcare. The only question is, why have we waited so long to adopt bar codes?

The current high level of focus on patient safety, recent drug company announcements, and the proposed ruling by the Food and Drug Administration (FDA)1 appears to have generated a critical mass of interest in bar coding technology. In response, the HIMSS Bar Coding Task Force has developed this publication, which provides healthcare information and management systems professionals with a solid general understanding of bar codes and their potential use in the healthcare enterprise.

Russell F. Lewis
Fall 2003

1 Bar Code Label Requirement for Human Drug Products and Blood: Proposed Rule. *Federal Register.* March 14, 2003; 68(50):12500-12534.

Introduction

Healthcare professionals learn early in their careers that when humans read or transcribe information there is a small but very real error rate. However, with training, procedural checks, double checks and well-designed processes, it is generally accepted that such errors will be caught and corrected before any real damage is done. The Institute of Medicine (IOM) 1999 report on the "quality chasm" in healthcare shattered that illusion. Visual and transcription errors are at the core of an unacceptable problem of medical errors that requires correction.

Another lesson learned is that for every difficult and complex problem, someone will propose an obvious and simple solution...that won't work. Patient safety is such a complex issue that cannot be fixed by a single solution. Rather, unprecedented cooperation through the medical supply chain, across software vendors and within provider organizations, is required. Refinement and consistent adaptation of bar code technologies, or more generically Auto Identification (Auto ID) standards, is a critical step toward solving the nation's patient safety challenge.

Attempts to adapt bar coding in healthcare date back several decades to the late 1970s, when National Cash Register offered a Hospital Order Communications System product built around bar codes. Sheets of bar codes were placed by computer terminals on patient units for staff to swipe the patient's bar code label, then the bar codes of the tests, procedures, and medications to be ordered for the patient. A decade later, a hand-held device dubbed the "Steam Iron" was introduced to the healthcare market. This device included a keyboard, display, and bar code reader. For a variety of reasons, these systems didn't catch on.

In 1983, the American Hospital Association (AHA) led the establishment of the Health Industry Business Communications Council (HIBCC, www.hibcc.org). At the time, the Hospital Management Systems Society (the precursor organization to HIMSS) became an early HIBCC participant. By 1985, HIBCC had developed both supplier and provider bar code labeling standards for the healthcare industry. While the labeling standard, HIBC/LIC, and Health Industry Number (HIN) are broadly used in provider warehouses and the healthcare supply chain, unit-of-use bar coding and applications are elusive. The only widespread use of bar codes in a clinical context has been for specimen labeling.

Noting the substantial history of bar coding, but also frustrated by lack of implementation at the point of care, the HIMSS Advocacy Committee responded to the IOM report. A Bar Coding Task Force was convened in 2001 to investigate bar code technology and determine what was needed to achieve ubiquitous use in patient care. This group quickly discovered that bar coding was a multifaceted issue for which understanding was limited and confined to small pockets within the industry. From this starting point, a number of products and activities have evolved.

- A white paper was prepared to provide a general understanding of the topic (available at www.himss.org).
- To support advocacy efforts, a Bar Coding Position Statement was developed and approved by HIMSS' Board of Directors (see box). This statement recognizes four general areas for bar code use within the healthcare environment: patient registration, supply chain, clinical care delivery, and patient accounting and billing.
- The HIMSS position statement was presented at an FDA hearing to evaluate bar code label requirements for human drug products.
- Comments were submitted to the FDA on the proposed rule for bar code label requirements for human drug products and blood
- Participation with the AHA and others in an effort that led to the formation of the National Alliance for Health Information Technology (NAHIT, www.nahit.org). NAHIT's primary role is the acceleration of standards use in the healthcare industry. Bar coding was identified by NAHIT as the most natural starting point.
- HIMSS Bar Coding Task Force also worked in collaboration with the AHA, the Health Research and Educational Trust (HRET), and the Institute for Safe Medication Practices (ISMP) on a joint project supported by the Commonwealth Fund. The project, titled "Pathways for Medication Safety," provides healthcare organizations with tools for reducing medication errors. Several tools, including one titled "Assessing Bedside Bar-Coding Readiness," are available free of charge on the Pathways Web site at www.medpathways.info.

While these resources have added to the body of knowledge on bar coding technology, the need for further education and member resources remains clear. The HIMSS Bar Coding Task Force has developed this implementation guide to provide healthcare information and management systems professionals with a solid general understanding of bar codes and their potential use in the enterprise.

Ned Simpson, FHIMSS
Chairperson, HIMSS Bar Coding Task Force

HIMSS Position Statement

With the goal of moving towards a fully electronic health record, the Healthcare Information and Management Systems Society (HIMSS) advocates the comprehensive use of standards-based bar coding technology in the healthcare environment.
The Society recognizes the significant benefits this technology can bring forward in the following areas:

- Patient registration and admission processes
- Patient safety, clinical care delivery, and patient tracking
- Product/supply logistics and material management coordination
- Patient accounting and billing

Methodology

- Improvements in the patient registration and admission processes can be achieved by use of bar codes on patient:
  - –forms
  - –labels and wrist bands
  - –records (including face sheets)
- Improvements in patient safety, clinical care delivery, and patient tracking can be achieved by use of:
  - –bar codes on unit-of-use medications
  - –bar codes on medical devices
  - –bar codes on medical/surgical supplies
  - –bar codes to identify care givers, clinicians and patients
  - –bar codes on order requisitions, test results, and patient charts/medical records
  - –bar coding scanners at the point of care
- Improvements in product, supply, and material management coordination can be achieved by use of bar codes on:
  - –unit-of-use items for inventory control/tracking
  - –bulk items to assist in materials tracking and logistics
  - –tracking of reusable/refurbished equipment and supplies, product recalls, and warnings
- Improvement in patient accounting and billing can be achieved by use of bar codes on:
  - –supply items to capture charges
  - –patient statements for identification of remittance advice

Final Statement

HIMSS recognizes that implementation of comprehensive use of standards-based bar coding technology is dependent upon multiple components, including organizational readiness and the existing IT infrastructure. A healthcare organization may choose to start at any point in this methodology and still achieve significant benefits. To assist organizations with assessing readiness and understanding the complexities of implementing this technology, HIMSS has developed a compendium of materials, which are available at: http://www.himss.org/

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Acknowledgments

We have many people and organizations to thank for this book. First, we thank Premier, Inc. for allowing us to use portions of a 1998 document, "Handbook For Implementation of Barcoding and Universal Product Numbers," to serve as the basis for chapters one and five.

I would like to thank Russell Lewis of Bridge Medical Systems for his contribution of untold hours as editor of this publication.

We thank the HIMSS Bar Coding Task Force members who served as editors and, in some cases, as content contributors for additional chapters:

- Trey Bullington – Alaris Medical Systems
- Lindsey Jarrell II – Healthlink, Inc.
- Carl McCann – Computer Sciences Corp.
- Mary Beth Navarra – McKesson Corp.
- Ned Simpson – NJSA

In addition, we thank the following individuals who gave unsparingly of their time to research the bar code literature, develop additional content, and proofread the work in progress: Mary-Michael Brown, Mike Issac, Jamie Kelly, Terry Kinninger, Marjorie Morales, Denean Rivera, Mike Wisz from Bridge Medical, an AmeriSource Bergen Co., and George Puckett from Choice Systems, Inc.

I would also like to acknowledge the valuable assistance of Joyce Sensmeier, MS, RN, BC, CPHIMS, Director of Professional Services for HIMSS.

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Chapter 1

The Basics

Bar codes have infiltrated every facet of our lives; you can find them in grocery stores, hospitals, department stores, jails, on farms, even in your own home. They have become an accepted part of our society, but what exactly are they and what do they represent? They all seem to look the same, but they are not. Different industries have developed their own standards for bar code content and format. Symbologies that we will study in this handbook are cross industry standards. If you are thinking about installing a bar code data management system, there are many issues to consider in making the right choice for your clinical and business needs.

What is a bar code?

A bar code is a graphic representation of data (alpha, numeric, or both) that is machine-readable. Bar codes are a way of encoding numbers and letters by using a combination of bars and spaces of varying widths. Both the lines and spaces are read. They may be thought of as another way of writing, because they replace key data entry as a method of gathering data. In business, correct usage of bar codes can reduce inefficiencies and improve a company's productivity, thereby growing its bottom line. Simply put, bar codes are a fast, easy, and accurate way of entering data.

A bar code typically does not contain descriptive data, just as your Social Security number does not contain your name or address. A bar code is a reference number that a computer uses to look up an associated record that contains descriptive data and other important information.

For example, a bar code found on a loaf of bread does not contain the product name, type of bread, or price; it contains a 12-digit product number. When the cashier scans this number at the checkout, it is transmitted to the store's computer, which finds the record associated with that item number in its database. The matching item record contains a description of the product, vendor name, price, quantity on hand, etc. The computer instantly does a price lookup and displays the price on the cash register as well as subtracts the quantity purchased from the quantity on hand. This entire transaction is done instantly; think of how long it would take the cashier to key in a 12-digit number for every item you wanted to buy.

Symbology is considered a language in bar code technology. Just as you might speak French while traveling in France, symbology enables a scanner and a bar code to communicate with each other. When a bar code is scanned, it is the symbology that enables the information to be read accurately. When a bar code is printed, it is the symbology that enables the printer to understand the information that needs to be turned into a label.

Bar codes come in many varieties. Most of us are familiar with those seen in grocery or retail stores, but there are many others that are used in various industries. In fact, there is more use of bar coding in manufacturing than in any other industry sector. Each industry has symbologies that are unique: They are not interchangeable. In some cases, companies have developed their own proprietary bar code symbologies. Why are there so many different types of bar codes? It's simply because different symbologies have evolved to solve specific problems.

Bar codes are read by sweeping a small spot of light across the printed bar code symbol. There's only a thin red line emitted from the laser scanner; what is happening is that the scanner's light source is being absorbed by the dark bars and reflected by the light spaces. A device in the scanner takes the reflected light and converts it into an electrical signal. The scanner's laser (light source) starts to read the bar code at a white space (the quiet zone) before the first bar and continues passing by the last bar, ending in the white space that follows it. Because a bar code cannot be read if the sweep wanders outside the symbol area, bar heights are chosen to make it easy to keep the sweep within the bar code area. The longer the information to be coded, the longer the bar code needed. As the length increases, so does the height of the bars and spaces to be read.

Major industries and their standards groups have adopted two-dimensional symbologies. Rather than using the bars and white spaces of linear bar codes, the two-dimensional symbologies use various combinations of black and white shapes. Developers say these symbologies eliminate space constraints in using bar coding on small packages, which is a major concern in healthcare. To read these two-dimensional symbologies, a digital picture is taken, and then software decodes the black and white shapes. This technology can read both bar codes and two-dimensional codes. For example, Data Matrix, a two-dimensional symbology, is said to offer several advantages over linear symbologies, including:

- Sizing (symbols can be as small as 2mm);
- Greater tolerance with respect to print quality;
- Greater range of readability, as Data Matrix can be printed directly onto any surface, including reflective materials used in some medication blister packs, as well as implantable devices and surgical instruments; and
- Error correction capability that enables the symbol to be read even if as much as 30 percent of it is damaged.

How can *you* benefit from bar coding?

Many people think of bar coding strictly as a technology. A broader way of looking at bar coding is viewing it as a tool for managing information. Bar codes enable quick, accurate data entry. Having accurate data available enables managers to make decisions based on valid information. For example, with a manual system you often must make an educated guess on inventory levels and when to reorder products. On the other hand, the accuracy of bar code scanning provides up-to-the-minute information about inventory levels, including the value of inventory investment. This information can help you maintain lower inventory levels and improve cash flow, which is invaluable to your hospital.

The most compelling advantages of bar coding and automatic data collection are:

- *Accuracy:* Bar coding increases accuracy by reducing the likelihood of human errors from manual entry.
- *Ease of use:* Bar codes are easy to use as long as the appropriate hardware and software components are in place to maximize the process of automatic data collection.
- *Timely feedback:* Bar coding promotes timely feedback of data captured in real time, enabling decisions to be made from current information.
- *Improved productivity:* Bar codes improve productivity in that many manual activities and tasks become automated, enabling resources to be utilized in other ways to increase efficiencies.

Bar code technology can be translated into three primary functions: tracking, inventory management, and validation. Whether you use one function or a combination of functions, the benefits in cost savings, improved productivity, and quality can be substantial.

Tracking

Anything that can be identified with numbers (or numbers and letters) can be tracked using bar code technology. Materials management, central services, medical records, radiology, pharmacy, and laboratory are areas where bar codes are commonly found in hospitals. However, applications continue to expand to nearly every area to help track cost per procedure, products used by clinicians, and total patient costs. In addition to assuring greater accuracy, bar codes help speed the process of recording where and what an item is, or what service is provided.

Bar codes can be used to track a product throughout the supply chain and clinical workflow. They may be used to track a supply to a particular patient and also can identify the clinician who used it with the patient. Bar coded numbers also can be used to track a particular item back to the manufacturer. For example, if a nurse discovers a defective supply item, bar coding can help track the item back through materials management and purchasing to the distributor and/or original manufacturer so the hospital can obtain a refund. Although it is possible to do the same thing manually, the amount of time involved would make the process too cumbersome. Often, the hospital will bear the cost of an unusable item rather than trying to investigate and complete all the paperwork.

Inventory management

Maintaining accurate inventory is a very complex process of knowing what you have, how much of it you have, who has it, where it is, how much it is worth, and when to reorder it. Every hospital maintains centralized and decentralized inventories that could include medical/surgical products, office supplies, linens, pharmaceutical products, X-ray film, cleaning supplies, laboratory products, and more. Bar coding helps you manage these inventories wherever they are located, so that the right materials are available when and where you need them.

Using a bar code also can help you monitor usage patterns throughout your hospital. In one hospital, the materials management department began collaborating with nurses to reduce inventory at nursing stations. Because the materials management department had accurate, documented information, they could create more realistic inventory levels. For example, if a particular unit used only eight of a certain item a day, but was keeping 17 of those items on the unit, the two groups worked together to find a satisfactory lower inventory level. In addition to the savings in inventory costs, this process strengthened communication and trust between materials management and nursing.

Scanning the bar code on a product can speed the reorder process. Some hospitals use systems designed to automatically reorder products when they reach a specified inventory level.

Validation

The validating function of bar coding can be an especially effective method of ensuring quality in a healthcare setting. Validation assures that an action has taken place or that the item you want is on hand. The ability to validate an action by a bar code scan helps reduce errors and waste, provides a management check on productivity, and helps construct the necessary documentation to meet requirements of the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) and insurance companies.

The most important validating function is to verify that the patient being treated is, in fact, the right patient and that the treatment that is about to occur is appropriate. Nurses can scan a bar code to confirm that the item they are about to use with a patient is the item ordered by the doctor. They also can validate that they have used the item with the right patient. Nurses do this by scanning the bar code on the employee identification badge, the bar code on the patient wristband, and the bar code on the item. This type of validation typically requires that decision support be in place to accomplish the checking function.

Categories of bar code applications

As in other industries, bar code applications have been used in healthcare for quite some time. These applications can be categorized in many ways, but for the purposes of this general discussion, we have chosen to group bar code uses into four categories:

- Supply logistics and material management coordination
- Point of care patient safety and clinical care delivery
- Document management
- Process logistics.

Supply logistics and material management coordination

Using the bar code as a unique identifier to create efficiencies in the supply chain is a very common practice in many industries, especially in functions that involve shipping and handling. This is how bar codes began to be used in the healthcare supply chain. Manufacturers, wholesalers and distributors adopted the use of bar codes on medical supply packaging in the 1980s to create service efficiencies for their distribution of bulk supplies. Commonly, only the label on the case or box was bar coded to facilitate rapid sorting and management of inventory in the distribution process. The use of bar codes at the lowest unit of measure was rare, and even today, only 61.1 percent of medical/surgical supplies are individually bar coded at the lowest unit of measure (the unit of use), according to a 2000 survey by the Health Industry Distributors Association (HIDA).[1] This number is continually rising, and in certain product categories, such as vascular products, the penetration of bar coding has achieved much higher levels.

In the healthcare supply chain today, bar codes are used in two primary processes that create efficiencies at a macro level. There is movement underway to expand the use of bar codes to generate efficiencies on a micro level that will have very significant effects on the entire supply chain.

The primary use of bar codes currently in the healthcare supply chain is for shipping and receiving purposes. Logistics packages use the data provided from the scanned information to properly route, reorder, and receive supplies from one inventory point to another, typically in a bulk volume. Bar codes placed on packing lists and delivery totes are commonly used to track, identify and capture information about orders and shipments both on the distributor/wholesaler side, as well as within materials management information systems at the healthcare site. The information captured is then fed into respective systems to complete and close out purchase orders, adjust inventory levels, and initiate the accounts payable process. Bar codes ensure the timely capture of accurate data within the process and reduce the learning curve for the personnel involved.

Additionally, bar codes have become more universally used for inventory management processes, particularly inventory counting. Many materials management information systems provide modules that enable the staff to quickly perform inventory counts by first scanning a bar code to identify the supply, then allowing a value to be entered based on the count. These modules are used in the distribution locations of the hospital as well as in the patient treatment areas in supply rooms. The counts often are compared with reorder points to generate recommended inventory orders. These inventory orders are then fed back to the distributor/wholesaler via the materials management information system to begin the cycle of the supply chain. This process is typically quicker and more accurate than a manual paper-driven process.

The increasing use of bar codes to capture data at the point of use has evolved to create an increasingly efficient supply chain by providing real-time visibility of the inventory levels on the nursing units. Bar coding supplies permits perpetual inventory level management and the reorder theories that support it. It also enables the supply chain to be more responsive to needs at the point of use. Capturing supply use by reading bar codes eliminates such inefficient and error-prone processes as staff writing down items used or taking sticky labels off supply items and posting them on patient-specific supply cards for later key entry. In addition to enabling efficient, accurate data capture about patients' supply consumption, scanning bar codes reduces much of the labor currently associated with managing supply inventory. Further, bar coding enables the hospital to hold clinical units financially accountable for supplies that may represent as much as 50 percent of the hospital's total inventory.[2] Because many of these supplies are billable items and represent potential revenue for the hospital, any improvement in capturing supply usage can have equally important impact on revenue enhancement.

In the future, bar code-enabled point-of-care technology used in the supply chain will permit predictive modeling. In particular, the distribution and manufacturing segments of the supply chain can be optimized to remove additional costs often associated with inappropriate amounts of inventory in the supply chain (too much or too little) as well as the logistics needed to overcome these inaccuracies.

Point of care patient safety and clinical care delivery

In the past few years, the excitement surrounding bar codes in healthcare has involved applications at the point of care, sometimes known as "Bar Code Enabled Point of Care" (BPOC). Other industries have experienced tremendous productivity improvements by using bar coding to capture data electronically at the point of service or point of sale for more accurate and timely recording and response. In healthcare delivery, BPOC capabilities not only enhance productivity, they improve the safety and quality of care. It is important to note that the scanning of bar codes prior to patient treatment can alert caregivers to potential errors before they occur, thereby preventing the error and avoiding patient harm. However, to be effective, bar code scanning at the point of care must be combined with software to provide decision support and enable alerts and warnings to prevent errors. By checking medical orders, patient and treatment information decision support systems can verify what are commonly called the "Rights":

- Right Patient
- Right Treatment
- Right Time.

Here's an example of how a BPOC system can improve medication administration. Starting by bar coding a patient's wristband, positive patient identification is the foundation of final validation that the appropriate care is being provided to the right patient. The importance of positive patient identification should not be underestimated. Too often, caregivers who are rushed or distracted fail to perform the basic task of checking the patient's ID; instead, they rely on their memory or a verbal response from a patient who may be confused or medicated. "Wrong patient" errors occur all too frequently; in fact, the JCAHO has established correct patient identification as one of six national patient safety goals. Scanning a patient's bar coded wristband is an excellent way to meet the goal of correct patient identification.

The caregiver scans the bar code on his or her employee ID and logs into the system. Bar coding the employee identification badge provides positive identification of the caregiver and ensures secure access to systems based on user privileges. Utilizing bar code scanning for caregivers also accurately captures user information for charting, charging and provides an effective audit trail. When the caregiver scans the patient's bar coded wristband, the caregiver has real-time access to the patient's orders and can view what currently needs to be done for the patient. When the caregiver then scans an item or medication, the scanned bar code is compared with the order profile. If it does not match, the caregiver is alerted to the discrepancy, and a potential error is averted. The scanning process also may trigger real-time documentation and billing

Point of care bar code scanning has begun to be implemented in several areas to ensure patient safety.

This example describes how combining software, decision support, and bar code scanning enables caregivers to verify that the right patient is receiving the right care at the right time for medication administration. Other examples of BPOC bar code scanning, including lab specimen management and phlebotomy, blood administration and numerous other patient treatments, will be discussed in Chapter 4.

Finally, bar codes can be used to generate patient charges. By scanning a bar code at the point of care, the charting and charging of the item can occur electronically.

Document management

Bar codes can be used in several ways to enable efficient and accurate management of paper documents and files.

Many hospitals use bar coding of patient medical record folders and patient account files to keep accurate file locator systems. Scanning the bar code on charts as they are checked out and returned is fast, easy and accurate. With portable scanners, official and unofficial satellite storage locations can be inventoried efficiently.

Bar coding can provide many benefits when documents are printed for use and returned for processing. For example, bar codes can be included on a patient statement to identify the patient and the healthcare encounter. Including a bar code on the part of the statement that the patient remits with their payment helps to ensure accuracy. The patient's account number would be encoded on the statement. Upon receipt of payment, the bar code would be scanned and credit issued to the proper account. This helps eliminate manual data entry and ensures that payments are applied to the proper account.

Process logistics

Bar coding can help any workflow that requires hospital staff to write down who or what they are working on. These can include:

- Annual equipment inventories
- Preventative maintenance
- Patient charges
- Linen inventory and distribution
- Sterile reprocessing
- Gas cylinder tracking
- Movable equipment management
- Forms inventory
- Patient menu requests.

Summary

In an ideal situation, there would be interoperability within the system to provide an end-to-end solution that maximizes safety and efficiency. Bar codes would be utilized throughout the clinical process and supply chain for near error-free tracking, validating, documenting, and billing. Of course, such a system would require the appropriate infrastructure, including databases and software, real-time communication, as well as decision support for alerts and warnings.

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[1] Markian Hawryluk, "Cracking the Code," *Healthcare Industry Executive magazine,* October 2000.

[2] Healthcare Financial Management Association, "Resource Management: The Healthcare Supply Chain 2002 Survey Results," July 2002.

Chapter 2

Keys to Successful Implementation

The adoption strategies and issues described in this chapter were gleaned from multiple bar code implementation projects. Here we present some of the hard lessons learned – including the impact on workflow – and an overview of issues to consider when selecting hardware and software and in applying bar code labels to badges, wristbands, medications, supplies, and other equipment.

Keys to success

Implementing bar coding applications without analyzing the effects on current workflow may, like all other information technology projects, perpetuate existing problems. Accordingly, end-users and any related disciplines must be involved early in the selection and implementation process. Thorough analysis of the problem that the bar code solution is intended to improve is necessary, and should be performed by a multidisciplinary committee representing all services that will interact with the system. Appointing a project champion, who is selected from the most affected end-user group, is key. For example, if the bar code solution under consideration is medication administration, then the involvement of the director of pharmacy or chief nursing officer is essential. Team members would include personnel who would interact with the system, such as other nurses, pharmacists, respiratory therapists, and personnel from the hospital information system department.

No technology should be implemented that perpetuates existing systemic problems. Understanding the organization's readiness to consider and embrace the bar code application is critical for recognizing this technology's benefits. Key success factors include organizational commitment and executive sponsorship, user involvement in planning, appropriate expectations, development and communication of success metrics, and anticipation of workflow and productivity changes. Technology alone will not solve the problem.

Bar code technology infrastructure

Bar Code scanners must be linked to a computer to pass on the data extracted from the symbology. There are three approaches for these connections:

- Scanners can be connected by wire to a computer, using either a PS2 connection inline with keyboard, a USB plug, RS 485, or through a serial port.
- The scanner can store the information that has been scanned until it is placed in a cradle connected to a computer, at which time it can download the information.
- Scanners can use wireless technology to transmit information.

Of course, the computer to which the bar code scanner is linked must be linked to the hospital's databases and other computers by some form of networking. The technology that links scanners, networks and computers is collectively called the infrastructure. Depending on what the bar code scanner is connected to, and how that device is connected to the rest of the hospital's network, communications and responses may be immediate (real-time) or held in batches for processing.

To achieve bar code enabled point of care (BPOC), a common approach is to attach a notebook PC, extra battery, monitor and bar code scanner to a cart that can be wheeled from bed to bed and exchange data with the hospital's network through the use of wireless technology.

Infrastructures are complex, difficult to maintain and expensive. Early users of BPOC had to install an infrastructure just for their initial application. Often, the introduction of a bar code application in the patient care areas necessitates the deployment of an 802.11 wireless network throughout the hospital. With planning and careful design, an effective common infrastructure can be installed to support multiple applications. In most cases, bar code implementation projects have not had to bear the cost of wireless networks because of the multi-use nature of the networks.

Bar code scanners

The most elemental contributor to the success or failure of a bar code system is the accuracy and usability of the scanning device. There are numerous scanner vendors, each with their own set of advantages and limitations. It is important to select the right scanner technology for the task at hand.

Some factors to consider include:

- Screen resolution
- Memory
- Portability
- Hand-held vs. hands-free
- Battery life
- Number and type of ports
- Processor power
- Wired scanner vs. wireless scanner vs. embedded scanner
- Real-time vs. non-real-time communication.

Following are some general lessons for making the right scanner purchase for applications and facilities.

Determine which scanning technology to buy: laser or imager

As healthcare suppliers and labelers incorporate newer symbologies, the issue of scanner technology becomes important. Laser scanning is the dominant technology at this time, and most scanners used in healthcare use laser engines.

Linear imagers are available that offer increased durability and scan speed, and raster lasers enable easier reading of multi-row symbols. Linear imagers and raster lasers offer evolutionary improvements over basic laser scanners. Area imagers represent a significant step forward in technology; they take a digital picture of the data, and then use software algorithms to search an image for codes and to decode them.

Most scanners used in healthcare today are not capable of reading RSS, RSS composite or two-dimensional symbologies. Certain medications in small packages will require one of these new symbologies, especially to record lot and expiration data. The March 2003 FDA proposed rule specified the use of RSS symbologies. Some current scanners may be upgraded by manufacturer to read RSS or PDF417. Laser scanners are currently available that have the ability to read RSS and RSS-composite symbologies. Most two-dimensional codes, such as Data Matrix, will require an imaging scanner to read them.

In 2003, many expect the cost of imaging scanners will decrease so that they will be comparable to the cost of laser scanners; earlier that year, imaging scanners were twice as expense. Over time, many expect image engines will replace laser engines because of their higher performance, greater flexibility and declining cost. Healthcare providers may decide to buy imaging scanners because these scanners will read all symbologies anticipated in the foreseeable future. Although it is unknown how long it will take for Data Matrix to gain wide acceptance in healthcare, it is likely that hospitals will have at least three to five years' notice of a shift to that form of the technology. Providers making decisions about buying scanners need to take into account several factors, including their ability to read symbologies: the distance from which the symbol might be read (depth of field/optical throw), the length of the symbols that are expected to be read (field of view), cost, power requirements, ease of use, and ergonomics.

Anticipate competition for devices or access to patients

Before selecting a scanning technology, hospitals should determine if a scanner is intended for use by a single or multiple applications. It is important to analyze potential workflow overlaps before delegating devices to multiple applications, because competition for scanners in patient care areas is likely to drive work-arounds. For example, most specimen collection occurs early in morning so that the laboratory can produce results and send them back to the patient's chart prior to the physician rounds. If a bar-coded medication administration application is also deployed, there is the possibility that the nurse could be administering medications at the same time that laboratory specimens are to be collected by another healthcare professional. Data is usually available from the laboratory information system that will provide the information that shows when specimens are typically collected throughout the day. Using this information with other workload data can potentially identify if and when there might be competition for a device or the patient. Bottom line – don't set up competition for devices or access to patients.

Catalog the likely bar code symbologies

Be sure to catalog the bar code symbologies being considered to ensure readability by the candidate scanners. Most scanners based on laser technology can only scan linear bar codes and will not scan many of the new 2D/matrix bar-code symbologies. Scanners based on imaging technology will scan all bar code symbologies.

Test scanners thoroughly for the environment

Scanners should be tested thoroughly to ensure they are appropriate for the intended environment. For the clinical environment, durability, size/weight, and ease of cleaning will be major determinants. Hospitals should verify the scanner drop test (multiple times) and understand the process for cleaning scanners. Durability also will determine how many spare devices must be kept on hand.

Test scanners to assess ability to handle curvature of bar code

The most important factor for readability of linear bar codes is curvature. If the surface curvature of the bar code is too great as it wraps around the patient's wrist or medication vial, it will not be read by the scanner. Scanners should be tested to assess the ability to handle curvature.

Test scanners for ability to handle distance

Patient wristband scanners should be tested for distance as well as curvature. This is particularly true when using a scanner tethered to the computer cart. In crowded patient rooms, the nurse may have difficulty getting the scanner close to the patient's wristband.

Insist on support for future upgrades

To protect the investment in bar code scanning equipment, hospitals should insist on guarantees from their hardware vendor that the scanners they purchase today will support new symbologies or will be easily upgradeable to support future innovations. Vendors' upgrade capabilities can include downloadable updates (e.g., flash ROM or EEPROM). For example, a new linear Reduced Space Symbology® (RSS) has been introduced to address the special limitations of small medication packages. Existing mid- to high-quality scanners are upgradeable to read RSS with only minor software modifications.

Avoid the complexity of having multiple devices

Avoid any scenario that causes your staff to use multiple scanning devices for different applications. This will cause almost certain failure.

Understand the software application

Software applications that make use of bar-coded information may need modification to read the newer symbologies. The scanners accomplish the task of reading and recognizing the bar code symbol as a data carrier. The scanner exports the captured data in a format that can be used by software applications. These application needs to accommodate formatting the data into a form that's useful for the application. This can include the building of rules governing the stripping of leading and trailing characters in the data string output from the scanner.

Patient Wristbands

Utilizing bar code technology at the point of registration enables an organization to construct a foundation upon which to further utilize bar code technology across the continuum of patient care. By bar coding the patient wristband that must be worn by the patient, caregivers and hospital support staff can use BPOC systems to ensure that patient identification is completed before administering medications, processing diagnostic procedures or simply transporting the patient to another part of the hospital.

There are several applications on the market that enable hospitals and healthcare entities to integrate their patient registration system with a bar code-enabled printer during the registration process. The most common application of this technology is to provide patients with bar coded wristbands to be worn during their hospital stay. Additionally, bar coding may be employed to create easily tracked print-on-demand forms at the point of registration. Examples of bar coded forms may include patient face sheets, consent forms and living will documents.

Still, there are guidelines that can facilitate a smooth transition to automated patient identification.

- Most hospitals have a policy requiring patients to wear wristbands at all times. Implementing bar code clinical systems immediately provides a rude awakening to the lack of conformance to the hospital's stated policies. Hospitals must be willing to mandate and enforce compliance.
- Prior to selecting a wristband vendor, hospitals should test wristbands and wristband stock thoroughly for durability, patient comfort, and legibility. In addition, hospitals should test to determine that labels don't bleed or smudge when they get wet (in showers or after exposure to solutions or blood).
- Integration of bar code-ready printers with health information and ADT systems is crucial. It is important that hospitals work very closely with their chosen bar code technology vendor to ensure that the plan for implementation includes a realistic hardware profile. The number of registration sites and the associated use of the bar code printers should be based on the peak volumes of patients in registration. Underestimating the equipment requirements needed to support the registration process will ultimately lower employee and patient satisfaction because that will cause increased waiting times during the registration process.
- Don't skimp on the stock. The quality of wristband stock is a major satisfaction determinant for both patients and employees/clinicians.
- Print on fluid-resistant labels using thermal printers. The use of ink jet printers on specialty labels can result in smearing that will be problematic for scanners at the bedside.
- Recognize there are a variety of ways to apply bar codes to patient wristbands.
  - Print directly onto fluid-resistant wristbands (effective).
  - Print bar codes on separate labels, then apply labels to patient wristbands (effective).
  - Print onto embossed identification cards, then insert cards into highly transparent sleeves in patient wristbands (problematic).
- Craft and enforce policy and procedures to provide quick access to replacement wristbands at all points of care. This does not mean a replacement wristband must be generated at all points of care, but quick access to a replacement wristband should be provided.
- While all Admission Discharge Transfer (ADT) systems can provide bar code labels, hospitals may need to acquire a software upgrade to facilitate the bar coding of wristbands.
- Patient wristbands should include human-readable information along with the bar code.
- Hospitals should plan on generating patient wristbands at every point of registration, including admitting and emergency departments.

Employee ID badges

Like patient bar coding, enabling machine-readable employee identification is not technically difficult. However, there are opportunities for challenges to arise. Following these steps can help facilitate implementation of automated employee identification.

- Careful thought should be given to selecting the unique employee/caregiver identifiers. It is important that the identifier not change during the employee/caregiver's tenure with the organization. Therefore, a badge number is typically a poor choice, as badges are often lost and a replacement badge will have a different number. A recommended identifier is the caregiver's employee number, perhaps with a unique suffix that can be 'retired' when a badge is lost and replaced with a new unique suffix.
- Deploy a bar code label printer in the employee services department and print the bar code at the same time as issuing the identification badge.
- The orientation of the bar code label on the identification badge is an important ergonomic and usability issue. If possible, orient vertically instead of horizontally.
- Likewise, it is also important for usability purposes to locate the bar code label on front of the identification badge.
- Nurses' hands are often filled with charts, medications, and at times the scanner itself, so the ease of scanning the identification tag is critical. The more difficult it is for nurses to scan, the more likely it is that they will attempt to work around the process.
- Make sure your bar code employee identification scheme conforms to the currently proposed Health Insurance Portability and Accountability Act (HIPAA) regulations for consistent identification numbers (cafeteria, payroll, access, etc.).
- Have identification badge replacement policies and procedures in place. For example, do not reuse an employee ID number on a different employee.

Medications

Bar code point of care systems require that bar codes be provided on the immediate container of all medications administered at the point of care to maximize the safety benefits of bar code verification systems. At present, only about 35 percent of formulary line items come from the manufacturer with bar-coded labels on immediate containers. Therefore, automating the point-of-care requires hospital pharmacies to apply bar-coded labels (or arrange for them to be applied by a repackager) to roughly two-thirds of their inventory. If the FDA proposed rule on bar code label requirements is approved, pharmaceutical companies will be required to place bar code labels on all prescription drugs and blood products.[1]

While bar code labeling is a challenge, it is not insurmountable when approached methodically with a thorough understanding of the existing options available and lessons learned.

- *Leverage manufacturer bar codes.* The efficacy of bar code scanning at the bedside relies in no small measure on the accuracy of medication bar code labels. Acquiring manufacturer bar-coded immediate containers down to the single tablet or capsule blisters, prefilled syringes, and smallest ampules and vials is the assumed best practice. When medications are not available in this form, controlled use of repackaging equipment under strict quality assurance is the best alternative.
- *Test labels.* To ensure labeling accuracy, the additional step of scanning the medication bar code to test the bar code label should be added to the standard pharmacy checks. Bar code verification should be the last step in the repackaging and labeling process to confirm that the correct bar code has been placed on each immediate container. Therefore, easy access to a bar code scanner and the BPOC software program in the repackaging area helps to ensure that this step occurs without fail.
- *Prioritize the bar coding process.* Hospitals should begin with a review of high-risk and high-usage medications so that a BPOC system can immediately address the most prominent threats to patient safety. Although the typical hospital pharmacy has a formulary consisting of 2,000 to 3,000 items, the pharmacy can achieve immediate patient safety gains by bar code labeling their top 500 most commonly used drugs. Expansion of the bar coding effort should continue from that point to ensure that virtually all medications sent to the point of care are bar code labeled.
- *Evaluate existing equipment.* Hospitals should investigate the bar code readiness of any existing packaging equipment in the pharmacy. Most oral, solid, and liquid packaging devices have the ability to print

bar-coded labels. If not, a software upgrade can usually enable bar code printing.

- *Automated over-wrapping systems.* Over-wrapping systems place a manufacturer's immediate container into a bar code labeled pouch or bag. This option is used more often with vials, syringes, and ampules than with tablets and capsules. Beware that over-wrapped products can cause problems with unit-based dispensing cabinets, as the size of the over-wrap makes it difficult to store the medication in small drawers.
- *Ink levels.* When using a label-generating application in conjunction with either laser-quality or thermal transfer printers for manual labeling of medications, it is important that the pharmacy closely monitor printer ink level because faint bar codes will pose scanning problems at the point of care.
- *Label content.* Labels should contain medication names (both generic and trade where appropriate), strength and volume, container size, expiration date, lot number, and manufacturer, in addition to the bar code that will contain the NDC number. Careful attention should be given to ensure that important elements of the existing manufacturer label are not concealed when the bar code label is affixed to the immediate container.
- *Bar code mapping.* Pharmacy computer systems have adopted the use of the NDC number as a primary identifier for drug products. However, purchasing from wholesalers may result in periodic substitution of one vendor's product for another, thus creating a discrepancy between the NDC number of the actual drug and the NDC number recorded in the pharmacy information system. Because of this variation, BPOC systems must provide a mapping functionality that pairs each drug's bar code to the corresponding formulary item in the system so that it can recognize these changes. Once the initial mapping is completed, new items can be mapped as part of the incoming procurement process. The BPOC system should provide an easy way to determine if a bar code has already been mapped and should enable mapping multiple bar codes to the same formulary item to accommodate variations in product availability.

Blood and blood products transfusion

Bar code systems are considered the most promising technology for eliminating blood transfusion errors. All blood coming from licensed blood banks is already bar coded, and hospitals use rudimentary scanners that check the code in the lab. Support is growing for the use of scanners and BPOC systems on patient units as well to protect them from transfusion error, most of which stem from misidentifying patients either when collecting samples for testing and cross-matching, or when they are about to get a transfusion. Early adopters of these systems have this advice to offer:

- *Optimize blood bag scanning.* From a technical perspective, there are some blood bag bar codes that must be scanned before others. For example, one should always scan the patient account number before the patient's blood type because the blood type will be known by the system for previously transfused patients and can alert for discrepancies. While there is a technical order required for scanning, that order should be optimized for end users to minimize the number of times the blood bag must be flipped to expose the compatibility label versus the donor label.
- *Reduce manual processes.* An implementation will flow better if the compatibility labels are automatically created from the blood bank system and if patient wristbands are created during the registration process. To the degree that end users are creating these bar coded items rather than computers, there may be basic data entry errors that create data mismatches in the system.
- *Start small.* There are many exceptional situations with blood transfusions, such as treating bone marrow recipients with changing blood types or administering pooled products. If you have targeted application usage for the basic blood transfusion process with plans for expansion over time, you'll begin reaping the benefits of an error-checking system sooner rather than later. It takes time to create a system to cover all scenarios; it's better to start using something that offers protection for 90 percent of the products transfused.

- *Implement a high-usage BPOC application, followed by less intensive applications.* Medication administration is a fairly intensive activity in hospitals. Nurses who use BPOC systems for medication administration get lots of practice with the system, because virtually all of their patients will need medications every single day. It is recommended that a hospital first implement bar coding for medication administration, and then move to a specimen and transfusion system. The transfusion system should be implemented last because that system will be used less frequently. This comment is not intended to reflect upon the relative value of the systems, but rather is meant to illustrate that frequency of use helps users become proficient.
- *Consider using an approach to "close the loop."* Using a BPOC system at the time of blood transfusion is a great step in the right direction, but how do you know that the right patient's blood was cross-matched? Unless you have implemented a specimen collection BPOC system, the possibility remains that the cross match blood sample was mislabeled. You can gain full control of your transfusion system by concurrently implementing both the specimen collection and transfusion identification pieces.

Specimen collection/identification

Keep the following guidelines in mind when implementing bar codes to aid in the function of specimen collection and identification.

- *Start development of the Laboratory Information System (LIS) interface early in the process.* The LIS interface is the source of the order data for the BPOC specimen application. Because all laboratory systems have the capability of producing collection labels, translating this function into a viable interface can create challenges. This is especially true since many laboratory systems have or have had some type of similar phlebotomy application. By the same token, the laboratory information system will be receiving data that has traditionally been entered manually, i.e., the collection date and time and the identification of the specimen procurer. Sending this data to the laboratory information system also can present new opportunities and challenges.
- *Have a detailed understanding of the LIS functionality.* There are two points to consider: (1) Laboratory systems have very sophisticated numbering subsystems. Because of the many permutations that may be utilized in the generation of these numbers, it is important to know when and how they are updated with status changes. (2) Because the BPOC specimen application will replace the label generation from the laboratory information system, it is also important to understand how labels have been produced so that the appropriate workflow scenarios will be replicated and enhanced with the BPOC specimen application.
- *Laboratory personnel must actively participate in the process and the implementation.* Because the laboratory is really the source and recipient of the data that is used by the BPOC specimen application, laboratory personnel must play an active role in the decisions that are made. They also must provide information about the capabilities of the LIS so that potential issues can be identified early. Ultimately, all of the samples received in the laboratory for analysis will flow through the specimen BPOC application.
- *Identify the end user.* Many hospitals use a variety of personnel to collect patient samples. As such, the workflow of the BPOC specimen application must be able to accommodate all of the various end user types. This will be especially important to delineate when developing policies and procedures to be used at the site as a result of introduction of this technology.
- *Identify and generate the specimen label format early in the process.* While the desired outcome of any laboratory order is the collection of a patient specimen, the specimen must be labeled with a document that will be utilized by the LIS for identification purposes. All laboratory systems today have the capability to generate patient specimen labels that contain bar codes. The bar code on the label is used to identify the specimen within the LIS. It also is used by laboratory instrumentation to identify the specimen for specific analyses. At a minimum, the label produced by the BPOC specimen application must mimic the label produced by the existing LIS so that it can be processed by the LIS and any instrumentation that utilizes bar codes.

- *Consider hardware selection carefully.* It is important to determine what physical setup will be utilized to perform the BPOC specimen collection. Factors to be considered include what other BPOC applications are, or will be, installed and who is the intended end user (traditional laboratory phlebotomists, nursing personnel, other non-nursing patient care personnel, or combinations of personnel). Based on the end-user population, multiple devices might be appropriate. In addition, the healthcare facility should not deploy devices that will be used for only one application if other BPOC applications are planned in the future.

Summary

The lessons outlined in this chapter have been amassed through extensive implementation experience. While some of the keys to implementation success are specific to a certain application, most are generally applicable to all bar code system endeavors. Still, the most critical key to success with any bar code application is not a technical exercise at all. Any healthcare information system application – bar code systems included – must be carefully integrated into user workflows. Without diligent attention to preserving workflow when possible and facilitating changes when necessary, technology applications are unlikely to succeed.

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[1] Bar Code Label Requirement for Human Drug Products and Blood: Proposed Rule. *Federal Register.* March 14, 2003; 68(50):12500-12534.

Chapter 3

Industry Standards

This chapter provides an overview of the major bar code standards and symbologies in the healthcare industry. It also includes a summary of the proposed FDA rule as well as other market drivers and their potential impact on both providers and suppliers.

For healthcare, the major standards are from the Health Industry Business Communications Council (HIBCC) and Uniform Code Council, Inc. (UCC). Symbology standards for ISO and blood product labeling standards from International Society for Blood Transfusion (ISBT) are also important.

Product identifiers

A unique and unambiguous bar code must be used to identify each specific product. In the HIBCC structure, this is called HIBC/LIC; in UCC/EAN, it is called the Universal Product Code (UPC). An umbrella term, Universal Product Number (UPN)® is used to refer to the two established bar code data formats: HIBC and UCC/EAN, which together could enumerate the entire universe of healthcare products. Thus, a HIBC/LIC or a UPC could be a UPN. Also, the bar code information must be created and assigned to each packaging level (or inventory unit) of each product. Having the bar-coded UPN on the smallest unit of use streamlines medical supply logistics and payment systems. It also makes point of care scanning possible and ensures that the right product is administered to the right patient at the right time.

There are similarities and differences between the HIBC/LIC and UPC. Both systems assign unique identifiers to the manufacturer or packager, and then the manufacturer assigns their own product identifier. Many products are sold to hospitals and also sold through retail outlets. Major retailers have tremendous purchasing power, and often products must carry the UPC code for retail distribution.

It is important to understand that HIBC/LIC and UPC are not bar code standards. However, it is important that a healthcare labeler (a manufacturer of healthcare products or a distributor producing customized kits) uses one of two standards: the Health Industry Bar Code (HIBC) Supplier Labeling Standard primary data structure (also referred to as the HIBC Labeler Identification Code, or LIC, format) or the UCC/EAN primary data structure. HIMSS and most other healthcare organizations recommend that hospitals have the capability to read and process UPN formats.

Healthcare providers have agreed to accept both of the UPN formats. The data structure of each provides the same basic information (identification of the labeler, the product or catalog number, and the packaging level). Therefore, hospital databases must be prepared to accept both formats. Providers should become familiar with both the HIBC Supplier Labeling Standard and the General EAN.UCC Specifications. The information provided here is a good starting point; however, be sure to obtain a copy of each standard as an exact reference.

Health Industry Business Communications Council (HIBCC)

The Health Industry Business Communications Council (HIBCC) is an industry-sponsored and supported not-for-profit organization. HIBCC is an organization whose primary function is to facilitate electronic communications by developing appropriate standards for information exchange among all healthcare trading partners. HIBCC is involved in several health industry initiatives, including electronic data interchange message formats, bar code labeling data standards, universal numbering systems, and the provision of databases that ensure common identifiers.

HIBC supplier labeling standard

This number is used to identify the manufacturer of the product.

The HIBC LIC primary data structure is eight to 20 characters long. It consists of a flag character, an LIC number, a product or catalog number, a unit of measure, and a link character. The bar code information and the human-readable information are always printed in this order. An asterisk (*) always precedes and follows the human-readable interpretation of the bar code. The elements of this data structure will be explained individually, in the order that they are used in the data structure.

- *1. Flag character.* Every bar code following the HIBC LIC format begins with a + as a flag character. The + indicates that the bar code follows the HIBC LIC data structure.
- *2. Labeler identification code.* A supplier choosing to follow the HIBC Supplier Labeling Standard purchases a Labeler Identification Code (LIC) from HIBCC. HIBCC assigns a four-character LIC code that represents the manufacturer's identity. The first character is alphabetic; the remaining three are typically numeric.
- *3. Product or catalog number.* The HIBC LIC facilitates the use of existing product or catalog numbers assigned by the labeler. It can be one to 13 characters long, and alphabetic, numeric, or a combination of the two. Often, characters such as hyphens, slashes, periods, asterisks, and even spaces are part of a product or catalog number. These characters are not encoded in the UPN bar code or printed in the human-readable interpretation of the bar code; however, the complete product or catalog number using these characters may be printed elsewhere on the label or on the package.
- *4. Unit of measure.* The unit of measure identifies the packaging level (e.g. unit-of-issue, shelf pack, carton, case, and pallet). These characters are not encoded in the HIBC/LIC bar code or printed in the human-readable interpretation of the bar code; it is identified as 0 to 9, with 0 identifying the unit-of-issue.
- *5. Link character (sometimes called check character or check digit).* The link character serves two purposes. It is used as a link to the optional secondary bar code, and as a check character for additional data security to catch manual data errors and detect bar code decode errors.

HIBC provider applications standard

By choosing to follow the HIBC Provider Standard, providers will benefit by having a defined standard for bar code labeling to identify everything from patients, medical records, caregivers, images, and assets to business documents. The provider should obtain a Labeler Identification Code (LIC) to define all its healthcare locations. These are assigned and maintained by HIBCC.

There are three data structures for the bar code label standard: Single Data Structure Format, Split Data Structure Format, and the Multiple Data Format. The Single Data Structure Format is used for basic identification. The Split Data Structure Format is used if the length of the data cannot be supported by the Single Data Format. The Multiple Data Format is used when there are multiple data associated where or on what object the label may be found.

Following is a description of the fields in the Single Data Format:

- *"Where" indicator.* The first field is one or three characters in length. It identifies where the label is applied. For example, "A" indicates the device is affixed to a patient.

- *"What" indicator.* The second field is one or three characters in length. It identifies the identification field. For example, "C" indicates the next field is a patient identification.
- *Data field.* The third field is variable in length. The field contains the actual data for identification. It is a unique identifier.
- *Link character (sometimes called check character or check digit).* The link character serves two purposes. It is used as a link to the optional secondary bar code and as a check character for additional data security to catch manual data errors and detect bar code decode errors.

Symbologies for the HIBC primary data structure

The HIBC Labeling Standards enable the labeler to choose either Code 128 symbology or Code 39 symbology. Both of these symbologies are alphanumeric. Originally, Code 39 was the only symbology permitted for the HIBC Standard; however, technology (symbology, printers, scanners, verifiers) has evolved since the HIBC Standard was put in place, and Code 128 now is used in most bar code applications. One reason is that Code 128 is a denser bar code than Code 39; that is, you can print more information in the same amount of space. With so many small unit-of-use items in healthcare, this is an important feature of the symbology. The data structure, of course, is the same regardless of which symbology you use.

Hospitals can expect to receive products marked according to the HIBC LIC format, using Code 128 Code 39 or Data Matrix. Bar code scanners can automatically discriminate one format from the other. This means that the scanners are preprogrammed to automatically identify the symbology used and decode the data. In addition, for Data Matrix, an image scanner must be used. Following are examples of each:

Code 39

EAH783G

Code 128

EAH783G

Data Matrix

Uniform Code Council, Inc. (UCC)

The Uniform Code Council, Inc. (UCC) is a not-for-profit standards organization that administers the Universal Product Code (UPC) and provides a full range of integrated standards and business solutions for more than 251,000 member companies doing business in 23 major industries, one of which is the healthcare industry. In cooperation with its global partner, EAN International, the UCC functions as a primary resource for business and industry, developing worldwide standards for identification codes, data carriers, and electronic commerce. UCC bar codes are used in grocery stores and other retail outlets.

UCC/EAN primary data structure for healthcare

A supplier choosing to follow the UCC/EAN format must purchase a manufacturer's identification number from the UCC. Known as the 'GTIN' (global trade item number), this number is used to identify the manufacturer of the product. UCC/EAN SCC-14 is a 14-character, fixed-length numeric data structure, which includes an application identifier, a packaging level indicator, a manufacturer/item number, and a check character. The elements of this data structure are explained below in the order they are used; however, the data structure should be considered as one number and should never be parsed.

- *1. Application identifier (AI).* Every bar code following the SCC-14 format for healthcare is preceded by the application identifier "01." An application identifier consists of two or more characters that indicate the format of a data element in the UCC/EAN-128 symbology. It defines the meaning and format of the data element.
- *2. Package level indicator.* This identifies the packaging level (e.g., unit of issue, shelf pack, carton, case, pallet). It is identified as 0 to 9, with 0 identifying the unit of issue.
- *3. UCC company ID number.* The company ID or manufacturer number is assigned by the UCC. UCC-assigned numbers start with 00, 06, or 07. A pharmaceutical product that is FDA-controlled starts with 03.
- *4. Manufacturer-assigned item number.* A five-digit item number is assigned by the labeler of the product.

This number is not necessarily the true catalog number, but a numeric identifier of the item.

- *5. Check digit (sometimes called a check character or link character).* This is used for additional data security, to catch manual data errors, and to detect bar code decode errors.

UCC/EAN secondary data

The UPN mandate requires only a primary data structure; however, the HIBC Supplier Labeling Standard and the UCC/EAN specification offer a method of encoding additional information, such as lot, batch, serial number, and expiration date. This is called secondary data. Secondary information is especially helpful as products move through the supply chain to the provider and ultimately are used in patient care. This kind of information is more critical for some products than others. For example, the secondary data structure will be of help to anyone in the supply chain (manufacturers, distributors, and hospitals) that must respond to the Safe Medical Devices Act (SMDA), which requires tracking of devices all the way to the patient. Other examples of products for which secondary data is critical include lab reagents and pharmaceutical products that have expiration dates.

Some labelers will choose to encode the secondary data, usually in a separate bar code. Occasionally, a labeler will concatenate or merge the data into one long bar code. The specific data structure for each format is found in the standard.

Symbologies for the RSS structure

New symbologies are emerging into practical usage that accommodate more information in an area of smaller bar code real estate. Currently, 90 percent of all healthcare items can be bar coded using widely accepted linear symbologies. The other 10 percent of items are too small for the application of symbologies such as Code 128. Emerging symbologies include linear symbologies such as RSS (Reduced Space Symbology), composite symbologies (such as CC-A, CC-B, and CC-C), and two-dimensional symbologies such as Data Matrix and PDF417 (portable data file).

RSS is a family of seven linear symbologies that complement existing technologies and symbologies. RSS symbols may be printed onto small labels applied to curved surfaces, such as vials, ampules, and blister packs. Composite symbols are a combination of a linear (one-dimensional) symbol such as RSS or UCC/EAN-128, and a two-dimensional component, such as PDF417 or a variant of MicroPDF417. All RSS variants enable the labeler to encode the NDC (national drug code) number onto a small label, but most of them do not allow the inclusion of secondary data, such as lot number and expiration date. All composite symbologies may be utilized to encode lot and expiration.

RSS Composite

The UCC's RSS symbology recently has been adopted by a number of pharmaceutical manufacturers that will be delivering medications and solutions with this symbology in the coming months. For example, by early 2003, Abbott had almost completed bar coding its entire line of intravenous solutions and injectable medications. Abbott's labels do not include lot number or expiration date. Pfizer has announced plans to bar code all 30 of its medications that it sells in blister packs by the end of 2003. These labels will include lot numbers and expiration dates.

Food and Drug Administration proposed rule

In response to concerns for patient safety and pressure from industry groups, the Food and Drug Administration (FDA) has proposed a rule to mandate the use of bar code labels on medications at the unit-of-use level. The intent to publish a mandate was first announced in December of 2001. The following July, the FDA held public hearings to learn more about the issues faced by the industry regarding such regulation.

The general consensus in the industry is that the adoption of bar code labels will help improve medication safety and improve operational efficiencies of providers. However, concerns were expressed about the costs of implementation of bar code labeling as well as the effectiveness if such coding was not universally adopted. In particular, pharmaceutical companies questioned how fast the industry could adopt bar coding so that it would be cost-effective to package and label at the unit-of-use level. Still, it's not a question of *if* bar coding will be adopted or mandated, but rather when and how.

On March 13, 2003, the FDA published a proposed rule in the Federal Register delineating the requirements for bar code labeling of human drug products and blood. The following requirements were included in the proposed rule.

- Manufacturers, repackers, relabelers and private label distributors of prescription drugs or OTC drugs regulated by the FDA are subject to the rule.
- Prescription drug products (excluding samples), biological products and OTC drug products dispensed under an order and commonly used in hospitals are covered by the rule.
- Each drug product described above must have a bar code that includes, at a minimum, the NDC number in a linear bar code symbology that meets UCC/EAN standards. The bar code must remain intact under normal conditions of use.
- Manufacturers, processors, repackagers and relabelers of blood or blood products intended for transfusions must provide a machine-readable label on the product which includes, at a minimum:
  - Unique facility identifier
  - Lot number related to the donor
  - Product code
  - ABO and Rh of the donor

The extent of FDA regulation is not clear. There are continuing questions around whether they will mandate a specific standard or symbology and, if so, when providers and suppliers will need to be compliant. Much remains to be seen, but the public opinion on this matter will soon be evident as the FDA posts the statements submitted during the 90-day comment period closed June, 13, 2003.

According to the Department of Health and Human Services, the final FDA rule is expected to be published in December 2003.

Market drivers

The ultimate value of standards lies in their adoption. Bar code use in the supply chain has had a well-identified value proposition. In retail technology in general and bar coding in particular, technology has taken hold when one of the top national players issues a purchasing requirement that all items will have bar codes that meet a certain standard. In healthcare so far, no dominant purchaser has driven such adoption. Within the past two years, however, a groundswell of support for adoption of bar code labeling in healthcare has grown around the demonstrated improvements in patient safety that are a result of reducing errors in medication administration and improving patient care and record keeping.

It does seem that, in light of the patient safety benefits, bar code adoption in healthcare is on the national agenda. Even before the FDA has finalized their medication bar coding standards, most major pharmaceutical companies have committed to applying bar codes to their medications. In many cases, they have been committing to included lot number and expiration dates, even though it is unlikely that the FDA will require that level of detail initially. With this commitment from suppliers and with public pressure for patient safety, hospitals should begin planning for the adoption of bar coding.

Summary

Whether through regulation or voluntary compliance, there are substantial implications for the industry in adopting bar code labeling at the point of care and throughout the supply chain. The most significant among them is the need for industry standards to define the format of the label, the need for manufacturers of supplies and devices to support bar code labels at the unit of use, and providers to implement processes to utilize the bar code products and systems to improve patient care.

Given the variety of bar code label formats, standardization is an initial challenge to the industry to adopting the labeling. The lack of a single format has caused confusion in the industry among the suppliers that create the bar codes and the information systems that must read the bar codes. This confusion has been a contributing factor to the slow adoption of bar coding by the supplier community. The lack of a single standard can be overcome from a scanning hardware perspective, because scanners can be programmed to read multiple symbologies, but the software applications and databases that use the encoded data need to be constantly modified as data structures change over time.

As the adoption of standards evolves, there are significant implications for both providers and suppliers. With careful thought and planning, the use of bar coding will enable investments in resources and changes to practices that ultimately will improve patient care and operational efficiencies.

Chapter 4

Clinical Applications

One of the paramount concerns of a hospitalized patient is receiving the wrong medication. Yet few patients know that they are 100 times more likely to receive the wrong blood than they are to be exposed to HIV and hepatitis through a blood transfusion and that most laboratory specimen errors occur right at the patient's bedside.

All clinical processes are subject to human error, and, where possible, bar coding is being employed to provide critical double checks for patient safety. This chapter describes several important clinical bar code applications.

Medication administration verification

Typically, a physician writes an order – electronically or manually – for a medication. This order is sent to the pharmacy through electronic or manual means (pneumatic tube, faxing, human transporter). The hospital pharmacist reviews and fills the order and sends it to the clinical unit by way of a pneumatic tube, robot, or human transporter. Most of these medications are loaded into an automated drug-dispensing device or are placed in individual patient bins in a medication cart. In most cases, the nurse correctly follows the physician's prescription, delivers the medication to the patient, and documents this administration in the medical record. However, one in five times, the nurse makes a mistake.[1] Most frequently, the nurse unintentionally gives the medication at the wrong time, doesn't give it at all, or gives the wrong dose.

When bar coding technology is used, the nurse scans his or her name badge and enters a secure password into a bedside computer (laptop, desktop, or handheld device). The nurse then scans the patient's wristband, which enables the patient's medication record, as ordered by the physician and transcribed by the pharmacist, to appear on the computer screen. The nurse then scans the bar-coded medication before giving it to the patient. This medication administration is recorded electronically, which makes it easily accessible to physicians and other clinicians.

If the nurse has unintentionally violated one of the "five rights"[2] of medication delivery, a warning appears on the computer screen before the patient receives the medication. Some bar code medication systems provide clinical alerts, such as reminding the nurse to take the patient's pulse before giving a medication or caution the nurse that a particular drug is easily confused with a similar-sounding or similar-looking medication. Bar coding used in medication administration has reduced medication errors between 71 percent and 86 percent.[3]

Blood transfusion verification

Blood transfusion involves several complicated steps. First, a physician must order the blood, specifying the product and amount. Second, consent to a blood transfusion must be obtained from the patient. Third, the patient must have a blood sample drawn at the bedside. Fourth, the blood sample must be properly labeled in the correct type of test tube. Fifth, the blood sample then must be transported (by pneumatic tube or by human transporter) to the laboratory blood bank. Sixth, a technologist must determine the blood type, and then the proper blood product must be prepared, labeled accurately, and transported back to the bedside. In the patient's room, two nurses are expected to correctly identify the patient, blood product, and the unit number; compare the patient's blood type with the product's blood type; and verify the physician's order and the patient's consent for the blood. Even with these numerous checks, the primary means for a blood transfusion error is when a nurse gives the properly labeled blood to the wrong patient.

When bar coding technology is used at the bedside, the nurse again enters the system by scanning his or her name badge and entering a secure password. The nurse then scans the patient's wristband, and through a series of electronically displayed prompts, scans the blood product, the blood product type, the patient's blood type, the blood unit number, and expiration date. If all prompts are accurately executed, the nurse is directed to start the blood transfusion. On the other hand, if any of the prompts are inaccurately executed (e.g., the patient's wristband identification number does not match the patient identification number on the blood product bag), an alert is generated. Bedside bar coding systems used in transfusion have resulted in 100 percent accurate patient identification and are recommended by industry experts.

Laboratory specimens identification

Collecting blood specimens is akin to the blood transfusion specimen process. A physician orders a laboratory test, and a technologist or nurse verifies the physician's order for the test, identifies the patient, draws the blood, places the blood specimen in the correct type of test tube, and places a label on the tube identifying the patient and requested test. Because laboratory specimens may guide the physician's care, they are drawn frequently on most hospitalized patients. Some laboratories print labels that identify the patient and expected test in advance. As the phlebotomist arrives on a clinical unit and proceeds from patient to patient, the labels are attached after the sample is placed in the test tube. It is at this point that most blood specimen errors occur, as patients are transferred to other units or discharged, test requests are modified, and/or specimens are required on an urgent basis. Using bar coding at the bedside to properly identify the patient and test results in accurate specimen labeling can prevent additional testing and patient discomfort.

In addition, a specimen identification system can assist hospitals in meeting federal and state legislation concerning patient safety and reduction of medical mistakes as well as ensuring compliance with hospital regulatory requirements calling for positive patient identification and other safety measures. As payer organizations recognize the value of quality care and reward top performing organizations, hospitals using BPOC technology may qualify for incentive plans by demonstrating error prevention. Finally, there is public relations value in that BPOC systems are a tangible promotion of patient safety among hospital employees and the community at large.

Major implementation milestones include determining how bedside bar coding systems will alter current hospital policies and procedures, making these changes, and communicating the changes to the rest of the hospital. Early decisions that must be addressed include hospital formulary review and update, selecting and providing bar code labels for patient wristbands, employee name badges, medications, blood components, and laboratory specimens. Generally, from the kickoff meeting introducing the new system-to-system deployment, six to nine months or longer will be needed to accommodate all implementation milestones.

Respiratory therapy treatment at the bedside

Similar to ordering medications, a physician typically writes an order either electronically or manually for respiratory therapy treatments. This order is sent to the pharmacy, where a pharmacist reviews and fills the order. A respiratory therapist uses a worksheet, which lists all of the medications and treatments he or she is responsible for administering during a shift. Medications are retrieved from the automated dispensing device on the unit prior to administration. When bar coding is used, the respiratory therapist scans his or her name badge and enters a secure password into a bedside computer (laptop, desktop, or handheld device). The therapist then scans the patient's wristband, which allows the patient's medication record, as ordered by the physician and transcribed by the pharmacist, to appear on the computer screen (e.g., Proventil 2.5 mg in 2.5 mL of normal saline every 3 to 4 hours via nebulizer). While nurses may be given access to all of the patient's medications, the system can limit the respiratory therapist's view to only the medications and treatments that he or she will be administering.

The therapist conducts a critical double check by comparing the order presented on the point-of-care system with the physician's original order in the chart. As the therapist confirms the order, an electronic signature documents that the verification process was completed. Next, the therapist scans the Proventil inhalation solution. The software performs a series of checks to make sure that the medication is scanned for the "five rights." The therapist then completes a final review of the medication and dose about to be administered. This step conforms to current standards for reviewing documentation before an electronic signature is applied. When the medication has been administered to the patient, the therapist confirms in the system that the dose of Proventil was given. As the medication administration is confirmed, the electronic medication administration record is updated. In addition, all charge events can be sent to the billing system to ensure timely and accurate patient billing and to the cost accounting system to ensure that the cost of care is accurately and efficiently captured.

A BPOC system is also instrumental in recording the use of respiratory therapy equipment during patient treatment. For example, preparing for oxygen therapy, the therapist will scan the bar code on the flowmeter and the patient's flow rate. Following established procedures, the therapist also scans the bar code on a new tubing package before hooking up the apparatus. Both the oxygen therapy treatment and the tubing charge are documented and sent to the billing system.

The use of bar code identification and electronic documentation of respiratory therapy treatments and equipment use creates a powerful set of data than can be used to optimize respiratory care within the hospital. As an example, suppose the infection control department notes an increase in the number of nosocomial infections within the last 30 days. Reports from the bedside point-of-care system can be used to determine if there is a link between a single device or type of device and the increased infection rate. This information is difficult to track and analyze without electronic bar code systems.

Data from the bedside point-of-care system also can be used to determine the number of treatment devices the hospital should have on hand to provide maximum utilization of each device during the peaks and valleys that typically occur with patient census.

Additionally, the BPOC system provides one means of positive patient identification. In conjunction with verbal verification of the patient's identity, the therapist is operating in compliance with JCAHO's 2003 National Patient Safety Goal #1 put forth to improve the accuracy of patient identification by mandating the use of at least two patient identifiers.

Most important, at the end of the shift, the therapist no longer has to remember to manually document treatments, equipment, and disposable charges. All the documentation has occurred as a byproduct of scanning at the bedside.

Dietary management

Bar codes can play a useful role in streamlining and safeguarding the dietary management process of meal preparation and tray distribution throughout the hospital.

Dietary management systems manage all information regarding patient diets, including menu printing, patients' choices of meals, and restrictions set by allergies or doctors' orders. In addition, they may support the logistics of food preparation and distribution, provide tools to accurately calculate dietary intake requirements, and enable caregivers to ensure that all meals affected by restrictions from doctors are cross-checked and verified by a dietitian before delivery to patients.

Certain tests and procedures require that a patient not consume food or drink for a specified number of hours prior to their commencement. The personnel passing the meal trays may not be the primary caregivers for that patient and may not know the patient's schedule. If the patient is mistakenly fed, the test or procedure must be cancelled and rescheduled, wasting resources, time, money, and trying the patient's patience.

When interfaced with a dietary management system, a BPOC application using bar coding scanning can automatically ensure that the right meals get to the right patient in the right portions. At mealtime, the caregiver identifies the patient by scanning his or her bar-coded wristband. This pulls up a patient profile that includes the latest diet order. A bar-coded meal ticket on the tray is scanned and cross-checked with the patient's diet order. If the ticket and order match, the tray can safely be delivered.

The system protects the health and safety of patients while reducing staff time in serving meals by automatically verifying patient compatibility, checking against patient food allergies and dislikes of basic food ingredients. The system also may enable integrated charging whereby menus and menu items can be individually priced and charged to the patient automatically. Daily, weekly, or monthly summary reports can be generated at the touch of a button, providing accurate statistics of menu items orders, menu types, and diet types for analysis and review.

Even before reaching the patient, bar codes may be used to improve one of the most tedious jobs in meal preparation – checking patient trays on the trayline. This involves a person visually checking every item on a tray to ensure the items are appropriate for the patient's diet and meal choices. Bar-coded food items and meal tickets for the patients' choices can make this process more efficient. The trays are scanned at the end of the assembly for accuracy against a patient's pre-checked diet meal ticket. Only those trays not passing the scan would need personnel attention.

Gamete tracking in the fertilization process

Bar code technology would make it virtually impossible for in vitro fertilization (IVF) clinics to mix up eggs, sperm cells, or embryos. A bar code system would assign each component in the IVF process (the prospective parents, the sperm, egg, and embryo) a unique identifier.

The two partners involved are recognized by a specified code; their sperm cells, eggs, and fertilized embryos are identified by a corresponding ID. Throughout the process, the bar code scanning system is used to verify the correct union of appropriate components. The technology stops scientists from fertilizing eggs or transferring embryos to the patient unless the identification bar code matches. Likewise, the grown embryos will be transferred to the patient only after the system has successfully matched the embryos' ID with the parents' ID.

Summary

Patient health and safety is the primary goal in healthcare. With so many healthcare organizations refocusing their efforts on lessening medication errors and increasing patient safety, it is apparent that bar coding has a place at the table. Of all the functions bar coding can serve in the healthcare setting, clinical applications are among the most important from a patient safety perspective. From medication administration to blood transfusions and beyond, bar code implementation can take the risk of human error out of the equation while streamlining costs and saving time.

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[1] Barker, K.N., Flynn, E.A., Pepper, G.A., *et al.* Medication Errors observed in 36 healthcare facilities. *Archives of Internal Medicine.* September 2002;162: 1897-1903.

[2] See Appendix C, "Case Study: Medication Administration: Five Rights, Many Wrongs."

[3] Johnson, C.L., Carlson, R.A., Tucker, C.L., *et al.* Using BCMA software to improve patient safety in Veterans Administration Medical Centers. *Journal of Healthcare Information Management.* 2002; 16(1):46-51.

Chapter 5

Non-Clinical Applications

Among the many important bar code applications are systems designed to streamline administrative tasks and heighten the effectiveness of non-clinical services such as patient registration and supply chain management. These applications have enormous potential to make the healthcare process more accurate and efficient.

Supply chain management in hospitals

Hospitals have always been involved in some sort of materials management process. Modern hospitals utilize a mind-boggling array of equipment and supplies from the most modern and high-tech devices like specialized stents and catheters for heart surgery, to everyday items, such as gauze bandages and protective pads. Hospitals utilize mountains of various food products to feed their patients and staff and even keep an inventory of teddy bears, balloons, and greeting cards for the gift shop.

"You can buy a cotter pin at a home store that sports a bar code," says Garren Hagemeier, executive director of the Healthcare Electronic Data Infrastructure Coalition (HEDIC), in Little Rock, Ark. "But in healthcare, only about 30 percent of medical products are identified to the piece-part level. If every product down to the smallest unit could be identified, then it could be tracked into and throughout the healthcare facility. There's even a bar code standard for patient identification, if only it were more widely adopted."

Receiving

Bar codes are more widely utilized by manufacturers at wholesale units-of-measure such as the case or box level. As such, many hospitals are able to make use of some level of bar code technology during the receiving process, although there are still significant gaps in standardization that prevent a "grocery store" experience at the hospital receiving dock. A variety of hospital information systems and most of the large medical and pharmaceutical suppliers offer handheld bar code scanning systems that can be utilized during the receiving process.

Typically, a hospital employee uses a portable handheld bar code device to scan the bar code label on each package. The "received" package's bar code ID is compared with the "ordered" package's ID. This comparison is performed via software on the handheld scanner itself for a simple match/no-match comparison, or the received product's ID is transmitted to the computer in a store-and-forward process when the scanner is docked. Alternatively, this information is transmitted from the scanner via wireless technology directly to the receiving software system where the comparison is made. We are starting to see the labeling of totes with a unique "license plate" bar code ID, which enables the user to scan the tote ID as a way of processing the entire tote contents at once. This "receive-by-license-plate" method also can apply to larger units, such as the pallet or even shipping container. Significant time savings can be realized by scanning one license-plate ID and "checking in" everything stored on a pallet at one time.

The software confirms that the received product matches the ordered product and is in the correct unit of measure. The system should accommodate the inevitable "substitutions" and "generic-equivalents" common in today's healthcare environment. Ideally, the system compares this information with an electronic version of the invoice in what is commonly called a "three-way match." That is, the invoice matches the receipt that matches the original order. This may seem like an obvious result, but it is a very time-consuming and expensive process to perform manually. Across all U.S. industries, the International Organization of Management Accounting (IOMA) estimates it costs $10 per invoice to match and process payments manually, but less than $3 when automated matching is utilized. It is not unusual for a hospital to process 2,000 to 3,000 invoices each month. This translates to a savings of more than $20,000 per month.

The receiving process is one area of the system that is often underestimated by the supply chain management staff. Typically, everyone is focused on "saving time and money" through the use of bar code technology and automation in general. However, the phrase "garbage in means garbage out" is very significant to the entire automated supply chain management process. If accurate product ID, quantity, pricing, and other information is not entered into the system correctly at the first point of contact – often, receiving – then there is very little hope that meaningful savings can be achieved with the system. A critical component in accurate data is a usable bar code ID to drive the receiving process. Without a usable bar code ID on the package, the product ID will need to be entered manually, significantly increasing the chance of errors. Frequently, the effort to ensure an accurate receiving process can be greater than that in a totally manual system. The payoff comes through reductions in effort elsewhere in the supply chain management process.

Put-away and verification

After the product is correctly received, it must be put away in the correct location. This step can really benefit from the use of bar code technology. For example, when a product is received at the hospital dock, it is frequently "broken down" into smaller units (e.g., case to box to each) and distributed to several other locations throughout the facility. Here, too, we are beginning to see the use of uniquely labeled totes to speed the put-away process for exactly the same reasons the system is beginning to be used during receiving. The user can indicate that dozens of products have been put away by simply scanning one bar code tag on the tote.

Accuracy is crucial at every stage of the supply chain process, and the most effective method available today is to scan the bar code on the product and the bar code on the shelf or storage location. This method provides a positive verification that the product is being placed in the correct location. Unfortunately, there are very few facilities that make use of this put-away verification process. Fewer than 50 percent of medical supplies and even fewer pharmaceuticals are bar coded at the unit-of-use level. Further, too few hospitals have bar coded product storage locations. Together, this means that getting the right product in the correct location is not always assured. It also might be noted that the use of bar coded totes will not improve the "scan-verified" put-away process, as each item must be individually scanned to ensure it is placed in the correct bin location.

Hospital supply chain employees should be constantly aware of the correct quantity-on-hand (QOH) amounts for each item and storage location. A good inventory management system will print the expected QOH on the picking ticket or display it on the portable bar code scanner. This enables supply chain employees to be conscious of significant variance in QOH from the amounts the computer expects for a given location.

Picking and internal transfer

When the inventory control system designates items – by part number, description, and quantity – to be gathered from a supply storage area to satisfy demand in another location, that process is called "picking." Often, inventory management systems generate the picking lists in some logical order – ideally, related to the physical order in which the products will be gathered. For example, if the products are stored on the shelves in numbered bin locations, the list might be printed in Bid ID order. The hospital employee moves down the list in order and, in so doing, travels around the stock room in an efficient manner. Typically, the inventory system will generate one list for each delivery location and the hospital employee will pick all the products for that delivery location in one step. Many times, the products are put into storage containers or totes for ease of transportation.

Replenishment ordering

When it comes time for reordering, frequently buyers choose what might be called the "tell me what you want" methodology. In an automated inventory environment, buyers should be utilizing the "tell me what you have" methodology. In the first, or "tell me what you want" methodology, buyers create orders on a vendor-by-vendor basis. For each vendor, they indicate the products requiring replenishment and designate the quantity to be ordered. Through experience and often trial and error, the buyer can compute the desired quantity to order based on the current quantity on hand. It's "through experience" because not just anyone can look at the shelf, see three widgets on hand, and determine that two cases of widgets need to be ordered. Through experience, the buyer is aware that the hospital uses 20 widgets per week and that they come from the wholesaler in cases of 24.

A more practical approach is the "tell me what you have" methodology. In this process, anyone can record the quantity on hand of each item. Utilizing a bar code scanner makes this process particularly quick, accurate, and efficient. The hospital employee scans the bar code for the product – either from the package itself or from a bar code ID label affixed to the shelf. Then, the quantity on hand is entered. The hospital employee does not need to have any prior knowledge of the product, its order history, who the vendor might be, in what unit of measure the product is shipped from the wholesaler, or other details. All of this information is stored in the inventory management system and is utilized to compute the replenishment quantity. Further, the inventory management system gets updated, accurate, on-hand information.

Cycle counts

Done correctly, cycle counts can bring any inventory system to a new level of accuracy and effectiveness. By utilizing bar code technology, especially portable bar code scanners, the process is quick and very accurate. Cycle counts done in combination with replenishment ordering makes the process of verifying on-hand quantities almost painless.

As hospital employees move around the hospital with portable bar code scanners, they identify any products that appear to have a low quantity-on-hand or simply scan all the products in each area. After the product bar code ID is scanned, the user enters the actual quantity on hand. This updates the inventory system with current, accurate, on-hand information. The system should then be able to compute a reorder quantity and generate picking instructions to a storage location or create a replenishment purchase order to the appropriate wholesaler.

Summary

As this chapter has demonstrated, non-clinical bar code applications have great potential to increase efficiency and accuracy in healthcare organizations. Almost every back-end function can benefit from bar code implementation with proper planning and the right equipment.

Chapter 6

Cost Justification for Clinical Systems

Preventable medical errors result in 44,000 to 98,000 deaths among hospital patients each year – more than the number of people who die from workplace accidents, motor-vehicle wrecks, breast cancer, and AIDS.[1] Medication errors alone cause an estimated 7,000 deaths every year.[2] These medication errors cost the nation more than $2 billion annually in terms of lost income, lost household production, disability, and healthcare expenditures.[3] Individual hospitals may expend as much as $5.6 million annually to treat the effects of these medication mistakes.[4]

These distressing statistics have resulted in mounting pressure on hospitals to improve patient safety from many organizations, including the U.S. House of Representatives, Institute of Medicine, the Joint Commission on Accreditation of Healthcare Organizations, and purchasing consortiums such as the Leapfrog Group.

Healthcare institutions also are facing rising public awareness and concern regarding their safety and that of their family members while hospitalized.[5] Increasingly, consumers are expecting, and even demanding, that technology that is manifest in their everyday lives should be visible in their local healthcare institutions. Computers and bar codes are examples of technology with which the public is completely familiar, and this technology is beginning to appear with more frequency in hospitals. Bar code-enabled point-of-care technology (BPOC) holds the potential to reduce medication errors, avert costly remedies required to treat the aftermath of medication errors, and provide other valuable benefits to a healthcare facility.

BPOC patient safety technology

As described earlier in this manual, bar code enabled point of care technology combines a portable computing device, imbedded logic, and a bar code scanner that reads bar codes on a patient's wristband as well as their medicines prior to medication delivery. If the BPOC software identifies a mismatch between the patient and the medication the nurse is about to administer, an alert informs the nurse of this mistake and an error can be prevented. Early adopters of BPOC technology are reporting medication error rate reductions from 70 percent to 86 percent.[6, 7]

Constructing a return on investment evaluation

Identifying the return on investment for patient safety bedside bar coding systems is intuitive, yet elusive. Clinicians, who fully appreciate the hazards of hospital practice and the ease with which a serious mistake may be made, view bar coding technology as a means for protecting their patients and their livelihoods. Hospital administrators, who are removed from the bedside, often require documentation that bedside bar coding will result in FTE reductions or lower other specific costs.

Bedside bar coding can help avoid costs associated with medication, blood transfusion, and laboratory specimen collection errors. For example, the average cost of a harmful medication error is $4,600,[8] and the average amount of a medication error malpractice award is from $363,000[9] to $668,000.[10] In their proposed bar code rule, the FDA estimated the average direct cost of an Adverse Drug Events (ADE) at $2,257.[11] Research supports that an average-sized hospital may experience as many as 40 medication errors each day. In their proposed bar code rule, the FDA estimated 28.4 ADE per year, on average, for each hospital.[12] If each harmful medication error costs $4,600, bar coding at the bedside may avert millions of dollars in losses each year. In addition to avoiding patient harm, suffering (perhaps death), litigation, and malpractice costs, bar coding software is often device-independent. Budgeting for bedside bar coding systems includes anticipating the costs associated with hardware, software, interfaces, training, and implementation. However, if computers are already in use at the patient's bedside, hardware costs may be incidental or shared among several department budgets.

Although ensuring that medication errors do not occur is the right thing to do, hospitals must be able to articulate the potential returns on this significant investment before investing in such technology. Medication safety programs should be analyzed and planned in the same manner as any other investment, using the tools and language of finance in the planning process. The healthcare provider must look at the cost/benefit determinations in a medication safety system and estimate quantifiable returns. Also important, providers should evaluate other significant intangible benefits to the organization as well as a return-on-investment (ROI) calculation.

ROI is the ratio of profit to investment. In the case of BPOC, profit is largely measured by costs avoided through use of the BPOC system as well as other less tangible benefits. The ROI consideration starts with the volume and cost of medication errors at each hospital. Most hospitals have difficulty appreciating the number of medication errors committed in their institutions because they do not have a systematic technology in place to accurately capture such data. As a result, hospitals tend to dramatically underestimate their medication error rates. Recently, a landmark medication administration error study conducted in 36 healthcare facilities reported that 19 percent of medication administrations were done erroneously, and seven percent of these errors were potentially harmful.[13] According to a leading medication safety expert, the increased hospital cost of treating ADEs averaged $4,600 per incident.[14] Other investigators have estimated that the typical cost of an ADE ranges from $2,260 to $5,000.

Using these metrics, hospitals can postulate the number of potentially harmful medication errors occurring every year by multiplying the annual number of medication doses administered by 1.3 percent (19 percent times 7 percent).[15] Next, hospitals can estimate the potential cost of these errors by multiplying the number of harmful errors by $4,600 or (another figure between $2,000 and $5,000).[16] Accordingly, these costs may be reduced by 70 to 86 percent, the reported error avoidance rate with BPOC.[17, 18]

Other costs associated with medication errors include death and disability and resulting legal costs. In 2000, the median compensation award for medication errors was $668,000 per award.[19] Investment in medication safety systems may be justified in terms of risk management and legal liability alone. Other costs that may be associated with medication errors include accreditation costs, human capital costs, marketing costs, and inability to generate new business.[20]

After estimating the annual costs associated with ADEs and determining the number and costs of errors avoided, hospitals may compare these financial savings with the cost of the BPOC system. Expenses associated with patient safety technology, such as BPOC, include one-time capital costs, one-time operating costs, and ongoing costs.[21] These expenses will depend largely on the hospital size and existing infrastructure. Generally, one-time capital costs that must be considered include those for a server, hardware (workstations, handheld devices, laptops, printers, scanners, bar code label machines), software license, interfaces, network, vendor implementation, vendor travel expense, and disaster recovery. One-time operating costs are those costs associated predominantly with project planning, implementation, staffing, and training. Ongoing costs include software maintenance fees, staffing requirements, and other clinical resources.[10]

The FDA anticipates that the cost of implementing a BPOC system (including scanners, readers, software, and training) in a 191-bed hospital would approach $377,000.[22] Others estimate the cost of implementing, training, and ongoing costs of a BPOC system for a 500-bed hospital will approach $2 million.[23]

Other value-added benefits

In addition to reducing medication errors, there are many other potential patient safety benefits from implementing a BPOC system. These systems, used to their fullest capability, also can improve the safety of blood transfusions and laboratory specimen collections. The infrastructure provided by medication safety checking makes this economically cost-effective and provides a consistent workflow for nurses.

Hospitals should perform an ROI analysis, including cost savings from the prevention of adverse medical events and the related reduction of potential liability, before implementing a BPOC system. However, these will not be the only persuading factors in implementing a BPOC IT system. Less obvious benefits can also be realized, such as increased satisfaction of nurses in their daily work. This can reduce nursing turnover – a growing and increasingly expensive problem in healthcare. The technology reduces the nurses' paperwork burden, enabling nurses to spend more time interacting with patients and providing higher-quality care. A BPOC system can provide a sense of protection to nurses, which reduces stress levels.

There are important public relations considerations and benefits from implementing BPOC technology. The news media has made the public keenly aware of patient safety and medical error issues. For instance, a widely publicized report by The Commonwealth Fund said one-fifth of adults surveyed, or 22.8 million people, reported they or a family member had experienced a medical error of some kind; of these, an estimated 8.1 million households reported experiencing a medical error that became a serious problem.[24] Implementing a BPOC system is a very visible sign of the steps a hospital is taking toward patient safety. Every time a patient receives a medication, the patient and medication is scanned at the bedside. Often, patients who have received medications in this manner will refuse further medications without such an obvious safety check.

Summary

While a BPOC system offers plentiful benefits, the realization of these benefits is only achieved after a comprehensive assessment of the current medication use process, from medication delivery at the loading dock, to physician ordering, order transcription, pharmacy dispensing, nurse administration, documentation, and billing.

A BPOC IT investment offers hospitals significant tangible and intangible benefits. Tangible benefits include fewer costly medical errors, increased nurse satisfaction, increased communication among caregivers, more accurate clinical records, and improved safety in the use of high-alert medications. Intangible benefits include public perception of the organization's commitment to safety, word-of-mouth value from former patients, and patient satisfaction.

Although today there is no government or payer mandate to implement BPOC systems, it is likely such systems eventually will become an essential part of doing business in healthcare. These systems will result in higher quality of care, reduced medical errors and a more cost-efficient healthcare system.

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Appendix A

Guidelines for Bar Code Equipment and Supplies

Decisions on equipment and supplies should be among the last made when implementing a bar code-based system. First, understand your application and at least begin your software selection. These considerations will drive and frame your selection of appropriate hardware and supplies.

This guide provides some brief comments on equipment and supplies that may be considered as part of bar coding solutions. To identify specific vendors, HIMSS' Solutions Toolkit (www.solutions-toolkit.org) can be a useful start.

Bar code technology, like any technology, must be applied properly to work effectively. A primary consideration when implementing bar code technology should be the workflow of the healthcare provider. The implementation of comprehensive use of standards-based bar coding technology is also dependent on multiple components, including organizational readiness and the existing IT infrastructure. A healthcare organization may choose to start at any point in this methodology and still achieve significant benefits.

An important caveat in selecting equipment: Do not base decisions on price alone. It can be very expensive if the equipment does not work with the existing application or if the people assigned to use the equipment find it too awkward to use. Remember standing in a supermarket checkout line as the clerk struggles to scan the bar code and finally ends up keying in information? This frustrates the user, frustrates the customer, subjects the system to errors – possibly costing the supermarket money – and reduces productivity. The same is true in the healthcare industry. As an extreme example, consider the worker who has to inventory products on the top shelf of a warehouse. Should this person have to climb a ladder just to scan the bar codes, or would it be faster and safer if the job could be accomplished from the floor with the use of a long-range bar code scanner?

Bar code printing

Dot matrix printers

Dot matrix impact printers were not designed to print bar codes; therefore, they are not necessarily a good choice in bar code applications. Dot matrix printers use a series of pins that strike a ribbon against the label stock to form characters. They use multiple pass ribbons and must be monitored very closely to maintain print quality. Dot matrix printers cannot meet specifications for all of today's symbologies.

Laser and ink jet printers

Desktop laser printers can be used for bar code printing. Depending on the application, this may or may not be a good choice. Lasers can print very high-quality bar codes. Desktop laser printers often have a curved paper path and difficulty accepting thick stock; therefore, the choice of label stock and adhesives is somewhat limited. These printers use 8.5" x 11" sheets. So you may waste labels if you need only a few labels or your label size does not easily configure to 8.5" x 11". Laser printers are, however, an excellent choice for printing bar coded menus, or, for example, a pick list.

Thermal printing

There are two general types of thermal printers:

- Direct thermal printers
- Thermal transfer printers

Thermal printers use a computer-controlled print head with thousands of print elements that heat and cool very rapidly. Like conventional fax machines, thermal direct printers imprint the paper directly (no ribbon); thermal transfer printers imprint using a temperature-sensitive ribbon that transfers an image to paper or synthetic materials.

Both types are capable of producing high-quality symbols and can be used to print as few as one label at a time or batches of labels. Some thermal printers can be used in both thermal direct and thermal transfer mode. Others are designed to be used in only one mode. Thermal printers are available as stand-alone units with their own keyboards for manually entering data, or they can be directly controlled by a PC, mid-range, or mainframe computer equipped with the necessary interfaces. Your materials management information system should be able to utilize a thermal printer.

Thermal direct printing

Thermal direct printers create high-quality images on temperature-sensitive paper without using a ribbon. Some fax machines work in the same way, but the quality of paper used in thermal direct printers is much better than that used in fax machines.

The paper is chemically treated so that an image will be formed when exposed to heat from the print head. In addition to being temperature-sensitive, thermal paper is also light-sensitive. It can darken if exposed to extreme temperatures, bright sunlight, or certain types of lighting commonly found in warehouses.

Several grades of thermal direct stock are available. The less-expensive grades are more sensitive to light and may not be readable with infrared light sources. The more expensive grades are less sensitive to bright light and can be read with infrared light sources.

As a rule, thermal direct printers are not recommended for label printing applications in which the label needs to last two years or longer. However, thermal direct labels are used for a multitude of applications where the labels do not need to last very long and where the benefits of low maintenance and no ribbon consumption are desired.

Thermal transfer printing

Thermal transfer printers create a high-quality bar code label quickly. Thermal transfer printers use a specially formulated wax- or resin-based ribbon and can print on a variety of paper and synthetic materials, satisfying a wide variety of applications.

Bar code verifiers

The key to a good bar code-based system is a high-quality bar code or one that can be read the first time it is scanned. When printing bar codes, it is important to have a process in place to ensure that every bar code is a high-quality bar code. A bar code that looks good is not necessarily a good bar code. A device called a bar code verifier measures bar code quality. These measurements are based on ANSI Print Quality Guidelines (ANSI INCITS 182) established by the American National Standards Institute. HIBCC recommends that the symbol quality in its final configuration shall be no lower than a C/06/660, and that labelers should attempt to reach B/06/660. If you decide to print your own bar codes, become familiar with these guidelines and consider purchasing a bar code verifier.

Bar code scanners

Sometimes the term “bar code scanner” is used interchangeably with the term “bar code reader.” A bar code scanner is the device that actually scans the bar code. A bar code reader is composed of a bar code scanner that is integrated with a decoder that links the scanner to the host computer. This is important to understand as you prepare to make purchasing decisions.

Once again, equipment decisions must be based on an understanding of your application. Questions to consider include:

- What is the distance between the label and the scanner?

- Is the label always in the same fixed position?
- What is the orientation of the label?
- What is the length of the bar code?
- Is the label durable enough to withstand frequent contact with a bar code wand?
- What is the light quality in the area where the bar code will be read?
- Do you need to gather information in real time or batch?

With these questions answered, you are ready to explore bar code scanner options. Bar code scanners can be classified as contact (touching the bar code) or non-contact.

Bar code wands

A scanner that touches the bar code is called a bar code wand. It is sometimes referred to as a light pen. Bar code wands are effective for scanning easily accessible bar codes on flat surfaces. They require minimum training and are easy to use as long as the person remembers to scan the entire bar code from quiet zone to quiet zone (the white space at either end of the bar code).

Wands are sometimes attached to portable data terminals (PDT) so that variable information can be entered after the bar code is scanned. For example, to restock shelves, the UPN of an item may be scanned and the number of replacement items needed keyed into the PDT. When the process is completed, the information is loaded into the computer for reconciliation.

Linear charge-coupled device (CCD)

A linear charge-coupled device scanner needs to touch (or be about six inches from) the bar code symbol. It uses image technology to sense all bars and spaces at one time. These contain no moving parts and therefore are quite rugged. It may not be a good choice for a warehouse application, but in areas where it is easy for the user to place the scanner over the bar code, it is an option to consider.

Laser scanners

An advantage of a laser scanner is its scanning range from contact to distances of 15 feet or more. This is why laser scanners are used in medical centers for scanning patient wristbands and in medical center warehouses for scanning inventory. Lasers also may be attached to PDTs for additional data entry. Although there are some laser scanners that can read a few of the two-dimensional symbologies, most two-dimensional symbologies require an imager to read them. As manufacturers are increasingly using two-dimensional symbology, laser scanners will gradually give way to imagers as the most flexible choice for point-of-care bar-code reading.

Image scanners

These devices interpret an area rather than a line. They are essential for reading matrix symbologies and can also read the more traditional one-dimensional bar codes. Because unit-of-use items are often small, it is likely that they will be encoded with the two-dimensional symbologies.

Image engines that incorporate digital technology are capable of reading both linear and two-dimensional symbologies. Image engines offer several advantages over laser engines, including:

- Durability (image engines have few or no moving parts);
- Omni-directional reading, making it easier for users to read symbols;
- The ability to take digital pictures;
- The ability to read very small multi-row and composite symbologies; and
- The ability to read matrix codes and OCR.

Until recently, laser engines have offered longer reading distances and a sharp aiming line, but image engines have been improved so that their performance now is comparable to that of laser engines. The use of image sensors in consumer electronics product applications is driving down the cost of imaging, increasing pixel resolution and sensitivity, and decreasing the size of the sensors.

Technology deployment is typically a multi-year process. Be aware that more-expensive image scanners acquired in anticipation of a future need to read two-dimensional symbologies may reach the end of their useful life before the need for two-dimension reading is a reality.

Labels

Over the next year, more healthcare products will be bar coded before they are delivered to medical centers. However, you must be prepared to do some labeling of products, especially at the unit-of-issue level. The tangible and intangible benefits of using bar codes on medical products far outweigh the initial expense, even if you have to apply labels yourself.

A very important part of a bar code-based system is the label. Think of the label as a vehicle for carrying information; it is not just a sticker. When selecting labels, you need to work with your label vendor to consider the material on which the information is printed and the adhesive to hold the label securely in place.

Making label decisions requires having answers to a lot of pertinent questions. Keep in mind that a label that works for human-readable information may or may not work for bar codes. When you have the answers to the following questions, your label vendor can identify the appropriate label and adhesive combination for your application. Note that some hardware providers include special deals for labels.

Questions to consider for each application include:

- To what textures and surfaces must the label adhere? Paper, card stock, plastic, glass, metal, wood, other?
- How long does the label have to last? Days, weeks, months, years?
- Will the label be applied to a flat, curved, or uneven surface?
- What will the label be exposed to? Heat, extreme cold, moisture, chemicals, autoclaving, liquids?
- Will the label be printed and applied in one environment and then stored in another (e.g., printed and applied at room temperature and stored in a refrigerator or freezer)?
- Should the label be permanent or removable?
- Will variable information be encoded or sequential numbers?
- What kind of bar code scanners will be used to read the bar codes – contact or non-contact? (Depending on the application, you may or may not know the answer to this question, or you may not have control over it.)
- Will the label be subject to abrasion, such as contact scanning or being rubbed against other items on a shelf?
- What kind of lead time is needed between producing and applying the label?

When your team has identified the label needs, the next consideration is acquiring the labels. Your choice is to buy preprinted labels or to purchase bar code printers and print your own. There are advantages to both approaches. You should not assume that buying a bar code printer and printing your own is the most expensive method.

Preprinted labels

Preprinted labels can be an excellent choice if the volume is high enough, the information is known ahead of time, the information is the same for every label (e.g., hundreds of labels with the same product number or sequential numbers), and there is adequate lead time between obtaining information to be printed and applying the labels. When considering preprinted labels, be sure to include the labor costs of inventory management.

Labels printed on demand

On-site or demand printing has the advantage of giving you flexibility and control over the content and quantity of labels you print and use. Printing your own labels may be a good choice in a UPN environment where you may only be printing labels for certain products for an interim period, or the quantity of those products changes with each order. You can always use the printer for other applications when you no longer need to label incoming products.

Bar code printing software

Many people responsible for implementing a bar code labeling system find bar code printing software helpful. These packages, often called “label prep” packages, are developed to make it easy to design and print a bar code label. The packages also may have a database capability that can help you build your list of UPN numbers. Some software labeling packages also can connect to databases on remote hosts. This is convenient if the database already has been established or is part of a larger system.

The capabilities of your software system or standalone UPN system will help you determine whether you should consider using one of these packages. Make sure the package you select is designed for UPN bar code labeling. Many packages will indicate that you can print health industry bar codes; however, that frequently means only that they can print bar codes in Code 128 or Code 39 symbology. Instead, you will want a package that helps you create bar codes in the HIBC LIC and UCC/EAN-accepted UPN formats, including appropriate flag characters and application identifiers.

Radio frequency devices

Radio frequency identification (RFID) capabilities are a rapidly emerging technology. While laboratory work is very promising, these devices cannot be printed onto paper stock. The RFID chips must be programmed using vendors' equipment. Vendors of scanning equipment are developing scanners that can interpret all printed symbologies and read RFID devices.

Appendix B

Bar Coding Timeline

Progress in terms of bringing the benefits of bar coding to healthcare has been glacial. However, the future looks promising. Today, the healthcare industry is on the cusp of widespread adoption of bar code-enabled point-of-care (BPOC) patient safety technology. Below is a brief chronology of the bumpy road we have traveled to that end.

1932 Grocery guru Wallace Flint first suggests an automated bar code checkout system. Others in the industry deem it economically unfeasible.

1972 Creation of the Uniform Product Code. By the mid-1970s, UPC has become an industry standard, as U.S. grocers begin adopting point-of-sale bar code systems en masse.

Early 1980s Word quickly spreads to other industries of increased productivity. The aviation, automotive, and defense industries begin leveraging bar codes for unprecedented efficiency gains. Visionary healthcare practitioners spread the word about the potential benefits of bar coding in the pharmacy for improved medication dispensing.

1983 The Health Industry Business Communications Council (HIBCC) is founded to develop a uniform bar code standard for all products shipped to hospitals.

1989 An American Hospital Association (AHA) survey shows bar codes being used to facilitate hospital materials management, but not clinical applications.

Mid-1990s Hospitals begin to recognize the value of taking bar code technology to the bedside for medication administration, even as awareness grows of medical errors in U.S. hospitals. These new clinical applications, known collectively as bar code-enabled point-of-care (BPOC) systems, revitalize bar coding's appeal.

1995-2002 Early users of BPOC systems publish data documenting a 65- to 86-percent decrease in medication errors. Installations in VA facilities result in the elimination of 86 percent of errors.

1998 FDA begins evaluating "an FDA requirement that drug companies package in unit-dose form..."

1999 The Institute of Medicine (IOM) report notes that bar coding "is an effective remedy" for medication errors, "a simple way to ensure that the identity and dose of the drug are as prescribed, that it is being given to the right patient, and that all of the steps in the dispensing and administration processes are checked for timeliness and accuracy."

An Institute for Safe Medication Practices (ISMP) survey finds 43 percent of hospitals had discussed the possibility of BPOC but only 2.5 percent used this technology in some areas of the hospital, and just one percent had fully implemented it throughout the organization.

2001 The FDA announces plans to propose a rule by April 2002 requiring bar code labels on all human drugs and biological products. Premier Inc. and Novation announce plans to require unit-of-use bar-coding on all pharmaceutical products covered under these two group purchasing organizations' new and renewed contracts.

ISMP and AHA join the American Society for Hospital-System Pharmacists (ASHP), the National Coordinating Council for Medication Error Reporting and Prevention, the Joint Commission for Accreditation of Healthcare Organizations (JCAHO), and others in publicly urging the FDA to mandate manufacturer bar-coding of all prescription drug products. ASHP CEO Henri P. Manasse, Jr., PhD, ScD, cites the "irrefutable patient safety benefits of such coding" and declares "the time for discussion is over . . . the time for substantive action has arrived."

May – American Pharmaceutical Partners Inc. (APP) takes a leadership role in the efforts to reduce medication errors with plans to introduce bar codes for all sizes of products. APP sets a go-forward policy of bar code labeling new products, even individual vials as small as two mL.

2002 An ISMP survey finds 84 percent of hospital respondents believe a slight increase in cost would not deter them from purchasing a specific vendor's unit dose medication with a bar code, despite tight pharmacy budgets.

February – Nearly 77 percent of 619 respondents to the HIMSS 2002 Hot Topics Survey reported that their organization uses bar coding technology. The survey, conducted at the HIMSS 2002 Annual Conference and Exhibition, addressed key topics influencing the healthcare IT industry, including the issue of patient safety. The two areas in which bar coding was reported to be most prevalent were laboratory (45 percent) and supply chain/materials management (40 percent). However only 15 percent of respondents indicated that their organization uses bar coding technology for medication administration at the point of care.

May – FDA delays issuance of its barcoding proposal to November (from April). The FDA's Center for Drug Evaluation and Research indicates that the agency will gather public comments before issuing the proposed regulation (per Unified Regulatory Agenda, *Federal Register*).

June – The National Alliance for Health Information Technology, a coalition to develop voluntary standards for health information technology (IT) is formed by representatives of healthcare providers, information technology vendors, and national health and technology associations. The first project on the Alliance's agenda is working with the Food and Drug Administration to be a part of its bar coding regulatory process.

July – HIMSS presents testimony to the FDA on bar coding as key to improving patient safety and productivity, expressing strong support for industry cooperation in achieving viable point-of-care, unit-of-use bar coding to reduce medical errors and improve productivity.

July – Abbott Laboratories announces plans to affix unit-of-use bar codes to all of its hospital injectable pharmaceuticals and IV solutions product lines by early 2003. Approximately one-quarter of Abbott's injectables and IV solutions will use Reduced Space Symbology® (RSS), which enables a miniaturized bar code to be applied to single-unit containers as small as a pen cap.

December – Baxter Healthcare unveils new technology, ENLIGHTENED(HRBC), a next-generation, high-resolution bar code technology for flexible IV bags that includes lot number and expiration date information. Baxter's bar codes feature a 14-character Uniform Code Council/European Article Number (UCC/EAN) symbology.

2003 Pfizer Inc., in a bid to reduce medication errors, says it will begin printing bar codes on individually packaged pills used in hospitals using RSS14 symbology.

March – The FDA announced proposed rule for Bar Code Label Requirements for Human Drug Products and Blood.

Appendix C – Case Study

Medication Administration: Five Rights and Many Wrongs

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Objectives

This is a case study about the evaluation and implementation of technology to help reduce medication errors at Carilion Health System. During our study period from July 2000 to July 2002, we focused on the effectiveness and cost benefit of selected portions of information technology and explored whether this technology would actually reduce medical errors. Our objective was to quantify and verify outcomes caused by these technologies. We did many things right, but like a manual medication management process itself, we also made errors. Fortunately, our evaluation and the implementations harmed no one.

Background

Carilion is an integrated delivery system covering some 1,400 square miles of service area across southwestern Virginia. Serving a population around 1.5 million from more than 100 care locations, our key care units include 11 hospitals and a large primary care network with 250 employed physicians and lead caregivers. Carilion generates about $1.3 billion in annual revenue with an operating margin around 4 percent. We were the recipients of the National Quality Award in 2002.

Carilion started focusing on the matter of medication errors at a Board of Directors planning meeting in 1999. We discussed the implications of the upcoming Institute of Medicine reports and how the public might view this news. We developed several high-level organizational beliefs about medical errors. First, the media will continue to cover safety issues because even though the public doesn't understand quality, they will understand safety. Second, we have a nursing shortage in southwestern Virginia. We know the nationwide shortage of nurses is getting worse, because for every five nurses retiring, only one new nurse comes into the profession. Consequently, each nurse will be under greater productivity pressure. Third, by some estimates, U.S. healthcare costs are increasing as much as 15 to 20 percent a year. As a nation we spend about 13 to 14 percent of GNP on healthcare with this amount likely to increase. Therefore, we believe cost pressures won't shrink. Fourth, we think consumers soon will expect bar codes (and other safety technologies) as a clinical standard. Consumers are conditioned to see bar codes in every industry and question their absence in hospitals. Finally, we generally believe hospitals and physician offices will need Information Technology (IT) to prove to patients that healthcare is carried out with a "new standard of care," especially when it comes to using IT to keep patients safe.

As others before us, we used the landmark work by Lucian Leape to ground our understanding of the issue. Our CEO, a physician, participated in the study and lived the strengths, weaknesses and implications of this work. The Leape study looked at errors around the "five rights of medication administration" – the Right Patient, Right Drug, Right Dose, Right Amount and the Right Time. We dispense more than 5 million medications per year. Thus, our large volume drove our concern to explore the risks of medication errors.

An analysis of adverse drug events *(Figure 1)* shows the tasks where errors occur and the percent of errors generally discovered. Two groups of professionals are the "Safety Nets" for the patient; the pharmacists and nurses. Errors can be defined in many ways, because there is a wide range of impact. Using an official definition, an error is any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the healthcare professional, patient or consumer. Such events may be related to professional practice, healthcare products, procedures and systems, including prescribing or communication, product labeling, packaging and nomenclature, compounding, dispensing, distribution, administration, education, monitoring and use. Not all errors are life-threatening. This definition, along with data from the National Coordinating Council on Medication Errors and Reporting Prevention, suggests about 5 percent of errors cause harm. What this chart doesn't show is the amount of distance and time between the tasks and the players. We believe these dimensions add to the risk of errors. We concluded Carilion would need a range of solutions, but we also wanted to evaluate each of the possible solution sets, and their projected relative effectiveness in our environment. Thus, we explored technology for physicians, pharmacists and nursing in an effort to understand all the topics around integration and the various solutions that must work together, as well as the links that cause the entire process to succeed or fail.

Figure 1. Medication Errors Happen

39%	12%	11%	38%
Ordering	**Order Verification**	**Preparation and Dispensing**	**Administration**
Physician	Pharmacist	Pharmacy Technician Nurse	Nurse
contraindications	contraindications	similar looking drugs	wrong patient
bad handwriting	wrong dosage	wrong drug	wrong drug
wrong dosage	drug interactions	wrong dosage	wrong time or omitted
wrong drug	intervention		wrong dosage
	Pharmacist is first safeguard		**Nurse is final safeguard**

[1] Leape L.L. et. Al. Systems analysis of adverse drug events. JAMA 1995;274 35-43)

Implementation strategy

Our implementation strategy and approach was to form a steering committee and to follow the Carilion phases of formal project implementation. A project charter was used to guide and communicate our effort, and the steering committee adopted an active role for project oversight. They created and involved cross-functional teams, ensuring flowcharting and workflow analysis was a multi-disciplinary effort. This group became the champion for critical components identified within the project and led the adoption of process improvements.

Carilion uses an annual process developed from work at Harvard in 1996 by Robert Kaplan and David Norton, called the Balanced Scorecard. It is a vehicle for translating strategy into action and creating improvement imperatives. Each year, we construct or update major "themes," multi-year projects supporting strategic, measurable objectives to move our organization forward *(see FY02 scorecard, Figure 2)*. After studying the literature, we believed we knew enough about the issues to commit our organization to medication-error reduction projects. As a result, several strategic initiatives were developed encompassing, deploying automated drug-dispensing equipment buying and piloting some type of system for medication administration and implementing computerized provider order entry. A key tenet of these initiatives was that Carilion would require maximum integration on the nurses unit. If it came to a compromise, we agreed to settle for less integration for the automated drug-dispensing equipment, pharmacy robot and materials management functions. Nursing ease of use, documentation and rules integration would be top priorities.

Carilion felt very strongly about a solution set that provided integration at the nursing unit. We placed a very high emphasis on nursing unit integration because experience had taught several of us that, without integration, the challenges of bringing information from the hospital information system, pharmacy system, rules engine and nursing documentation together would fail. We also knew groups like Leapfrog would

Figure 2. FY 2002 Scorecard Initiatives

Automated Drug Dispensing Equipment and Medication Administration Check

Provider Order Entry

Operating Room Information System

Central Kitchen

Value Model

Revenue Cycle Management
– Patient Financial Management Services
– System Payment Denials
– Improved Insurance Coding
– Late Charges

Reduce Radiology Results Turns Around Time

Decision Support Reporting System

Develop Clinical Quality Indicator Reporting

CMC Building Project

Cost Reductions/Margin Enhancements
– Saint Albans
– Psychiatric OP Clinics
– Implement Clincal Supply Barcode Technology
– Occupational Medicine
– Burrell Nursing Home
– Durable Medical Equipment

Increase Select Volumes
– CMG: Patient Volume and Schedule Improvements
– Lab Outreach Revenue

Community Hospitals Clinical Information System

Trusted Employee Recruitment and Retention (Nursing, Cardiac Cath Lab, Operating Room, Imaging Services)

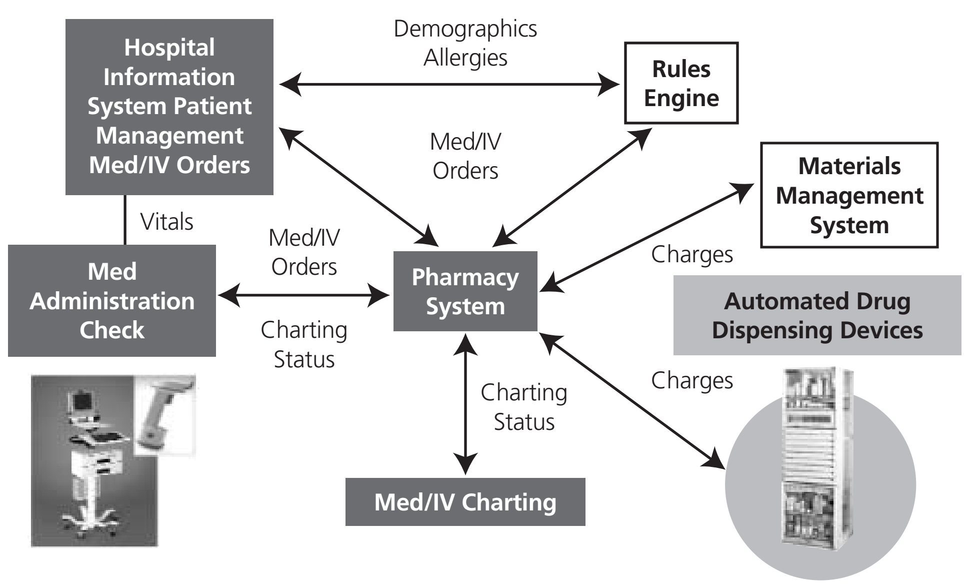
Human Resources/Payroll Information Systems stress a highly integrated solution to reduce errors. We had in place or built a number of interfaces solely for the medication administration process. *(See Figure 3)*

Our hospital information system and pharmacy system are integrated by the same vendor and interfaced using an integration engine. Demographics flow from the hospital information system to the pharmacy system and the automated drug-dispensing equipment. Orders, drug updates and the medication administration system each have information sent from pharmacy to the hospital information system. Billing information flows from the automated drug-dispensing equipment to the pharmacy system and on to the hospital information system; inventory data flows to the materials management system. Lab results also are routed to pharmacy. The rules engine sees transactions between the pharmacy, medication administration system, hospital information system and lab. The medication administration system is completely wireless and flows to and from the pharmacy system and the hospital information system.

Challenges, successes and failures

Carilion had to combine systems for medication ordering, order verification, medication preparation and dispensing and medication administration to provide the complete clinical solution. We have a very robust pharmacy system, which we decided to leave alone. Our first action was to study CPOE options. As we looked at our alternatives, we knew from the literature that CPOE is key in reducing errors. For our organization, getting MDs to "the glass" is a key strategic objective in implementing clinical decision support. However, there are problems with CPOE; for example, CPOE doesn't help with some nursing issues; it may, in fact, initially make errors worse. Lastly, and most importantly, it is clear that CPOE is difficult to control and often hard to implement, sometimes taking years to put in place. Despite the negatives, our conclusion was to immediately begin a CPOE implementation. CPOE is now activated in several of our in emergency departments at our medical centers.

Figure 3. Clinical Cluster



Also during our early evaluations, we decided not to implement a robot in pharmacy. Rather, we chose to pilot a medication administration solution with the accompanying technologies of bar coding and wireless.

During the preparation for a medication administration pilot, we decided we would address improvements to our drug charging process. Recovered drug charges would thus provide the value for the project. We had a nursing charging compliance and documentation problem. Drug dispensing equipment was evaluated and seen as a great way to capture charges. In the early stages of this project, we rolled out 65 units of automated drug dispensing equipment. The need for a clear policy and procedure to deal with the medications that were found in the drug dispensing units without bar codes was identified as a weak area of our process. This led to pharmacy services dedicating pharmacy technicians time to ensure that medications were checked for bar codes and added to the application cross-reference file for proper identification. In essence, we ended up building a "bar code formulary." As a result, the charging problem is now solved, as we charge on removal of the drug from the automated drug-dispensing equipment.

Issues with lack of unit-dose bar coding are large, well-known and expensive. With the benefit of hindsight, we should have considered implementing a pharmacy robot. We didn't because we had concerns about how the return on investment would be affected if we deployed the pharmacy robot and couldn't get the pilot nursing unit functions to work well. As it turns out, about 40 percent of the drugs we administer have bar codes on them at the unit dose level. To add bar codes at the hospital level costs about 12 to 18 cents per unit. This is a significant cost barrier to overcome. Today, there aren't many cost-effective alternatives for placing the bar codes on the medication at the hospital site. Therefore, Carilion had to invest in contracts for bar coding or engage in producing our own bar codes.

The solution we selected for medication administration is shown in Figure 3. By putting bar codes on the patient bracelet, our employee badges and each unit of medication we dispense, the stage was set for our pilot. We used the wireless network to link the process with the computers in the background providing the "wireless safety net" each step of the way. At the conclusion of the administration process, the entire set of nursing documentation was complete and online for all to see. If the system detected a problem during any of the steps, a warning message was issued and recorded. As a result, we were able to began to accumulate data on each of the five rights of medication administration.

As the pilot progressed, we elected to switch the basis of our hospitals' new devices primarily from wired to wireless. By then, we had added wireless devices for our operating rooms and our case management activities and recently for our repository. We moved to wireless networks because Carilion wanted to set the stage for more caregiver mobility. Wireless frees up space at the nurse's unit and untethers caregivers to work closer to patients. We ended up with 88 wireless access points within two medical centers. We have 43 access points for one hospital within our medical center, and 45 points in the others. This does not include coverage areas for elevators and stairwells, because we thought it best to have people log off when they traveled from floor to floor. We are outfitting the nursing units with wireless laptops on carts with 12-hour battery systems. Battery management is a topic to master before a large rollout of mobile devices. These are custom units with a total cost for the entire package, cart, laptop, screen, battery system, network cards, etc., of about $6,600 each. Of course, these mobile devices access our full portfolio of applications and are shared by all the caregivers on a unit.

Education

Our education approach for this project was to go broad and layered across the organization. We started the process by conducting Windows pre-testing for the nursing staff. This was an important step to determine the depth of training needs. If a satisfactory score was not achieved, then a one-hour basic Windows class was required for nursing personnel. The second step addressed the level of education needs for the medication administration application as well as the automated dispensing equipment. We conducted three-hour medication administration system educational sessions and two-hour automated dispensing equipment educational sessions. We also conducted overview sessions for all nursing leadership, physician group meetings, resource nurses, education consultants, pharmacy and IS.

Training reinforcement was delivered using an education board displayed on the nursing units for three months while refresher courses were offered on an ongoing basis. For new employees, this education was folded into the nursing orientation program as a required course. Followup with surveys proved to be an important indicator in determining if our education was effective.

Technology links

The "technology links" of the medication administration process and project turned out to be where the technical "gottas" reside. We had a range of issues with bar coding patient bracelets. The simple challenges aren't so simple. With new technology in place, we ran into difficulties that had to be overcome. The first of these is that standardization of bar codes is anything but standard. Another is that wireless transmitters on the units were not always consistent and therefore we had to work with the vendors and with our wireless network design to identify weak access points and blind spots. We experienced inconsistent power sources and also had to try different avenues to accommodate a bar code on the patient identification bracelet. We had to find the right print font that was small enough for the armband and yet would be picked up by the bar code scanner as well as be readable by our average caregiver. Furthermore, we had to re-educate staff concerning the need to change and charge scanner batteries.

Bar coding techniques also generated training surprises. We assumed the act of scanning was easy to learn, but more than half of the staff needed to practice the "rolling action" of the scanning motion.

Outcomes

As our project continued, we tracked success metrics to ensure that we were on target for adherence to policies as well as measuring the effectiveness of technology. Our pilot study for the medication management system generated six months of data and started after the technology had passed a burn-in period. During the period, more than 58,000 doses were documented within the system. We measured a "time of administration" as our most frequent error. To qualify as a timing error, a medication entry was generated plus or minus 30 minutes late or early, or more, from its scheduled administration time. This happened 10,239 times, or on 22.66 percent of the medications charted. Furthermore, 3,833 of the warnings, or 8.48 percent, were because the system detected an early administration attempt. Most critically, 45 wrong patient warnings were generated, and the system recorded 13 wrong drug warnings.

Financial analysis was preformed on the CPOE, drug dispensing equipment and the medication administration system projects. One key assumption is that the ratio of adverse drug events (ADE) to medication errors often is reported at levels ranging from one ADE per ten medication errors to one ADE per five medication errors. The cost of an adverse drug event is conservatively estimated at $2,500 to $5,000 per event.

The CPOE portion for the emergency room is conservatively returning an 11 percent internal rate of return. The drug dispensing portion is returning a 9.2 percent internal rate of return. Our financial feasibility analysis for a five-year period predicts a 13.5 percent internal rate of return for the medication administration portion of the project. As a result, we projected more than $6 million in total savings. Approximately $4 million in labor savings is forecasted from the medication administration system project alone. One key conservative assumption in this projection is a 50 percent savings reflected in the 2.75 nursing hours saved for every 12-hour shift, using an average hourly rate of $22.91.

The balance of our medication administration system quality savings, such as reduced adverse events, includes a forecasted reduction of 152 averted errors, which could cause harm. Each of the three portions of these solutions stood on its own, and great care was taken not to count cost or savings twice. In terms of technology services person hours, we spent over 5,000 hours for the pharmacy, medication administration system, and ADE portions of the project. The CPOE portion was about 4,000 hours. We are sure this was time well spent, and we are very optimistic this very conservative approach will ultimately show even more benefits than our calculations predict.

Summary and plans

In summary, the medication administration pilot project combined with the other related projects proved that both the financial and quality outcomes we envisioned are obtainable. The value of these technologies for our system, our patients and the communities we serve is real and measurable. Our scorecard initiatives were achieved, and we're well on our way to long-term strategic reductions in medication errors. We are now completing these rollouts and the expansion of rules management with the rules engine across the enterprise. We currently estimate it will take about a year to finish the implementation of the medication administration system, and several years to finish the CPOE portions of the initiatives. We expect the process improvements and tuning of these systems to continue well beyond the conclusion of formal implementation.

Appendix D

Bar Code-Related Organizations

These organizations have an interest in bar coding to advance healthcare efficiencies. Contact them for additional information.

Healthcare Information and Management Systems Society (HIMSS)
230 East Ohio Street, Suite 500
Chicago, IL 60611-3269
Phone: (312) 664-HIMSS (4467)
Fax: (312) 664-6143
www.himss.org

HIMSS is the healthcare industry's membership organization exclusively focused on providing leadership for the optimal use of healthcare information technology and management systems for the betterment of human health. Founded in 1961 with offices in Chicago, Washington D.C., and other locations across the country, HIMSS represents more than 13,000 individual members and some 150 member corporations that employ more than 1 million people. HIMSS shapes and directs healthcare public policy and industry practices through its advocacy, educational, and professional development initiatives designed to promote information and management systems' contributions to quality patient care. Visit www.himss.org for more information.

The HIMSS Web site has a special section for bar code information and resources.

Standards and Code Setting Organizations

Health Industry Business Communications Council (HIBCC)
5110 North 40th Street, Suite 250
Phoenix, AZ 85018
Phone: (602) 381-1091
Fax: (602) 381-1093
E-mail: info@hibcc.org
www.hibcc.org

HIBCC is an industry-sponsored, not-for-profit standards development organization. It is a fully accredited member of the American National Standards Institute. HIBCC's mission is to facilitate electronic commerce by developing appropriate standards for information exchange among healthcare trading partners.

HIBCC develops and maintains the HIBC Supplier Labeling Standard, the HIBC Provider Applications Standard, the UPN Data Repository, and EDI message formats. All healthcare providers and their trading partners can become members of HIBCC.

ISO Automatic identification and data capture techniques (JTC1/SC31)
www.iso.ch/iso/en/stdsdevelopment/tc/tclist/TechnicalCommitteeStandardsListPage.TechnicalCommitteeStandardsList?COMMID=156

ISO (International Organization for Standardization) is the world's largest developer of standards. Although ISO's principal activity is the development of technical standards, ISO standards also have important economic and social repercussions. ISO standards make a positive difference, not just to engineers and manufacturers for whom they solve basic problems in production and distribution, but to society as a whole.

NDC Codes – Food and Drug Administration
Center for Drug Evaluation and Research (CDER)
http://www.fda.gov/cder/ndc/database/Default.htm

The National Drug Code (NDC) is the commonly accepted code for identifying packages of drugs. The Food and Drug Administration is responsible for administering this code through the Center for Drug Evaluation and Research (CDER). Currently, the NDC number can be presented in a number of different formats; however, the FDA has announced that it intends to publish new regulations governing the administration and format of the code.

Uniform Code Council (UCC)
8163 Old Yankee Street, Suite J
Dayton, Ohio 45458
Phone: (937) 435-3870
Fax: (937) 435-7317
E-mail: info@uc-council.org
www.uc-council.org

The Uniform Code Council establishes and promotes multi-industry standards for product identification and related electronic communications. In addition to standards documents, the council has several reference materials on bar coding in the healthcare industry.

Industry Organizations

AIM – Association for Automatic Identification and Data Capture
634 Alpha Drive
Pittsburgh PA 15238
Phone: 412 963 8588
FAX: 412 963 8753
Email: info@aimglobal.org
www.aimglobal.org

AIM Inc. is the global trade association for the Automatic Identification and Data Capture (AIDC) industry. Members are manufacturers or service providers of technologies such as radio frequency identification, bar code, card technologies (magnetic stripe, smart card, contactless card and optical card), biometrics, and electronic article surveillance.

Health Industry Distributors Association (HIDA)
66 Canal Center Plaza
Suite 520
Alexandria, VA 22314
Phone: (703) 549-4432
Fax: (703) 549-6495
www.hida.org

HIDA is a not-for-profit trade association that represents medical products distributors and home care companies. It provides industry information and data, industry-specific education and training, federal and state government relations information and advocacy, operations and systems products and services, and an annual trade show and education forum. The Supply Chain Committee of HIDA has been actively involved with UPN-related issues.

Healthcare Distribution Management Association's Industry Coalition on Patient Safety
1821 Michael Faraday Drive, Suite 400
Reston, VA 20190-5348
Michael Gallo, Associate Director
Phone: (703) 787-0000
Fax: (703) 787-6930
www.healthcaredistribution.org

The Healthcare Distribution Management Association (HDMA) formed a group designed to influence the upcoming debate over the proposed rule by the FDA to mandate bar codes on all human drug and biological packaging. The new group, called the Industry Coalition on Patient Safety, is made up of drug manufacturers, distributors, group purchasing organizations, pharmacies and standards associations. The short-term goal of the new coalition is to develop consensus on bar code recommendations that are made to the FDA to encourage improvements in patient safety while causing the least interference to existing business processes.

Standards Advocacy Organizations

Coalition for Healthcare eStandards (CHeS)
3300 Washtenaw Avenue, Suite 222
Ann Arbor, MI 48104-4250
Phone: (734) 677-3300
Fax: (734) 677-6622
E-mail: info@CHeStandards.org
www.chestandards.org

The Coalition for Healthcare eStandards is comprised of some of the largest group purchasing organizations in healthcare and several e-commerce companies serving hospitals and the healthcare industry, which have joined forces to adopt and promote uniform industry data standards for supply chain transactions over the Internet. The companies have formed the "Coalition for Healthcare eStandards" to ensure that the cost savings promised by e-commerce will not be compromised by multiple, inconsistent data standards. According to the Efficient Healthcare Consumer Response industry report, billions of dollars are wasted each year in the healthcare supply chain due to the fact that data standards are either lacking entirely or are not as widely used or well developed as in various other industries.

Health Care eBusiness Collaborative (HCEC)
1405 North Pierce, Suite 100
Little Rock, Arkansas 72207
Phone: (501) 661-9408
Fax: (501) 661-0507
E-mail: hedic@hedic.org
www.hedic.org

Health Care eBusiness Collaborative (HCEC) is a national association of electronic trading partners in healthcare that are working together to expand and improve electronic data interchange (EDI) and electronic commerce (EC) capabilities throughout the healthcare industry. HCEC was organized in 1991 (as The Healthcare EDI Coalition) by 33 major provider groups to facilitate collaborative implementation of electronic standards across the industry. The HCEC Board of Directors consists of 7 provider group representatives, 4 provider representatives, and 4 trading partner representatives.

HCEC helps organizations optimize EDI/EC development efforts and minimize EDI/EC costs through cooperative efforts and sharing of information, experiences, and resources within the healthcare EDI/EC community. HCEC facilitated the industry-wide Joint Communiqué on implementation of UPN in July 1999 and will monitor the industry-wide progress toward that goal.

The National Alliance for Health Information Technology (NAHIT)

Lora Fulton, program manager
Phone: (312) 422-2182
E-mail: lfulton@nahit.org
www.nahit.org

Groups representing healthcare providers, information technology vendors, and national health and technology associations created the National Alliance for Health Information Technology, a coalition to develop voluntary standards for health information technology in June 2002.

The first project on the Alliance's agenda is applying bar coding to medication and biological product packaging. The Alliance will work with the FDA to be a part of its bar coding regulatory process. Other areas of focus could include automated medication administration, electronic medical records, and improving communication and transaction networks among physician offices, hospitals, payers, and throughout the supply chain.

Appendix E

Additional Resources

Books

The Impact of Information Technology on Patient Safety, edited by Russell F. Lewis. (HIMSS 2002).

Bar Code Compliance Labeling for the Supply Chain: How to Do IT, by Rick Bushnell and Jim Dooley (April 2000).

Bar Code Technology in Healthcare: A Tool for Enhancing Quality, Productivity and Cost Management, by Karen M. Longe and Lisa B. Brenner (July 1993).

Getting Started with Bar Codes: A Systematic Guide, by Rick Bushnell and Richard B. Meyers (October 1998).

The Bar Code Book: Comprehensive Guide to Reading, Printing, Specifying and Applying Bar code and Other Machine Readable Symbols, by Roger C. Palmer (January 2001).

The Bar Code Implementation Guide: Using Bar Codes in Distribution, by Stephen Pearce and Rick Bushnell (October 1997).

UPN Bar Code Labeling: A Guide for Implementation in Healthcare, by Karen M. Longe (January 1998).

Magazines

The publishers of these magazines devoted to bar coding and other data capture technologies offer free subscriptions:

Frontline Solutions is published by Advanstar Communications. To subscribe online, go to the company's Web site (www.frontlinetoday.com).

Supply Chain Systems Magazine is published by Helmers Publishing, Inc. To subscribe online, go to the company's Web site (www.SCS-Mag.com).

Pharmacy and Medical Packaging News is a free monthly electronic magazine for medical and pharmaceutical manufacturing professionals (www.devicelink.com/pmpn/index.html).

Web sites

www.himss.org/content/mindmaps/barcode/index.html
HIMSS' comprehensive guide to bar coding in healthcare.

www.himss.org/content/files/whitepapers/wp_barcoding.pdf
HIMSS Advocacy White Paper – Bar Coding for Patient Safety.

www.info801.com
Systemmé INFORMATICA is an information technology consultancy specializing in business communications technologies including automatic identification technology.

Over 25 different files available for download, including:
- 2-D Bar Code Standards from HIBCC & UCC
- A New White Paper about Point of Care Bar Coding from Bridge Medical
- A pamphlet about the Health Industry Bar Code from HIBCC
- Offsite links to additional on-line resources
- Software to print all types of bar codes, including PDF-417 and Data Matrix
- Print a Data Matrix Code via an on line web page
- The Health Industry Bar Code (HIBC) Standards – a Windows Help File.

www.mederrors.com
MEDERRORS.com is a Web site devoted to providing information on medication errors and adverse drug events in hospitals, problems that affect millions of Americans each year – patients, families, and clinicians. MEDERRORS.com is sponsored by Bridge Medical, a leading authority on bar code-enabled point of care systems.

Medication bar code readiness assessment

This assessment is provided with the permission of the Pathways for Medication Safety Team, a joint project of the American Hospital Association, the Health Research and Educational Trust, and the Institute for Safe Medication Practices (ISMP) with support of the Commonwealth Fund.

This tool will help hospitals better understand what is required to apply this emerging technology in health care and how to best implement a bedside bar coded drug administration system. The materials will help organizations understand the issues related to bar coding in health care, assess their readiness, and take the initial steps toward an effective implementation. Please keep in mind that this particular tool does not include specific tasks for the actual implementation of a bedside bar coded drug administration system.

The Pathways Bar Code Readiness Assessment tool provides a brief background on bar-coding technology. It opens with a short explanation of bar coding within the larger context of technology in health care. The focus then moves more specifically to exploring the benefits and challenges of implementing bar-coding technology for drug administration in health care. A list of supplemental reading also is included.

A self-assessment tool for evaluating a healthcare organization's readiness for implementing a bedside bar coded drug administration system is included. This tool helps organizations evaluate specific elements that are most closely associated with successful implementation of a bedside bar coded drug administration system. The size and complexity of each organization will vary and should be considered when discussing the prerequisites to successful implementation.

The tool is accompanied by several attachments that serve as examples of elements described in the self-assessment:
- A template for a technology vendor request for proposal (RFP).
- A worksheet to estimate the cost savings associated with implementing technology.
- Examples of cause and effect diagrams and a Failure Mode and Effects Analysis (FMEA) for a bedside bar coded drug administration system that demonstrates anticipated failure points and their causes.

The Pathways tool is available in a modular, electronic format at www.medpathways.info and www.ismp.org

Healthcare Information and Management Systems Society
230 East Ohio Street
Suite 500
Chicago, IL 60611-3269

Implementation Guide for the Use of
Bar Code Technology In Healthcare

Many experts are touting bar coding as a key technology to increase efficiency and patient safety in healthcare. This guide will ground readers in the basics and provide insights to enable the implementation of bar codes in healthcare organizations.

The book offers a ground-level education in the basics of bar coding and how it fits into the following areas:

- Patient registration
- Patient safety efforts
- Product and supply logistics
- Patient accounting and billing
- Industry standards.

This publication is also practical: It provides adoption strategies and helpful guidance for making bar coding work in your organization.

What you will find inside:

- The Basics
- Keys to Successful Implementation
- Industry Standards
- Clinical Applications
- Non-Clinical Applications
- Cost Justification for Clinical Systems
- Plus several helpful Appendices, including
  - Guidelines for Bar Coding Equipment and Supplies, and
  - Case Study: Medication Administration: Five Rights and Many Wrongs

"The National Alliance for Health Information Technology (NAHIT; Web site www.nahit.org) formed its Bar Code Work Group to advance the implementation of point-of-use bar codes through the development of voluntary standards. NAHIT endorses the *HIMSS Bar Code Implementation Guide* as an excellent educational primer for providers to use as they begin planning for bar coding implementation. This Guide lays the groundwork for identifying the different facets of bar coding and explains the various bar coding options."