

Bar Coding Medications to Improve Patient Safety



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Objectives

- **Identify different bar code types and the advantages and disadvantages of each.**
- **Describe how bar code technology can be employed to enhance patient safety**
- **Identify pitfalls, problems, and workarounds that could compromise patient safety.**

Patient Case

Drug Look alike

- 29 year-old female in labor
- Pushed for 3 hours with little descent, C-section initiated
- Patient became hypotensive with 750 mls of blood loss
- Dextran 500mls ordered, rapid IV infusion, for volume expansion
- Unfractionated heparin selected in error from med cart
- Error noted after 500 mls administered



Patient Case

Dilution Error

- 5 day-old male infant
- Prematurity, 32 weeks
- Treated with beractant, TPN + UFH 0.5 units/mL
- New PICC line inserted, flushed with heparin/saline
- New TPN bag at 4 PM
- Baby began to hemorrhage from all access sites
- 7 transfusions, 10-15 mL





UPC (Universal Product Code)

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Machine Readable

Human Readable

Manufacturer ID Number
639382

ID Number or identifier
00039

Check digit
3

Bar Code Technology

- Developed in 1974, appears initially in food industry for supply chain management
- Wal-Mart, Safeway refused to buy products without bar codes
- Provides a fail safe automated identification and feedback system in real time
- Does the “five rights” checking in one easy efficient process.
 - Medication, Dose, Patient, Route, Time
- Allows nursing staff to focus more on the patient than checking “To-Do” lists.
- Allows for more effective and efficient use of pharmacy technicians.
- Frees up pharmacists from drug distribution for more patient care related responsibilities.



FDA Regulations

- Bar Code Label requirements for Human Drug Product and Biological products.
- Requires linear bar codes on most prescription and certain OTC products
- Bar code must contain at a minimum the NDC # of the drug
- Blood products require machine readable information in a format approved by FDA. Machine readable information must include at a minimum:
 - The facility identifier, the lot number relating to donor, the product code, and the donor's ABO and Rh
- All new products introduced to market after regulations passed must have bar code within 60 days

Factors to consider when implementing a Bar Code Scanning Process

- FDA Regulations
 - Institutional requirements
- Availability of unit-of-use bar-coded products
- Repackage in-house or outsource
- Format of bar codes to be used
- Choice of scanners
- Drug Dictionary issues
- Scanability issues
- Patient wrist bands
- Employee ID badges
- System Platform choices: RF based system or hard docked system
 - Choice of form factors
- Obstacles for implementation
 - Human factors
 - Infrastructure issues
 - Work arounds

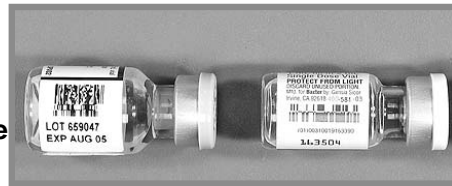
Bar Codes Formats

- One Dimensional Bar Codes
- Advantages
 - 1D linear bar codes are standard and in common use.
 - Can be read by majority of commercial bar code readers
 - high degree of accuracy
 - 1 misread per 1.7 millions scans for code 39
 - many formats to choose from
- Disadvantages
 - limited amount of data
 - as data increases length and size of bar code increases



Bar Codes Formats

- Two Dimensional bar codes
- Advantages
 - 30 times smaller than a code 39 bar code
 - higher degree of accuracy
 - 1 misread per 10.5 million scans for data matrix
 - Bar codes that are up to 60% damaged can be easily and accurately read
 - Data matrix bar code fonts can be easily printed with standard Windows printers
- Disadvantages
 - can only be read with specially programmed imager
 - not in widespread use
 - Imagers are more costly. Two dimensional Bar codes
- Need to be able to de-code multiple formats, styles and dimensions since there is no industry standard



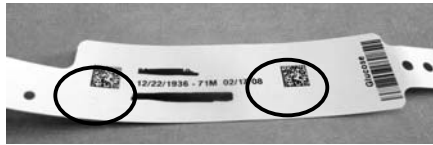
Bar Code Readers

- 2D Scanners
 - can read both 1 and 2 dimensional bar codes
 - more costly due to 2D scanning capability \$300-\$500
 - can be tethered or wireless
- Imagers
 - can decode 1D, 2D (data matrix, RSS etc).
 - more expensive than 1D or 2D scanners
 - Wireless imager using Blue Tooth Technology
 - Need to assure no conflicts exist with Blue tooth technology and 802.11B wireless technology.



Patient ID Bracelet

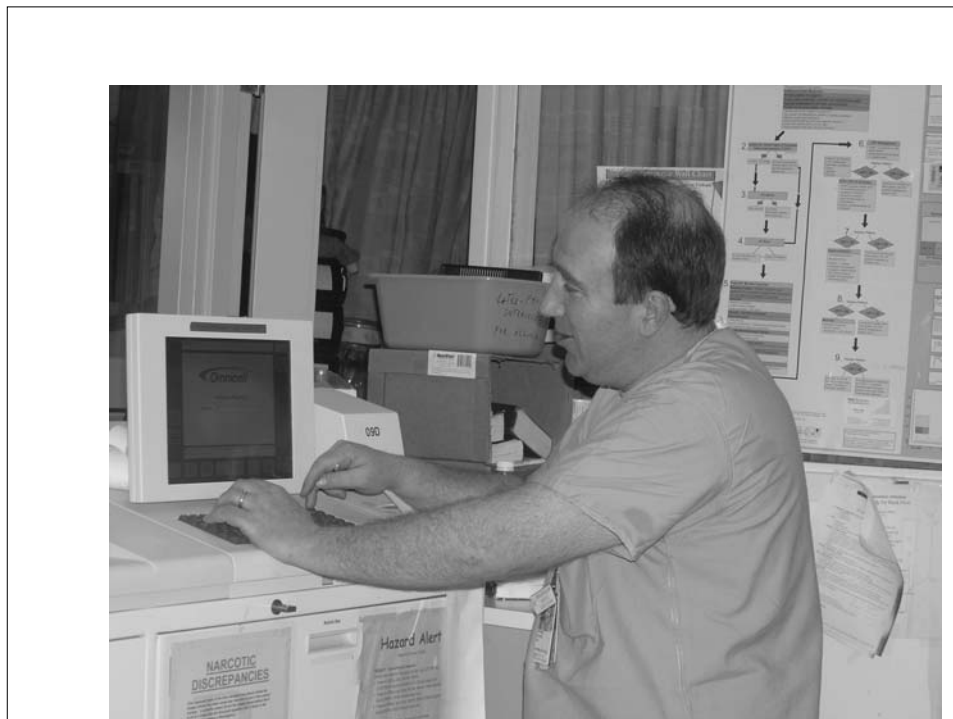
- Desired features:
 - Low cost
 - Durability
 - All patients
 - Accommodates multiple bar code formats.
 - Potential for future applications:
 - Picture ID, RFID tags etc.
 - eMAR Software will only accommodate one active ID bracelet at a time (uses check digit)



Employee ID Badges



- Chose PDF bar code to diminish ability to copy
- Initial expense to re-badge
- Requires daily activation by user
- No use of temporary badges







Scheduling of medications

EMAR v.1.1.010 - To Do List - 02/06/2007 10:11AM

Emartest1Homeer P 17A 111 1 11/14/2003 11:22 AB795

10901975 (DWI) 01/01/1980 (27 yrs.) M Select OE eMAR Results LMR Resource

Takeoff Screens eMAR Screens Reports View eMAR Refresh Medication Administration Record

To Do List - 02/06/2007 10:11AM Allergies: Codeine NSAIDs

▼ Labs for Scale Meds

Test Name	Test Result	Test Date	Reference Range	Abnormal Flag
Creatinine	N/A	N/A	N/A	N/A
Potassium	N/A	N/A	N/A	N/A

▼ Overdue Medications

- INFLUENZA VACCINE TRIVALENT 0.5 MILLILITERS IM x1 Dose due: 02/06/07 08:00^{AM} Times one
- ADENOSINE 6 MG IV x1 Starting STAT (02/06) Dose due: 02/06/07 08:00^{AM} Times one
- PNEUMOCOCCAL VAC. POLY. 0.5 MILLILITERS IM x1 Dose due: 02/06/07 08:00^{AM} Times one

▼ Medications Due

- HEPARIN FLUSH(10 UNIT/ML) 5 MILLILITERS IV Q24H Next administration due: 02/06/07 10:00^{AM} Q24H
- INSULIN REGULAR HUMAN Sliding Scale SC AC+HS Next administration due: 02/06/07 11:00^{AM} 07:00-11:00-17:00-22:00

► Other x1

▼ Other Maintenance

- PENICILLIN V POTASSIUM 250 MG PO Q6H Next administration due: 02/06/07 16:00^{AM} Last Admin: 02/06/2007 10:03^{AM} (250 MG) 04:00-10:00-16:00-22:00

Manual Entry Not Given EndMed Pan Admin History Start Sched QIC Manual Pt. Entry

Real Time Alerts to Nurse

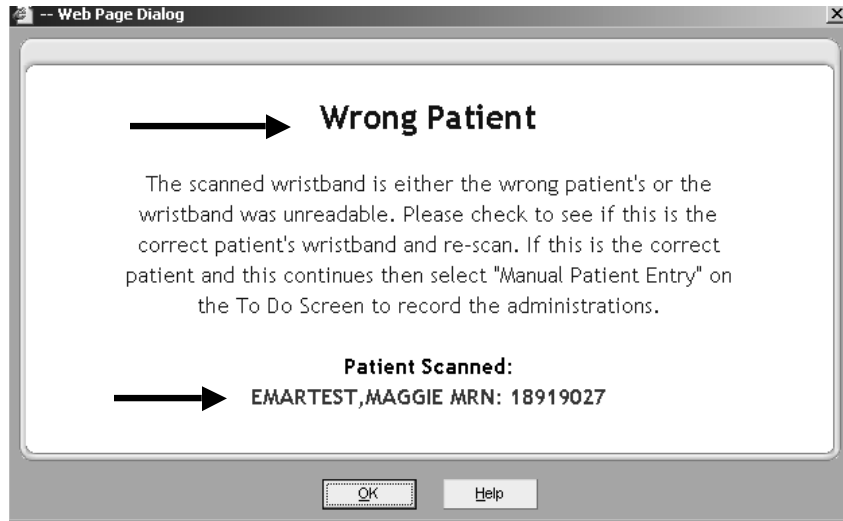
Web Page Dialog

→ **Wrong Medication**
Medication is not part of patient's active medication profile.

→ **Product Scanned:**
SODIUM BICARB 650 MG TABLET
Please zoom the order to verify Pharmacy approved packages

OK Help

Real Time Alerts to Nurse



"Knowledge Links" in the application

Takeoff Screen eMAR Screen Reports View eMAR Refresh Medication Administration

To Do List - 02/06/2007 10:11 AM Allergies: Codeine NSAIDs

▼ Labs for Scale Meds

Test Name	Test Result	Test Date	Reference Range	Abnormal Flag
Creatinine	N/A	N/A	N/A	N/A
Potassium	N/A	N/A	N/A	N/A

▼ Overdue Medications

- INFLUENZA VACCINE TRIVALENT 0.5 MILLILITERS IM x1** ⓘ
Dose due: 02/06/07 08:00^{AM} Times one
- ADENOSINE 6 MG IV x1 Starting STAT (02/06)**
Dose due: 02/06/07 08:00^{AM} Times one
- PNEUMOCOCCAL VAC. POLY. 0.5 MILLILITERS IM x1** ⓘ
Dose due: 02/06/07 08:00^{AM} Times one

▼ Medications Due

- HEPARIN FLUSH(10 UNIT/ML) 5 MILLILITERS IV Q24H**
Next administration due: 02/06/07 10:00^{AM} Q24H

Micromedex Knowledge Link

DrugPoint® Summary

HEPARIN SODIUM

Details in DRUGDEX®	HEPARIN
Tradenames	<ul style="list-style-type: none"> Hep-Lock Hep-Lock U/P Hepflush-10 Vasceze Heparin Lock Flush See Complete Tradename Listing
Class	<ul style="list-style-type: none"> Anticoagulant Heparin (class)
Adult Dose	<ul style="list-style-type: none"> Acute coronary syndrome: 60 to 70 units/kg IV bolus (maximum 5000 units) then 12 to 15 units/kg/h (maximum 100 units/h) Acute ST segment elevation myocardial infarction: 60 units/kg IV bolus (maximum 4000 units) then 12 units/kg/h (maximum 1000 units/h) Anticoagulant therapy - Collection of blood specimen for laboratory: 70 to 150 units/10 to 20 mL sample of whole blood Anticoagulant therapy - Transfusion of blood product: 400 to 600 units/100 mL of whole blood Atrial fibrillation - Thromboembolic disorder: intermittent IV injection, 10,000 units bolus then 5000 to 10,000 units every 4 to 6 h Atrial fibrillation - Thromboembolic disorder: continuous IV infusion, initial 5000 units bolus then 20,000 to 40,000 units/day Atrial fibrillation - Thromboembolic disorder: SUBQ injection, 5000 units IV bolus followed by 10,000 to 20,000 units SUBQ, then 8000 to 10,000 units every 8 h OR 15,000 to 20,000 units every 12 h Deep venous thrombosis: Treatment and Prophylaxis: 80 units/kg IV bolus then 18 units/kg/h

Local intranet

Medication Location

Potassium N/A

Overdue Medications

- INFLUENZA VACCINE TRIVALENT
Dose due: 02/06/07 08:00^{AM}
- ADENOSINE 6 MG IV x1 Starting:
Dose due: 02/06/07 08:00^{AM}
- PNEUMOCOCCAL VAC. POLY. 0.5
Dose due: 02/06/07 08:00^{AM}

Medications Due

- HEPARIN FLUSH(10 UNIT/ML) 5
Next administration due: 02/06/07
- INSULIN REGULAR HUMAN Sliding
Next administration due: 02/06/07

Other x1

Order: Zoom EMARTEST,HOMER (MRN: 18901975) -- Web Page Dialog

-eMAR Information

eMAR Rec #: 2572826
PENICILLIN V POTASSIUM 250 MG PO Q6H <I> <FDI>
 Schedule: 04:00-10:00-16:00-22:00

Administrations during past 24 hours:

Rec	Date/Time	Dose/Route	Given	Entered
8654895	02/06/07 10:03	250 MG PO	Given	02/06/07 10:03 HARMUTH,YOLANDA B

-Common

Schedule History

Original RX Schedule: 04:00-10:00-16:00-22:00
 Original Time of the first dose: 02/06/07 10:00

Date/Time	Schedule	Next Dose	Entered By
1. 02/06/2007 09:50	04:00-10:00-16:00-22:00	02/06/07 10:00	HARMUTH,YOLANDA B

Reason: Patient Asleep

Pharmacy Location: Pt Med Drawer

Close Print Help

Other Medications

- PENICILLIN V POTASSIUM 250 MG PO Q6H (I) (FDI)
 Next administration due: 02/06/07 16:00^{AM} 04:00-10:00-16:00-22:00
 Last Admin: 02/06/2007 10:03^{AM} (250 MG)
- LOPRESSOR 25 MG PO TID HOLD IF: SBP<100, HR<55 (I) (FDI)
 Next administration due: 02/06/07 16:00^{AM} 08:00-16:00-22:00
 Last Admin: 02/06/2007 10:03^{AM} (25 MG)

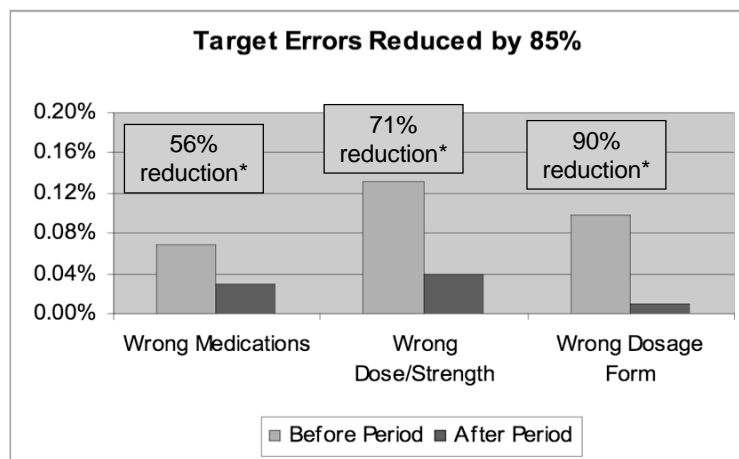
Manual Entry Not Given PostMed Pain Admin History Start Sched. D/C Manual Pt. Entry

Error Prevention Data

February 2008

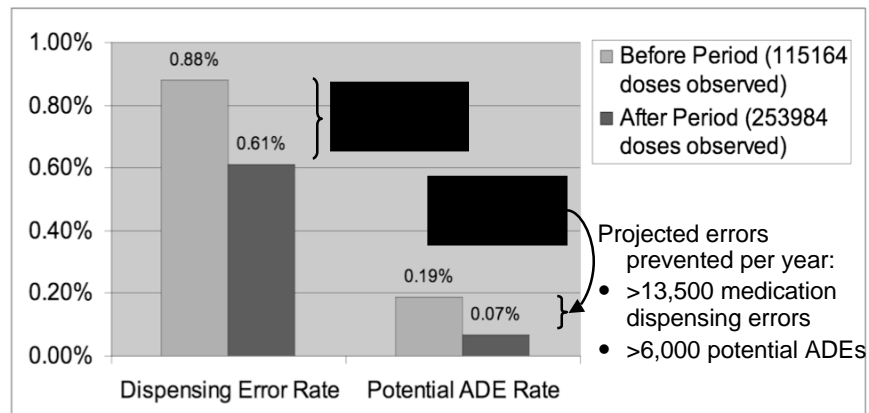
Total Patients	4617
Total Administrations	398,504
Wrong Drug Intercepted	5824
Wrong Patient Intercepted	137
Expired Medications Intercepted	314

The value of Barcode Technology on Different Types of Dispensing Errors



* $p < 0.001$ (Chi-squared test)

Dispensing Errors and Potential ADEs: Before and After Barcode Technology Implementation



* $p < 0.0001$ (Chi-squared test)

E Poon. Ann Intern Med 2006;145:426-434

RFID in healthcare settings

- A radio based wireless system that provides real time information about patient, staff, or assets
- Uses A transponder (RF tag) electronically programmed with unique information
- Patient bracelets
 - Patient tracking
 - Automating room turn around process
 - Personal property tracking
- Staff Id badges
 - Employee tracking
 - Employee login
- Medication Safety
 - Drug tracking
 - Receipt from wholesale drug distributor
 - Drug preparation and delivery
 - Passive programming of IV Pumps
- Asset tags
 - Medical Equipment and device tracking



Conclusions

- No one intervention (bar coding, eMAR, CPOE, automation etc) will solve all of our problems in the Medication Administration System.
- Technology can never replace the critical thinking of clinicians
- Ideal Practice needs to drive technology
- Strong partnership with Information Systems department
- End user feedback is essential to design, implement and maintain technology
- Support from medical staff leadership, pharmacy leadership, nursing leadership, and senior executive leadership
- Human factors play a key role in acceptance