



Using Automation and Technology to Reduce Medication Errors and Improve Patient Safety.



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Brigham and Women's Hospital

- 755-bed academic tertiary medical center
 - 57,000 annual visits to emergency room
 - 45,000 admissions
- Home-grown inpatient CPOE system
- Home-grown Electronic MAR
- Home grown Pharmacy Information system
- Alaris® System Smart Pumps



Brigham and Women's Hospital

- All medical/surgical specialties
 - 156 ICU beds
 - Intermediate Care Units
- 75 Mother Baby Beds
- 2500 RN's
 - Average age 44
- Pharmacy staff 135 FTE's
 - 75 full-time pharmacists
 - 60 full-time pharmacy techs



Volume Indicators

Pharmacy Service	Volume Per Year
Med Orders Approved	4,083,475 orders
Outpatient Pharmacy	6.7 million doses
Sterile Products Division	413,509 admixtures
Investigational Drug Services	225 active protocols
Code Cart Exchanges	1,635 exchanges

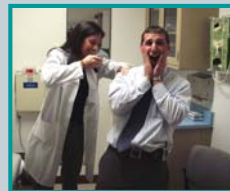


BWH Strategic Plan

- **What**
 - Safe Medication Administration Focus
 - Reduce medication errors, increase the safety of our patients by enabling care providers to make more informed decisions during the medication use process
- **How**
 - Reengineer the Medication Administration process
 - Implement safe and effective Medication Administration technologies, including:
 - Practitioner Order Entry
 - Intelligent Infusion Pumps
 - Clinical pharmacist on units
 - eMAR (electronic Medication Administration Records)
 - Bar Coding verification of medications, patients and staff



What are we talking about?



- It's *not* about pharmacists, nurses, or physicians individually.
- It is about a complex set of processes that are used by all three disciplines to provide medication therapy for our patients.
- Recognizing the need to change is the first step!



Medication Use Process Basics

• Software

- CPOE
- eMAR
- Pharmacy Systems
- Medication Decision Support systems
- Incident Reporting software
- ADE Surveillance software
- Medication reconciliation



Medication Use Process Basics

• Hardware

- Wireless infrastructure
- Bar coding (patient ID, nurse ID, medication ID)
- Medication Repackaging
- Intelligent Infusion Pumps
- Automated Medication Dispensing Machines (Omniceil)
- Drug storage carousels
- Robotics



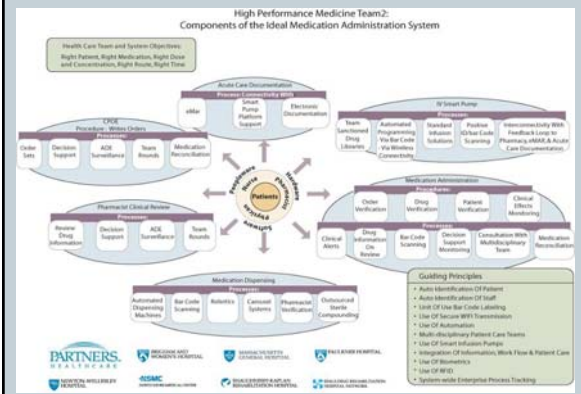
Medication Use Process Basics

• Peopleware

- Electronics won't do it alone
- Teamwork Training
- Walk Rounds
- User feedback
- Robust medication safety improvement teams
- Dedicated Medication Safety Officer

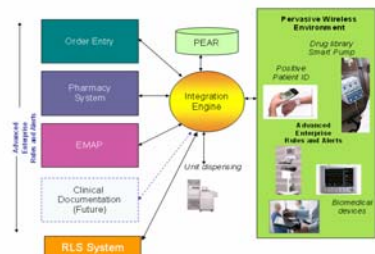


Ideal Gold Standard Medication Use Process

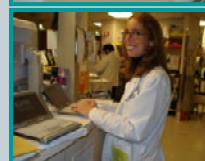


Pervasive Wireless Environment

Integration, common data sets and models, intuitive outputs, mobility, and Enterprise wide clinical decision support are all key components to a successful medication administration process




CPOE




Positive Impact of CPOE

- Provides templates to assure all critical elements of an order are entered
- Linked directly to other clinical systems, pharmacy, nursing, laboratory, radiology et
- Opportunity to program in specific medication use interventions
- Opportunity to use standardized order sets and pathways



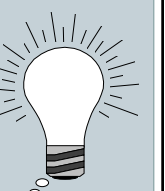
Positive Impact of CPOE

- Eliminates errors due to poor or illegible handwriting
- Clearly identifies prescribers
- Provides basic drug-allergy screening at time of MD order entry
- Provides basic drug-drug, drug-food, drug lab test interaction screening at time of MD order entry
- Dramatically speeds up availability of orders




Positive Impact of CPOE

- Provides access to enter orders from anywhere there is a terminal, including off-site
- Limits/restricts access to prescribe drugs or drugs classes to selected clinicians e.g.. Chemotherapy
- Provides a wealth of information and data
- Can link inpatient and outpatient data




CPOE -Areas of Concern

- Increased volume of medication orders by 30%
- Can be difficult to use in emergency situations
- Can be too easy to use allowing clinicians too much freedom e.g. Renew all, keep all functions and use of multiple order sets



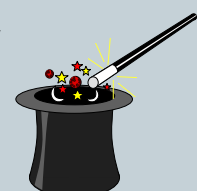
CPOE -Areas of Concern

- Increased nurses expectations for medication availability
 - 1-2 hours to 15 minutes
- Structured approach to order entry requires more time .
- Network down time or system slowness can dramatically impact your ability to complete your work.
- Accessibility of computers and printers can be a problem



CPOE -Areas of Concern

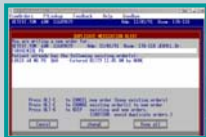
- Valuable tool but it is not the only tool
- Doesn't solve problems that may exist in other medication use processes e.g.. Ordering, dispensing, administering and monitoring
- Doesn't eliminate verbal or telephone orders
- Tends to minimize face to face contact with care providers





CPOE -Areas of Concern

- May condition staff to react only when the computer alerts them.
- How staff deals with system alerts will determine how effective the system will be
- Current data shows that compliance with house officers appropriately responding to allergy alerts at BWH is 20%
- BWH Pharmacy documents over 1700 Clinical interventions per month



CPOE Points of Consideration

- Create an OE steering Committee that includes all users and interested parties
- Use the evaluation of OE as an opportunity to improve current processes before you computerize
- Review hospital infrastructure to make any necessary changes to support OE
- Lookout for new or unanticipated sources of errors.
- Use the tools of CQI to constantly improve your OE system.
 - Flow charts
 - FMEA
 - Human Factors Engineering



CPOE Points of Consideration

- Make sure your system meets the needs of the entire patient care process and all users.
- Beware of too much system flexibility...this can lead to problems
- Make sure all support systems are fully integrated.
- Determine what level of clinical decision aid screening will be done at MD entry.
- Set system performance criteria monitor constantly and provide feedback to users



BCMA



Infrastructure Decisions for BCMA

- Wireless communication
- Medication bar coding
- Employee ID badges
- Patient ID bracelets
- Hardware
- Software application design




Wifi Radio Frequency Network

- Decision to use wireless system based on nursing staff preference
- Worked with IS Architectural Council to assure availability of wireless infrastructure
 - Security of wireless infrastructure
 - Interference with telemetry
 - HIPPA issues
 - Blue tooth



Hardware Decisions


- 2D Imagers
 - Both 1 and 2 dimensional bar codes
 - Wireless blue tooth compatible
- Computer Hardware
 - Full size laptop
 - Complete desktop functionality
 - Mobile carts



Bar Code Selection

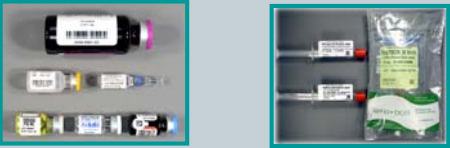
Data Matrix

- Advantages
 - Lot number, exp. Date, NDC number readable
 - 30 times smaller than a code 39 bar code
 - Higher degree of accuracy
 - Data matrix bar code fonts easily printed with standard printers
- Disadvantages
 - Specially programmed imager
 - Limited use
 - Imagers are more costly




Safely Labeled and Packaged Products and Bar codes

- Two dimensional bar code
- Tall man lettering
- Unit dose syringes
- Tamper evident caps



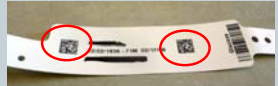
Employee ID Badges

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



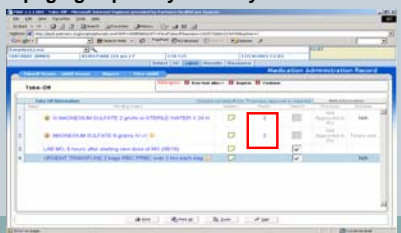
Patient ID Bracelet

- 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)



Software Features

- Bidirectional links to pharmacy
- Screens display if the pharmacist has approved an order
- Nurse can prioritize when medication needs to be approved
- Automatic paging capability in the system



"Knowledge Links" in the application

Medication Administration Record

To Do List - 02/04/2007 10:11AM

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 (1)
- ADENOSINE 6 MG IV x1 Starting STAT (02/04)
- PNEUMOCOCCAL VAC. POLY. 0.5 MILLILITERS IM x1 (1)

Medications Due

- HEPARIN FLUSH(10 UNT/ML) 5 MILLILITERS IV Q24H
Next administration due: 02/04/07 10:00"
- INSULIN REGULAR HUMAN Sliding Scale SC AC-HS
Next administration due: 02/04/07 11:00"

Micromedex Knowledge Link

KnowledgeLink

Drug/Path Summary

HEPARIN SOLUIN

Details in OVERDUE:

- Indications:
 - Heparin Lock
 - Heparin LIP
 - Heparin Lock Flush
 - Heparin Heparin Lock Flush
- Class:
 - Anticoagulant
 - Research Class

Adverse Effects:

- Acute coronary syndrome: 80 to 70 mg daily IV bolus (maximum 500 units) then 12 to 11 mg/dough (maximum 120 mg/dough) (100 units)
- Acute ST segment elevation myocardial infarction: 60 mg daily IV bolus (maximum 4000 units) then 12 mg/dough (100 units)
- Anticoagulant therapy: Transfusion of blood product 400 to 600 units/100 mL of whole blood
- Bleed Reaction: Thrombocytopenic disorder independent of heparin: 10,000 units/100 mL or more than 10,000 units/dough
- Drug Reaction: Thrombocytopenic disorder continuous IV infusion, when 5000 units bolus then 20,000 to 40,000 units/dough
- Drug Reaction: Thrombocytopenic disorder continuous IV infusion, when 5000 units bolus then 10,000 to 20,000 units/dough
- Drug Reaction: Thrombocytopenic disorder independent of heparin: 10,000 units/100 mL or more than 10,000 units/dough
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Scheduling of Medications

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Next administration due: 02/04/07 11:00"

Other Medications

- PENICILLIN V POTASSIUM 250 MG PO Q4H (R)
Next administration due: 02/04/07 10:00"
- LOPRESSOR 25 MG PO TID HOLD IF: SBP < 100, HR < 55 (R)
Last Admin: 02/04/2007 10:03" (25 MG)

Scheduling of Medications

Medication Administration Scheduling

Lock Schedule: Custom

APPROXIMATION SCHEDULE

Medication	02/04	02/05	02/06	02/07	02/08	02/09	02/10	02/11	02/12	02/13	02/14	02/15	02/16	02/17	02/18	02/19	02/20
HEPARIN FLUSH(10 UNT/ML) 5 MILLILITERS IV Q24H	07:00	07:00	07:00	07:00	07:00	07:00	07:00	07:00	07:00	07:00	07:00	07:00	07:00	07:00	07:00	07:00	07:00

Medication

Medication	02/04	02/05	02/06	02/07	02/08	02/09	02/10	02/11	02/12	02/13	02/14	02/15	02/16	02/17	02/18	02/19	02/20
HEPARIN FLUSH(10 UNT/ML) 5 MILLILITERS IV Q24H	07:00	07:00	07:00	07:00	07:00	07:00	07:00	07:00	07:00	07:00	07:00	07:00	07:00	07:00	07:00	07:00	07:00

Medication

Medication	02/04	02/05	02/06	02/07	02/08	02/09	02/10	02/11	02/12	02/13	02/14	02/15	02/16	02/17	02/18	02/19	02/20
INSULIN REGULAR HUMAN Sliding Scale SC AC-HS	11:00	11:00	11:00	11:00	11:00	11:00	11:00	11:00	11:00	11:00	11:00	11:00	11:00	11:00	11:00	11:00	11:00

Medication

Medication	02/04	02/05	02/06	02/07	02/08	02/09	02/10	02/11	02/12	02/13	02/14	02/15	02/16	02/17	02/18	02/19	02/20
PENICILLIN V POTASSIUM 250 MG PO Q4H	04:00	04:00	04:00	04:00	04:00	04:00	04:00	04:00	04:00	04:00	04:00	04:00	04:00	04:00	04:00	04:00	04:00

Medication

Medication	02/04	02/05	02/06	02/07	02/08	02/09	02/10	02/11	02/12	02/13	02/14	02/15	02/16	02/17	02/18	02/19	02/20
LOPRESSOR 25 MG PO TID HOLD IF: SBP < 100, HR < 55	08:00	08:00	08:00	08:00	08:00	08:00	08:00	08:00	08:00	08:00	08:00	08:00	08:00	08:00	08:00	08:00	08:00

Medication Location

Medication Location

Under Zoom (EMARTESTJEPHER (MHN 139115) - Web Page (Dialog)

EMAR Pac #: 2572826
PENICILLIN V POTASSIUM 250 MG PO Q4H <E> <FDE>
Schedule: 04:00-10:00-16:00-22:00

Administrations during past 24 hours:

EM	CS	CS	CS	CS	Entered
864495	02/06/07 10:03	250 MG PO	Given	02/06/07 10:03	HARRIS, YOLANDA B

Schedule History

Date/Time	Schedule	Next Code	Entered By
1/22/06/2007 08:50	04:00-10:00-16:00-22:00	02/06/07 10:00	HARRIS, YOLANDA B

Pharmacy Location: PS Med Drawer

Medications Due

- PENICILLIN V POTASSIUM 250 MG PO Q4H (R)
Next administration due: 02/06/07 16:00"
- LOPRESSOR 25 MG PO TID HOLD IF: SBP < 100, HR < 55 (R)
Next administration due: 02/06/07 18:00"

Paging link

Medication Administration Record

To Do List - 02/24/2007 07:08PM

Overdue Medications

- PENICILLIN V POTASSIUM 250 MG PO Q4H (R)
Next administration due: 02/24/07 16:00"
- LOPRESSOR 25 MG PO TID HOLD IF: SBP < 100, HR < 55 (R)
Next administration due: 02/24/07 18:00"

Medications Due

- INSULIN REGULAR HUMAN Sliding Scale SC AC-HS
Next administration due: 02/24/07 11:00"

Other Medications

- HEPARIN FLUSH(10 UNT/ML) 5 MILLILITERS IV Q24H
Next administration due: 02/24/07 10:00"

Paging Link

Continued Feedback

Continued Feedback

Real Time Alerts to Nurse

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

Real Time Alerts to Nurse

Wrong Patient

The scanned wristband is either the wrong patient's or the wristband was unreadable. Please check to see if this is the correct patient's wristband and re-scan. If this is the correct patient and this continues then select "Manual Patient Entry" on the To Do Screen to record the administrations.

Patient Scanned:
EMARTEST, MAGGIE MRN: 18919027

eMAR Lessons Learned

- A new "close-looped" Medication Administration System (MAS) will drive many practice changes for all disciplines
- Education and training costs were significantly higher than expected, but were vital to our success
- Clinicians must teach clinicians

eMAR Lessons Learned

- Be ready to uncover and fix unknown processes that have been supporting the existing MAS
 - 44 software changes were identified for our CPOE system
- Be ready for extreme variances in staff acceptance
- Workflow analysis is essential for all clinicians
 - Integration of technology must complement daily activity.

eMAR Lessons Learned

- Staff, especially nurses, need to be involved in equipment decisions;
 - Nursing staff Preferred Laptop vs. sub-notebook
 - Nurses preferred mobile Cart vs. Handheld
- Must engage medical staff early on in screen design, implementation decisions, and staff training.



Next Steps

- Design and implement Chemotherapy application.
- Integration of Emergency Department, Labor and Delivery, PACU, and Neonatal nurseries into eMAR process.
- Interface of Smart Pump platform:
 - Wireless server
 - Pharmacy and eMAR
- Role of RFID tags



Automating IV Drug Delivery Platform

“Seamless digital pathway from Computerized Provider Order Entry to the patient vein”



What is an Intelligent Infusion Device?

- Embodies a Dose Error Reduction System (DERS) and a clinical guidance system (drug library) that offers the user:
 - information and guidance for hospital-established best practices
 - alerts the user to potential or actual administration errors



Closing the Loop with “Intelligent Infusion Devices”

- **Goals:**
 - Reduce error potential to absolute minimize
 - Wrong drug
 - Wrong rate
 - Wrong patient
 - Auto-identification of care providers
 - Auto-identification of patients
 - Prevent “work arounds”



Closing the Loop with “Intelligent Infusion Devices”

- Provide automated identification options for pump programming including:
 - 2 dimensional “smart” bar codes
 - Remote wireless programming via WiFi network



Closing the loop with “Intelligent Infusion Devices”

- **GOALS:**
 - Bi-directional communication with Pharmacy, order entry and EMAR systems
 - Automate pump programming
 - Feedback loop to pharmacy to coordinate timely delivery of IV drug preparation.
 - Data tracking

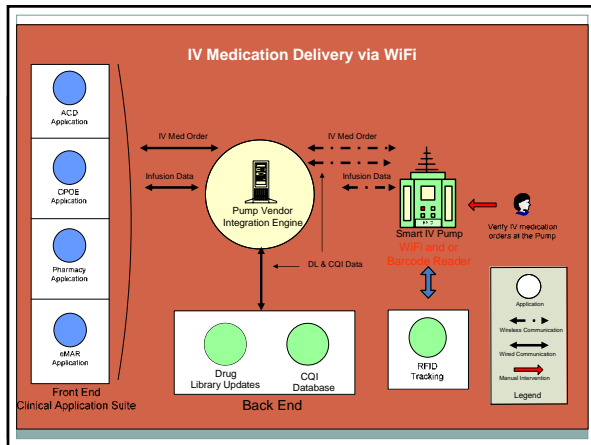


Functional Requirements

- **Multiple delivery platforms**
 - Continuous infusion
 - PCA
 - Epidural
 - Syringe delivery
- **Patient Monitoring**
 - Vital signs
- **Connectivity strategy for managing pump information**
 - Wireless strategy for sending new data and updates to drug libraries
 - Wireless strategy for downloading data from pumps for QI data mining
 - Wireless pump programming

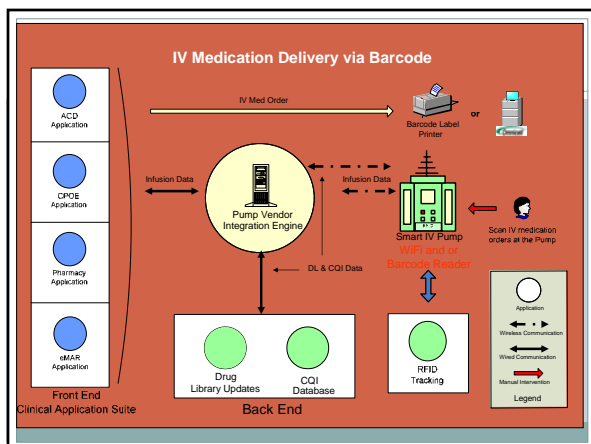
Functional Requirements

- **Dosing Guidance and Dose Error Reduction System**
 - Drug Libraries
 - Hard and soft limit alerts to clinicians
 - Suggested starting dose prompt advisories
 - Customizable for multiple practice environments
- **Automated Drug recognition capability**
 - Bar code scanning
 - Secure wireless communication
 - RFID
- **Comprehensive interface capability**
 - Pharmacy
 - eMAR
 - telemetry



Concerns and Hurdles

- **Wireless transmission security**
 - WPA vs. WPA II
- **Use of Mobile computers for data mining**
 - Power levels and interference with hospital network
- **Development of new software for interface with pharmacy band eMAR**



Smart Pump Technology and Bar coding

The images show various smart IV pumps and a close-up of a barcode label. The label is for **MASSACHUSETTS GENERAL HOSPITAL** and contains the following information:

- Drug: **hydromORPHONE 0.5 mg/mL**
- Total Amount: **hydroMORPHONE: 25 mg**
- Concentration: **0.5% Sodium Chloride 50 mL Bag**
- Expiration: **EXP 08/30/2007**
- Lot: **LIC# 102000036**
- Warnings: **FOR IV USE ONLY**, **Preservative Free**, **LateX Free**
- Manufacturer: **CYP 30005132**, **MSD**
- Barcode: **25mg/50mL**
- Barcode Type: **2D**

BAR CODE LABEL CONTENT per HIBCC labeling standard

The Pump Recognizes Drug Name & Concentration in 2D Bar Code

- Calls up correct Drug Library entry
- Critical for PCA !!!



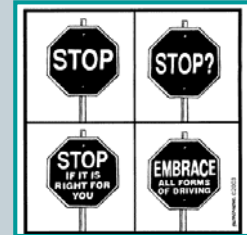
Be careful what you wish for....

**“To err is human but to really mess things up... you need a computer”
Anonymous**



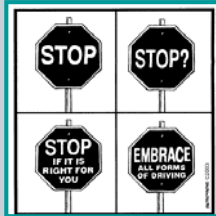
Weaknesses of Intelligent Infusion Devices

- Use of library is not mandatory and can be worked around.
- Staff often ignore or bypass soft and hard alerts.
- Safety alerts cannot detect errors that are within the accepted range.



Weaknesses of Intelligent Infusion Devices

- Pump programming is still a manual process
- Technology needs more refinement, integration, and controls to achieve the ultimate goal of medication error reduction
- Maintenance of drug library requires dedicated resources



Automated Dispensing Cabinets



Point of Care ADM Process

- **Pros**
 - Shortens time to med availability
 - Batch fill process
 - Highly interfactable
 - May improve level of drug control
- **Cons**
 - Not focused on med error prevention
 - Doesn't prevent staff from accessing drugs through back door process
 - Needs to close loop from dispensing to med administration.



Bar Code Based ADM Restock Process

- 90% of medications come from Omnicell machines
- **Old process:**
 - labor intensive for tech and pharmacists
 - Fill by individual med by individual machine
 - Requires manual redundant checks by pharmacist
- **New Process**
 - More efficient
 - Batch fill (50 machines at a time by drug)
 - Bar code verification for pick accuracy
 - Limited role for pharmacist
- Major weakness in off carousel scanning process.



Robust Pharmacy Information System

Nursing and Pharmacy on Same Page

SESSION NUMBER:	Open session	Printed	Printout	MENU	Send		
	Session	Approved	Printed	Prepared	Checked	Sent	Deliv'd
	X 3287808		07:38				
	X 3287875		13:49				
	R3 40464473		13:06	13:31	13:31	13:32	
	R3 40463378		13:14	14:05	14:23	14:23	
	R2 40414513		14:19				
	R2 40485211		12:43	13:34	13:36	13:38	
	X 3287849		10:44				
	R2 40492808		14:37				
	R4 40427632		14:43	14:52	14:57	14:58	
	40538306		13:26	13:29	14:13	14:21	
	R11 40252968		14:52	14:57			

Tracking Medications through the Process

RX	STAT	NI	P	U	R
01TEST,WILHEMINA	17A-301	3	167		
02MARTEST,2MARGE	17A-321		1		
03MARTEST,2MARGE	17A-311		9		
04TEST,A PHARMACY TEST ET	17A-118		3		
05MARTEST,2MARGE	17A-132		1		
06MARTEST,CARL	17B-162		1		
07MARTEST,2MARGE	17B-142		1		
08MARTEST,2MARGE	17B-122		1		

Electronic Documentation

- Clinical pharmacy Consults
- Documentation of clinical interventions through Adult RX system
 - Monitoring
 - Safety
 - Avoidance of ADEs
 - Alteration of drug regimens
 - Cost effectiveness

Electronic Medication Reconciliation Pre-Admission Medication List (PAML)

- Home medication electronic list matched with planned action on admission
- Pharmacist review and reconciliation
- Finalized list available for all providers

Adverse Drug Event Prevention

- The ADE Monitor has a rules based search engine that screens medication orders and lab results for potential real time adverse drug events, focusing on preventable ADEs.
- Prospective prevention of possible ADEs because information is available to unit based pharmacist for follow-up
- Provides another source of data trending.

ADE Monitor Reports by Pharmacist Coverage Area

Daily ADE Monitor Alerts

ROOM	ID	DATE	MRN	PATIENT	AGE	RULE	Rule Text	TEXT	
POD	777								
777	45582227	5/29/2007			1003	Pr ordered for colchicine 6 times a day for at least 4 days greater than or equal to 2.0	COLCHICINE is in the list of current med- ications ordered by TODD JEROME, J MD, JMS D, at 05/29/ 09 09:00:00. D/Cubation is greater than 1.9	Colchic 6	
Please Click One: Intervention Accepted Intervention Not Accepted No Intervention-Not an ADE No Intervention-Action Already Taken									
777	45582226	5/29/2007			1039	Patient ordered for famotidine CR, ranitidine and serum creatinine = 2	FAMOTIDINE is in the list of current med- ications ordered by FELICIA TERESA, RN, MHA, at 05/29/ 09 09:55:00. D/Cubation is greater than 2	Is ser	
Please Click One: Intervention Accepted Intervention Not Accepted No Intervention-Not an ADE No Intervention-Action Already Taken									
777	45582228	5/29/2007			66	1039	Patient ordered for famotidine CR, ranitidine and serum creatinine = 2	RANITIDINE HCL is in the list of current meds. GRANITIDINE HCL was ordered by COLLEEN MCELREATH, LA, VORNIC, M.D., at 05/29/09. CREA TIDINE = 2.87 at 6:14pm, 05/29/07. D/Cubation is greater than 2.3	Is ser
Please Click One: Intervention Accepted Intervention Not Accepted No Intervention-Not an ADE No Intervention-Action Already Taken									
777	45582225	5/29/2007			1122	Pr on Famotidine AND	Patient is on famotidine	Com	



- ### What do we want to know?
- Technology is reliable
 - Technology is being used as intended with all safety features activated
 - Datasets contain clinically appropriate limits and everything that needs to be included is included in the dataset
 - Nuisance alarms are minimal
 - Clinicians observe dose warnings and take appropriate action
 - Performance improvement activities actually improve patient care and employee safety

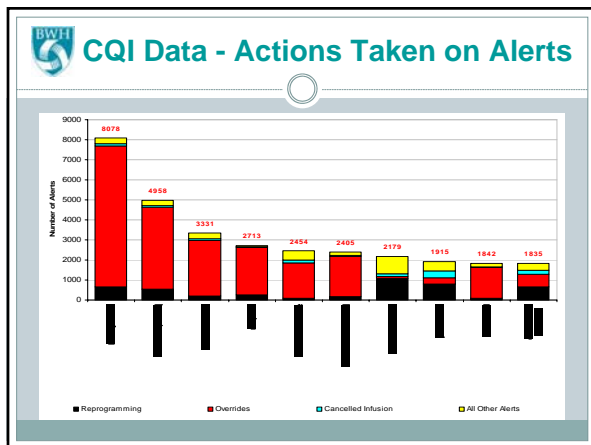
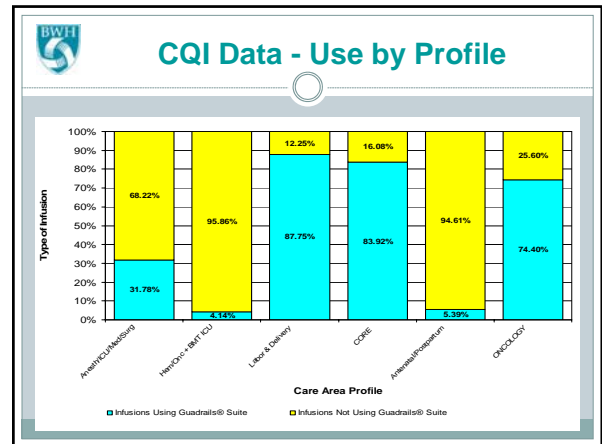
- ### How to make sense of the data?
- Prioritize
 - Use team approach
 - Engage data "owners"
 - Select high volume alerts
 - Select high risk drugs
 - Look for the easy fix



- ### Performance Indicators
- Clinical Pharmacist Interventions:
 - 20,370 documented interventions in FY07
 - Top Interventions:
 - Dose Adjustment : (38%)
 - Change in Drug Regimen: (14%)
 - Change in Frequency: (10%)
 - Change in Route: (11%)
 - Non-formulary Substitution: (9%)
 - Pharmacokinetic Consult: (1%)
 - Prevent Potential ADE: (4%)
 - Recommend Increased Monitoring: (2%)
 - Rate of Acceptance by MD = 90%

ADE Monitor Annual Results

- Alerts received: 43,161
- Alerts reviewed in detail by pharmacist: 20,361
- ADEs & Potential ADEs: 2,050
- Accepted Interventions/Prevented ADEs: 2,003
- 97% acceptance rate



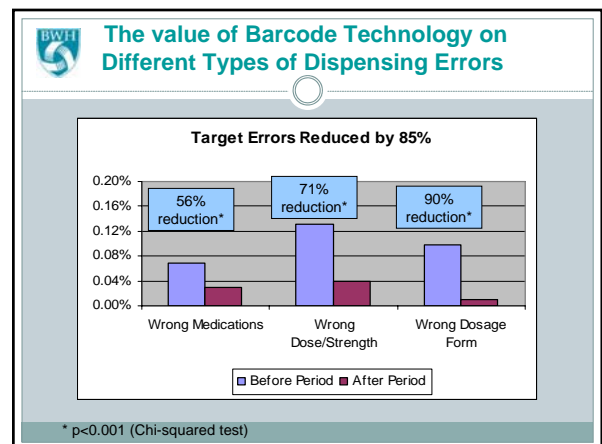
“Good Catches” Large Volume Parenteral Programming Errors Prevented

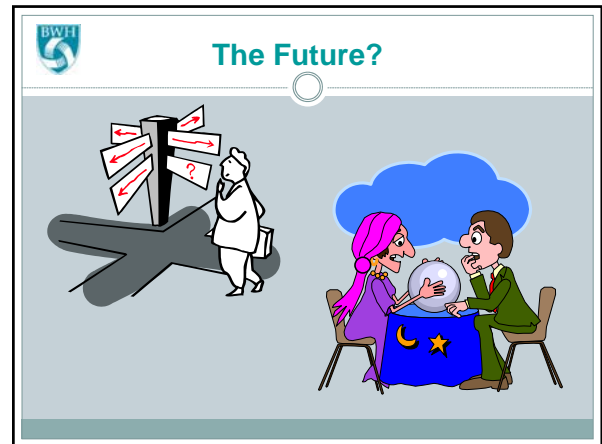
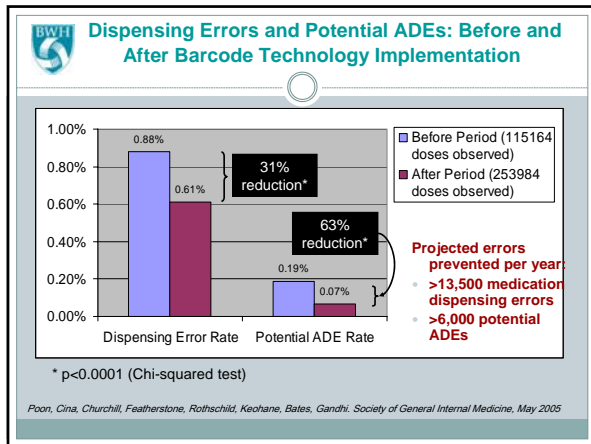
Drug Name	Initially Program	Changed to	Limit
diltiazem	80 mg/hr	8 mg/hr	30 mg/hr
insulin	50 units/hr	7 units/hr	40 units/hr
insulin	505 units/hr	5.5 units/hr	40 units/hr
insulin	95 units/hr	10 units/hr	40 units/hr
magnesium sulfate	1000 gram/hr	1 gm/hr	4 gm/hr
PHENYLEphedrine	200 mcg/min	120 mcg/min	180 mcg/min
DOPamine	10 mcg/kg/min	5 mcg/kg/min	5 mcg/kg/min
heparin	450 units/kg/hr	22 units/kg/hr	40 units/kg/hr
heparin	756 units/kg/hr	12 units/kg/hr	40 units/kg/hr
phenytoin	100 mg/min	50 mg/min	50 mg/min

eMAR Error Prevention Data

February 2008

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





Robotic Technology

- Improves dispensing accuracy via bar code scanning
- Improves speed of delivery
- Improves utilization tracking and inventory management
- Frees up valuable pharmacist time

Robotics and Automation in the Sterile Products Suite

- Intellifill Syringe filling Robot from ForHealth Technology**
 - Saves supply costs by using less expensive syringes
 - Saves on labor costs
 - Bar code verification
- RIVA**
 - Can make both IV bags and syringes
 - Saves on labor costs
 - Bar code verification

Robotics and Automation in the Sterile Products Suite


- Cytocare**
 - Prepares chemotherapy using robotic technology
 - 59 safety checks to assure products are safely and accurately prepared
 - Bar code verification
 - Separate chemo waste disposal

Potential value of 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


Potential uses of RFID Technology in Hospitals

- **Patient bracelets**
 - Patient tracking
 - Automating room turn around process
 - Personal property tracking
- **Staff Id badges**
 - Employee tracking
 - Employee login



Potential uses of RFID Technology in Hospitals

- **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



Peopleware to keep it all going.



Drug Safety Committee

- **Sub-committee of the Pharmacy & Therapeutics committee**
 - Co Chairs Anne Bane and Bill Churchill
 - Staffed by the Medication Safety Officer
- **Primary responsibilities:**
 - Adverse drug event and medication error surveillance
 - Development and implementation of system enhancements for the prevention of future events
 - Identify areas of improvement to prevent future events
 - Data trending
 - Review of High Risk Medications
 - Utilization of ISMP Alerts

Order Set Committee

- Order set committee is sub-committee of drug safety committee
- **Co Chairs Anne Bane (nursing) and Karen Fiumara (pharmacy)**
 - Staff pharmacists and Nurse educators staff the committee.
- **Order sets updated in 2006 include:**
 - Obstetric
 - Orthopedic
 - Thoracic
 - Endocrine
 - Radiology - Oral Contrast

Smart Pump Library Management

- **Multidisciplinary sub-committee of Drug Safety Committee**
- **Charged with development, management, and implementation of smart pump drug libraries**
 - **Co-Chairs: Carol Luppi RN, Jon Silverman Pharm D.**
 - × Supporting cast:
 - × Anne Bane RN
 - × Paul Szumita Pharm D
 - × Bill Churchill MS, R.Ph.
 - × Chris Niemann R. Ph.
 - × Nurse Educators



Adding Value to the Medication Administration System (MAS)

- No one intervention (bar coding, eMAR, CPOE, automation etc) will solve all of the problems in our MAS. We must have a multi-faceted approach to improving patient safety.
- To achieve success you need :
 - Well defined and documented strategic plan for integrating and implementing safety technology.
 - Buy-in from medical staff leadership, pharmacy leadership, nursing leadership, and senior executive leadership
 - Strong nursing-pharmacy collaboration and teamwork
 - Consistent presence of pharmacists on the units to assist with all medication related issues.
 - Strong partnership with Information Systems department



Some thoughts...

- Ideal Practice needs to drive technology
- Human factors play a key role in acceptance
- Technology can never replace the critical thinking of clinicians
- End user feedback is essential to design, implement and maintain technology
- Develop systems that are user maintained and incorporates table-driven databases
- No one intervention (bar coding, eMAR, CPOE, automation etc) will solve all of our problems in the Medication Administration System.
- The work never ends!



Our approach should be.....

There are those who look at things the way they are, and ask why... I dream of things that never were, and ask why not?

Robert F. Kennedy