Mary Lanning Memorial Hospital

715 North St. Joseph Avenue
Hastings, Nebraska 68901

Patient Safety: Implementation of Bedside Bar Code Medication Administration

Criteria 1 – Leadership/Planning/Human Resources

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Overview

Mary Lanning Memorial Hospital (MLMH), is a 157-bed, JCAHO accredited, regional referral hospital located in rural Nebraska. MLMH has an average daily census of 77 and yearly inpatient admissions of 6,461 (2004). The regional health industry has a primary and secondary service area that draws users of the system of care from an approximately 32,000 square miles area that stretches into Kansas.

As an agency, MLMH has been progressive in its leadership role in quality of care issues both within the state and nationally. The Hospital has participated in all peer-review research projects conducted by CIMRO of Nebraska, formerly, the Sunderbruch Corporation. Nationally, the Hospital was recognized as the Nebraska state leader in preventing surgical wound infection and joined 52 others nationwide to participate in the National Surgical Site Infection Prevention Collaborative to test ways to reduce surgical site infections.

In addition, MLMH was the first hospital in Nebraska to commit to and participate in the national reporting mechanisms for quality indicators and most recently was named an award finalist for the 2004 American Hospital Association's Quest for Quality Prize. The Quest for Quality Prize, first presented in 2002, is to honor hospital leadership and innovation in patient care quality, safety and commitment.

Philosophically, the promotion of quality and patient safety started with the Hospital's Board of Trustees. The Trustees' aim was to create a healthcare environment that supports, in both words and actions, error identification and offers solutions to prevent errors from recurring, while minimizing individual blame. MLMH's Strategic Plan designated a priority goal "To continue to identify and implement patient safety initiatives that will positively affect care delivery while minimizing patient safety errors, defects, and sentinel events, and striving for zero

defects". With this goal in mind, the hospital charted a course to improve our medication administration process.

Historically, MLMH's medication error rate has been below the national error rate. In 2003, our reported medication error rate was 10 errors per 10,000 doses compared to the national reported error rate of 30 errors per 10,000 doses. We recognize that one error can prove to be one too many. In 2000, a sentinel event occurred as a result of a medication error that led to severe brain damage and ultimately death of one of our patients. This event reinforced the need for a standardized medication administration process.

The hospital team reviewed the literature to identify patient safety initiatives/systems that were available to reduce medication errors. The extent and impact of medication errors and the role of systems approaches in detecting and reducing them came to national attention in 1999 after the publication of the Institute of Medicine (IOM) report, *To Err Is Human: Building a Safer Health System* and again in 2001 with the second IOM report, *Crossing the Quality Chasm: A New Health System for the 21st Century, 2001*.

Medical journal findings continue to show that medication errors are frequent and that adverse drug events, or injuries due to drugs, occur more often than necessary. The problem is also a growing concern of consumers. According to a recent survey conducted for the American Society of Health System Pharmacists medication errors were the number one concern of hospitalized patients. The Commonwealth Fund data from 2002 report 1 in 5 American families experienced a serious drug error with 33% occurring during hospitalization and in a 1997 National Patient Safety Foundation survey two in five adults (42%) have been involved, either personally or through a friend or relative, in a situation where a medical mistake was made. Of those, 28% reported the medical mistake as a medication error.

Medication errors are rarely the fault of an individual healthcare professional but rather represent the failure of what can be called the medication use system. About a third of these errors are errors in drug administration. Bar code technology is likely to be especially useful for reducing the incidence of errors at that stage, particularly in acute-care facilities such as hospitals, which rely on regimented processes for administration of drugs. Thus, in the acute-care setting, the Institute for Safe Medication Practices (ISMP) sees the patient's bedside as offering one of the greatest potentials for utilizing bar coded medications to enhance safety.

Bar coding has been discussed as a useful tool in medication error prevention as early as 1985. Recommendations for bar code-enabled point-of-care (BPOC) systems are numerous. Several studies have also emerged that reveal positive results within hospitals that have started utilizing bar codes at the point of care. Strategies to improve hospital medication-use systems must be grounded in an acknowledgment of their complexity. Between 80 and 200 steps may be associated with the administration of a single dose of medication in a hospital.

The specific aim of the project was to improve the care of patients receiving medication through the use of a bar code medication administration system by reducing medication errors by 90% caused by wrong drug, wrong dose, wrong patient, wrong time or wrong route .

Methods

In 2001, a 15 member Medication Management Task Force comprised of pharmacy personnel, nursing personnel, quality improvement staff, medical staff, and administration mapped the medication management process from prescription to administration. The team found this process included more than 65 steps, which had the potential to be vulnerable to human error. The team, together with the hospital's 17-member quality improvement committee evaluated the past five years medication error occurrences and found that the majority of

medication errors occurred during the steps associated with physician ordering and medication administration.

Research studies show that most medication errors occur in the physician ordering (39%) and medication administration (38%) stages. This national trend in where medication errors occur was similar to the findings at Mary Lanning. These two stages in the medication administration process are nearly equal contributors; nearly half of all physician errors are intercepted (86% by nurses, 12% by pharmacists). Likewise, one-third of transcription and dispensing errors are caught prior to administration. In contrast, only 2% of medication administration errors are intercepted rendering the medication administration stage the most vulnerable to errors that may adversely affect the patient's care.

One key factor that played into the Mary Lanning decision to prioritize bar code-enabled point of care (BPOC) technology included the fact that most of the hospital's medication errors originated during the prescriber ordering and nurse administration phases of the medication process. Other factors influencing the decision were cost: resources related to Computerized Physician Order Entry (CPOE) implementation can be upwards of 5 times greater than BPOC, Mary Lanning's philosophical approach that sharp end users would be more likely to identify and reduce errors, and the fact that while CPOE can reduce errors related to the written order it does not eliminate or reduce wrong patient errors. Further, the implementation of bar code technology would create consistency in practice and reduce the number of steps in the medication administration process decreasing end user dependence upon memory.

A final contributing factor was the electronic Medication Administration Record (MAR) component. Bar code technology would eliminate the opportunity for error in recording data as it performs the data entry in a fraction of the time required for manual entry. This process will, ideally, reduce staff documentation time and produce more accurate and legible reporting.

The MLMH medication safety plan was developed using the framework developed in *Pathways for Medication Safety*: Leading a Strategic Planning Effort. The model is comprised of seven goals: Create, communicate a leadership-driven culture of safety; Improve error detection, reporting, and use of the information to improve medication safety; Evaluate where technology can help reduce the risk of medication errors; Reduce the risk of errors with high-alert medications prescribed and administered to high-risk patient populations or at vulnerable periods of transfer through the health care system; Establish a blame-free environment for responding to errors; Involve the community in medication safety initiatives and medication self-management programs; and, Establish a controlled formulary in which the selected medications are based more on safety than cost. Activities that have occurred under these goals include:

1. Create; communicate a leadership-driven culture of safety;

A. MLMH strategic plan contains the mandate to continue to identify and implement patient safety initiatives which will positively impact care delivery processes while minimizing patient safety errors, defects and sentinel events, striving for zero defects.
B. Developed and implemented marketing plan to communicate organization's commitment to patient safety.
C. Designated 1.0 FTE special project coordinator for BPOC implementation and ongoing oversight.
D. Conducted staff survey to discern hospital culture as it related to patient safety.
    - 97.5% of nursing personnel were aware of patient safety policies that focus on non-punitive reporting.
    - 83% of nursing personnel reported awareness of reduction of medication errors as the top priority related to patient safety currently under development at MLMH.

2. Improve error detection, reporting, and use of the information to improve medication safety;

A. Created a communication mechanism to keep staff, managers and senior leadership informed about medication safety.

B. Future implementation of online incident reporting with Quantros.

3. Evaluate where technology can help reduce the risk of medication errors;

A. Conducted three site visits to locations implementing BPOC technology.

B. Completed VHA Patient Safety Organizational Assessment.

C. Completed Pathways for Medication Safety: Assessing Bedside Bar-coding Readiness: Section 3.2

D. Compared, evaluated, and analyzed multiple bar code systems for best-informed decision.

4. Reduce the risk of errors with high-alert medications prescribed and administered to high-risk patient populations or at vulnerable periods of transfer through the health care system;

A. Evaluated storage and use of high-alert medications and initiated best practices safety recommendations.

B. Established a medication administration plan that includes safety checks for high-risk medications.

C. Established 100% unit-dose medication packaging with the exception of those medications that prohibit unit dose such as inhalers or eye drops.

D. Established a process for cognitive, independent double check of all high-alert medications before administration.

5. Establish a blame-free environment for responding to errors;

A. Conducted a staff survey regarding level of fear with making and reporting errors with 97.5% of nursing personnel stating they consider MLMH culture to be one that encourages reporting of occurrences without fear of punishment.

B. Conducted board and staff training on benefits of blame-free environment.

C. MLMH Board of Trustees established a blame-free error reporting policy.

6. Involve the community in medication safety initiatives and medication self-management programs;

A. Participate in annual community health fair and provide information on medication safety issues.

B. Established self-management programs for patients with diabetes.

7. Establish a controlled formulary in which the selected medications are based more on safety than cost.

A. Reviewed all standard order sets to limit the choices of drugs and ensure only formulary medications and approved therapeutic substitutions are included for selection.

B. Ensured error potential was a standing item for discussion on all medications considered for formulary addition.

C. Implemented an ongoing process to review all therapeutic categories of drugs currently available in the hospital and eliminate unnecessary therapeutic duplication.

To implement BPOC, a team of end-users from administration, pharmacy, nursing, quality improvement and information technology was formed. The team evaluated several key elements: the patient care delivery system, complete medication process, pharmacy procedures, admitting process, staffing, and potential training needs. Also considered, were the steps in the pharmacy information system, including how the main information system, unit-dose packaging system, and dispensing system would interact with bedside bar code scanning. Flowcharts were developed detailing the modifications bar coding would require.

The hospital also updated the formulary, then mapped the associated medication bar codes to it. Bar code labeling equipment was leased to generate and repackage those medications not already bar coded and supplied from the pharmaceutical manufacturer in unit-dose packages.

IV labels were also programmed to contain bar codes. Prior to implementation all medication bar codes were tested for scanability. The team also developed a Medication Administration Standard of Practice for BPOC.

In preparation for implementing AcuScan-Rx (MLMH's choice for BPOC system), the following technology upgrades were completed:

1. Installation and integration of Horizon Meds Manager (HMM) – a pharmacy software management system. This system interfaces with the hospital's ADT (admissions, discharge/transfer) system, lab, and billing to provide flow of information to/from pharmacy. It further interfaces with the Pyxis (medication dispensing unit) and BPOC technology. HMM creates the medication profile for the patient and screens for appropriate dose, drug interactions, therapeutic duplications and disease interactions. HMM also provides double check/verification of prescribed orders and real-time patient information available at time of order entry.
2. Implementation of PakPlus-Rx – unit-dose packing system. All forms of medication are packaged in bar coded form with this system. Unit doses are then re-checked by hospital pharmacist for double-check on accuracy.
3. Upgrades to the Pyxis dispensing system to include;

A. ParRx-a pharmacy bar code system. This allows pharmacy personnel to scan all medications for verification of correct drug and dose prior to filling the Pyxis unit.
B. Cubies – Medication dispensing units were upgraded to include individual cubicles with lids for each medication. Upon selection of a medication by authorized personnel, only the drawer and cubicle with lid containing the selected medication opens for dispensing.
C. Bio Id – Again on the medication dispensing units. Bio Id provides the ability to restrict access to medications to authorized personnel.

Results

Effective process change that results in sustainability is demonstrated by qualitative and quantitative results. The qualitative results from this project included development of a one patient at a time medication administration philosophy, streamlining the medication process, real time recording of medication administration, and acceptance by staff and patients. The quantitative results saw an **88% decrease** in medication errors related to wrong drug, wrong dose, wrong patient, wrong time or wrong route.

Prior to implementation of BPOC, a common nursing practice was delivering numerous medications to multiple patients during rounds. This process even for the most skillful of nurses is fraught with potential error. The change to BPOC now requires a nurse to administer medications one patient at a time.

A testimony illustrating this qualitative improvement: A nurse on the Medical/Surgical Unit prepared an anti-diabetic medication and entered a patient's room to deliver the medication. When the nurse scanned the patient's wristband she realized she was in the wrong patient's room. She shared this story saying she was skeptical of using AcuScan when administering medications but now she was sold. Other qualitative improvements included the capturing of medication administration time electronically by scanning the medication, the patient and the nurse administering the medication. This process change eliminates pen and paper documentation and creates a legible MAR.

Since the implementation of BPOC there have been two scheduled system downtimes. During downtime, the medication administration process reverts back to the paper medication administration record with documentation by hand. Comments nurses have made during downtime include: "I want my scanner back, it doesn’t seem as safe without it", "How did we ever manage all this paper?", "I don't want to admit it, but I really like AcuScan". Patients have

also commented after being transferred to other facilities and returning to MLMH about how much safer they feel knowing that the caregiver is scanning to double check that they have the correct medication and patient.

Quantifiable data was collected through the incident reporting system. This data was then aggregated based upon the number of month's the perspective unit had implemented BPOC. To determine the rate of improvement, like months prior to implementation were calculated. An explanation of the measurable results of this process change can be found in Attachment B along with graphical illustration of the improvement.

Lessons Learned

Three primary barriers were identified in the implementation of this project: financial, staff resistance to technological change, and integration of computer systems. The financial barrier was to weigh the cost/benefit analysis of implementing BPOC. This potential barrier was met head on by senior leadership and the Board of Trustees whose recognition that reducing harm to patients in a significant way is a benefit that will always out way the cost. The relationship between the delays created by computer system integration and staff resistance to change worked in a positive way to help overcome these two barriers. During the delays, staff were given the opportunity to work with the technology utilizing mock scenarios. This created an increase in their comfort level and proficiency.

Six categories were identified as new "types of errors" post BPOC implementation. These included: Violation of the AcuScan system, Loop not closed, Pharmacy order entry/nurse verification, Nursing error outside the five rights, Medication error based on lab value, and Process errors (Attachment C). Recognizing that in our previous method of medication administration, these types of errors were not identified making our new system invaluable.

Attachment A

BPOC Implementation Plan

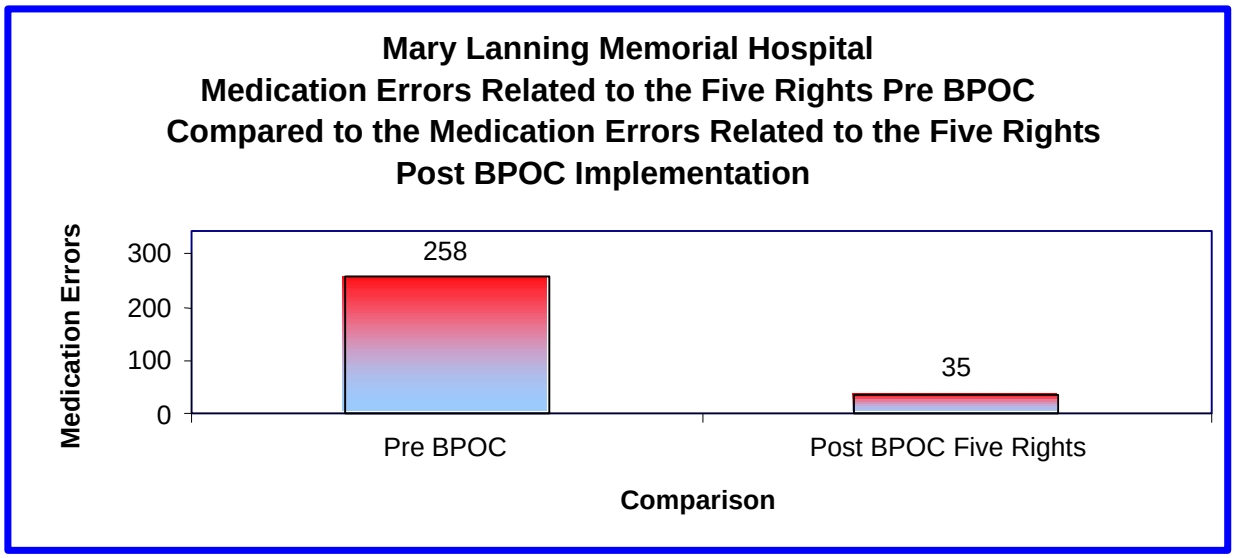
Task	Completion Date
Policy revisions for non-punitive environment	February, 2002
Board of Trustees Approval to move forward with BPOC system	February, 2002
Site Visits	March, 2002
System definition	April, 2002
Internal nursing staff survey on MLMH safety policies/change to electronic system	July, 2002
Formulary changes	August, 2002
Interface review/Drug bar code/PakPlus-Rx started	October, 2002
Data requirement definitions/Define roll out plans	November, 2002
Load/verify table/parameter entries	November, 2002
Compile interface programming	November, 2002
Complete facilities/network requirements for hardware installation	November, 2002
IV bar code/Employee barcode/ Patient bar code	December, 2002
Copy/verification of formulary/drug additions	January, 2003
Testing of BPOC with Pharmacy, Billing, and ADT systems	Dec. 2002-Nov 2003
Order hardware for training	January, 2003
Order hardware for pilot unit	June, 2003
"Go-live" planning check list	July, 2003
Identify existing/new policies to be revised	July, 2003
Application training/expert users	July, 2003
Implementation rollout plans	August, 2003
End user training preparation	October, 2003
"Go-live" resource support plan	October, 2003
System review/application testing	December, 2003
End user training pilot unit (Peds/Short Stay/Cardiopulmonary)	Dec. 2003-Jan. 2004
Proficiency testing	February, 2004
Two-week shadowing process utilizing both methods for MAR creation	February, 2004
"Go-live" pilot unit	February, 2004
End user training second unit (Oncology/Inpatient Med/Surg)	March 2004
"Go-live" second unit	April, 2004
Nursing/pharmacy policy revision	May 2004
End user training third unit (ICU)	April, 2004
"Go-live" third unit	April, 2004
End user training fourth unit (Subacute/Infusion Center)	April-May, 2004
"Go-live" fourth unit	May, 2004
End user training fifth unit (OB/Nursery)	May-June, 2004
"Go-live" fifth unit	June, 2004
End user training sixth unit (Behavioral Services)	June-July, 2004
"Go-live" sixth unit	July, 2004

Attachment B

Medication Errors Pre and Post BPOC Implementation

Overall Hospital Performance Pre and Post BPOC based upon the Five Rights of Medication Administration

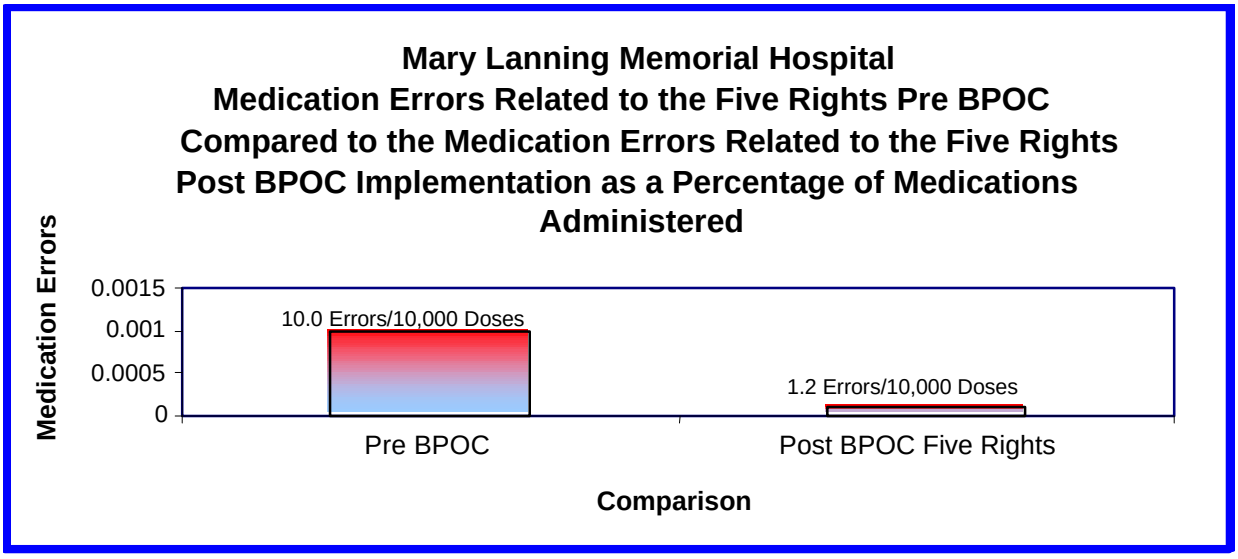
The number of errors based upon the five rights of medication administration pre BPOC compared to the number of medication errors following implementation where the user violated the BPOC system (system is set-up based upon the five rights of medication administration). The pre and post values are equal in time related to implementation and unit.



Overall Hospital Performance Pre and Post BPOC based upon the Five Rights of Medication Administration as percentage compared to the number of doses administered

The number of errors based upon the five rights of medication administration pre BPOC compared to the number of medication errors following implementation where the user violated the BPOC system (system is set-up based upon the five rights of medication administration). The pre and post values are equal in time related to implementation and unit.

Pre BPOC Number of Errors / Pre BPOC Number of Doses Compared to Post BPOC Number of Errors / Post BPOC Number of Doses

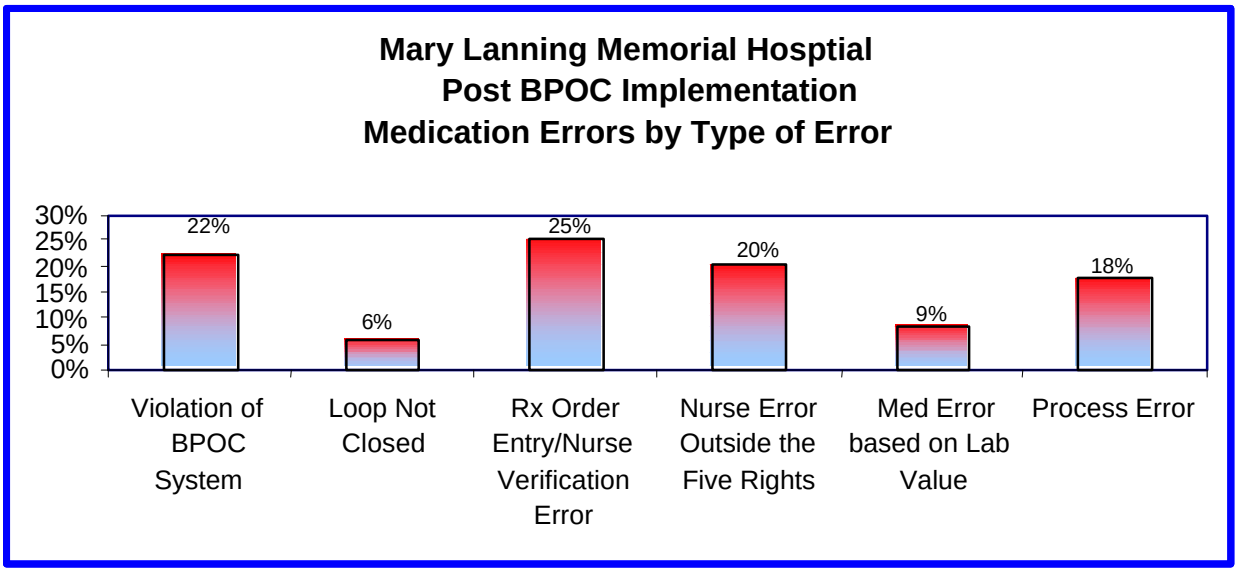


Overall Hospital Performance Post BPOC Implementation

Post Implementation Medication Errors by Type of Error as a Percentage

Below is a pareto chart indicating the new types of medication errors as a percentage of errors committed post BPOC implementation. These errors include:

- user violated the BPOC system (system is set-up based upon the five rights of medication administration)
- error in pharmacy order entry/nurse verification process
- error in medication administration based on lab values (sliding scale insulin and coumadin)
- error in medication administration loop remains open (related to ER and PACU not on BPOC)
- nursing errors outside the five rights for medication administration
- other process issues



Attachment C

New Types of Errors Post BPOC Implementation

New Type of Error	Definition
Violation of the BPOC System	did not follow the 5 rights for medication administration
Loop not closed	Medication errors occurred between a non BPOC nursing unit (ER and PACU) and a BPOC nursing unit
Pharmacy order entry/nurse verification error	Order entered incorrectly by pharmacist and nurse verified order as correct -
Nurse error outside of the five rights	Examples: Nurse hung the correct IV solution but did not infuse it at the ordered IV rate, did not follow heparin protocol, medication only partially infused, administered prn medication too soon, created order and gave medication to patient and medication not ordered for patient
Medication error based on lab value	Sliding Scale Insulin given per blood glucose result and Coumadin given per INR result did not follow protocol
Process errors	MD entered order on wrong side of order sheet, MD order difficult to read, Allergy not noted, RT nebulizer order not started, Pneumonia Protocol not followed, No pre-op antibiotic for Group B Strep, History from office not correct re: titer, Placing medications on hold, Order not processed, Patient not weighed in ER