Medication Safety:
Assuring Safe Outcomes

This course has been awarded six (6) contact hours.

This course will be updated or discontinued on or before October 31, 2017.

First Published: June 9, 2006
Revised: June 9, 2008
Revised: June 9, 2010
Revised: August 8, 2013

Acknowledgements

RN.com acknowledges the valuable contributions of…

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…Robin Varela, RN, BSN, for updating and editing the 2008 revised version of this continuing nursing education course.

...Tanna R. Thomason, RN, MS, CCRN, PCCN & John Joseph Engelbert, Pharm D, RPH, original authors of this course.

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Purpose

The purpose of this course is to provide information about safe prescription and transcription of medication dosages, instruction about safe administration practices, and guidance regarding medication safety based on The Joint Commission (TJC) National Patient Safety Goals (NPSGs).

The course will also discuss special considerations for the older adult, peripheral IV complications pertaining to intravenous medication administration, and monitoring for allergic reactions.

Case studies are provided to outline the importance of monitoring priorities for patients receiving high-alert medications such as those used for anticoagulation therapy, antibiotic therapy, and congestive heart failure.

Objectives

After successful completion of this course, you will be able to:

1. Define medication errors and adverse drug events.
2. Identify the nine “do not use” abbreviations that may result in transcription errors along with suggested alternatives for documentation.
3. Describe risk reduction strategies to prevent transcription errors.
4. Identify two common “look-alike” or “sound-alike” medications in your work place and safety steps to minimize potentials errors.
5. Identify two potential benefits from using a bar coding system for medication administration.
6. Describe methods to improve the reconciliation of medications across the continuum (ROMAC) at your work place.
7. Identify the importance of assessing allergies and the "five Rs" prior to medication administration.
8. Identify and contrast symptoms and treatments for mild versus severe allergic reactions.
9. Describe the rationale for using a two patient identifier system when assessing for the “right” patient.
10. Identify three examples of high-risk drug calculation categories and strategies to prevent medication calculation errors.
11. Describe the influence of pH and osmolality on the patency of peripheral veins.
12. Identify and self assess personal medication knowledge via critical thinking questions listed in the

case studies.

Introduction

Safely administering medication requires a vast amount of knowledge on behalf of the healthcare professional. It is one of many high-risk tasks that can lead to devastating consequences for the patient and for the healthcare professional's career.

Healthcare professionals are responsible for their own actions regardless of a written order from a healthcare provider. If a healthcare provider writes an incorrect order (e.g. Demerol 500mg instead of Demerol 50mg), anyone who administers the written incorrect dosage is responsible for the error. Because of this, healthcare professionals should question any order that appears unusual, and decline to give the medication until the order is clarified.

Note! Although some statistics provided in this course may seem outdated, they are landmark studies that still affect practice today.

Course Overview

This course provides a foundation for a global review of medication safety with a primary focus on the hospital setting. The target audience includes healthcare professionals who administer medications as a routine part of their patient care.

The course begins with an overview of the serious nature of medication errors and offers select definitions. Prevention of transcription errors is emphasized with a discussion about the most commonly misinterpreted abbreviations.

Health assessment and medication allergies are discussed along with a review of the five "R"s. Medication safety in the elderly is also reviewed.

The course discusses IV therapy, including infiltration and phlebitis as they relate to medication delivery.

Monitoring for both mild and serious potential drug allergies is reviewed with application of this information in the case studies.

Critical thinking questions are listed throughout the module as a means to promote self-assessment of the reader's knowledge and understanding.

Definition of Medical Error

According to the National Coordinating Council for Medication Error Reporting and Prevention (2013), a medication 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; order communication; product labeling, packaging, and nomenclature; compounding; dispensing; distribution; administration; education; monitoring; and use."

Medication errors can occur in any of the following medication delivery stages:

- Prescribing
- Order transcription
- Dispensing
- Distribution
- Administration

For additional information on medication errors, see RN.com's Medication Error Reduction course.

Reporting Medical Error

If a medication error occurs at your facility, it needs to be reported. Always ensure patient safety following an error and adhere to your facility policy and procedure.

Complete the required paper work on quality variance. If an untoward outcome such as a sentinel event occurs, it may be necessary to report the error to The Joint Commission (TJC).

In addition, you may wish to ask the pharmacist, healthcare provider, or nurse manager about reporting the information to the United States Food and Drug Administration or the USP Medication Error Reporting Program.

The purpose of reporting medications errors is to help prevent mistakes from happening again and to evaluate trends across the nation.

U.S. Food and Drug Administration's MedWatch Reporting Program
1-800-FDA-1088

USP Medication Error Reporting (MER) Program 1-800-233-7767

How Safe Are Our Medication Practices?

According to the Institute of Medicine Report (1999), **7,000 people per year die from medication errors and 2% of hospital admissions have an adverse drug event.**

The Joint Commission has implemented new monitoring criteria to assure hospitals are monitoring and practicing safe medication administration (TJC, 2008).

The Institute of Medicine (under the jurisdiction of the U.S. Congress), has set a minimum goal of a 50% reduction in all medical errors over the next five years. Stakeholders in the medical community and healthcare professionals are looking for better solutions to prevent common medication errors.

Note!
The 1999 Institute of Medicine Report is a landmark study that is still applicable today.

An Adverse Drug Event

An adverse drug event (ADE) is defined as any harm, expected or unexpected, resulting from the use of a medication. This may also result from omission of a medication (National Coordinating Council for

Medication Error Reporting and Prevention, 2006).

Potential adverse drug events are called “near misses.” In these situations, a medication related event had the potential to cause harm to a patient but did not result in an injury.

Both categories of adverse drug events are concerning to healthcare professionals and hospital administration.

Test Yourself
Potential adverse drug events are called _____.
Answer: Near misses

A Sentinel Event

TJC defines a sentinel event as any unexpected occurrence involving death or serious physical or psychological injury, or the risk thereof.

The phrase “the risk thereof” includes “any process variance for which a recurrence would carry a significant chance of a serious adverse outcome” (TJC, 2013). Simply stated, a sentinel event is an unexpected negative outcome which, if repeated, would also likely cause the same negative outcome.

Medication related examples of sentinel events include:

- Unexplained death (as a result of errors of commission or omission)
- Major permanent loss of function (as a result of errors of commission or omission)

Upon identification of a sentinel event, your organization’s Sentinel Event Team or Committee will meet to discuss all aspects, including how to prevent this event from happening in the future. This type of investigation is only required with the most serious type of medication errors.

Test Yourself
True or False? A sentinel event is any unexpected occurrence involving death or serious physical or psychological injury, or the risk thereof.
The correct answer is: True!

Root Causes of Sentinel Events

Please refer to TJC's website for a graph that shows the number of sentinel events reviewed by TJC between 2004-2012. http://www.jointcommission.org/assets/1/18/2004_4Q_2012_SE_Stats_Summary.pdf TJC, (2013)

Critical Thinking:
After looking at the graph, which types of medication errors do you see most often at your facility or in the professional practice in your unit/department?

If you have suggestions for improvements, do not hesitate to share your ideas with your leadership team. Your suggestion or innovative ideas could save someone’s life!

National Patient Safety Goals (NPSGs)

The National Patient Safety Goals (NPSGs) were originally established in 2002 by the Patient Safety Advisory Group for The Joint Commission (TJC). TJC uses these NPSGs to help accredited organizations address specific areas of concern in regards to patient safety. These NPSG are updated periodically.

The updated 2013 National Patient Safety Goals require all healthcare organizations to improve the effectiveness of communication among caregivers (NPSG 2). As part of this goal, the timely reporting of critical test results and diagnostic procedure reporting is of utmost importance (NPSG.02.03.01).

The third NPSG addresses medication safety. All medications, medication containers and other solutions on and off the sterile field in perioperative and other procedural settings must be correctly labeled in a timely manner (NPSG.03.04.01), and patient medication information must be maintained and communicated accurately to all healthcare professionals (NPSG.03.06.01).

Improving Communication Among Caregivers

Research has shown that breakdowns in communication are the most common cause of medication-related sentinel events. Improving communication requires healthcare professionals to "accurately and completely reconcile medications across the continuum of care" (TJC, 2013).

Although a number of factors influence safe medication administration practices, two problem areas have stood out over the years: verbal and telephone orders and the lack of standardization of abbreviations, acronyms, and symbols.

To help prevent these errors, TJC requires accredited facilities to follow the NPSGs "read back" of all verbal and/or telephone orders. The requirements also include a directive to follow the guidelines for the standardization of abbreviations.

A list of DO NOT USE abbreviations, acronyms, and symbols must be adhered to throughout a facility. The use of and storage of look-alike, sound-alike medications should also be addressed.

Read back of Verbal Orders

Most healthcare professionals should already practice the habit of reading back all new verbal and telephone orders to the prescribing healthcare provider. This form of communication is required and mandatory. Simply "reading back" the order, however, is not entirely correct.

The optimal practice is for the receiver to write down the complete order (or enter it into the computer). After writing down the order, the receiver should then read it back and receive confirmation from the individual who gave the order.

The "read back" requirement is not just for medications, but is also required for ALL types of verbal or telephone orders for all healthcare professionals (e.g. a respiratory therapist who receives a verbal order for a specific breathing treatment).

This "read back" requirement also applies to telephone communication of critical test results.

Implementation and Monitoring of Read Back Practices

How are different units/departments implementing and monitoring this practice?

- Some units are discouraging or refusing to receive verbal orders unless it is an emergency. When

a healthcare prescriber gives a verbal order, the healthcare professional may hand the provider a blank “order form” or offer them an unoccupied computer terminal. If not yet implemented in your hospital, this practice may decrease verbal orders.

- Other nursing units/departments are “auditing” practice by keeping a written scorecard whenever a verbal or telephone order is overheard. If the healthcare professional receiving the order “reads it back”, a “met” score is recorded. Some healthcare organizations monitor how many times a healthcare professional requests that a healthcare prescriber reads back the verbal/telephone order. This quality data is then shared with the staff.
- After writing down the new order, some departments are using a written code of “RB” next to their name. For example: Lasix 20mg Intravenous Push now. Telephone Order: Dr. B. Jones to Sally Sondrel, RN “(RB)”.
- Many hospitals have modified order forms (or computer software) to include a blank box to be “checked” and “initialed” when a telephone or verbal order is “read back.”

Be sure to repeat the name of the drug, the dosage ordered, and request or provide correct spelling. This is particularly important to prevent errors for sound-alike drugs.

Emergency Situations

What about emergency situations such as a Code?

If the healthcare prescriber calls out the medication order and the healthcare professional repeats it back before administering the drug, (and the code recorder is documenting the name of the drug, dose, time, route, and rate), is this acceptable?

TJC tells us that “yes,” in certain situations such as a Code or in the OR, it may not be feasible to do a formal “read back.” In such cases, “repeat back” is acceptable.

Test Yourself
True or False? During a code, it is not necessary to perform a read back.
The correct answer is: True!

Abbreviations

TJC discourages the use of identified high-risk standard abbreviations. In 2004, The Joint Commission created a “do not use” list of abbreviations as part of the requirements for improving the effectiveness of communication among caregivers (NPSG.02). In 2010, NPSG.02.02.01 was integrated into the Information Management standards as elements of performance 2 and 3 under IM.02.02.01.

Currently, this requirement does not apply to pre-programmed health information technology systems (for example, electronic medical records), but this application remains under consideration for the future. Organizations contemplating introduction or upgrade of such systems should strive to eliminate the use of dangerous abbreviations, acronyms, symbols, and dose designations from the software.

The official “Do Not Use” abbreviations list can be viewed in Appendix I.

In addition, each organization accredited by TJC is asked to identify and apply at least three additional “do not use” abbreviations, acronyms, or symbols of its own choosing. Appendix I of this course contains a list of abbreviation suggestions compiled by TJC accredited organizations.

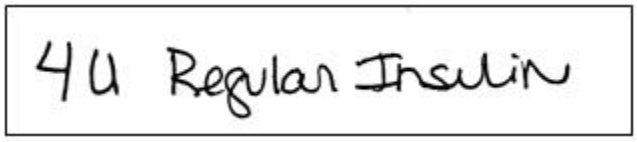
List of commonly used (and optional)
"Do Not Use" abbreviations

Abbreviation	Potential Problem	Preferred Term
µg (for microgram)	Mistaken for mg (milligrams) resulting in one thousand-fold dosing overdose	Write "mcg"
c.c. (for cubic centimeter)	Mistaken for U (units) when poorly written	Write "ml" or "mL" for milliliters
AD, AS, AU (right ear, left ear, each ear)	Mistaken as OD, OS, OU (right eye, left eye, each eye)	Use "right ear," "left ear," or "each ear"
OD, OS, OU (right eye, left eye, each eye)	Mistaken as AD, AS, AU (right ear, left ear, each ear)	Use "right eye," "left eye," or "each eye"
S.C. or S.Q. (for subcutaneous)	Mistaken as SL for sublingual, or "5 every"	Write "subcut" or "subcutaneously"
D/C (for discharge)	Interpreted as discontinue whatever medications follow (typically discharge meds)	Write "discharge"
Q hs (nightly at bedtime)	Mistaken as Q hour (every hour)	Use "nightly"
SSRI (sliding scale regular insulin)	Mistaken as selective –serotonin reuptake inhibitor	Spell out "sliding scale"

The Dangers of Transcription Abbreviations

The "U" (units) looks like a "0" (zero)

A common example of an abbreviation error begins when the abbreviation "U" is written instead of "units."



A handwritten order for 4u of regular insulin might be mistaken for 40 units of regular insulin and thus a potentially life-threatening drug error may occur.

To avoid this type of error, skip the abbreviation and write out the full word "units." ALWAYS clarify with prescribing physician when unclear.

Q.D. Mistaken for QID

The Latin abbreviation for "every day" is "Q.D." When a healthcare professional reads an order for Lasix 20mg Q.D., he/she will administer one dose of this drug every 24 hours. On occasion, the period

after the “Q” has sometimes been mistaken for an “I” and the drug has been given QID or four times a day.

In this example, if the transcriber thought the order was QID, the patient would receive a total of 80mg of Lasix in 4 (20mg) doses over 24 hours. As practitioners, we all know that either dose (20mg/day or 80mg/day) is within normal ranges for many of our patients. Potential risks of giving the higher (incorrect) dose include dehydration and hypokalemia, which can result in life-threatening dysrhythmias. To compound the problem, schedule abbreviation errors may continue for many days before being discovered.

Similarly, the abbreviation “Q.O.D.” for every other day can be mistaken as “QD” (daily) or “QID” (four times a day). To avoid all of these potential scheduling errors, the physician’s order should be written with detail. For example, “Lasix 10mg IV once a day” (instead of Lasix 10mg IV QD) or “KCL 20mEq PO four times a day” (to replace KCL 20 mEq PO QID).

The above examples outline the importance of the nurse’s role in examining and questioning all orders when abbreviations or writing is unclear. Extreme care must be taken with both units of drug dosages and with dose frequencies.

Misinterpretation of Decimal Points and Zeros

Unnecessary zeros at the end of a prescribed dose is another potential danger zone. The decimal point may not be seen when orders are handwritten using trailing zeros or no leading zeros.

For example, your patient can receive “Morphine Sulfate 1mg IV Q 1 hour prn pain.”

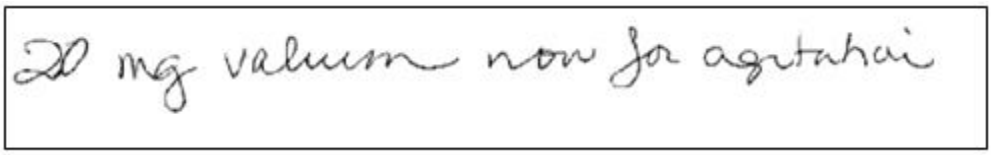
If the order was written “Morphine Sulfate 1.0mg IV Q 1 hour prn pain,” it is possible that a novice clerk or healthcare professional might transcribe a handwritten order as “Morphine Sulfate 10mg IV Q 1 hour prn pain.” Three 10mg doses later, the patient has a respiratory arrest and the transcription error is finally discovered!

Examples of correct and incorrect use of decimal points and zeros:

Correct	Incorrect
2 or 2.	2.0 (the decimal point may not be seen)
0.2	.2 (the decimal point may not be seen, so adding the zero before the decimal adds clarity to this order)

Healthcare professionals can also improve quality by assuring that they are not using the “do not use” abbreviations when writing verbal or telephone orders in the medical record.

An example of an ambiguous order:



Is the physician ordering 20 mg for a patient who takes valium daily or 2 milligrams for a patient who doesn't normally take valium?

The Importance of Spell Checks

When “reading back” verbal and telephone orders, nurses can further enhance their practice in medication safety by asking the prescriber to “spell” the name of the medication.

Confusion over the similarity of drug names, (either verbal orders or illegible hand-written orders) can result in a medication error.

Potential confusion can occur between similar brand names, between similar generic names, and between similar brand and generic names.

This confusion can be compounded by incomplete knowledge of drug names, newly available products, similar packaging or labeling, and incorrect selection of a similar name from a computerized medication dispensing system.

Sound Alike Medications

Many drugs have similar sounding names and can be easily confused when transcribing a verbal order.

In 2010, the look-alike/sound-alike requirement (NPSG.02.02.01) was moved to the Medication Management standard MM.01.02.01. According to this standard, hospitals are required to develop a list of look-alike/sound-alike medications that are commonly stored, dispensed and administered.

The best source of information on look-alike/sound-alike medications is The Institute for Safe Medication Practices (ISMP).

Copy and paste this link to your browser to view the ISMP's List of Confused Drug Names: http://www.ismp.org/Tools/confuseddrugnames.pdf

Sound Alike Medications

Case Scenario

According to the Institute of Safe Medication Practices (2003), a patient was admitted to the hospital for treatment of severe psoriasis. Soriatane (Acitretin) 25 mg was prescribed, but the handwritten order was misread and entered into the pharmacy computer as Sertraline (Zoloft) 25 mg.

Soriatane is a retinoid that is indicated for severe psoriasis, but in this case, the antidepressant, Zoloft, was dispensed and administered for one week.

This event may have increased the patient’s length of stay, since he did not receive immediate treatment for his chief complaint. Fortunately, he wasn’t harmed from taking Zoloft for a week. A healthcare professional discovered the error during a pre-administration review of the indications for each of her patient’s medications.

Tall Man Lettering

As part of a campaign to decrease errors of look-alike/sound-alike medications (LASA), the Institute for Safe Medication Practices (ISMP) recommends that hospitals take measures to address the issue of these medications. The institute has developed a concept of tallman lettering, or capitalization of a few letters within a drug name, to differentiate a standard set of LASA drug name pairs.

When two medications have very similar names, using capital (or Tall Man) letters in the middle of the drug name, has been shown to decrease the risk of error (ISMP, 2010c). For example:

ALPRAZolam - LORazepam

PARoxetine - FLUoxetine

buPROPion - busPIRone

predniSONE - prednisoLONE

This concept can assist healthcare professionals in identifying LASA drugs and alerting them to the possibility of a medication error. The capitalization of parts of drug names calls attention to the differences between drugs that look and/or sound the same.

Tall man lettering should be implemented as a multi-step process, involving staff education and ongoing audits to fully implement the program. Staff need to be educated on avoiding misinterpretation of tall man letters, so that they understand what they are reading. This can be accomplished at in-service training sessions, unit meetings and annual skills labs.

Copy and paste this link to your browser to view drug-name sets with recommended tall man letters:

http://www.ismp.org/tools/tallmanletters.pdf

Combination Look-Alike/Sound-Alike Medications

To facilitate compliance with this quality effort, the TJC is requiring each hospital to select a minimum of 10 combinations of look-alike/sound-alike medications for focused efforts. Five of these combination meds must come from their master list of high risk meds. The other five can be selected by each hospital. Remember that these names may not sound just exactly alike as you read them or look at them in print, but when handwritten or communicated verbally, these names can cause a potential mix-up.

Partial list of sound-alike drugs:

High-Risk Insulins	
Humalog Insulin	Humulin Insulin
Lispro Insulin	Lente Insulin
Novolog Insulin	Novolin Insulin
Other High-Risk Meds	
Dilaudid (Hydromorphone)	Morphine Sulfate
Diflucan	Diprivan
Advair	Advicor
Ambisome	Amphotericin B
Celebrex	Celexa
Ephedrine	Epinephrine
Folic Acid	Folinic Acid
Taxol	Taxotere
Zyprexa	Zyrtec

Don't be fooled! When taking a verbal order from a healthcare provider, always ask them to spell-out the medication for you! It's also acceptable to ask for the rationale of why the particular drug is being started. With the correct spelling and knowledge of drug rationale, you are off to a solid start in the prevention of a sound-alike drug error.

For a comprehensive List of Confused Drug Names compiled by the ISMP log on to www.ismp.org.

Suggestions!

- **Ask about posting a list of "do not use" abbreviations at the nurses' station.**
- **Carry a pocket reference or name-badge reference card.**
- **Never use these high-risk abbreviations when writing verbal orders!**

High-Alert Medications

ISMP creates and periodically updates a list of high-alert medications. The list is lengthy and includes categories of medications that are used only in specialized settings, such as anesthetics, chemotherapeutic agents, dialysis solutions, neuromuscular blocking agents, and radiocontrast agents. Some of the specific medications listed are for the most part limited to use in specialties, such as magnesium sulfate and oxytocin in Labor & Delivery.

As a part of its 5 Million Lives safety campaign, IHI focuses on four categories of high-alert medications which represent areas of greatest harm and greatest opportunity for improvement (5 Million Lives Campaign, 2008):

• Anticoagulants

• Insulin

• Narcotics and opiates

• Sedatives

Know the list of high-alert medications which your organization has developed. Pay particular attention to policies and procedures related to the high-alert medications used in your practice area. You may be very familiar with the specific medications, but your organization may have established more stringent safety-oriented policies and procedures than you have used in the past. Policies may include independent double-checks or the use of specialized supplies.

Copy and paste this link to your browser to view the complete list of ISMP High-Alert Medications:

http://www.ismp.org/Tools/highalertmedications.pdf

Electronic Order Entry

The diversity of causes of medication errors requires many possible solutions. The most immediate and far-reaching may be in the area of technology including computerized physician order-entry (CPOE) systems and bar coding. The CPOE system allows real-time patient identification, drug dose recommendations, adverse drug reaction reviews, and checks on allergies and test or treatment conflicts. Physicians and nurses can review orders immediately for confirmation.

By utilizing electronic order entry, organizations can most certainly minimize medication errors, including those related to poor handwriting, thus drastically reducing risk to patients and costs associated with drug-related morbidity and mortality.

CPOE/e-Prescribing systems can provide automatic dosing alerts (for example, letting the user know that the dose is too high and thus dangerous) and interaction checking (for example, telling the user that two medications ordered together can cause untoward interactions).

On the other hand, CPOE can also present several possible dangers by introducing new types of errors. Prescriber and staff inexperience may cause slower entry of orders at first, use more staff time, and can be slower than person-to-person communication in an emergency situation. Physician to nurse communication can worsen if each group works alone. Automation can cause a false sense of security. So CPOE needs to be utilized with caution and all staff members need adequate training prior to use.

Electronic Order Entry

Think About it:
Numerous institutions are beginning to see a marked reduction in medication errors and adverse drug events with the implementation of CPOE systems.
Is this happening at your facility? If so, have you noticed a reduction in “transcription-related” medication errors?

Bar Code Scanning

An additional method of improving patient safety is through enhanced information technology via the use of machine-readable codes. By using bar code scanning devices, we can help guarantee that the right drug and dose are being administered to the correct patient.

In an effort to improve patient safety in the hospital setting by reducing medication errors, the Food and Drug Administration (FDA) has published a final rule entitled: *Bar Code Label Requirements for Human Drug Products and Biological Products.* Bar codes allow healthcare professionals to use bar code scanning equipment to verify that the right drug (in the right dose and right route of administration) is being given to the right patient at the right time. This system is intended to help reduce the number of medication errors that occur in hospitals and healthcare settings

The FDA estimates that once implemented, bar coding medications will result in more than 500,000 fewer adverse events over the next 20 years.

The FDA further estimates a 50% reduction in medication errors that would otherwise occur when drugs are dispensed or administered.

Some hospitals that currently have bar code systems in place report an even higher error reduction from bar code usage.

How Bar Coding Works

A bar code system works as follows:

1. A patient is admitted to the hospital. The hospital gives the patient a bar coded identification bracelet to link the patient to his or her computerized medical record.
2. As required by the rule, most (and hopefully all) prescription drugs and certain over-the-counter drugs would have a bar code on their labels. The bar code would reflect a drug-specific number.
3. The hospital would have bar code scanners or readers that are linked to the hospital's computer system of electronic medical records.
4. Before a healthcare professional administers a drug to the patient, they would scan his/her bar coded employee identifier, the patient's wrist band to confirm patient identity, and then each package of medications to be administered at the bedside. The system would verify the dispensing authority of the caregiver, confirm the patient's identity, match that identity with his/her medication profile, check the "rules engine" for any alerts or reminders for the nurse, electronically record the action in an online medication administration record (MAR), and store data for later aggregate analysis.

The NPSGs require us to improve the accuracy of patient identification. At least two patient identifiers are required wherever taking blood samples, or administering medications or blood products.

Preventing Errors Using Bar Coding

Bar coding can help prevent common drug errors such as:

- Wrong patient
- Wrong dose of drug

- Wrong drug
- Wrong time to administer the drug

For example, a bar code system could prevent a child from receiving an adult dosage of a drug and prevent a patient from mistakenly receiving a duplicate dose of a drug he or she had already received.

A bar code system can also allow the computer to record the time that the patient receives the drug, ensuring more accurate medical records.

Current Status of Bar Coding

In the year 2000, the Institute of Safe Medication Practice (ISMP) conducted an assessment on bar coding in hospitals. At that time, only 2.5% of hospitals had implemented this technology. In 2005, only 11.5% of hospitals were using this technology. The American Society of Health System Pharmacists has established a goal that by the year 2015, 75% of hospitals will use machine-readable coding to verify medications before dispensing.

Despite the interest in this safe medication practice technology, numerous challenges face hospitals. Barriers for implementing bar coding include the following:

- Only about 35% of drugs currently contain manufacturer's bar codes. In the future, regulation should cause this percentage to increase.
- There is no uniform standard for bar coding medications.
- No standard exists for relabeling or bar coding in-house medications. In the absence of such standards, hospitals are left to follow whatever commercial standard exists.
- Interfacing the bar-coded medication administration system with the hospital's Information Technology can be costly.
- Bar code scanners need to be readily available and set up to be user-friendly in order to minimize any disruption of a nurse's workflow.
- During times of nursing staff shortage, temporary "agency" or "floating" nurses may be unfamiliar with the system and its proper use. Time and money must be spent to orient these practioners to use the technology safely.

Limitations of Bar Coding

Bar coding was initially anticipated to improve patient safety by adding an extra layer of precaution for nurses who administer drugs according to the "five rights." Yet, today, even though barcode scanning technology is widely used in healthcare in the United States, medication errors persist. Some of common concerns with barcode scanning include:

- **Noncompliance:** Failure to scan. When a system doesn't work well, there's a temptation not to use it. When staff nurses repeatedly encounter technical difficulties with the equipment, such as dead batteries, missing cables and unreliable wireless connectivity, non-compliance can occur.

- **The urge to override an alert:** All medication dispensing systems have an override feature, so medicine can be administered in an emergency without formal orders. But sometimes staff may become too comfortable with this feature. For example, if a nurse is unaware that pharmacy orders have changed on a patient's insulin dose, and she receives an alert that the dose is wrong, she may override the alert without investigating as she has administered this dose before and it seems

right to her.

- **Unnoticed Alerts:** If a nurse has to leave a cart in the hall and enter the patient's room with only a hand-held scanner, she may administer the wrong drug and not see the alert until she returns to the cart and sees the alert on the monitor. It's crucial that audible or visual alerts be impossible to miss.

- **The matter of workarounds** (finding an alternative method of accomplishing a task when the standard process is not working well): A common workaround in barcode scanning is to have a second set of patient wristbands in another location that can be scanned instead of the original wristband. If there are logistical issues that make scanning processes inconvenient, they should be resolved rather than ignored. Nurses need to feel comfortable pointing out these areas in need of improvement, and nurse managers should strive to collaborate with IT departments to correct them.

- **Dangerous distractions:** When an accepted workflow process is interrupted, errors are more likely to occur. Consider a scenario in which a nurse scans and verifies a patient's medication, but is then called away to assist a colleague. She sets the drugs back down on the cart and walks away. Five minutes later, she returns to the cart and administers the drugs to the wrong patient.

American Sentinel (2013).

Medication Reconciliation

Medication reconciliation refers to the process of thoroughly reviewing patients' complete medication regimen at the time of admission, transfer, and discharge and comparing it with the regimen being considered for the new setting of care.

As of July 2011, medication reconciliation has been incorporated into National Patient Safety Goal #3, "Improving the safety of using medications." This NPSG requires organizations to maintain and communicate accurate medication information and to compare the medication information the patient brought to the hospital with the medications ordered for the patient by the hospital in order to identify and resolve discrepancies across the continuum of care. This process is referred to as the Reconciliation Of Medications Across the Continuum of care (ROMAC).

Most medication errors occur during "hand-off" between units, departments, and facilities, as a medication list may include outdated medications and IV meds which are no longer needed.

The Medication Administration Record (MAR) needs to be updated before the patient transfers. The healthcare provider gives an order to "continue same meds." The receiving nurse may receive a confusing MAR and can then be prone to making a medication error.

This practice of "continue same medications" is no longer acceptable. The healthcare provider must "reconcile" the medications before the transfer.

ROMAC Begins At Admission

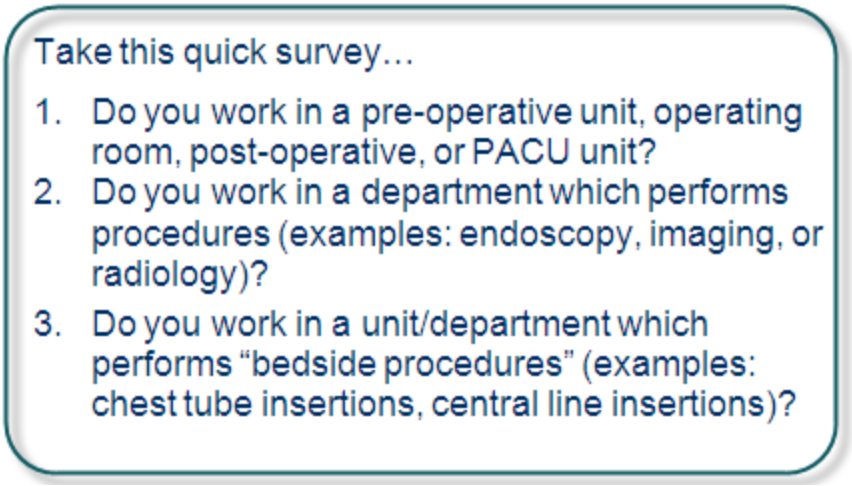
Did you know that the ROMAC process must begin at admission? Did you know that healthcare facilities are required to implement a process for obtaining and documenting a complete list of the patient's current medications upon the patient's admission?

This process must include a comparison of the admission medications to the meds taken at home. If the healthcare provider does not want to continue a medication previously taken at home, it must be indicated on your ROMAC documentation tool.

Medications must also be “reconciled” when a patient is transferred to another level of care, to a new practitioner, or to a new setting (e.g. a hospitalized patient is transferring to a Rehab facility).

Many healthcare facilities have established useful “transfer” documentation tools to assist with this process. A complete list of medications must also be provided to the patient on discharge as well.

Labeling Medications



If you answered “yes” to any of the three questions above, you should know that TJC has a regulatory standard requiring healthcare professionals to “label all medications, medication containers (e.g. syringes, medicine cups, basins), or other solutions on and off the sterile field in perioperative and other procedural settings.”

If a medication or solution is to be given immediately, it does not require a label. However, if a medication or solution will be given intermittently, the syringe or container must be labeled. The label should include:

- Drug name, strength, amount
- Date prepared and the dilutent for all compounding IV admixtures

According to TJC, in most cases of medications and solutions in the procedural setting, only the drug name and strength (concentration) will be needed. These regulatory standards help broaden our scope of medication safety.

Medication safety is a very broad topic. The first part of this course emphasized the most current issues you are probably hearing about every day in your organization. The following sections reviews the more “traditional” parts of medication safety including the “5 Rights,” allergies, and IV medication issues.

Labeling Anticoagulants

Anticoagulants are one of the top 5 drug types associated with patient safety incidents in the U.S.

(TJC, 2008a). TJC established a National Patient Safety Goal specific to improving safe administration of anticoagulants.

The most commonly used anticoagulants are also the ones most frequently cited in error reports: unfractionated heparin, warfarin, and enoxaparin, a low molecular weight heparin (LMWH).

General guidelines for safe anticoagulant therapy include:

- Improving staff communication and access to information.
- Implementing close pharmacy oversight and involvement, such as a pharmacist-managed anticoagulation service.
- Enhancing patient education.
- Managing anticoagulant therapy with a multi-disciplinary team.
- Using evidence-based protocols and best practices.

More info:

The entire classification of anti-thrombotic drugs is considered high-alert, including:

- **Direct thrombin inhibitors such as argatroban and lepirudin.**
- **Factor Xa inhibitors, such as (Arixtra®).**
- **Glycoprotein IIb-IIIa inhibitors, such as abciximab (ReoPro®).**
- **Thrombolytics, such as alteplase (Activase®).**

TJC Recommendations: Anticoagulants

TJC recommends that healthcare organizations implement policies and procedures that:

- Set organization-wide dose limits on anticoagulants and screen all orders for exceptions, that is, require a confirmatory override by the physician.
- Clearly label and differentiate syringes and other containers used for anticoagulant drugs.
- Clarify all anticoagulant dosing for pediatric patients, and use programmable pumps to ensure accurate and consistent dosing.
- Promptly re-evaluate patients whose anticoagulant is being held for a procedure, including an assessment of the need to reorder anticoagulant therapy.
- Provide timely communication of all anticoagulant-associated lab values to the provider or person managing anticoagulation therapy.
- Educate and assist inpatients who require anticoagulant drugs to practice administering their own medications. This will help reduce the risk of errors after discharge.

Did You Know?
32.2% of preventable adverse drug events in a teaching hospital involved anticoagulants. This was double the amount caused by any other medication (Purdue University PharmaTAP, 2008).

Assessing Health Status

The healthcare professional should always assess a patient's health status and obtain a medication history prior to giving any medications.

The extent of the assessment depends on the patient's current illness and past medical history.

Health Assessment Quiz:

Your patient is to receive his routine morning dose of hydrochlorothiazide, amlodipine (Norvasc), and enalapril (Vasotec). You know that all three of these medications can lower _____.

The correct answer is: Blood Pressure.

Health Assessment Quiz

- **Hydrochlorothiazide**
- **Amlodipine (Norvasc)**
- **Enalapril (Vasotec)**

Each of the three drugs listed above lowers blood pressure via a different mechanism. Name the drug classification of each medication.

Answer:
Hydrochlorothiazide is a diuretic.

Amlodipine is a calcium channel blocker.

Enalapril is an angiotensin enzyme inhibitor (ACEI).

The healthcare professional should always assess the blood pressure of a patient before administering any anti-hypertensive medications.

By the same token, the healthcare professional would also check the latest potassium blood level before administering a dose of Lasix.

Appropriate Routes of Administration

It is important to determine whether the route of administration is appropriate. For example, a patient who is nauseated may not be able to take oral medications.

Another example is when a confused patient pulls out their intravenous (IV) catheter before their next dose of intravenous (IV) Digoxin. Is this patient able to swallow the PO form of Digoxin?

What about the new CVA patient who gags and coughs when the nurse attempts to administer PO meds?

Collaborative problem solving with the physician will assure the appropriate route of medication administration for this patient.

In general, the nurse must assess the patient prior to administering any medication to obtain baseline data by which to evaluate the effectiveness of the medication.

Assessing Allergies

An important part of a patient's history is the patient's knowledge of his or her drug allergies.

Some patients can tell you extensive allergy information while others are vague and uncertain.

If the patient is a poor historian, the patient's primary physician should offer information about allergies.

Prior to administering medications, the healthcare professional must make a mental note of all drug allergies while checking against the current medication administration record (MAR) for potential incompatibilities.

Medications should not be administered until allergies are known.

Global Medication Administration Guidelines

Use the following clinical guidelines for administering medications:

1. Question any order that you consider incorrect. Healthcare professionals are responsible for their own actions.
2. Be knowledgeable about the medications you are going to administer. Understand the rationale for the specific drug as it relates to either the patient's past medical history or treatment of current illness. Ask yourself - does this drug make sense for this particular patient?
3. Know your patient's drug allergies and ask questions when unsure about potential incompatibilities.
4. Use only medications that are in a clearly labeled container.
5. Do not use liquid medications that are cloudy (excluding select insulins) or medications which have changed color from baseline.
6. Do not leave medications at the bedside. Check your hospital's policy for a list of medication exceptions such as cough syrup or skin creams.
7. If a patient vomits after taking an oral medication (especially a first time medication), report this to the shift supervisor, pharmacist, and healthcare provider.
8. Take special precautions when administering high-risk medications. For example, ask another healthcare professional to double-check the dosages of anticoagulants, insulin, and certain IV preparations per your hospital's policy.
9. When a medication is omitted for any reason, clearly record the rationale for holding the medication.
10. When a medication error is made, report it immediately to the shift supervisor, the healthcare provider, and the pharmacist.

Adapted from Kozier, Erb, Berman & Burke (2000)

Getting the 5 Rs Right... Every Time!

Preparing and administering medications requires accuracy and the full attention of the healthcare

professional. The "five rights," or “5 Rs,” is a traditional checklist to promote accuracy in drug administration.

1. **Right drug**
2. **Right dose**
3. **Right client (with 2 identifiers)**
4. **Right route**
5. **Right time**

Right Drug

When a new drug is ordered, the healthcare professional is responsible for assuring the Medication Administration Record (MAR) is updated appropriately. Once the order has been transcribed onto the MAR, the healthcare professional typically dates and initials to verify this order is correct. Many healthcare facilities require the shift supervisor to be designated as responsible for verifying the order was transcribed correctly at a minimum of every 24 hours.

To assure correct drug administration, the healthcare professional compares the label of the drug with the MAR at least three times:

- Before removing the drug from the storage container
- Before placing the drug in the medicine cup for distribution; and
- Before giving the drug to the client

If the drug is ordered by trade name, but dispensed from pharmacy by the generic name, the nurse must verify that there is not a discrepancy. For example, another name for Dexamethasone (generic) is Decadron (trade name).

A common source of errors occurring between generic and trade names is with Hydromorphone (generic) which is not Morphine, but actually Dilaudid (trade name) (TJC 2006). Always check when unsure.

Right Drug Alert!!

A common drug error is the misinterpretation of Hydromorphone.

Hydromorphone is Dilaudid NOT Morphine Sulfate.

Did you know that Hydromorphone is 10 times stronger than Morphine Sulfate? It would be easy to make this mistake and over medicate your patient!

Right Dose

Whenever a medication must be prepared from a dose other than what is ordered, the chance of error increases.

After calculating the dose, having a second healthcare professional check the calculation is recommended, especially if it is an unusual calculation or involves a potentially toxic drug.

Common scenarios where it is helpful to have another nurse double-check your calculations include:

- Weight-based drugs

- Drug conversions
- Cutting tablets
- Unfamiliar IV calculations
- High-risk drugs

Weight-Based Drugs:
For example, a bolus of heparin is typically given in units per kilogram.

Test Yourself
The healthcare provider wants you to administer heparin 40 units/kg for a 70 kg patient. What is the correct dose of heparin?
The correct answer is: 2800 units.

Drug Conversions

Drugs may need to be converted from grams to milligrams or milligrams to micrograms.

Test Yourself
Consider an order for Vancomycin 0.5grams. The drug is prepared in milligrams. How many milligrams are equal to 0.5grams?
The correct answer is: 500mg =0.5grams.

Cutting of Tablets:

The pharmacy cannot always provide the drug in the specified dose.

Example: Metoprolol 25mg po BID. The pharmacy sends you a 50mg tablet.

Don’t forget to cut the tablet and have another nurse check the dose just to be sure.

IV Drip Calculations

Unfamiliar IV Drip Calculations:

Dopamine is given in mcg/kg/minute. Since this drug is more complex and harder to calculate, check with another healthcare professional or pharmacist.

Many infusion pumps have “profiles” built in to assist correct dosing.

Be aware as infusion pumps can mysteriously “travel” to other departments which may use a “different profile.”

Make sure your infusion pump has the correct programmed unit of measurement.

High-Risk Drugs:

Examples include: insulin, heparin, warfarin, and narcotics.

Test Yourself
High alert medications include:

A. **Insulin**
B. **Heparin**
C. **Narcotics**
D. **All of the above**

The correct answer is: D. All of the above.

Right Client

True story… A healthcare professional with approximately 9 months of work experience was caring for five patients. Each patient had routine 9 a.m. medications. Each patient was to receive an average of 7 medications. While standing at the noisy medication cart, the professional began by preparing meds on two of her patients. She opened up each pill and put them into separate plastic medicine cups. She kept the medication wrappers in her other hand and went into the room to give the morning medications to patient X. As she gave each medication, she explained the name, dose, and rationale to the patient. About halfway through this process, the healthcare professional discovered she was giving medications to the WRONG PATIENT! She caught her error because the type of medications "just didn't make sense" for this patient type.

What went wrong during this process? The nurse had not cross-referenced the MAR to the patient's ID band. A breakdown with drug administration to the "right" client might occur at any time or in any setting, but especially in a hectic work environment when the nurse has several patients who need medications within a similar time frame. To identify patients correctly, the nurse must verify the MAR against the client's identification bracelet. By forming this identification system on a routine basis, the nurse will develop good habits to prevent giving medications to the wrong patient.

Improving the Accuracy of Patient Identification

The 2013 National Patient Safety Goals also require us to "improve the accuracy of patient identification. At least two patient identifiers (neither can be the patient's room number) are required wherever taking blood samples, or administering medications or administering blood products.

Do you ever have a "name alert" sign posted behind your nursing station, indicating two patients with similar names?

The rationale for this required double identifier is the risk associated with administering medications to patients with similar or identical names.

The second identifier should already be identified by your organization. Many organizations are using the date of birth, medical record number, or hospital/clinic ID # as the second identifier.

In the behavioral health areas, a second identifier might be a patient photograph.

Remember to check both the patient name and second identifier against your medication administration record (MAR) ID before you administer your medications.

Take the time to familiarize yourself with "acceptable second identifiers" according to your organization.

Right Route

The healthcare provider's order must designate a route of administration. If the route of administration is missing or if the specified route is not recommended, the healthcare professional must consult the prescriber for clarification.

When injections are administered, the healthcare professional must use only preparations intended for parenteral use.

Injections of a liquid intended for oral use can produce local complications, such as sterile abscesses or fatal systemic effects.

To promote safe practices, many pharmaceutical companies label parenteral medications "for injectable use only" (American Society of Health-Systems Pharmacists [AHFS], 2001).

Right Time

Each hospital has routine time schedules for medications ordered at standard intervals. For example, medications to be given three times a day (T.I.D.) may be routinely scheduled for 09:00, 13:00, and 21:00.

A drug may also be ordered every 8 hours, which is also 3 times a day. However, the drug ordered Q 8 hours needs to be given at 8 hour spaced intervals around the clock.

For example, 1mg IV Q 8 hours could be given at 01:00, 09:00, and 17:00.

Even though both examples are given three times a day, the timing differs considerably.

All routinely ordered medications should be administered within 30 minutes before or after the scheduled time, depending on the policy of your organization. Professional judgment for holding a medication or administering a medication slightly early always takes precedence but must be communicated to the healthcare provider.

Right Time

Certain medications require precise timing. Many of the aminoglycoside classification of antibiotics (e.g. tobramycin, gentamicin) require careful monitoring of peak and trough blood levels. These levels assist the healthcare provider in determining absorption and help guide future dosing.

Some experts recently added 3 more Rights to the existing list:

- Right documentation (completed after administration)
- Right reason (confirm rationale for giving the medication)
- Right response (ensuring that the drug leads to the desired effect).

(Lippincott, 2012).

In addition to the 8 Rights, always remember to assess your patient for allergies.

By getting "back to basics" and using the eight Rs, each healthcare professional can feel safer about the administration of patient medications.

Individualized dosing helps to prevent toxic side effects such as nephrotoxicity and ototoxicity.

Considerations for the Older Patient

An older person can present with unique medication challenges, many of them related to decreased organ perfusion and potential drug toxicity.

Additional medication challenges include short-term memory impairment which may cause a person to take incorrect dosages, multiple doses, or even skip doses. Impaired vision may lead to over-or under-dosage.

Impaired agility in opening containers may encourage a patient to miss a medication dose.

Despite the pharmacy coverage for Medicare patients, financial factors and limited transportation may keep the patient from refilling prescriptions.

The physiologic changes in elderly persons which may influence medication safety will be discussed in greater detail in the sections that follow.

Drug Toxicity and Physiological Changes

The elderly are at risk for drug toxicity for a variety of reasons. Drug reactions may be dose-related or the result of the drug's interaction at the cellular level. The elderly may have several chronic illnesses that require medication for management. These medications may interact, producing undesirable symptoms.

Absorption and metabolism of medications are altered in elderly patients because of decreased gastrointestinal (GI), renal, and liver function. Generally speaking, medications are not metabolized as quickly and blood levels of medications remain higher for a longer period of time. Elderly patients are more sensitive to medications and at increased risk of drug toxicity (American Geriatric Society [AGS], 2013).

Opioid and nonopioid analgesics can be given effectively to elderly patients, but must be used cautiously because of increased susceptibility to depression of both the nervous and respiratory systems.

Morphine sulfate or Fentanyl are recommended as a better alternative for IV pain management because they do not have a toxic metabolite (AGS, 2013).

Copy and paste the following link to your browser to review the 2012 Beers Criteria:

http://www.americangeriatrics.org/files/documents/beers/BeersCriteriaPublicTranslation.pdf

Drug Toxicity and Physiological Changes

As mentioned previously, liver impairment may occur in the elderly. Hepatic breakdown of drugs may be different even when two drugs are in the same drug classification. For example, diazepam (Valium) and lorazepam (Ativan) are both benzodiazepines. Diazepam is metabolized into other sub-metabolites which have a longer-acting effect when compared to the metabolic breakdown of lorazepam. Thus, diazepam will have more sedative effects in the elderly than lorazepam. In patients with hepatic or renal insufficiency, drugs metabolized by those organs may have a prolonged half-life, increasing their likelihood to produce side effects (AHFS, 2001).

Some drugs having a very narrow therapeutic window in the elderly include: digoxin, theophylline, warfarin, lithium, lidocaine, and aminoglycosides. Rather than the more commonly seen side effects of nausea, vomiting, diarrhea, and rash, symptoms of drug toxicity in the elderly frequently include delirium, depression, worsening dementia, orthostatic hypotension, falls, and incontinence (Smeltzer & Bare, 2000).

The effects of aging on drug metabolism:

CHANGE	EFFECT
Slower gastrointestinal (GI) motility	Less complete and slower absorption of medications from GI tract
Decreased renal function	Slower elimination of renal cleared drugs resulting in slower elimination and higher drug concentrations in the bloodstream for longer periods
Decreased liver function	Slower elimination of drugs normally cleared by the liver resulting in higher drug concentrations
Increased proportion of fat to lean body mass	Retention of fat-soluble drugs and potential for toxicity (e.g. sedatives/hypnotics)
Heart is dependent upon endogenous catecholamines for effective pumping along with decreased myocardial contractility	Beta-blocking agents may precipitate heart failure. Closely monitor heart rate and blood pressure with new or altered beta-blocker therapy.
Dopamine-making capacity of neurons decreases	Phenothiazines (Thorazine, Compazine) further block dopamine uptake, precipitating Parkinsonian-like symptoms.
Dependence on prostacyclin-mediated renal vasodilation to maintain glomerular blood flow	Non-steroidal anti-inflammatory drugs (NSAIDS) that block prostacyclin may decrease renal blood flow and precipitate acute renal failure. Monitor BUN and Creatinine levels with new NSAIDS or increased dose adjustment.
Dependence on elevated renin levels to maintain renal perfusion	Angiotensin-converting enzyme inhibitors (ACEI) may decrease renal blood flow and precipitate acute renal failure. Monitor BUN and Creatinine levels with new ACE inhibitor therapy. MD may order an ultrasound of renal arteries to r/o renal stenosis prior to staring ACEI therapy.

Wagner, Johnson & Kidd, 2006 (modified)

In summary, it is essential to closely monitor the elderly patient's response to medications while anticipating side effects and interactions. When drug dosages are increased or new drugs added, the nurse should increase surveillance in those areas. Typical signs of drug toxicity in the elderly involve CNS changes.

Local Verses Systemic Complications

Complications associated with IV therapy are classified according to their location. Local complications are usually seen at or near the cannula insertion site. These complications are more common than systemic complications and are not as serious.

Trauma to the intima of the vein can lead to local complications causing fluid to leak into the surrounding tissue causing edema. This process can potentially lead to necrosis of surrounding tissue. If necrosis occurs, the patient could require skin grafting. Healthcare professionals who perform intravenous procedures must use techniques to prevent trauma to the venous intima and must frequently monitor the IV site and IV system for signs of potential complications.

Systemic complications are those occurring within the vascular system, usually away from the actual IV site. Although less frequent, these complications can be life-threatening. If an infection at the IV site is not detected early or goes untreated, a systemic blood sepsis infection may result.

Some local complications may also lead to the more serious systemic complications. For example, a severe thrombophlebitis (blood clot and swelling within a blood vessel) can potentially develop into a pulmonary embolism if the thrombus becomes detached and free-flowing into the vascular system (Perdue, 2001).

Note!
Nurses who perform intravenous procedures must use techniques to prevent trauma to the venous intima (innermost lining of the vein).

Infiltration

Infiltration is the administration of a non-vesicant (agent that does not cause blistering) solution or medication into surrounding tissue (Smeltzer & Bare, 2000). This can occur when the IV cannula dislodges or perforates the wall of the vein. The result of an infiltration includes inadequate delivery of prescribed fluid and/or medication, complaint of discomfort at the site, and possible tissue damage.

Patient Assessment

A complete assessment of the patient, IV site, involved extremity, and infusion system is necessary to determine the presence of an infiltration.

The site around the tip of the cannula and extremity should be inspected for the following signs and symptoms:

- Swelling or a feeling of skin tightness
- Blanching
- Firm, cool tissue
- Slowing of infusion rate
- Discomfort

Additional Assessment Tips

Comparison of the IV site with the same area on the opposite extremity may also be helpful. If the assessment of the involved extremity is inconclusive, the application of pressure on the vein about two inches above the insertion site (must be above the tip of the cannula) with a finger or tourniquet will decrease or stop the free flowing IV infusion rate if the cannula is in the vein. If an infiltration is present, the rate will remain unchanged. If the infusion continues despite the venous obstruction, an infiltration has occurred.

Aspirating the IV tubing and cannula for a blood return is not a reliable method for determining

the absence of an infiltration. **A blood return may not be present when small veins are used because they may not permit blood flow around the cannula (Perdue, 2001).**

Interventions for Infiltrated IV Therapy

Once an infiltration has been identified, the cannula must be discontinued.

Check your institution's policy regarding which type of compress (warm or cold) should be applied. Generally speaking, if the infiltration solution was isotonic, a warm compress is used to alleviate discomfort and help absorb the infiltration by increasing circulation to the affected area.

Sloughing can occur from the application of a warm compress to an area infiltrated with certain medications such as potassium chloride. In this situation, a cold compress is recommended. Elevation of the extremity can also help alleviate swelling.

Additional nursing interventions for infiltrated IV's include:

- Healthcare provider notification of both the infiltration and the type of solution or medication which infiltrated into the tissue.
- Document site assessment and intervention. Example: "Right forearm IV site edematous. Surrounding site was cool to touch and skin had appearance of tightness. Patient complains of pain at the IV site. IV discontinued. Arm elevated, moist pack applied. Healthcare provider notified no new orders at this time." Two hours later: "Right forearm edema subsiding. Patient states more comfortable. Moist pack discontinued. Continue to elevate arm."
- If continued IV access is needed, a new cannula should be placed in the opposite extremity or in a site above and away from the previous site.

Always check your organization's policy when unsure.

Prevention Strategies for Infiltration

Not all infiltrations can be avoided, but certain measures will help minimize the risk and severity of an infiltration.

These include:

- Avoid cannula movement. Do not insert the peripheral IV over a flexion site (fingers, wrist, or antecubital area). Securely tape the cannula to protect from excessive movement.
- No blood pressure measurements, restraints, or taped arm boards on or near the IV site.
- Flush saline locks Q 8 hours or per institution's policy. Document flushes on the MAR. Missed saline flushes will decrease the lifespan of the cannula.
- Monitor IV site Q shift or more frequently if necessary.
- Patient Education: educate patient to report any signs and symptoms of swelling, discomfort, or change in appearance of IV site.

Phlebitis

Phlebitis is an inflammation of a vein related to a chemical or mechanical irritation, or both (Smeltzer & Bare, 2000). The phlebitic vein is no longer useful for IV therapy and often causes patient discomfort.

Phlebitis can also predispose the patient for possible blood stream infections.

Patient Assessment

The site around the tip of the cannula and extremity should be inspected for the following signs and symptoms:

- Pain and tenderness along the course of the vein
- Erythema
- Inflammation at site
- Feeling of warmth at site

Peripheral Intravenous Complications

Risk Factors for Phlebitis

Factors which substantially increase the risk for infusion phlebitis include the following:

- Improper cannula gauge and length
- Lack of skill of individual inserting the cannula
- Incorrect anatomic site of cannula (near areas of flexion)
- Prolonged duration of cannulation (> 72 - 96 hours)
- Infrequent dressing changes
- Acidic or Alkaline pH and/or hyperosmolality of the infusion solution

Check your organization's policy for the phlebitis scale of choice. Phlebitis should be rated according to a uniform scale.

Phlebitis scale

SEVERITY	ASSESSMENT FINDINGS
0	No clinical symptoms
1	Erythema at access site with or without pain
2	Pain at access site with erythema and/or edema
3	Pain at access site with erythema, streak formation, and/or palpable venous cord 1 inch or less in length
4	Pain at access site with erythema, streak formation, palpable venous cord > 1 inch in length, and/or purulent drainage

(From: INS Standards of Practice, 2011)

Phlebitis is classified according to the causative factors and can be mechanical or chemical in origin.

Mechanical Phlebitis

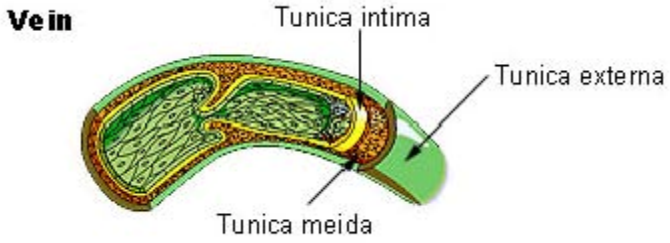
Mechanical phlebitis is associated with the placement of a cannula. Cannulas placed in flexion areas often result in this complication. As the extremity is moved, the cannula irritates the vein intima, causing injury and resultant phlebitis.

A large cannula placed in a vein that has a smaller lumen than the cannula irritates the intima of the vein causing inflammation and phlebitis.

Cannulas that are poorly taped have a tendency to move in and out of the vein allowing the cannula tip to irritate the intima (Perdue, 2001).

The experience of the person inserting an IV cannula clearly influences the risk for phlebitis.

In comparative trials, the availability of an IV therapy team of highly experienced nurses who insert IV catheters and provide close surveillance of infusions resulted in a two fold lower rate of infusion-related phlebitis and an even greater reduction in catheter-related sepsis (Maki & Ringer, 1991).



Anatomy of a vein
Courtesy of the National Cancer Institute, 2005. www.nih.nci.gov.

Chemical Phlebitis

Chemical phlebitis is associated with a response of the vein intima to certain chemicals infused into or placed within the vascular system. An inflammatory response can be created by the solution and/or medication and can also be triggered by improper dilution of drugs or inappropriate rates of infusion.

Normal blood pH is 7.35 - 7.45. The normal pH for solutions is 7.0, which is neutral. The pH for alkaline, or basic solutions ranges from 7 to 14; that for acid solutions ranges from 7 to 0 (Taber, 1999). The pH of dextrose solutions is acidic, ranging from 3.5 to 6.5.

	pH Value
Blood pH	7.35 – 7.45
Acid	0 - 7
Base	7 - 14
Acid values causing phlebitis	0 - 4.5
Base values causing phlebitis	9 - 11

Osmolarity

Solutions or medications with a high pH or osmolality predispose the vein intima to irritation. The more acidic the solution, the greater the chance of phlebitis.

Blood plasma is 290mOsm/liter. Solutions that approximate 290 mOsm are considered isotonic and those greater than this value are considered hypertonic. Solutions less than 290 mOsm are called hypotonic.

Following is a chart of the pH and osmolality of the most common IV solutions:

SOLUTION	pH	OSMOLALITY
5% Dextrose in water	3 - 5	252 mOsm/liter
5% Dextrose in water with .33 Sodium Chloride	4	365 mOsm/liter
5% Dextrose in water with .45 Sodium Chloride	4	406 mOsm/liter
5% Dextrose in water with Ringer's Lactate solution	5	524 mOsm/liter
Ringer's Lactate solution	6.5	274 mOsm/liter

(Kozier et al., 2000)

Osmolality refers to the measure of solute concentration.

pH and Osmolality Concentrations

The tonicity of solutions infused into the circulation has an effect on the vein intima. The vein intima can be traumatized by the administration of hyperosmolar fluids (solutions having an osmolality higher than 290 mOsm/liter), especially if they are administered at a rapid rate or through a small vessel.

Isotonic solutions may become hyperosmolar when they are mixed with certain medications such as electrolytes, antibiotics, and nutrients, especially when certain medications are added to solutions less than 100 ml.

The normal blood flow in the vessel can dilute the drug, but if the vein is small or the circulation is slow (as in an elderly patient), the blood cannot adequately dilute the drug. If the blood cannot dilute the pH effect of the drug, the venous IV site becomes red and the patient complaints of pain.

In summary, chemical phlebitis may be caused by acidic, alkaline, hypertonic, and hypotonic solutions. Patients receiving any of these high-risk drugs or solutions can benefit from a central intravenous catheter. You can approach this subject with the primary healthcare provider.

Prevention Strategies for Chemical Phlebitis

The basic principles of aseptic technique and measures for the prevention of chemical phlebitis must be carried out.

Many of the problems associated with chemical phlebitis can be eliminated by implementation of the following:

- Use of filters for solutions high in particulate matter.
- Use of recommended solutions or diluents when mixing medications.

- Dilution of known irritating medication to the greatest extent possible.
- Administration of intravenous push medications through a port of compatible free-flowing infusion.
- Rotation of peripheral sites at recommended intervals.
- Use of large veins for the administration of hypertonic or acidic solutions to provide greater hemodilution (Perdue, 2001).

Treatment of Chemical Phlebitis

- Discontinue peripheral IV at earliest sign of phlebitis - apply compress to site for 20 minutes, 4 times daily until site improves.
- Initiate new IV site if appropriate.
- If other complications arise, notify the shift supervisor and contact the healthcare provider if appropriate.
- Document site assessment and intervention. Example: “Patient complained of pain in lower left arm near IV site and elbow area. IV site found reddened around catheter and tender to touch. IV discontinued. Warm compress applied for 20 minutes and positioned on pillow for comfort.” Documentation two hours later: “Left lower arm IV site remains red despite warm compress and elevation. Surrounding tissue the approximate size of a quarter is noted to be red and firm to touch. No drainage noted to old IV site. Healthcare provider notified. Antibiotic order received to cover possible cellulitis.”

Drug Reactions

Allergic Reactions

Allergic reactions may cause an unpredictable response to a drug. Exposure to an initial dose of a medication may cause an immunological response. The drug acts as an antigen, which causes antibodies to be produced. With repeated administration, the client develops an allergic response to the drug, its chemical preservatives, or a metabolite of it.

Upon admission, patients are asked about any allergy history including medications, food, and environmental factors. Once again, this information is to be clearly communicated to other members of the multidisciplinary team and documented per your facilities policy. Sharing this information in shift-to-shift report is imperative.

An allergic reaction may be mild or severe. Allergic symptoms vary, depending on the patient and the specific drug. Among the different classes of drugs, antibiotics cause a high incidence of allergic reactions. Mild allergic symptoms are summarized in below:

Symptom	Description
Urticaria (hives)	A vascular reaction of the skin characterized by the eruptions of irregularly shaped pale wheals with red margins and pale centers.
Eczema (rash)	Erythema, papules, vesicles, pustules, scales, crusts, or scabs alone or in combination. May be dry or with watery discharge. May be spread over entire body or in regions.
Pruritis	Severe itching.

Rhinitis	Inflammation of the nasal mucosa.

(Elkin et al., 2000)

Treatment for Allergic Reactions

Treatments for Mild Allergic Reactions

The most common treatments for mild allergic reactions are:

- Avoid the offending drug
- For hives, rash and itching: cold compress, topical corticosteroids and/or oral antihistamines

Treatments for Severe Allergic Reactions

Severe allergic reactions can be life-threatening. The use of IM or IV epinephrine is typically used. In this situation, you should prioritize the ABC's: Airway, Breathing, and Circulation. If the patient is unstable, notify the physician and activate the hospital's Code Team.

Severe Allergic Reactions (Type 1) with Anaphylactic Shock

- Constriction of bronchioles with wheezing
- Edema of the pharynx and larynx
- Shortness of Breath
- Severe Hypotension
- Cardiac Arrest
- Vascular Collapse

(Elkin et al., 2000)

Case Study One: Antibiotic Allergy

L.W. is a 58-year-old, 5'6", 92 kg female admitted to the oncology unit with a diagnosis of ovarian cancer, post total hysterectomy. Her medical history is significant for coronary artery disease (CAD) and angina. The patient's chart describes an allergy to ampicillin, which consisted of blisters four to five days after taking the medication.

On post-op day number three, she presents with a temperature of 101.6, a new cough, increased sputum production, and shortness of breath. Stat chest-X-ray, blood and sputum cultures are ordered.

Case Study One: Antibiotic Allergy

Today's labs:

Lab Test	Result	Normal Value
WBC	22,000	5,000-10,000 mm
Sodium	138	136 - 145 mEq/L
Potassium	4.1	3.5 - 5.0 mEq/L
BUN	38	10 - 20 mg/dl
S. Creatinine	2.4	0.5 - 1.2 mg/dl
Glucose	218	70 - 105 mg/dl
Triglycerides	312	35 - 160 mg/dl

Albumin		3.5 - 5.0 g/dl

Vital Signs: HR 100 BP 135/ 85 Temp 101.8
Intake: 3,633 ml
Output: 2,432 ml
Net 24 hour: +1,201 ml

Case Study One: Antibiotic Allergy

The healthcare provider prescribes the following antibiotics to be given:

Zosyn 3.37 grams in 50ml D5W IVPB Q 8h
Vancomycin 1,500mg in 100ml IVPB Q 12h

- The antibiotics arrive from pharmacy at approximately 09:30.
- You give the Zosyn from 10:00-10:30.
- The vancomycin is started at 11:15.

As the vancomycin is hanging you notice that the phlebotomist has arrived to draw the blood cultures.

Critical Thinking Question: What is wrong with this scenario?

Answer:
Blood cultures should be drawn prior to administering the first antibiotic dose. It is the nurses' role to assure correct timing of blood culture samples and initiation of antibiotic therapy. Drawing blood cultures after the commencement of antibiotic therapy may result in false negative blood culture results. This can make antibiotic selection very difficult.

Case Study One: Antibiotic Allergy

About 30 minutes later, the patient's call light is on and she feels "scratchy" and "sick." The patient's skin on her face and upper limbs is flushed and red. You notice that the vancomycin is about 75% infused. Her RR is 32, HR is 120 and regular and her lungs have rales, but no rhonchi or wheezes are heard. Her blood pressure is 100/60. With the tachypnea and complaints of shortness of breath, you are worried about airway patency and decide to call a CODE.

Critical Thinking:

- **What are the possible causes of this acute change in patient condition?**
- **Do you think the presenting symptoms (tachypnea, SOB, tachycardia, flushed and reddened skin, and "scratchy" and "sick") are related to an allergic reaction from the vancomycin, the interaction between zosyn and vancomycin, or could it be from something else?**
- **Are the antibiotic dosages appropriate?**
- **Did you infuse the antibiotics over the appropriate time intervals?**
- **Did you check the five Rs prior to administration?**
- **Did you check for allergies prior to administration?**

Case Study One: Antibiotic Allergy

This case illustrates several issues related to antibiotic screening, administration, and patient assessment.

Penicillin antibiotics are the most likely medications to cause allergic drug reactions. Anaphylactic reactions to penicillin occur in 32 of every 100,000 exposed patients (The International Collaborative Study of Severe Anaphylaxis, 2003).

Allergic reactions to penicillin are separated into several clinical types, the most dangerous being the Type I reaction which is associated with an immediate (within 30 minutes) rash, dyspnea, edema, and hypotension.

Reactions of this type require emergency medical treatment including respiratory support and the administration of epinephrine.

Delayed or latent reactions that occur greater than 48 hours after exposure (Type 2) are usually more benign and are not life-threatening.

This patient has a history of a delayed rash from ampicillin, a penicillin-type antibiotic. Zosyn is a combination of piperacillin and tazobactam, both of which are penicillin-type compounds. They contain the chemical group common to all penicillins, the beta-lactam ring, and therefore carry the risk of cross allegencity with all penicillin-type antibiotics including ampicillin.

This patient's previous reported allergy, a delayed macropapular rash to ampicillin, may not predispose the patient to a Type I anaphylactic reaction, however it is generally agreed that all antibiotics of the penicillin class should be avoided if the patient reports any allergic reaction from a penicillin. (In retrospect, the Zosyn should NOT have been given.)

Cephalosporin antibiotics are much safer and may be used in patients with caution in delayed penicillin allergies.

Case Study One: Antibiotic Allergy

Vancomycin is a glycopeptides antibiotic that is chemically distinct and different from penicillin and is safe to give in penicillin allergic patients.

However, rapid infusions of vancomycin can cause a reaction known as "Red man syndrome." Red man syndrome can sometimes be confused with Type I anaphylactic reactions. Red man syndrome from vancomycin is unlike Type I penicillin allergy in that it is not a true anaphylactic reaction but a non-immunologic histamine release characterized by pruritus and an erythematous rash that involves the face, neck, and upper torso and occasionally hypotension (University of Illinois, 2004).

Red man syndrome can be avoided by giving vancomycin at a rate that does not exceed 500 mg / 30 minutes. The above patient received 1100mg of vancomycin over 30 minutes or twice the rate which is safe!

Management of this red man syndrome reaction is to stop the infusion of vancomycin, call the physician, and anticipate treatment with an antihistamine.

The absence of bronchospasm (lack of wheezes) differentiates this reaction from a Type I allergy to penicillin.

The nurse misdiagnosed this as a Type I anaphylactic reaction to penicillin.

Key point!

A reaction that resulted in a CODE could have been avoided by a close review of allergies and proper administration rate of the vancomycin.

Case Study One: Additional Antibiotic Related Concerns

Critical Thinking:

Does anything else about this case study concern you?

- **Timing of Blood Cultures:** Drawing blood cultures after the antibiotics are started may result in false negative blood culture results. If antibiotics have already been started, this may interfere with the ability to isolate the infecting bacteria. This will make antibiotic selection very difficult and a bit of a guessing game. Blood cultures should be drawn prior to administering the first antibiotic dose. It is the nurse's role to assure correct timing of blood culture samples and initiation of antibiotic therapy.
- **Assessment of Renal Insufficiency and Antibiotic Dosing:** Vancomycin is cleared via the kidneys. The patient has a baseline S. Creatinine of 2.4, which indicates her kidneys are not functioning at a normal level. Typically the physician will adjust down either the strength of the vancomycin or the frequency of the drug in patients with elevated S. Creatinine. This will also help prevent the side effect of ototoxicity. Always check with your healthcare provider or pharmacist when unsure of appropriate antibiotic dosing.
- **Treating a life threatening anaphylactic reaction:** If the patient did experience a true life threatening anaphylactic reaction with bronchospasm, epinephrine is the drug of choice. Corticosteroids (i.e. Hydrocortisone) or antihistamines such as dipenhydramine (Benadryl®) may be helpful but are considered second line agents in the treatment of acute bronchospams. Epinephrine should be given as a 0.3 to 0.5 mg/ml of a 1:1000 (1mg/ml) solution subcutaneously (SubQ) or intramuscularly (IM). The IM route in the thigh may be the preferred route (Chowdhury, 2002). The IV route should be reserved only for those patients who do not respond to the IM route, or in cases of shock or severe dyspnea. The dose of IV epinephrine is 3-5mls of a 1:10,000 solution.

Case Study Two: Congestive Heart Failure

J.E. is a 74-year-old male, S/P anterior wall myocardial infarction two years ago with resulting damage to his left ventricle and moderate cardiomyopathy with an ejection fraction of 38%. He presents to the emergency room with a chief complaint of shortness of breath (SOB), orthopnea, and a 5 kg weight gain.

Physical Exam: 3+ pitting edema bilateral ankles; positive jugular-venous distension (JVD), and S3 gallop. Breath sounds indicate crackles halfway up bilaterally.

Vital Signs:

RR 30 and labored
HR 110

Temp 99.2
BP 160/100

Past Medical History:
Atrial Fibrillation – onset 1 month ago; Peptic ulcer disease (PUD); 1 year history of degenerative joint disease (DJD) treated with Ibuprofen

Case Study Two: Admission Meds & Lab Results

Admission medications:

- Digoxin 0.25mg po daily
- Spironolactone 25mg po twice a day
- Lasix 40mg po daily
- Coreg 6.25mg po twice a day
- K-Dur 20 mEq po twice a day
- Colace 100 mg po daily
- Ibuprofen 400mg po four times a day for joint pain
- Pantoprazole 30mg po twice a day
- Enteric coated Aspirin 325mg po daily

Admission Labs:

Lab Test	Result	Normal Value
WBC	6,800	5,000-10,000 mm
Sodium	133	136 - 145 mEq/L
Potassium	3.4	3.5 - 5.0 mEq/L
HCO_3	28	21 – 28 mEq/L
Cl	92	90-110 mEq/L
BUN	48	10 - 20 mg/dl
S. Creatinine	1.2	0.5 - 1.2 mg/dl
Glucose	144	70 - 105 mg/dl
Hgb	13.6	12-18 g/dl
HCT	36.2	37 - 52%
BNP	1100	0-100 pcg/ml

Digoxin level is 2.0 ng/ml (normal: < 2.0 ng/ml)

Case Study Two: Initiation of Treatment

The patient is admitted to the hospital with a diagnosis of CHF.

He is given IV furosemide 80mg IV X 2, potassium supplements and is placed on a 2-gram sodium diet.

He is started on enalapril (Vasotec) 5mg once a day. All pre-admission meds are continued.

On day number two, his dyspnea has improved, his weight has decreased by 2.5 kg, but his mental status had changed; he has become more confused and lethargic.

He also has become severely nauseated with emesis times three.

Case Study Two: Lab Results & Vital Signs

Day 2 Labs Results:

Lab Test	Result	Normal Value
Sodium	142	136 - 145 mEq/L
Potassium	5.4	3.5 - 5.0 mEq/L
HCO_3	33	21 – 28 mEq/l
Cl	94	90-110 mEq/l
S. Creatinine	3.8	0.5 - 1.2 mg/dl
Glucose	188	70 - 105 mg/dl

Vital Signs:

HR 58 RR 20 BP 120/76 Temp 98.6
Intake 1350 mls
Output 3100 mls

Net 24 hour I/O: -1750 mls

Critical Thinking:

- What might be causing a change in this patient's renal function?
- Are there any possible drug interactions?
- Does declining renal function affect any of the drugs this patient is taking?
- What might be the cause of the confusion and lethargy?

Case Study Two: Adverse Effects of Medications

This case demonstrates the potential for adverse effects from medications in the CHF patient population.

Enalapril is an angiotensin converting enzyme inhibitor (ACEI). ACEI drugs have become a standard of care in the treatment of CHF due to their beneficial effects on symptom reduction and mortality.

CHF patients benefit from ACEI therapy because these drugs help dilate arteries and prevent afterload resistance, and they have also been shown to reduce mortality (Chavey, 2001).

ACEI therapy is not without its side effects. A percentage of patients may develop acute renal failure, especially during initiation of therapy.

The use of ACEI will have the favorable benefit of decreasing afterload, which may increase cardiac output and improve renal blood flow. However, if volume is depleted too rapidly (i.e. the patient is dehydrated or over-diuresed) and blood flow to the kidneys is not improved, renal failure can develop.

Risk factors for acute renal failure include:

- A history of renal artery stenosis
- Dehydration or aggressive diuresis
- Sodium restriction
- Concomitant use of non-steroidal anti-inflammatory drugs (NSAIDS)

Case Study Two: Adverse Drug Interactions

The drug-to-drug interaction to be on the watch for is the combination of ACEI and NSAIDs.

Patients with CHF are often dependent on renal prostaglandins for blood flow to the kidneys. NSAIDs block these renal prostaglandins and therefore increase the risk of ACEI induced renal failure.

Remember that Digoxin is cleared via the kidneys. In this case, the renal failure induced by ACEI can increase Digoxin levels causing toxicity.

Digoxin's therapeutic index is narrow, as the therapeutic range and toxic range differ by only a two-fold factor (or in other words, it would only take one additional dose of Digoxin to put someone into toxicity).

Digoxin clearance is dependent on renal function, and dosage must be adjusted for renal impairment. At one time, Digoxin was considered the drug of choice in CHF. However, recent studies have shown it to be less effective than ACEI and it should be considered second line but still is commonly used in the treatment of CHF (Dee, 2003).

This case study represents multiple factors to reflect upon. Because of this patient's history of atherosclerotic heart disease, renal artery stenosis may also be present.

The physician might have considered discontinuing the NSAIDs and/or using a lower initial dose of the ACEI therapy.

The physician might have also considered holding the Digoxin and using a less aggressive diuresis which could have prevented this adverse drug reaction resulting in renal insufficiency and Digoxin toxicity.

WARNING!
Non Steroidial Anti-inflammatory Drugs (NSAIDs) should be used with *extreme* caution in a patient on an Angiotensin Converting Enzyme Inhibitor (ACEI) medication.

Case Study Two: The Role of the Healthcare Professional

Critical Thinking:
Is there anything else that concerns you?

When initiating new ACEI therapy in a CHF patient (with potential renal artery disease or elevated baseline S. Creatinine), the role of the healthcare professional includes:

- Monitor blood pressure response (ACEI drugs lower B/P)
- Monitor intake and output (if renal insufficiency is starting, you may see a drop in urinary output)
- Monitor lab results, especially S. Creatinine and BUN

- Collaborate with physician and/or pharmacist when you notice a patient is on both NSAIDs and ACEI medications, as they typically are not tolerated well together
- Monitor for signs and symptoms of Digoxin toxicity in all patients, but especially those on new ACEI therapy

Case Study Three: Anticoagulation

T.T. is an anxious 68-year-old obese female patient with a history of degenerative joint disease (DJD) who comes to the hospital for a total knee replacement.

Her significant medical history includes a 10-year history of smoking, mild COPD, and arteriosclerotic heart disease (ASHD). She has a one-year history of vicodin use (about 8 tablets per day). There are no known allergies.

Her surgery goes well and anesthesia is consulted for pain control. She is started on an epidural infusion of morphine sulfate.

Her post-op medications include:

- Percocet (oxycodone) 1 tablet q6 hourly prn for breakthrough pain
- Enoxaparin (Lovenox®) 30mg SubQ twice a day
- Ketorolac (Tordol®) 30mg po Q 6 hours
- Colace 100mg twice a day
- Senakot 2 tabs at night
- Pravastatin 20mg Q evening
- Albuterol Inhaler 2 Puffs four times a day

Critical Thinking:

After examining this list of medications, can you identify a potential adverse drug reaction in this patient?

Case Study Three: DVT Prophylaxis

T.T. is clearly at risk for deep vein thrombosis post her total knee replacement. The current standard of therapy is that some type of prophylaxis be given.

The low molecular weight heparin, enoxaparin (Lovenox), is considered the treatment of choice for the prevention of thrombotic events.

Because of her history of narcotic use, obesity, and respiratory disease, epidural pain control is chosen to control pain while minimizing the adverse effects of narcotics. Also, the adjunctive use of the injectable non-steroidal anti-inflammatory agent (NSAID) ketorolac (Toradol) is attractive as it has been shown to decrease narcotic requirements thereby avoiding the potential adverse effects of respiratory depression and postoperative ileus. Ketorolac inhibits platelet aggregation and may impair homeostasis as well.

Did You Know?

Low Molecular Weight Heparin (LMWH) has a much longer anticoagulation effect than Unfractionated Heparin (UFH)? The anticoagulation effect of LMWH lasts approximately 12-24 hours, compared to the effects of UFH which last about 2-3 hours. In a patient on enoxaparin, who requires the removal of an epidural catheter, it is recommended that the removal is

performed 24-48 hours after the last dose of enoxaparin to avoid excessive bleeding.

Case Study Three: Chest Pain

On post operative day number four, the patient develops chest pain. Her EKG shows ST segment elevation, and CPK and Troponin are elevated. A cardiologist makes a diagnosis of unstable angina and the patient is to be sent to the cardiac cath lab later in the day.

She is given a bolus of 10,000 units of unfractionated heparin and placed on continuous infusion heparin at 1,000 u/hour.

Current medications include:

- Cefazolin 1gm IV Q 8 hours
- Enoxaparin 30mg subcutaneous Q 12 hours
- Percocet (oxycodone) 1 tablet q6 hourly prn for pain
- Colace 100mg po twice a day
- Imdur 60mg po daily
- Aspirin 325 po daily
- Nitroglycerin 0.4mg sublingual prn chest pain.
- Nitropaste 1 inch Q 6 hours topically

Case Study Three: Anticoagulation Alert

There have been several cases reported of the inadvertent administration of both unfractionated heparin and low molecular weight heparin (enoxaparin, Fragmin®). This can lead to excessive anticoagulation and an increased risk of severe bleeding.

The potential drug-drug interaction is identified and the enoxaparin is discontinued. The patient is continued on a heparin infusion. The following sliding scale orders are written.

Draw PTT every 6 hours:	
For PTT 30 - 39	Bolus 2,000 units and increase infusion by 1,000 U/hr
For PTT 40 - 50	Increase heparin by 1,000 U/hr
For PTT 50 - 75	No change
For PTT 76 - 90	Decrease Heparin by 1,000 U/hr
For PTT 90 - 120	Decrease heparin by 2,000 U/hr
For PTT > 120	Stop drip and call physician

Critical Thinking:

On reviewing the patient's medication list, should the healthcare provider be contacted for any clarification?

Yes! Both Heparin and enoxaparin (Lovenox) should NOT be given... it's too much anticoagulation!

Case Study Three: Lab Results

The PTT comes back at 0400 at 38. The patient is given a bolus of 2,000 units of heparin and heparin drip is increased by 1,000 u/hr. Routine morning labs drawn are done at 06:00 and the results are:

Lab Test	Result	Normal Value
Hgb	9.6	12-18 g/dl
HCT	33.8	37-52%
Platelets	45,000	150,000-400,000 mm^3
PTT	110 seconds	(per sliding scale protocol)

Critical Thinking:

Please comment on the above lab values:

- Why has the PTT value gone from 38 seconds to 110 seconds in just 2 hours?
- What are your thoughts about the low hemoglobin and hematocrit?
- How would you assess if these values are the patient's baseline or a change?
- What are your thoughts about the low platelet count? With low platelets, what are you monitoring for?

Case Study Three: Interpretation of Lab Results

The PTT is outside the accepted therapeutic range, however it should be evaluated for the "time drawn" in relation to the heparin dosage. If this PTT is drawn only two hours after the heparin bolus, it does not reflect the heparin infusion and therefore should not be used to make adjustments. A common error by nursing and the laboratory is to not correctly time labs that are to be used for dosage adjustments. PTT should only be used to adjust dosages if they are drawn at least four hours after the dosage adjustment.

After evaluating previous labs, the low hemoglobin and hematocrit are normal for this patient. Remember to "trend" lab results before responding to just an isolated value. The patient's platelet count should be evaluated again, as a common adverse effect from both LMWH and UF heparin is thrombocytopenia (a decrease in platelets).

The healthcare provider is concerned about thrombocytopenia and begins a transition to warfarin. The patient is started on warfarin 5mg daily. Three days later the heparin is discontinued. The patient is complaining of new urinary urgency.

Case Study Three: Vital Signs & Urinalysis

Vital Signs: Temp 100.9 HR 100 BP 120/66 RR 18

Today's Lab Results:

Lab Test	Result	Normal Value
WBC	12,000	5,000 - 10,000 mm
Sodium	140	136 - 145 mEq/L
Cl	104	90 - 110 mEq/L

Potassium	3.8	3.5 - 5.0 mEq/L
HCO_3	28	21 - 28 mEq/L
Glucose	188	70 - 105 mg/dl
S. Creatinine	1.0	0.5 - 1.2 mg/dl
INR	2.3	2.0 - 3.5 for patients on warfarin

Urinalysis Results: Specific Gravity 1.015; pH 8.0
Protein, Glucose, Ketones, Bilirubin, and Blood are Negative
WBC 20-30

Urine Culture: Source: clean catch mid stream
> 100,000 Proteus Mirabalis

Case Study Three: Adverse Drug Interaction

The patient is prescribed Sulfamethoxazole/ Trimethoprim® DS B.I.D.

The patient continues on warfarin at a dosage of 5 mg Q day.

Three days later the patients is afebrile but her urine is a pinkish color.

Notable lab results:

Lab Test	Result	Normal Value
WBC	7,500	5,000 - 10,000 mm
INR	8.9	2.0 - 3.5 for patients on warfarin

Critical Thinking:
Why has the INR increased so drastically?

This patient likely developed the elevated INR from an interaction between the antibiotic and warfarin. Septra changes the metabolic pathway of warfarin, increasing the warfarin potency. Warfarin commonly interacts with other medications especially antibiotics (Hirsh, 2001). A better choice may have been the antibiotic Cephalexin as it is less likely to increase the INR and increase risk of bleeding.

Conclusion

Despite all best efforts, medication errors and adverse drug events will occur. Prevention is the key to minimizing these errors. Using the information provided in this course will help you to become a safer nurse with medication administration.

Please remember that most of the time an error is made not because we have incompetent employees working in the hospital, but because something is wrong with the system.

We need to learn more about the broken systems and how to best fix the problems. Maybe the problem begins with the ordering and stocking of the medication or perhaps with the dispensing from

the pharmacy.

Some medication errors occur from “look-alike” drugs being stored too closely together. When not spelled out, medication errors occur with verbal orders for “sound-alike” medications.

Reporting of medication errors and adverse events needs to occur in a non-threatening, non-punitive environment. We cannot begin to fix the problems until we are clear on which processes are broken.

Each healthcare professional has an ethical obligation to share information about all medication errors and adverse drug events.

Apendix I: TJC Do Not Use List

Copy and paste the following link into your browser to view the official JC Do Not Use Abbreviations list:
http://www.jointcommission.org/assets/1/18/Do_Not_Use_List.pdf

The Joint Commission (2012). Facts About The Official "Do Not Use" List.

Web Resources

Medications are in a constant state of change. The following web sites are useful for updates on new medications, medication warnings, and general medication safety. Happy browsing!

Updates and Alerts

Center for Drug Evaluation and Research (CDER)
http://www.fda.gov/AboutFDA/CentersOffices/OfficeofMedicalProductsandTobacco/CDER/
Provides information on recently approved labeling changes for Reference Listed Drug (RLD) products. The supplements are grouped by month and year of approval.

FDA Drug Approvals List
http://www.fda.gov/Drugs/DevelopmentApprovalProcess/HowDrugsareDevelopedandApproved/DrugandBiologicApprovalReports/ANDAGenericDrugApprovals/default.htm
Updated weekly, this site provides the FDA Drug Approvals list.

MedWatch
http://www.fda.gov/medwatch
Important safety information — Provides “Dear Health Professional” letters and other safety notifications by year. Labeling changes related to drug safety are provided by month and year.

Web Resources

General Drug Websites

Agency for Healthcare Policy
http://www.ahcpr.gov/
The Healthcare Research and Quality Act of 1999 reauthorized and renamed the Agency for Healthcare Policy and Research as the Agency for Healthcare Research and Quality (AHRQ). AHRQ is the lead agency charged with supporting research designed to improve the quality of healthcare. Site topics include: research findings, quality assessment, clinical information, consumer health information, and links to other related sites.

Centers for Disease Control and Prevention
http://www.cdc.gov/
CDCP is a Federal public health agency charged with health promotion and quality of life by preventing and controlling disease, injury, and disability. This site offers information on health topics from A-Z.

Infusion Nurses Society
http://www.ins1.org/
The Intravenous Nurses Society (INS) promotes excellence in infusion nursing through standards, education, advocacy, and outcome research. This site offers information on standards, certification, meetings and education, and related industry links.

Institute for Safe Medication Practices
http://www.ismp.org/
The Institute for Safe Medication Practices (ISMP) is a nonprofit organization that works closely with healthcare practitioners and institutions, regulatory agencies, professional organizations and the pharmaceutical industry to provide education about adverse drug events and their prevention. This site includes medication safety alerts, error reporting, alerts for patients, drug product safety testing, links to other pertinent sites, and more.

Joint Commission on the Accreditation of Healthcare Organizations
http://www.jcaho.org/
General information on JCAHO as well as information targeted for specific groups such as Healthcare Organizations and Professionals.

Medication Errors Reporting (MER) Program
http://www.usp.org/frameset.htm?http://www.usp.org/reporting/
The Medications Errors Reporting (MER) Program site within the U.S. Pharmacopeia site enables healthcare professionals who encounter actual or potential medication errors to report confidentially to USP online, by fax, or by phone. “By sharing these experiences, pharmacists, nurses, physicians, and students can contribute to improved patient safety and to the development of valuable educational services for the prevention of future errors.”

National Cancer Institute
http://www.nci.nih.gov/
The National Cancer Institute (NCI) provides the latest information on types of cancer, treatments, clinical trials, statistics, and more. Information is provided in Spanish and English.

National Home Infusion Association
http://www.nhianet.org/
NHIA is a multi-disciplinary organization dedicated to providing education, information, and legislative and regulatory representation to support clinicians and organizations providing intravenous drug and nutritional therapies to patients in non-hospital settings.

National Library of Medicine
http://www.nlm.nih.gov/
This site offers health information through Medline, Medlineplus, and other resources.

Pharmaceutical Research and Manufacturers of America
http://www.phrma.org/

The Pharmaceutical Research and Manufacturers of America is a group of U.S. companies committed to pharmaceutical research. The website includes a database of new drugs currently in development and information about the drug development process. It also includes links to member companies.

PharmWeb
http://www.pharmweb.net/
PharmWeb provides information for healthcare professionals and patients, including information on medications, a directory of pharmaceutical information on the Internet, and a collection of related links.

U.S. FDA Center for Drug Evaluation and Research
http://www.fda.gov/cder/
This site offers drug information about existing and new products, approvals, alerts, and regulatory guidance from the Food and Drug Administration Center for Drug Evaluation and Research.

U.S. Food and Drug Administration
http://www.fda.gov/
This site provides information on drugs and new drug approvals, regulatory guidance, and more.

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