Preventing Drug Product Confusion Errors: Strategies for the Pharmacy Buyer

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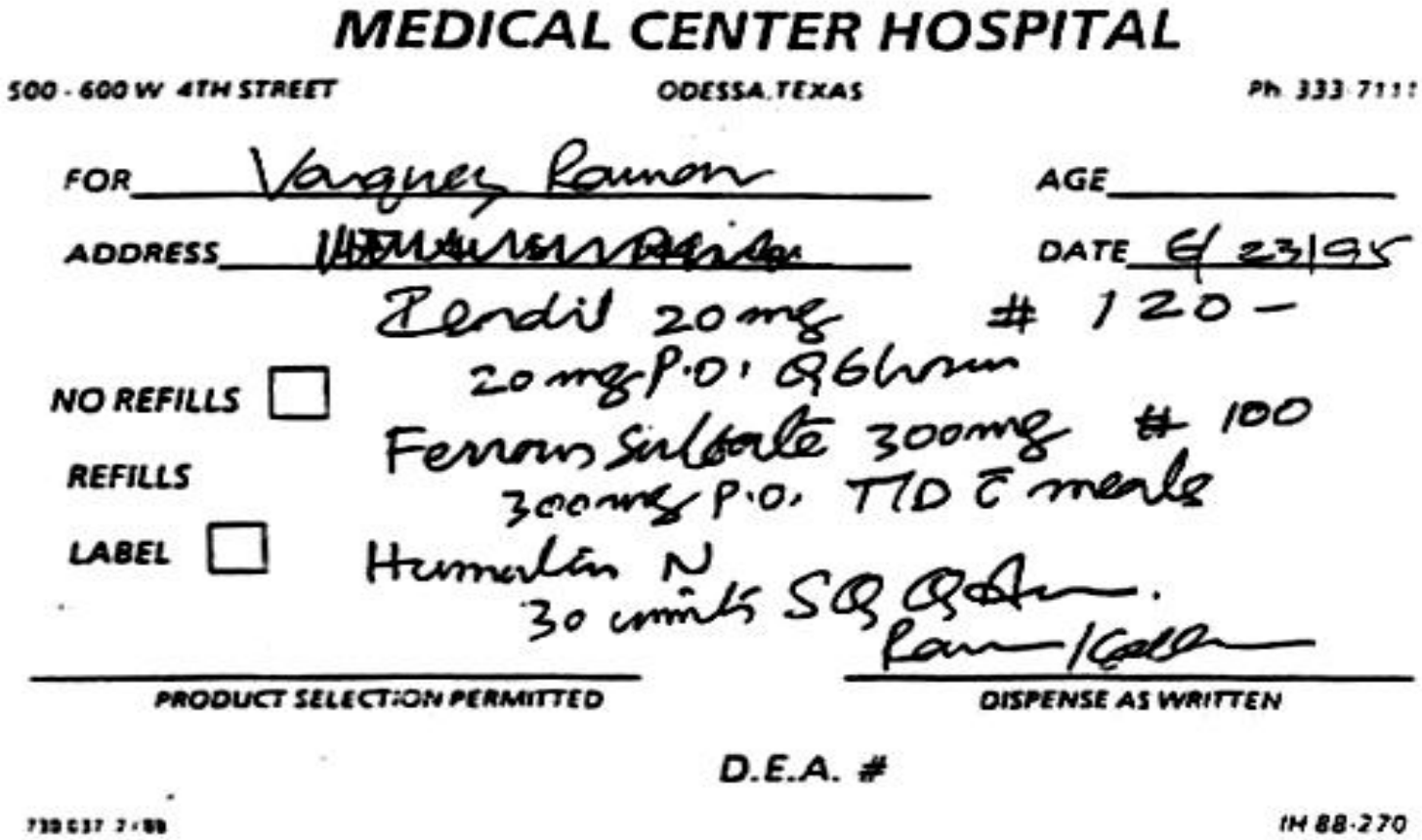
Objectives

- By the end of this presentation, participants will be able to:
  - Compare and contrast the culture of blame and the culture of safety in health care.
  - Identify the major causes of drug name and drug product confusions.
  - List safe medication practices that can reduce the likelihood of drug product confusion.



MEDICAL CENTER HOSPITAL

500 - 600 W 4TH STREET ODESSA, TEXAS Ph. 333-7111

FOR Vasquez Ramon AGE

ADDRESS [redacted] DATE 6/23/95

Zestril 20 mg # 120 -
20 mg P.O. Q6hrs prn

NO REFILLS ☐

Ferrous Sulfate 300 mg # 100
300 mg P.O. TID c meals

REFILLS

LABEL ☐

Humulin N
30 units SQ Q AM.
Ramon Gallegos

PRODUCT SELECTION PERMITTED

DISPENSE AS WRITTEN

D.E.A. #

IH 88-270

http://www.medmal-law.com/illegibl.htm

Plendil or Isordil?

- Isordil® prescribed
- Plendil® dispensed
- Cardiologist found negligent
- $450,000 damage award
- First ever award for bad penmanship!

Culture of Blame or Safety

- Culture of Blame (still dominant)
  - Error is fault of individual
  - Error should be punished
  - Training, vigilance seen as solutions
- Culture of Safety (ascending?)
  - Errors due to system problems
  - Focus on learning and CQI
  - Non-punitive reactions to error
  - Tangible commitment to safety by leadership

Culture of Safety

- Safety Climate Survey available (free!) from QualityHealthCare.org:

  “In a culture of safety, people are not merely encouraged to work toward change; they take action when it is needed. Inaction in the face of safety problems is taboo, and eventually the pressure comes from all directions — from peers as well as leaders. There is no room in a culture of safety for those who uselessly point fingers or say, "Safety is not my responsibility, so I’ll file a report and wash my hands of it."

Establish A Culture of Safety (from QualityHealthCare.Org)

1. Designate a Patient Safety Officer
2. Provide Feedback to Front-Line Staff
3. Conduct Safety Briefings
4. Conduct Patient Safety Leadership WalkRounds™
5. Appoint a Safety Champion for Every Unit
6. Involve Patients in Safety Initiatives
7. Create a Reporting System
8. Simulate Possible Adverse Events
9. Create an Adverse Event Response Team
10. Relay Safety Reports at Shift Changes
11. Reenact Real Adverse Events from Your Facility

Obstacles to Adoption of Non-Punitive Culture/Systems

- Need for “accountability,” tension between accountability and learning
- Fear of litigation, reprisal
- Lack of trusted and time-tested state and federal statutory protection from discovery
- Lack of knowledge about structure, function, and purpose of non-punitive systems
- Generalized resistance to change

Wrong-Drug Errors

- Supposed to get Drug A, get Drug B instead
- Flynn et al. (JAPhA, Vol. 43, No. 2, p. 191-200) recently reported that wrong-drug error rate in outpatient pharmacy was 0.13%
- With 3 billion scripts filled per year, this means 3.9 million wrong drug errors per year.

Why Do These Errors Happen?

- Similarity- and frequency-based errors in cognitive processing
- Memory (recall and recognition)
- Perception (visual and auditory)
- Motor control (picking wrong drug from drop-down menu)
- Poorly designed systems (e.g., handwritten orders, oral orders, no CPOE, etc.)

Drug Name Confusions

- Account for 15-25% of all reported medication errors in the US
- Specifically identified by IOM in their report on medical errors
- Mandated initiatives underway at FDA to address the problem
- Several ongoing ‘disasters’ involving high-profile products

Examples (from USP-MERP)

- Lamisil® vs. Lamicel®
- Accupril® vs. Accutane®
- Celebrex® vs. Celexa®
- Cisplatin vs. carboplatin
- Hydroxyzine vs. Hydralazine
- Zosyn® vs. Zofran®
- Prilosec® vs. Prozac®
- Pediapred® vs. Pediaprofen®
- Prepridil® vs. Bepridil®

Confusion not limited to drug names!

Plaque muddles Luther King killer with Hollywood actor

Officials are blaming a mix-up after a plaque honored the man who killed Martin Luther King instead of actor James Earl Jones.

The actor was the voice of Star Wars' Darth Vader and The Lion King's Mufasa.

The plaque, however, commemorated James Earl *Ray* for "keeping the dream alive"...

STAMPS ISSUED IN HONOR OF BLACK HERITAGE

Thank you

James Earl Ray

for Keeping the Dream Alive
City of Lauderhill
January 19, 2002

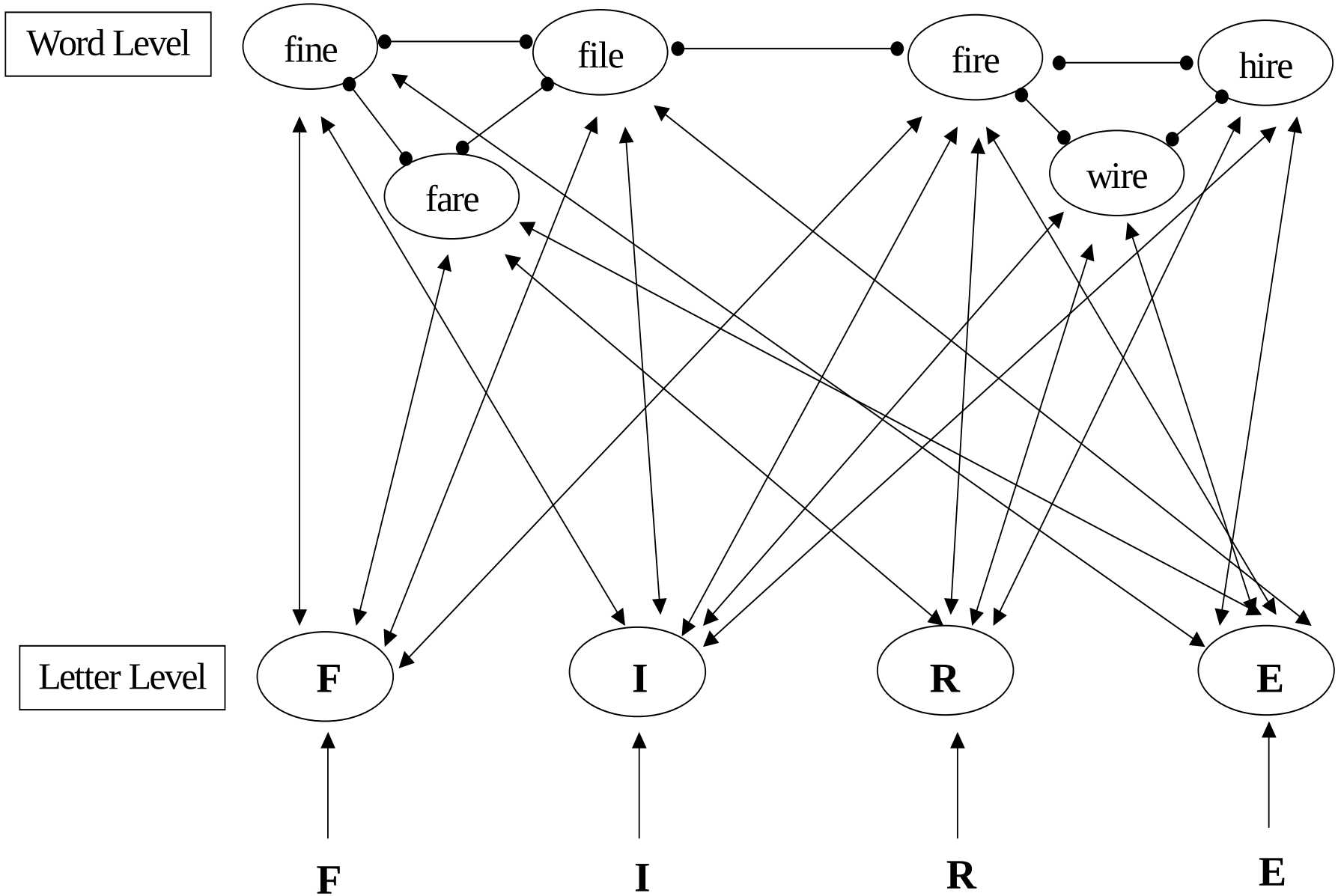
Objective Measures of Name Similarity

- N-gram measures of spelling similarity (e.g., bigram, trigram)
- Edit distance
- Phonetic measures
- Phonological measures
- Multiple attribute measures
- These measures have been validated in several peer-reviewed publications

Visual Perception of Drug Names

- Perceptual features at multiple layers of abstraction (e.g., segment, letter, word)
- Spreading activation between layers
- Activation/competition models
- Influence of similarity and frequency

Interactive Activation Model



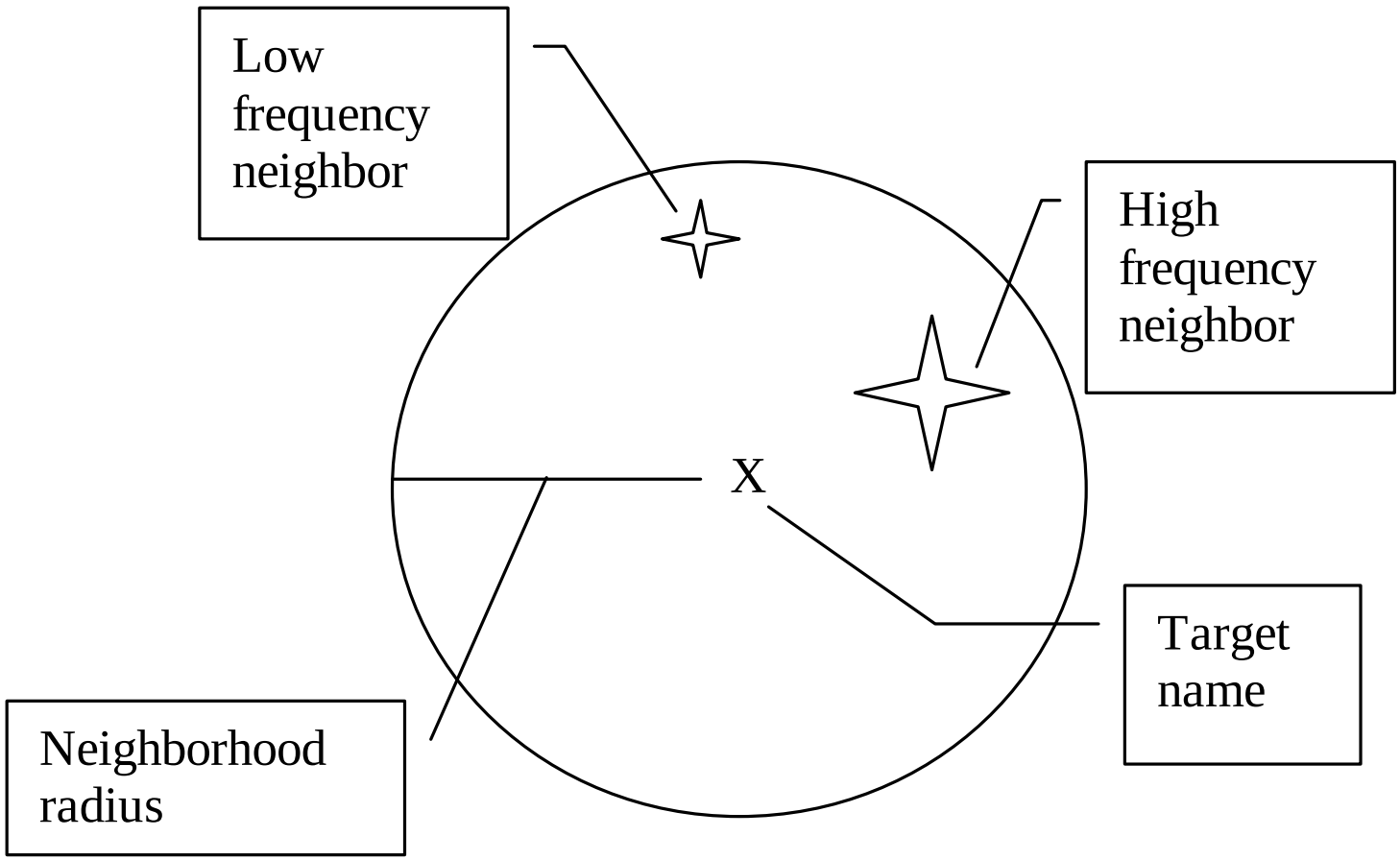
Similarity and Frequency

- In general, frequency (of prescribing) increases perceptual accuracy
- In general, similarity (to other names) decreases perceptual accuracy

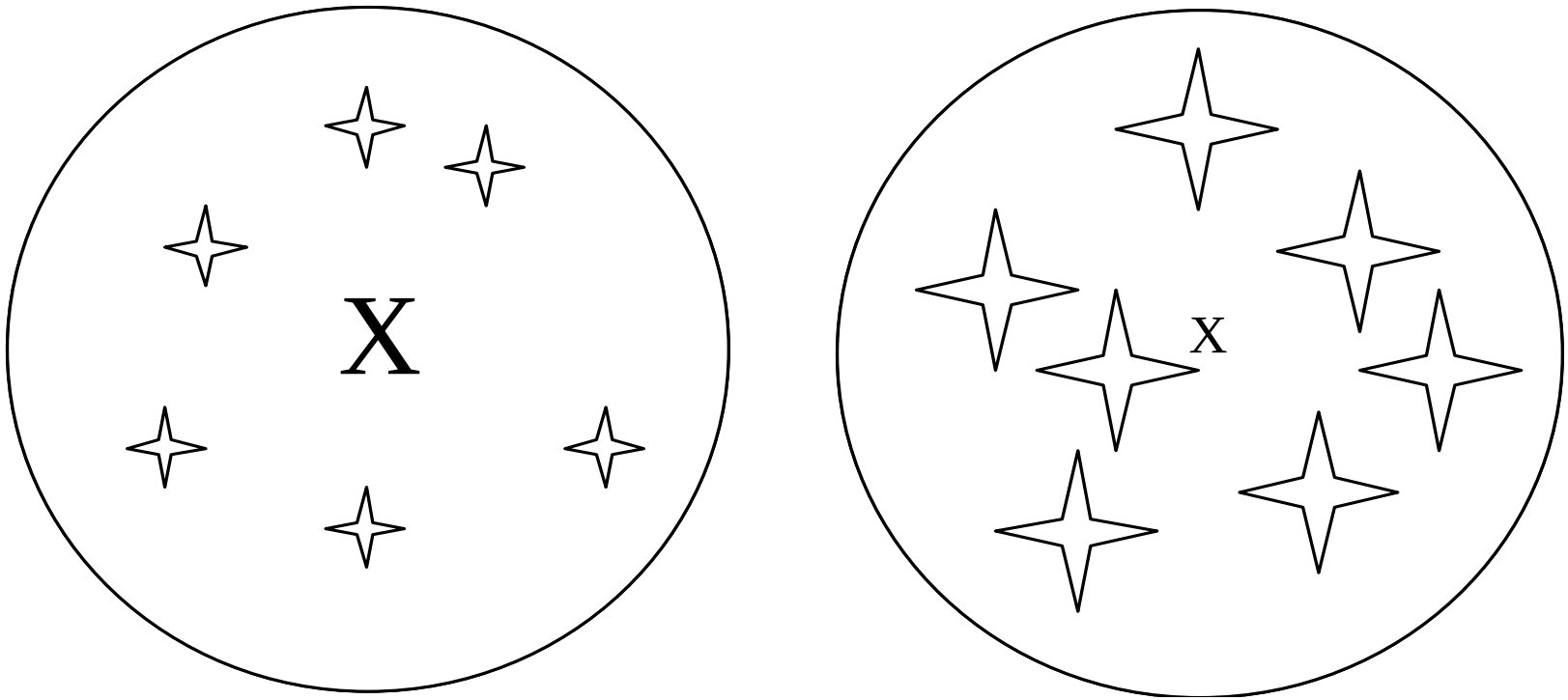
Definitions

- Stimulus Frequency: the log prescribing frequency of a given drug
- Neighborhood: the set of names within a given distance (3 edits) of a stimulus name
- Neighborhood density: the number of other names in a stimulus word's neighborhood
- Neighborhood frequency: the mean log prescribing frequency of the names in the neighborhood

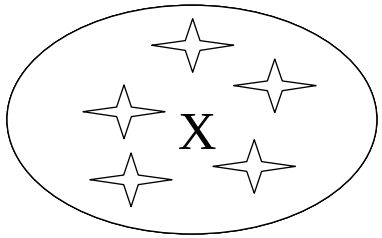
Neighborhood Illustration



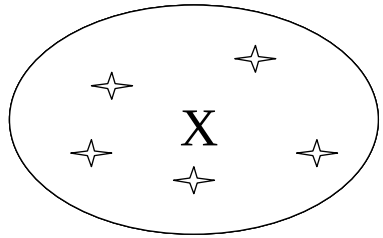
Dense Neighborhoods: High and Low Frequency



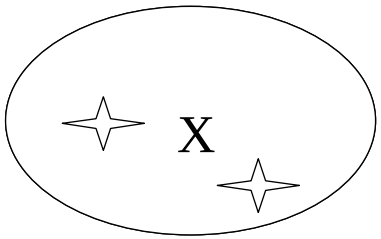
1) High SF, High NF, High ND



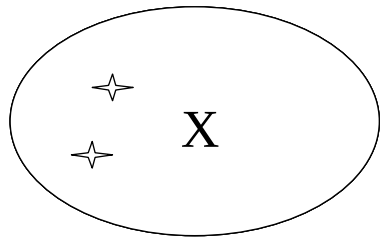
2) High SF, Low NF, High ND



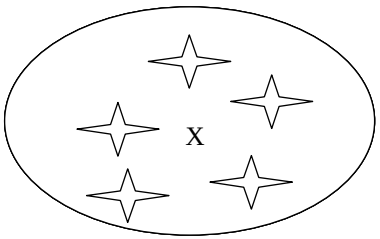
3) High SF, High NF, Low ND



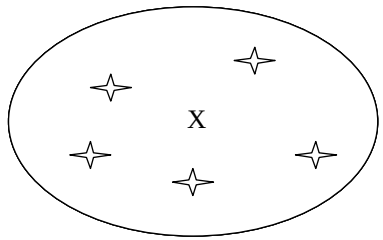
4) High SF, Low NF, Low ND



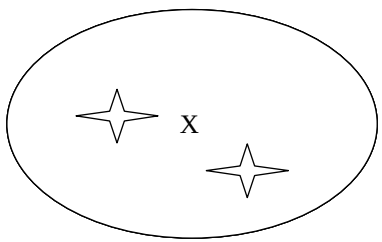
5) Low SF, High NF, High ND



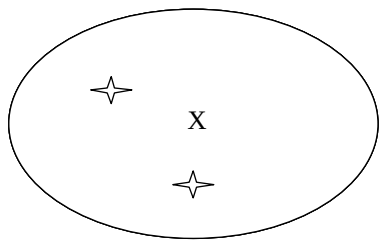
6) Low SF, Low NF, High ND



7) Low SF, High NF, Low ND



8) Low SF, Low NF, Low ND



Examples

- High log SF names (log SF > 7): Ventolin®, Dyazide®, Provera®
- Low log SF names (log SF < 3): Vistazine®, Antispas®, Protaphane®
- Name from a sparse neighborhood: Flexeril® (no neighbors in NAMCS/NHAMCS)
- Name from a dense neighborhood: Dynabac®, Synalar®, Rynatan®, Dynapen®, Dynacirc®, Dynacin®, Cynobac®

Hypotheses

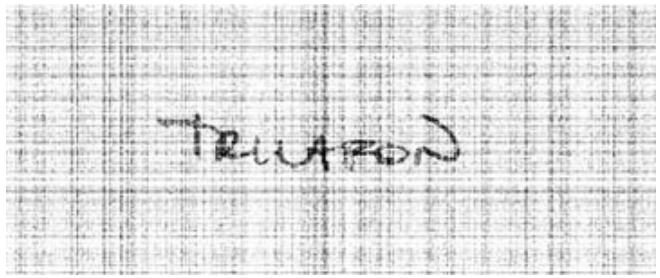
- Error rates in visual perception will increase as stimulus frequency decreases
- Error rates in visual perception will increase as neighborhood density increases
- Error rates in visual perception will increase as neighborhood frequency increases

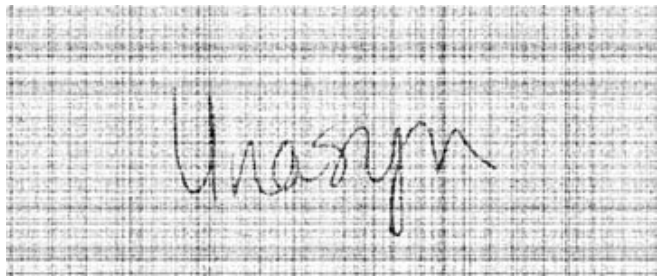
Stimuli: Drug Names

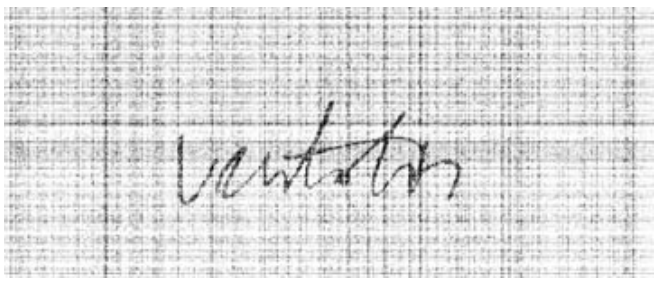
- Twenty names each were selected at high and low levels of prescribing frequency (i.e., the log of the number of NAMCS/HAMCS prescriptions), neighborhood frequency (i.e., the average log prescribing frequencies of names within an edit distance of 3 from a given name), and neighborhood density (i.e., the number of names within an edit distance of 3 of a given name).

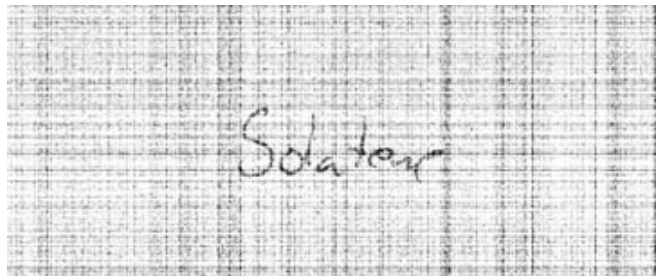
Participants and Task

- Participants were licensed, practicing pharmacists drawn from attendees at the 2000 National Community Pharmacists Association annual meeting (N=37)
- Task is a noise-masked visual perception task
- Participant must identify a degraded drug name after 3-second exposure





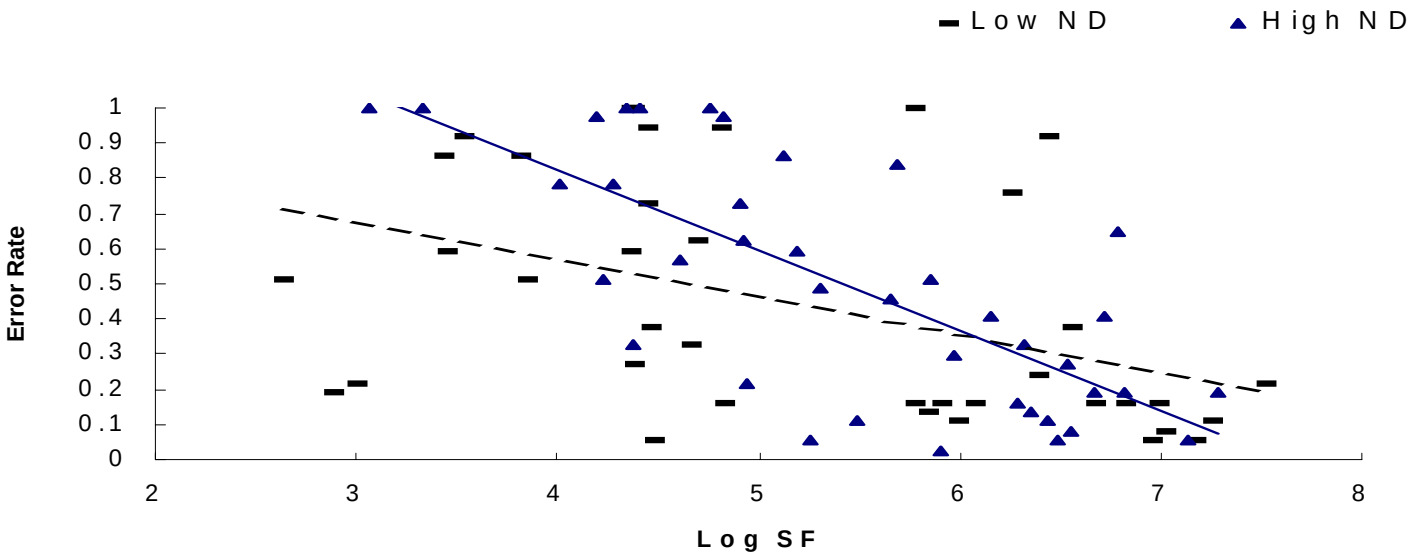




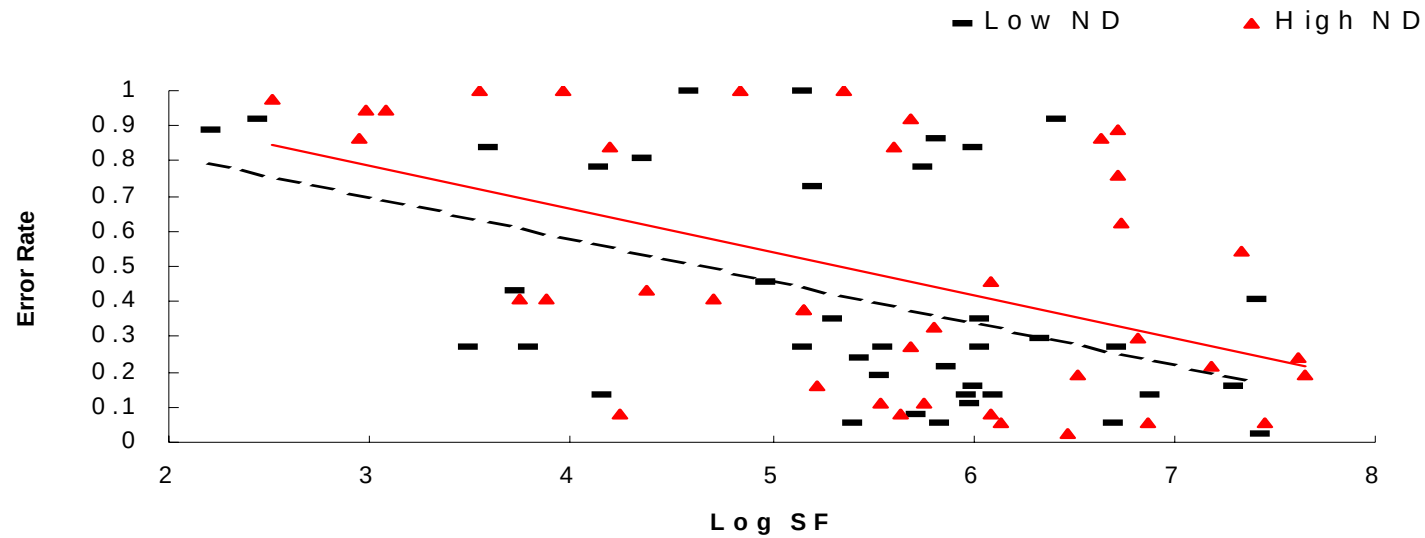
Procedure

- Pharmacist seated in front of Macintosh computer
- Drug names appear for 3 seconds
- Names degraded as if sent by a bad fax machine
- Row of XXXXs replaces name after 3 seconds
- Pharmacist types in correct response
- 5 practice trials, 160 test trials

(a) High NF



(b) Low NF



Discussion and Implications

- Word frequency effect is extremely powerful. Rare names much more difficult to perceive than common names.
- Dense neighborhoods inhibit perception, especially of low frequency names in high frequency neighborhoods.
- Keep neighborhoods sparse to minimize error.
- Use neighborhood measures as part of pre-approval screening.

Conclusion

- The less frequently a drug name is prescribed, the more difficult it is to be perceived correctly in a noise-masked visual perception experiment.
- For low frequency words, the presence of similar neighbors significantly increases the probability of a perceptual error.

Limitations

- Somewhat contrived, laboratory task
- Relatively small, non-representative sample of pharmacists (NCPA attendees)
- Noise and exposure durations may be unrealistic

Patient Safety Lessons

- Similarity and frequency are still basic mechanisms of error. Look for them everywhere.
- Probability of error not most important endpoint
- Minimize harm
- Harm is a function of number of opportunities for error, probability of error and severity of error

What about Prevention?

- Pre-approval screening
- Post-event labeling changes (e.g., Lamictal, cisplatin)
- CPOE-based solutions
- Safe prescribing practices
- Doctor-patient interaction
- Dispensing and administration fixes

Pre-Approval Screening

- FDA and manufacturer's joint responsibility
- Should use validated measures
- Should search on multiple attributes
- Criteria for acceptance/rejection of new names should be rational and explicit
- Companies soon mandated to submit pre-approval info about name confusion

Labeling Changes

CPOE-based Solutions

- Warnings on known confusing names
- Dose checking
- Indication checking
- Non-alphabetical presentation on menus
- Querying for distinguishing attributes
- “Tall man” lettering

Safe Medication Practices (from ISMP)

- Prescriptions should clearly specify the dosage form, drug strength, and complete directions.
- Include the product's indication on all outpatient prescriptions and on inpatient *prn* orders.
- With name pairs known to be problematic, reduce the potential for confusion by writing prescriptions using both the brand and generic name.

Safe Medication Practices (from ISMP)

- Accept verbal or telephone orders only when truly necessary. Encourage staff to repeat back all orders, spell the product name, and state its indication.
- When feasible, use magnifying lenses and copyholders under good lighting to keep prescriptions and orders at eye level during transcription.

Safe Medication Practices (from ISMP)

- •Change the appearance of look-alike product names on computer screens, pharmacy and nursing unit shelf labels and bins (including automated dispensing cabinets), pharmacy product labels, and medication administration records by highlighting, through bold face, color, and/or tall man letters, the parts of the names that are different (e.g., hydr**OXY**zine, hydr**ALA**zine).

Safe Medication Practices (from ISMP)

- Affix “name alert” stickers to areas where look or sound-alike products are stored (available from pharmacy label manufacturers).
- Store products with look or sound-alike names in different locations. Avoid storing both products in the fast-mover area. Use a shelf sticker to help locate the product that is moved.

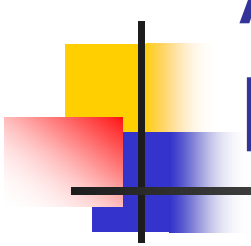
Making Formularies Safer

- Clean and prep formulary database
- Create two subsets
  - Oral solid dosage forms
  - Injectable dosage forms
- Compute similarity scores between all name pairs
- Identify all pairs whose name similarities exceed some threshold and that match on other attributes
- Screen selected pairs for severity of consequences of a confusion
- Propose, implement, and evaluate interventions to deal with the most problematic pairs

Drug Product Attributes

- Brand name
- Generic name
- Strength
- Dosage form
- Route of administration
- Pharmacologic category

Analysis Plan and Organization of Results



- Select pairs that exceed threshold of similarity or distance
- Sort in ascending order of distance
- Link to known error pairs and indicate which pairs have been previously reported as confusing
- Tally total number of pairs and number of previously reported pairs

Increasing Levels of Similarity

1. Name similarity only (distance<=8)
2. Similar name and identical strength
3. Name, strength, and one member of pair must be in “high alert” category (e.g., opiates, antineoplastics)
4. Name, strength, route of administration

Injectables: Name Similarity Only

3; **LIPID 10% INJ**; 0.1; LIPID; CALORIC AGENTS; IV PIGGYBACK;
LIPID 20% INJ; 0.2; LIPID; CALORIC AGENTS; IV PIGGYBACK;
Unreported

5; **EPOGEN**; ; EPOETIN; HEMATOPOLETIC AGENTS; SUBCUTANEOUS;
NEUPOGEN; ; FILGRASTIM; UNCLASSIFIED THERAPEUTIC AGENTS; SUBCUTANEOUS;
Reported

5; **TOBRAMYCIN**; ; TOBRAMYCIN; AMINOGLYCOSIDES; IV PIGGYBACK;
VIBRAMYCIN; ; DOXYCYCLINE HYCLATE; TETRACYCLINES; IV PIGGYBACK;
Unreported

5; **PREMARIN**; ; CONJUGATED ESTROGENS; ESTROGENS; INTRAVENOUS;
PRIMAXIN; ; IMIPENEM-CILASTATIN; MISCELLANEOUS B-LACTAM ANTIBIOTICS; IV PIGGYBACK;
Reported

5; **LINCOMYCIN**; ; LINCOCIN; MISCELLANEOUS ANTIBIOTICS; INTRAMUSCULAR;
VANCOMYCIN; ; VANCOMYCIN; MISCELLANEOUS ANTIBIOTICS; IV PIGGYBACK;
Unreported

Injectables: Name, Strength, One Antineoplastic

6; **MITHRAMYCIN**; ; PLICAMYCIN INJ; ANTINEOPLASTIC AGENTS; IV PIGGYBACK;
MITOMYCIN; ; MUTAMYCIN; ANTINEOPLASTIC AGENTS; SYRINGE;
Reported

6; **MITHRAMYCIN**; ; PLICAMYCIN INJ; ANTINEOPLASTIC AGENTS; IV PIGGYBACK;
MUTAMYCIN; ; MITOMYCIN; ANTINEOPLASTIC AGENTS; SYRINGE;
Unreported

6; **STADOL**; ; BUTORPHANOL INJ; OPIATE PARTIAL; INTRAVENOUS;
TAXOL; ; PACLITAXEL; ANTINEOPLASTIC AGENTS; IV PIGGYBACK;
Unreported

7; **IDAMYCIN**; ; IDARUBICIN; ANTINEOPLASTIC AGENTS; SYRINGE;
MITOMYCIN; ; MUTAMYCIN; ANTINEOPLASTIC AGENTS; SYRINGE;
Unreported

7; **IDAMYCIN**; ; IDARUBICIN; ANTINEOPLASTIC AGENTS; SYRINGE;
MUTAMYCIN; ; MITOMYCIN; ANTINEOPLASTIC AGENTS; SYRINGE;
Unreported

Injectables: Name, Strength, One Antineoplastic, Route

7; **IDAMYCIN**; ; IDARUBICIN; ANTINEOPLASTIC AGENTS; SYRINGE;
MITOMYCIN; ; MUTAMYCIN; ANTINEOPLASTIC AGENTS; SYRINGE;
Unreported

7; **IDAMYCIN**; ; IDARUBICIN; ANTINEOPLASTIC AGENTS; SYRINGE;
MUTAMYCIN; ; MITOMYCIN; ANTINEOPLASTIC AGENTS; SYRINGE;
Unreported

8; **ADRIAMYCIN**; ; DOXORUBICIN; ANTINEOPLASTIC AGENTS; SYRINGE;
IDAMYCIN; ; IDARUBICIN; ANTINEOPLASTIC AGENTS; SYRINGE;
Reported

8; **ETOPOSIDE**; ; VEPESID; ANTINEOPLASTIC AGENTS; IV PIGGYBACK;
TENIPOSIDE; ; VUMON; ANTINEOPLASTIC AGENTS; IV PIGGYBACK;
Unreported

8; **MITHRAMYCIN**; ; PLICAMYCIN INJ; ANTINEOPLASTIC AGENTS; IV PIGGYBACK;
VIBRAMYCIN; ; DOXYCYCLINE HYCLATE; TETRACYCLINES; IV PIGGYBACK;
Unreported

Oral Solids: Name Similarity Only

2; **VITAMIN A**; 10,000 UNIT; VITAMIN A; VITAMIN A; ORAL;
VITAMIN E; 100UN; VITAMIN E; VITAMIN E; ORAL;
Unreported

3; **THYROLAR-2**; 25mcg/100mcg; LEVOTHYROXINE-LIOTHYRONINE; THYROID AGENTS; ORAL;
THYROLAR-3; 37mcg/150mcg; LEVOTHYROXINE-LIOTHYRONINE; THYROID AGENTS; ORAL;
Unreported

4; **MOTRIN**; 400MG; IBUPROFEN; NONSTEROIDAL ANTI-INFLAMMATORY AGENTS; ORAL;
MIDRIN; ; ISOMETHEPTENE-DICHLPHEN-APAP; MISCELLANEOUS ANALGESIC AND ANTIPYRETICS; ORAL;
Unreported

4; **NAPROSYN EC**; 375MG; NAPROXEN EC; NONSTEROIDAL ANTI-INFLAMMATORY AGENTS; ORAL;
NAPROXEN EC; 500MG; NAPROSYN EC; NONSTEROIDAL ANTI-INFLAMMATORY AGENTS; ORAL;
Unreported

4; **SOMA**; 350MG; CARISOPRODOL; SKELETAL MUSLE RELAXANTS; ORAL;
SENNA; ; SENOKOT; CATHARTICS AND LAXATIVES; ORAL;
Unreported

4; **PERMAX**; 0.05MG; PERGOLIDE; UNCLASSIFIED THERAPEUTIC AGENTS; ORAL;
VERMOX; 100MG; MEBENDAZOLE; ANTHELMINTICS; ORAL;
Unreported

Oral Solids: Name and Strength

5; **NIMODIPINE**; 30MG; NIMOTOP; UNCLASSIFIED THERAPEUTIC AGENTS; ORAL;
NIFEDIPINE; 30MG; PROCARDIA XL; CARDIAC DRUGS; ORAL;
Reported

5; **CLOZAPINE**; 25MG; CLOZARIL; ANTIDEPRESSANTS; ORAL;
LOXAPINE; 25MG; LOXITANE; TRANQUILIZERS; ORAL;
Unreported

5; **ADDERALL**; 10MG; AMPHETAMINE/DEXTROAMPHETAMINE; RESPIRATORY AND CEREBRAL STIMULANTS; ORAL;
INDERAL; 10MG; PROPRANOLOL; CARDIAC DRUGS; ORAL;
Reported

5; **RIMANTADINE**; 100MG; FLUMADINE; ANTIVIRALS; ORAL;
AMANTADINE; 100MG; SYMMETREL; UNCLASSIFIED THERAPEUTIC AGENTS; ORAL;
Reported

6; **ELAVIL**; 75MG; AMITRIPTYLINE; ANTIDEPRESSANTS; ORAL;
PLAVIX; 75MG; CLOPIDOGREL BISULFATE; UNCLASSIFIED THERAPEUTIC AGENTS; ORAL;
Reported

Oral Solids: Name, Strength, One Opiate

7; **DEMEROL**; 50MG; MEPERIDINE; OPIATE AGENTS; ORAL;
DESYREL; 50MG; TRAZODONE; ANTIDEPRESSANTS; ORAL;
Reported

7; **CARDENE**; 30MG; NICARDIPINE; CARDIAC DRUGS; ORAL;
CODEINE; 30MG; CODEINE; OPIATE AGENTS; ORAL;
Reported

8; **FOLTX**; ; FOLIC ACID/VIT B6/VIT B12; MULTIVITAMIN b
PREPARATIONS; ORAL;
TYLOX; ; ACETAMINOPHEN-OXYCODONE; OPIATE AGENTS;
ORAL;
Unreported

Oral Solids: Name, Strength, One Cardiac

5; **NIMODIPINE**; 30MG; NIMOTOP; UNCLASSIFIED THERAPEUTIC AGENTS; ORAL;
NIFEDIPINE; 30MG; PROCARDIA XL; CARDIAC DRUGS; ORAL;
Reported

5; **ADDERALL**; 10MG; AMPHETAMINE/DEXTROAMPHETAMINE; RESPIRATORY AND CEREBRAL STIMULANTS; ORAL;
INDERAL; 10MG; PROPRANOLOL; CARDIAC DRUGS; ORAL;
Reported

6; **AMLODIPINE**; 5MG; NORVASC; CARDIAC DRUGS; ORAL;
FELODIPINE; 5MG; PLENDIL; CARDIAC DRUGS; ORAL;
Unreported

6; **QUINIDINE SULFATE**; 200MG; QUINIDINE SULFATE; CARDIAC DRUGS; ORAL;
QUININE SULFATE; 200MG; QUININE SULFATE; ANTIMALARIAL AGENTS; ORAL;
Unreported

7; **CARDENE**; 30MG; NICARDIPINE; CARDIAC DRUGS; ORAL;
CODEINE; 30MG; CODEINE; OPIATE AGENTS; ORAL;
Reported

Oral Solids: Name, Strength, One Antineoplastic

8; **CAPOTEN**; 50MG; CAPTOPRIL; HYPOTENSIVE AGENTS;
CASODEX; 50MG; BICALUTAMIDE; ANTINEOPLASTIC AGENTS;
Unreported

8; **ALKERAN**; 2MG; MELPHALAN; ANTINEOPLASTIC AGENTS;
MYLERAN; 2MG; BUSULFAN; ANTINEOPLASTIC AGENTS;
Unreported

8; **ALKERAN**; 2MG; MELPHALAN; ANTINEOPLASTIC AGENTS;
LEUKERAN; 2MG; CHLORAMBUCIL; ANTINEOPLASTIC AGENTS;
Reported

Rating Severity of Harm (In Progress)

- Harm=Probability of error X num. opportunities for error X severity of each error X probability of not detecting
- Depends on direction of error
- Depends on duration of exposure
- Depends on patient clinical status
- Exposure to wrong drug vs. failure to receive right drug

What More Can a Buyer Do?

- Try not to stock look alike drugs together in the pharmacy
- Clarifying when one of the pharmacy staff places an odd order --- are they on the path to a med error?
- Create failsafe systems for stocking automated devices.
- Post common med errors or red label products with high potential for error.
- Communicate with suppliers about confusing names and labels
- Subscribe to, post, and use ISMP Medication Safety Alerts.

Summary

- By the end of this presentation, participants will be able to:
  - Identify the major causes of drug name and drug product confusions.
  - Describe safe medication practices that can reduce the likelihood of confusion.
  - Develop a specific strategy for reducing name confusion errors in the context of a specific clinical area.
- Did we achieve our objectives?