

National Patient Safety Goal- Identify and, at a minimum, annually review a list of look-alike/sound-alike drugs used in the organization, and take action to prevent errors involving the interchange of these drugs.

2006 - 2007

Confusing drug names is a common system failure. Unfortunately, many drug names can look or sound like other drug names, which may lead to potentially harmful medication errors. Increasingly, pharmaceutical manufacturers and regulatory authorities are taking measures to determine if there are unacceptable similarities between proposed names and products on the market. But factors such as poor handwriting or poorly communicated oral prescriptions can exacerbate the problem. In 2001, the Joint Commission on Accreditation of Healthcare Organizations published a *Sentinel Event Alert* on look-alike and sound-alike drug names. This NPSG recognizes that healthcare practitioners and organizations need to be aware of the role drug names play in medication safety as well as system changes that can be made to prevent errors.

Tables I and II below provide lists of the most problematic look-alike and sound-alike drug names for specific health care settings.* Examples of potential errors and safety strategies specific to each of the problem drug names are provided, when applicable. Table III provides a list of other look-alike or sound-alike drug names that were rated or suggested by experts. General safety strategies to help manage all sound-alike and look-alike drug names are listed below the Tables, and should also be considered for implementation with each of the problematic names.

An organization's list of look-alike/sound-alike drugs must contain a minimum of 10 drug combinations. At least 5 of these combinations must be selected from Table I or from Table II, as appropriate to the type of organization. An additional 5 combinations must be selected from any of the Tables I, II and/or III. This list is revised as necessary and ***the most recent additions appear in bold italics***. Deletions are listed at the end of each table. Organizations should reassess previous choices in light of new information, including the revised list, and selection of replacement or additional pairs as indicated by the results of that assessment.

Table I: FOR CRITICAL ACCESS HOSPITAL, HOSPITAL, OFFICE-BASED SURGERY

Potential Problematic Drug Names	Brand Name(s) (UPPERCASE) & Generic (lowercase)	Potential Errors and Consequences	Specific Safety Strategies**
1. Concentrated liquid morphine products vs. conventional liquid morphine concentrations.	Concentrated: ROXANOL morphine oral liquid (conventional concentration)	Concentrated forms of oral morphine solution (20 mg/mL) have often been confused with the conventional concentrations (listed as 10 mg/ 5 mL or 20 mg/5 mL), leading to serious errors. Accidental selection of the wrong concentration, and prescribing/labeling the product by volume, not milligrams,	Dispense concentrated oral morphine solutions only when ordered for a specific patient (not as unit stock). Segregate the concentrated solution from the other concentrations wherever it is stored. Purchase and dispense concentrated solutions in dropper bottles (available from at least two manufacturers) to help prevent

			<p>contributes to these errors, some of which have been fatal. For example, “10 mg” has been confused with “10 mL.” If concentrated product is used, this represents a 20-fold overdose.</p>	<p>dose measurement errors and differentiate the concentrated product from the conventional products. Verify that patients and caregivers understand how to measure the proper dose for self-administration at home. For inpatients, dispense concentrated solutions in unit-doses.</p>
2.	ephedrine and epinephrine	<p>ADRENALIN (epinephrine)</p> <p>ephedrine</p>	<p>The names of these two medications look very similar, and their clinical uses make storage near each other likely, especially in obstetrical areas. Both products are available in similar packaging (1 mL amber ampuls and vials).</p>	<p>See general recommendations below.</p>
3.	hydromorphone injection and morphine injection	<p>DILAUDID (hydromorphone)</p> <p>ASTRAMOPRH, DURAMORPH, INFUMORPH (morphine)</p>	<p>Some health care providers have mistakenly believed that hydromorphone is the generic equivalent of morphine. However, these products are not interchangeable. Fatal errors have occurred when hydromorphone was confused with morphine. Based on equianalgesic dose conversion, this may represent significant overdose, leading to serious adverse events. Storage of the two medications in close proximity to one another and in similar concentrations may contribute to such errors. Confusion has resulted in episodes of respiratory arrest due to potency differences between these drugs.</p>	<p>Stock specific strengths for each product that are dissimilar. For example, stock units with hydromorphone 1 mg unit dose cartridges, and morphine in 2 mg unit dose cartridges. Ensure that health care providers are aware that these two products are not interchangeable.</p>

**4. *hydroxyzine and
hydralazine***

VISTARIL, ATARAX
(hydroxyzine)

Because the first four letters of their names are identical, they are frequently stored next to one another on pharmacy shelves and automated dispensing cabinets and listed adjacently on computer screens. Their similar dosage strengths (10, 25, 50 and 100 mg) and tablet dosage forms also contribute to confusion. Confusion between the antihistamine (hydroxyzine) and the antihypertensive agent (hydralazine) could lead to serious adverse drug events.

Change 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. Differentiate drug names by using boldface, color, and/or “tall man” letters, to help emphasize the letter characters in each name that are unique to that name (e.g., hydrOXYzine, hydrALAzine). Choose generic manufacturers whose products exhibit clear labeling with “tall man” characters.

5.	<p>Insulin products</p> <p>Humalog and Humulin Novolog and Novolin Humulin and Novolin Humalog and Novolog Novolin 70/30 and Novolog Mix 70/30</p>	<p>HUMULIN (human insulin products) HUMALOG (insulin lispro)</p> <p>NOVOLIN (human insulin products) NOVOLOG (human insulin aspart)</p> <p>NOVOLIN 70/30 (70% isophane insulin [NPH] and 30% insulin injection [regular]) NOVOLOG MIX 70/30 (70% insulin aspart protamine suspension and 30% insulin aspart)</p>	<p>Similar names, strengths and concentration ratios of some products (e.g. 70/30) have contributed to medication errors. Mix-ups have also occurred between the 100 unit/mL and 500 units/mL insulin concentrations.</p>	<p>Limit the use of insulin analog 70/30 mixtures to just a single product. Limit the variety of insulin products stored in patient care units, and remove patient-specific insulin vials from stock upon discharged. For drug selection screens, emphasize the word “mixture” or “mix” along with the name of the insulin product mixtures. Consider auxiliary labels for newer products to differentiate them from the established products. Also apply bold labels on atypical insulin concentrations.</p>
6.	<p>Lipid-based daunorubicin and doxorubicin products vs. conventional forms of daunorubicin and doxorubicin</p>	<p>Lipid-based:</p> <p>DOXIL (doxorubicin liposomal)</p> <p>DAUNOXOME (daunorubicin citrate liposomal)</p> <p>Conventional:</p> <p>CERUBIDINE (daunorubicin, conventional)</p> <p>ADRIAMYCIN, RUBEX (doxorubicin, conventional)</p>	<p>Many drugs now come in liposomal formulations indicated for special patient populations. Confusion may occur between the liposomal and the conventional formulation because of name similarity. The products are not interchangeable. Lipid-based formulation dosing guidelines differ significantly from conventional dosing. For example, a standard dose of doxorubicin liposomal is 20 mg/m² given at 21-day intervals, compared to doses of 50 to 75 mg/m² every 21 days for conventional drug. Doses of liposomal daunorubicin are typically 40 mg/m² repeated every 2 weeks, while doses of conventional daunorubicin vary greatly and may be administered more frequently. Accidental administration of the liposomal form instead of the conventional</p>	<p>Staff involved in handling these products should be aware of the differences between conventional and lipid-based formulations of these drugs. Encourage staff to refer to the lipid-based products by their brand names and not just their generic names. Stop and verify that the correct drug is being used if staff, patients or family members notice a change in the solution’s appearance from previous infusions. Lipid-based products may be seen as cloudy rather than a clear solution. Storage of lipid-based products in patient care areas and automated dispensing cabinets is highly discouraged. Include specific method of administration for these products.</p>

form has resulted in severe side effects and death.

7. Lipid-based amphotericin products vs. conventional forms of amphotericin	<p>Lipid-based:</p> <p>AMBISOME (amphotericin B liposomal)</p> <p>ABELCET (amphotericin B lipid complex)</p> <p>Conventional:</p> <p>AMPHOCIN, FUNGIZONE INTRAVENOUS (amphotericin B desoxycholate)</p>	<p>Many drugs now come in liposomal formulation indicated for special patient populations. Confusion may occur between the liposomal and the conventional formulations because of name similarity. The products are not interchangeable. Lipid-based formulation dosing guidelines differ significantly from conventional dosing. Conventional amphotercin B desoxycholate doses should not exceed 1.5 mg/kg/day. Doses of the lipid-based products are higher, but vary from product to product. If conventional amphotericin B is given at a dose appropriate for a lipid-based product, a severe adverse event is likely. Confusion between these products has resulted in episodes of respiratory arrest and other dangerous, sometimes fatal outcomes due to potency differences between these drugs.</p>	<p>Staff involved in handling these products should be aware of the differences between conventional and lipid-based formulations of these drugs. Encourage staff to refer to the lipid-based products by their brand names and not just their generic names. Stop and verify that the correct drug is being used if staff, patients or family members notice a change in the solution's appearance from previous infusions. Lipid-based products may be seen as cloudy rather than a clear solution. Storage of lipid-based products in patient care areas and automated dispensing cabinets is highly discouraged. To reduce potential for confusion, consider limiting lipid-based amphotericin B products to one specific brand.</p>
8. <i>metformin and metronidazole</i>	<p>FLAGYL (metronidazole)</p> <p>GLUCOPHAGE (metformin)</p>	<p>Potentially serious mix-ups between metronidazole and metformin have been linked to look-alike packaging (both bulk bottles and unit-dose packages) and selection of the wrong product after entering MET as a mnemonic. Metformin is contraindicated in certain clinical situations where use might contribute to lactic acidosis. Administration of intravenous iodinated contrast media during radiologic procedures has been associated with acute renal dysfunction.</p>	<p>To avoid order entry errors, program computer order entry software to display entire names of associated products whenever the MET stem is used as a mnemonic. Use tall man letters for unique letter characters in names. Pharmacy should consider stocking metronidazole in only 250 mg tablets (metformin tablets are not available as 250 mg tablets.) See also the general recommendations below.</p>

9.	<i>OxyContin and oxycodone</i>	OXYCONTIN (oxycodone controlled-release) oxycodone (immediate release)	Mix-ups occur when staff confuse brand name, OxyContin, with oxycodone, or the prescriber uses the generic name to order the controlled release formulation without specifying “controlled release.” Patient may receive immediate release product in dose appropriate for controlled release. Significant overdose may occur.	Do not store immediate release and controlled release products together. If possible, have the pharmacy dispense oral oxycodone products for individual patients. Always specify dosage form. Use available brand name when prescribing. Educate staff about the potential for confusion. See general recommendations below.
10.	vinblastine and vincristine	VELBAN (vinblastine) ONCOVIN (vincristine)	Fatal errors have occurred, often due to name similarity, when patients were erroneously given vincristine intravenously, but at the higher vinblastine dose. A typical vincristine dose is usually capped at around 1.4 mg/m ² weekly. The vinblastine dose is variable but, for most adults, the weekly dosage range is 5.5 to 7.4 mg/m ² .	Install maximum dose warnings in computer systems to alert staff to name mix-ups during order entry. Do not store these agents near one another. Staff involved in handling these products should be aware of the differences. Use brand names or brand and generic names when prescribing and do not use abbreviations for these drug names.

Deleted name pairs: cisplatin & carboplatin; fentanyl & sufentanil; lantus & lente (insulin products); taxol & taxotere.

* Note: The name pairs listed were selected after a review of error report descriptions received by the Institute for Safe Medication Practices, the United States Pharmacopeia, the US Food and Drug Administration, and the Pennsylvania Patient Safety Reporting System (Pa-PSRS). Ratings based on judgments of severity and likelihood of confusion in the clinical setting were provided by outside experts using a modified Delphi process. The list was updated in August 2006 with deletions or additions recommended by medication safety staff at ISMP, USP and FDA and also based upon frequency of reports and potential outcome severity. Appreciation is expressed to Medco Health Solutions for their input to the ambulatory drug portion of these listings. The assistance of ISMP in providing potential error consequences and safety strategies for this project is also appreciated.

***** These safety strategies are not inclusive of all possible strategies to reduce name-related errors. Also see General Recommendation for Preventing Drug Name Mix-ups below.***

Table II: FOR AMBULATORY CARE, ASSISTED LIVING, BEHAVIORAL HEALTHCARE, DISEASE SPECIFIC CARE, HOME CARE, LONG TERM CARE

Potential Problematic Drug Names	Brand Name(s) (UPPERCASE) & Generic (lowercase)	Potential Errors and Consequences	Suggested Safety Strategies**
1. Avandia and Coumadin	AVANDIA (rosiglitazone) COUMADIN (warfarin)	<p>Poorly handwritten orders for Avandia (used for type II diabetes) have been misread a Coumadin (used to prevent blood clot formation), leading to potentially serious adverse events. Mix-ups originally occurred due to unfamiliarity with Avandia- staff read the order as the more familiar Coumadin. However, mix-ups between these two products continue to occur. Neither medication is safe without appropriate monitoring that is specific to the drug. Patients affected by a mix-up between these three drugs may experience a decline in mental status, lack of pain or seizure control, or other serious adverse events</p>	See general recommendations below.
2. Celebrex and Celexa and Cerebyx	CELEBREX (celecoxib) CELEXA (citalopram hydrobromide) CEREBYX (fosphenytoin)	<p>Patients affected by a mix-up between these three drugs may experience a decline in mental status, lack of pain or seizure control, or other serious adverse events</p>	See general recommendations below.
3. clonidine and Klonopin	CATAPRES (clonidine) KLONOPIN (clonazepam)	<p>The generic name for clonidine can easily be confused as the trade or generic name for clonazepam.</p>	See general recommendations below.
4. Concentrated liquid morphine products vs. conventional liquid morphine concentrations	Concentrated: ROXANOL morphine oral liquid (conventional concentration)	<p>Concentrated forms of oral morphine solution (20 mg/mL) have often been confused with the conventional concentration (listed as 10 mg/5 mL or 20 mg/5 mL), leading to serious errors. Accidental selection of the wrong</p>	<p>Dispense concentrated oral morphine solutions only when ordered for a specific patient (not as unit stock). Segregate the concentrated solution from the other concentrations</p>

			concentration, and prescribing/labeling the product by volume, not milligrams, contributes to these errors, some of which have been fatal. For example, “10 mg” has been confused with “10 mL.” If concentrated product is used, this represents a 20-fold overdose.	wherever it is stored. Purchase and dispense concentrated solutions in dropper bottles (available from at least two manufacturers) to help prevent dose measurement errors and differentiate the concentrated product from the conventional products. Verify that patients and caregivers understand how to measure the proper dose for self-administration at home. Dispense concentrated solutions in unit-doses if possible for residents in long-term care facilities.
5.	hydromorphone injection and morphine injection	<p>DILAUDID (hydromorphone)</p> <p>ASTRAMOPRH, DURAMOPRH, INFUMOPRH (morphine)</p>	Some health care providers have mistakenly believed that hydromorphone is the generic equivalent of morphine. However, these products are not interchangeable. Fatal errors have occurred when hydromorphone was confused with morphine. Based on equianalgesic dose conversion, this may represent significant overdose, leading to serious adverse events. Storage of the two medications in close proximity to one another and in similar concentrations may contribute to such errors. Confusion has resulted in episodes of respiratory arrest due to potency differences between these drugs.	Stock specific strengths for each product that are dissimilar. For example, stock units with hydromorphone 1 mg unit dose cartridges, and morphine in 2 mg unit dose cartridges. Ensure that health care providers are aware that these two products are not interchangeable.
6.	<p>Insulin products</p> <p>Humalog and Humulin Novolog and Novolin Humulin and Novolin Humalog and Novolog Novolin 70/30 and Novolog Mix 70/30</p>	<p>HUMULIN (human insulin products) HUMALOG (insulin lispro)</p> <p>NOVOLIN (human insulin products) NOVOLOG (human insulin aspart)</p> <p>NOVOLIN 70/30 (70% isophane insulin [NPH] and</p>	Similar names, strengths and concentration ratios of some products (e.g., 70/30) have contributed to medication errors. Mix-ups have also occurred between the 100 unit/mL and 500 units/mL insulin concentrations.	For drug selection screens, emphasize the word “mixture” or “mix” along with the name of the insulin product mixtures. Consider auxiliary labels for newer products to differentiate them from the established products. Also apply bold labels on atypical insulin concentrations.

		30% insulin injection [regular]) NOVOLOG MIX 70/30 (70% insulin aspart protamine suspension and 30% insulin aspart)		
7.	<i>lorazepam and alprazolam</i>	ATIVAN (lorazepam) XANAX (alprazolam)	These benzodiazepines have different potencies. A mix-up, especially in the elderly, would likely cause excessive sedation and increase fall risk.	See general recommendations below.
8.	<i>metformin and metronidazole</i>	FLAGYL (metronidazole) GLUCOPHAGE (metformin)	Potentially serious mix-ups between metronidazole and metformin have been linked to look-alike packaging (both bulk bottles and unit-dose packages) and selection of the wrong product after entering MET as a mnemonic. Metformin is contraindicated in certain clinical situations where use might contribute to lactic acidosis. Administration of intravenous iodinated contrast media during radiological procedures has been associated with acute renal dysfunction.	To avoid order entry errors, program computer order entry software to display entire names of associated products whenever the MET stem is used as a mnemonic. Use tall man letters for unique letter characters in names. Pharmacy should consider stocking metronidazole in only 250 mg tablets (metformin tablets are not available as 250 mg tablets.) See also the general recommendations below.
9.	<i>Topamax and Toprol XL</i>	TOPAMAX (topiramate) TOPROL-XL (metoprolol).	Error is likely attributable to the similarity in names with the "X" in XL of the beta-blocker, Toprol XL, looking like the ending of Topamax, an anticonvulsant. In addition, available dosage strengths (25, 50, 100, 200) are identical, adding to likelihood of mix-up. Imprint on the Topamax tablet is "TOP" on one side and 25 mg strength has "25" on the other, risking confusion with Toprol XL 25 mg. Patients needing Topamax may develop seizures and/or have adverse effects with Toprol XL. Patients needing a beta-blocker may have worsened disease symptoms without treatment. These products might be stored near one another if medications are stocked alphabetically by brand name or might appear near one another on computer screens.	Separate the storage of these products. Use both brand and generic names when prescribing these medications to differentiate the two drug names. See general recommendations below.

10.	Zyprexa and Zyrtec	ZYPREXA (olanzapine)	Name similarity has resulted in frequent mix-ups between Zyrtec, an antihistamine, and Zyprexa, an antipsychotic. Patients who receive Zyprexa in error have reported dizziness, sometimes leading to a related injury from a fall. Patients on Zyprexa for a mental illness have relapsed when given Zyrtec in error.	See general recommendations below.
		ZYRTEC (cetirizine)		

Deleted name pairs: amaryl & reminyl; lantus & lente (insulin products); lamisil & lamictal; serzone & seroquel.

* Note: The name pairs listed were selected after a review of error report descriptions received by the Institute for Safe Medication Practices, the United States Pharmacopeia, the US Food and Drug Administration, and the Pennsylvania Patient Safety Reporting System (Pa-PSRS). Ratings based on judgments of severity and likelihood of confusion in the clinical setting were provided by outside experts using a modified Delphi process. The list was updated in August 2006 with deletions or additions recommended by medication safety staff at ISMP, USP and FDA and also based upon frequency of reports and potential outcome severity. Appreciation is expressed to Medco Health Solutions for their input to the ambulatory drug portion of these listings. The assistance of ISMP in providing potential error consequences and safety strategies for this project is also appreciated.

*** These safety strategies are not inclusive of all possible strategies to reduce name-related errors. Also see General Recommendation for Preventing Drug Name Mix-ups below.*

Table III: SUPPLEMENTAL LIST

Other name pairs that were rated or suggested by experts:

Acetohexamide – acetazolamide

Advicor and Advair

Amicar - Omacor

Avinza – Evista

Cardura - Coumadin

Darvocet - Percocet

Diabeta – Zebeta

Diflucan – Diprivan

Effexor XR - Effexor

folic acid – leucovorin calcium (“folinic acid”)

heparin - Hespan

hydrocodone – oxycodone

idarubicin – doxorubicin - daunorubicin

lamivudine – lamotrigine

Leukeran – leucovorin calcium

MS Contin – Oxycontin

Mucinex. - Mucomyst

opium tincture – paregoric (camphorated opium tincture)

Prilosec - Prozac

Retrovir - Ritonavir

tizanidine - tiagabine

tramadol – trazadone

Wellbutrin SR - Wellbutrin XL

Zantac – Xanax

Zantac – Zyrtec

Zestril - Zyprexa

Zestril - Zetia

Zocor – Zyrtec

Deleted name pairs: bretyllium – brevibloc; chlorpropamide – chlorpromazine.

General Recommendations for Preventing Drug Name Mix-ups

What prescribers can do^{1,2}:

- Maintain awareness of look-alike and sound-alike drug names as published by various safety agencies.
- Clearly specify the dosage form, drug strength, and complete directions on prescriptions. These variables may help staff differentiate products.
- With name pairs known to be problematic, reduce the potential for confusion by writing prescriptions using both the brand and generic name.
- Include the purpose of medication on prescriptions. In most cases drugs that sound or look similar are used for different purposes.
- Alert patients to the potential for mix-ups, especially with known problematic drug names. Advise ambulatory care patients to insist on pharmacy counseling when picking up prescriptions, and to verify that the medication and directions match what the prescriber has told them.
- Encourage inpatients to question nurses about medications that are unfamiliar or look or sound different than expected.
- Give verbal or telephone orders only when truly necessary, and never for chemotherapeutics. Include the drug's intended purpose to ensure clarity. Encourage staff to read back all orders, spell the product name, and state its indication.

What organizations and practitioners can do^{1,2}

- Maintain awareness of look-alike and sound-alike drug names as published by various safety agencies. Regularly provide information to professional staff.
- Whenever possible, determine the purpose of the medication before dispensing or drug administration. Most products with look or sound-alike names are used for different purposes.
- Accept verbal or telephone orders only when truly necessary, and never for chemotherapy. Encourage staff to read back all orders, spell the product name, and state its indication.
- Consider the possibility of name confusion when adding a new product to the formulary. Review information previously published by safety agencies.
- Computerize prescribing. Use preprinted orders or prescriptions as appropriate. If possible, print out current medications daily from the pharmacy computer system and have physicians review for accuracy.
- When possible, list brand and generic names on medication administration records and automated dispensing cabinet computer screens. Such redundancy could help someone identify an error.
- Change the appearance and 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**AL**Azine).
- Install and utilize computerized alerts to remind providers about potential problems during prescription processing.
- Configure computer selection screens and automated dispensing cabinet screens to prevent the two confused drugs from appearing consecutively.
- 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 in pharmacies, patient care units, and in other settings, including patient homes. When applicable, use a shelf sticker to help locate the product that has been moved.
- Continue to employ independent double checks in the dispensing process (one person interprets and enters the prescription into the computer and another reviews the printed label against the original prescription and the product prior to dispensing).
- Encourage reporting of errors and potentially hazardous conditions with look and sound-alike product names and use the information to establish priorities for error reduction. Also maintain awareness of problematic product names and error prevention recommendations provided by ISMP (www.ismp.org), FDA (www.fda.gov), and USP (www.usp.org).

References:

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