

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.

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.

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

Potential Problematic Drug Names	Generic (lowercase) & Brand Name(s) (UPPERCASE)	Potential Errors and Consequences	Specific Safety Strategies**
1. cisplatin and carboplatin	PLATINOL (cisplatin)	Similarity in names can lead to confusion between these two products. Doses appropriate for carboplatin usually exceed the maximum safe dose of cisplatin. Severe toxicity and death has been associated with accidental cisplatin overdoses.	Install maximum dose warnings in computer systems. A boxed warning notes that cisplatin doses greater than 100 mg/m ² once every 3 to 4 weeks are rarely used and that the package insert should be consulted for further information. Use safe handling recommendations and safety stickers for cisplatin as provided by manufacturer. Do not store these two agents next to each other. Use generic names when prescribing and not chemical names or abbreviations.
	PARAPLATIN (carboplatin)		

2.	Concentrated liquid morphine products vs. conventional liquid morphine concentrations.	Concentrated: ROXANOL, MSIR	Concentrated forms of oral morphine solution (20 mg/mL) have often been confused with the standard concentration (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, 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.	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 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.
		Conventional: morphine oral liquid		
3.	ephedrine and epinephrine	ADRENALIN (epinephrine)	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).	See general recommendations below.
		ephedrine		
4.	fentanyl and sufentanil	SUBLIMAZE (fentanyl)	The products are not interchangeable. Confusion has resulted in episodes of respiratory arrest due to potency differences between these drugs. Some errors occurred when using sufentanil during drug shortages of fentanyl.	Do not stock sufentanil in patient care units outside OR/PACU settings Do not store these agents near one another if both products are available (e.g., pharmacy, anesthesia supplies).
		SUFENTA (sufentanil)		
5.	hydromorphone injection and morphine injection	DILAUDID (hydromorphone)	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	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.
		ASTRAMOPRH, DURAMORPH, INFUMORPH (morphine)		

			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.	
6.	<p>Insulin products</p> <p>Lantus and Lente Humalog and Humulin Novolog and Novolin Humulin and Novolin Humalog and Novolog Novolin 70/30 and Novolog Mix 70/30</p>	<p>LANTUS (insulin glargine) LENTE (insulin zinc suspension)</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>
7.	<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</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.</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</p>

	(daunorubicin, conventional)		Doses of liposomal daunorubicin are typically 40 mg/m ² 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 form has resulted in severe side effects and death.	and automated dispensing cabinets is highly discouraged. Include specific method of administration for these products.
	ADRIAMYCIN, RUBEX (doxorubicin, conventional)			
8.	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>AMPNOTEC (amphotericin B cholesteryl sulfate complex for injection)</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 amphotericin 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>
9.	Taxol and Taxotere	<p>TAXOL (paclitaxel)</p> <p>TAXOTERE (docetaxel)</p>	<p>Confusion between these two drugs can result in serious adverse outcomes since they have different dosing recommendations and use in various types of cancer.</p>	<p>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.</p>

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.
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* 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, and the US Food and Drug Administration, and previously published listings of sound-alike and look-alike drug name pairs. Ratings based on judgements of severity and likelihood of confusion in the clinical setting were then provided by outside experts using a modified Delphi process. The assistance of ISMP and the reviewers is 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	Generic (lowercase) & Brand Name(s) (UPPERCASE)	Potential Errors and Consequences	Suggested Safety Strategies**
1.	Amaryl and Reminyl AMARYL (glimepiride) REMINYL (galantamine hydrobromide)	Handwritten orders for Amaryl (used for type II diabetes) and Reminyl (used for Alzheimer's disease) can look similar. Patients receiving Amaryl in error would not be provided with blood glucose monitoring which could lead to a serious error.	See general recommendations below.

2.	Avandia and Coumadin	AVANDIA (rosiglitazone) COUMADIN (warfarin)	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.	See general recommendations below.
3.	Celebrex and Celexa and Cerebyx	CELEBREX (celecoxib) CELEXA (citalopram hydrobromide) CEREBYX (fosphenytoin)	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	See general recommendations below.
4.	clonidine and clonazepam (Klonopin)	CATAPRES (clonidine) KLONOPIN (clonazepam)	The generic name for clonidine can easily be confused as the trade or generic name for clonazepam.	See general recommendations below.
5.	Concentrated liquid morphine products vs. conventional liquid morphine concentrations	Concentrated: ROXANOL, MSIR Conventional: morphine oral liquid	Concentrated forms of oral morphine solution (20 mg/mL) have often been confused with the standard concentration (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, contributes to these errors, some of which have been fatal. For example, "10 mg" has been confused with "10 mL." If	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 dose measurement errors and differentiate the concentrated product

			concentrated product is used, this represents a 20-fold overdose.	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.
6.	hydromorphone injection and morphine injection	<p>DILAUDID (hydromorphone)</p> <p>ASTRAMOPRH, DURAMORPH, INFUMORPH (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.
7.	<p>Insulin products</p> <p>Lantus and Lente Humalog and Humulin Novolog and Novolin Humulin and Novolin Humalog and Novolog Novolin 70/30 and Novolog Mix 70/30</p>	<p>LANTUS (insulin glargine) LENTE (insulin zinc suspension)</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)

8.	Lamisil and Lamictal	LAMISIL (terbinafine hydrochloride) LAMICTAL (lamotrigine)	Patients with epilepsy who do not receive Lamictal due to an error would be inadequately treated and could experience serious consequences. Conversely, patients erroneously receiving Lamictal would be unnecessarily subjected to a risk of potential side effects (including serious rash) and would miss important antifungal therapy.	See general recommendations below.
9.	Serzone and Seroquel	SERZONE (nefazodone) SEROQUEL (quetiapine)	Beyond name similarity, these medications are both available in 100 mg and 200 mg strengths; both have similar instructions and dosage ranges; and both are used in similar clinical settings. Sedation or dizziness has occurred when Seroquel was dispensed instead of Serzone. Decompensation of mental status has occurred when Serzone was given instead of Seroquel. Further, there are many potentially dangerous drug interactions with Serzone. For example, there are reports of serious, sometimes fatal, reactions when patients receiving monoamine oxidase inhibitors are given drugs with pharmacologic properties similar to nefazodone.	See general recommendations below.
10.	Zyprexa and Zyrtec	ZYPREXA (olanzapine) ZYRTEC (cetirizine)	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.

*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, and the US Food and Drug Administration, and previously published listings of sound-alike and look-alike drug name pairs. Ratings based on judgments of severity and likelihood of confusion in the clinical setting were then provided by outside experts using a modified Delphi process. The assistance of ISMP and the reviewers is appreciated.

**These safety strategies are not inclusive of all possible strategies to reduce name-related errors. Also see *General Recommendations 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

Avinza – Evista

Bretyllium - Brevibloc

chlorpropamide – chlorpromazine

Diabeta – Zebeta

Diflucan - Diprivan

folic acid – leucovorin calcium (“folinic acid”)

heparin - Hespan

idarubicin – doxorubicin - daunorubicin

lamivudine – lamotrigine

Leukeran – leucovorin calcium

opium tincture – paregoric (camphorated opium tincture)

Prilosec and Prozac

Primacor - Primaxin

Retrovir - Ritonavir

tizanidine and tiagabine

Wellbutin SR - Wellbutrin XL

Zantac – Xanax

Zantac – Zyrtec

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:

1. ISMP. What’s in a name? Ways to prevent dispensing errors linked to name confusion. *ISMP Medication Safety Alert!* 7(12) June 12, 2002.
2. JCAHO. *Sentinel Event Alert*. Issue 19 - May 2001.