

FEATURE ARTICLE

Look-Alike, Sound-Alike Oncology Medications

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Confusing medication names and packaging may cause or contribute to potentially harmful medication errors. The names of several chemotherapy and supportive agents can look or sound like the names of other chemotherapy agents or unrelated medications and can be inadvertently interchanged, or mixed up. Poor handwriting, abbreviations of medication names, unclear verbal medication orders, memory lapses, and the large volume of medications currently in use are risk factors for look-alike, sound-alike medication errors. Risk reduction strategies include being aware of medications that look or sound like other medications, installing pop-up alerts in computer systems, prescribing medications by their generic and trade names, placing eye-catching labels and warning stickers on storage bins, storing medications in nonadjacent areas, and advising patients to be alert for potential mix-ups with look-alike, sound-alike medications.

Many medications have generic or trade names that can look or sound like the names of other medications. These “look-alike, sound-alike” medication names increase the risk of unintended interchanges or mix-ups of medications and may cause harmful medication errors. Several chemotherapy and supportive agents have names that sound and appear to be similar to other chemotherapy agents and, in some cases, look or sound like unrelated medications. Examples include similarities between the names of the chemotherapy agents carboplatin and cisplatin, docetaxel and paclitaxel, and vincristine and vinblastine. Doxorubicin has been confused with the antibiotic doxycillin, and methotrexate has been confused with methohexital, an ultrashort-acting barbiturate anesthetic (Joint Commission on Accreditation of Healthcare Organizations [JCAHO], 2005a; U.S. Pharmacopeia [USP], 2004a, 2004c). Look-alike, sound-alike medications commonly used in the care of patients with cancer are listed in Table 1.

Similarities in labeling and packaging of chemotherapy agents also increase the risk of medication errors. On labels, names of medications may be in small print that is easily misread. In addition, many medication labels have similar designs and layouts (Berman, 2004). Some chemotherapy agents are packaged using similar colors and designs on the outer box, vial label, and vial flip top. Vials may appear to be similar to one another in size and shape but contain vastly different medications (see Figure 1). Kenagy and Stein (2001) noted that simplicity, standardization, and differentiation are some of the human factors’ concepts that are relevant to the medication-use process, but these principles often have been ignored in the medication production process. They reported that “the consequences are predictable; bad names, bad labels, and bad packages represent accidents waiting to happen” (p. 2034).

At a Glance

- ◆ Medication name and labeling confusion plays a role in as many as half of all medication errors.
- ◆ Look-alike, sound-alike errors cannot be attributed solely to similar medication names and packaging; additional root causes and contributing factors usually exist.
- ◆ Nurses, especially those who prepare chemotherapy in addition to administering it, play a major role in preventing or averting look-alike, sound-alike medication errors.

Several factors cause or contribute to errors involving look-alike, sound-alike medications. Poor handwriting, especially faint or illegible script, can lead to drug errors. Abbreviation of medication names can cause confusion regarding which of several similar-sounding medications is the intended medication. Similarly, chemotherapy treatment protocols stated as acronyms (e.g., CHOP, ABVD) can cause confusion. Referring to chemotherapy agents by their nicknames (e.g., “Donna” for daunorubicin, “epi” for epirubicin) has caused errors. Verbal orders involving sound-alike medications may be misinterpreted or misunderstood. Prescribers who place an incorrect prefix or suffix on the name

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Table 1. Look-Alike, Sound-Alike Medications Commonly Used in the Care of Patients With Cancer

DRUG NAME	LOOK-ALIKE OR SOUND-ALIKE MEDICATIONS
Adriamycin® (Bedford Laboratories, Bedford, OH)	Aredia® (Novartis Pharmaceuticals Corp., East Hanover, NJ) and Idamycin® (Pharmacia, New York, NY)
aldesleukin	oprelvekin
Alkeran® (Celgene Corporation, Summit, NJ)	Leukeran® (GlaxoSmithKline, Research Triangle Park, NC)
asparaginase	pegaspargase
BiCNU® (Bristol-Myers Squibb, Princeton, NJ)	CeeNU® (Bristol-Myers Squibb)
capecitabine	gemcitabine
carboplatin	cisplatin
carmustine	lomustine
cisplatin	carboplatin
cyclophosphamide	cyclosporine
Cytosar® (Pharmacia)	Cytoxan® (Bristol-Myers Squibb) and Cytovene® (Roche Laboratories, Inc., Nutley, NJ)
Cytosar	Cytosar and cytarabine
darbepoetin alpha	epoetin alpha
daunorubicin	doxorubicin
doxorubicin	daunorubicin, doxorubicin liposomal, Doxil® (Ortho Biotech Products, L.P., Bridgewater, NJ), Droxia® (Bristol-Myers Squibb), and idarubicin
Doxil	doxorubicin and Droxia
doxorubicin liposomal	doxorubicin and doxacinil
epirubicin	daunorubicin, doxorubicin, and idarubicin
Epogen® (Amgen Inc., Thousand Oaks, CA)	Neupogen® (Amgen Inc.)
filgrastim	pegfilgrastim and sargramostin
fluorouracil	flucytosine and fluocinonide
gemcitabine	capecitabine
Idamycin	Adriamycin
idarubicin	doxorubicin
leucovorin	Leukine® (Berlex Laboratories, Inc., Richmond, CA) and Leukeran
Leukeran	Alkeran, leucovorin, and Leukine
Leukine	Leukeran
lomustine	carmustine
melphalan	Myleran® (GlaxoSmithKline)
methotrexate	methohexital
mitomycin	mitoxantrone
mitoxantrone	mitomycin
Myleran	melphalan
nelarabine (Arranon® [GlaxoSmithKline])	Navelbine® (GlaxoSmithKline) (vinorelbine tartrate)
Neumega® (Wyeth Pharmaceuticals Inc., Philadelphia, PA)	Neulasta® (Amgen Inc.) and Neupogen
Neupogen	Neumega
oprelvekin	aldesleukin
paclitaxel	docetaxel, Paxil® (GlaxoSmithKline), and paroxetine
Paraplatin® (Bristol-Myers Squibb)	Platinol-AQ® (Bristol-Myers Squibb)
Platinol-AQ	Paraplatin
Proleukin® (Chiron Corp.)	Leukine
tamoxifen	Tamiflu® (Roche Laboratories, Inc.) and tamsulosin
Taxol® (Bristol-Myers Squibb)	Paxil and Taxotere® (Aventis Pharmaceuticals Inc., Bridgewater, NJ)
Taxotere	Taxol
vinblastine	vincristine, vindesine, and vinorelbine
vincristine	vinblastine, vindesine, and vinorelbine

Note. Based on information from Institute for Safe Medication Practices, 2004, 2005; Joint Commission on Accreditation of Healthcare Organizations, 2005a; U.S. Pharmacopeia, 2004a, 2004c.

of a medication may create a word that resembles the name of another, unintended medication. Lastly, many new medications are introduced each year; each generally has a generic and trade name, and either may sound or appear to be similar to other medications already in use (Hoffman & Proulx, 2003; Institute for Safe Medication Practices [ISMP], 2005).

In 2001, JCAHO issued a *Sentinel Event Alert* on look-alike, sound-alike medication names. JCAHO (2001) noted that tens of thousands of generic and trade name (also called brand or proprietary name) medications are on the market; thus, the potential for error related to confusing medication names is significant. JCAHO (2001) further indicated that new names



Figure 1. Similar Packaging, Labeling, and Vial Sizes and Shapes Contribute to Look-Alike Chemotherapy Errors

that are similar to existing medication names continue to be approved and medication errors continue to occur despite review of the names before introduction to the market. Pharmaceutical manufacturers, the USP, the International Nonproprietary Names Committee of the World Health Organization, the U.S. Food and Drug Administration (FDA), the U.S. Adopted Names Council, the U.S. Patent and Trademark Office, and other entities are involved in this review (JCAHO, 2001). See the inset on page 41 for a more detailed explanation regarding the naming of medications.

Confirmation bias is believed to play a role in look-alike, sound-alike medication errors. Confirmation bias occurs when a person selectively notices or focuses on evidence that supports what the person believes or expects while ignoring evidence that does not confirm the beliefs or expectations (Nott, 2001). The following sentence illustrates this type of selective thinking: It doesn't matter how words are rewritten because the human mind does not read every letter by itself, but the word as a whole. Confirmation bias exists when healthcare providers look at medication packaging or labeling and "see" what they expect to see, without realizing that the medication they are holding is incorrect.

Error Incidence

The number of errors that occur—or are averted—as a result of look-alike, sound-alike medication names and packaging is unknown. Similar medication names, either written or spoken, accounted for approximately 15% of all reports to the USP Medication Errors Reporting Program from 1996–2001, which are the most recent data available (USP, 2001). The ISMP (2004) estimated that name and labeling confusion plays a role in as many as half of all medication errors.

The ISMP (2005) recently received a report of "rubicin" product confusion. A nurse noticed that the color of a dose of idarubicin was different from the color of a dose she had administered previously. Investigation revealed that the patient had inadvertently received daunorubicin instead of the prescribed idarubicin. The ISMP (2005) noted that "with five different 'rubicin' drugs on the market, each with similar names, and two with liposomal forms, mix-ups are not surprising" (p. 1).

In another reported error involving look-alike, sound-alike chemotherapy agents, Cytosar® (Pharmacia, New York, NY) was ordered and Cytoxan® (Bristol-Myers Squibb, Princeton, NJ) was administered. The error was discovered by a pharmacist the following day when a pharmacy technician pulled the incorrect vial to prepare another dose. Root causes of the error and contribut-

ing factors extended beyond the two medications having similar trade names. Both agents are used to treat leukemia, are for IV use only, and were stored in the same pharmacy cabinet. The pharmacist reported that he was overworked, and a double-check system was in not place at the time of the error (USP, 2004a). As illustrated by this case report, errors often cannot be attributed solely to look-alike, sound-alike medication names. Additional root causes and contributing factors usually exist.

Various organizations concerned about medication safety, such as the ISMP, JCAHO, and USP, have created lists of look-alike, sound-alike medications to aid in their identification (ISMP, 2004; JCAHO, 2005a; USP, 2004c). The USP (2004b) has suggested that lists of similar medication names can be used to evaluate an institution's existing formulary and identify which products appear on the list, determine whether products with similar names are stocked next to each other, and track medication errors involving look-alike, sound-alike medications. However, in the USP (2004b, p. 4) list, cytarabine is noted as a look-alike, sound-alike medication with Cytosar. In fact, Cytosar is the trade name for the generic medication cytarabine. Errors in look-alike, sound-alike medication lists only add to the confusion about such medications.

Joint Commission on Accreditation of Healthcare Organizations Patient Safety Goals

One of the JCAHO (2005b) national patient safety goals is to identify and, at a minimum, annually review a list of look-alike, sound-alike medications used in an organization and take action to prevent errors involving the interchange of drugs. Organizations must create a list of look-alike, sound-alike medications that contain a minimum of 10 medication combinations. At least five of the combinations must be selected from JCAHO (2005a) Table I (for critical-access hospitals, hospitals, and office-based surgery centers) or JCAHO (2005a) Table II (for ambulatory care, assisted living, behavioral health care, disease-specific care, home care, and long-term care), as appropriate to the type of organization. An additional five combinations must be selected from any of the JCAHO (2005a) tables (I, II, or III, which is a supplemental list of 20 additional look-alike, sound-alike medication name pairs) (see Figure 2). The detailed tables can be accessed via the JCAHO Web site (www.jcaho.org/accredited+organizations/patient+safety/05+npsg/lasa.pdf).

Although the JCAHO national patient safety goal focuses on look-alike, sound-alike medication names, organizations also should identify look-alike packaging and proactively take steps to reduce the risk of this type of potential error (McCoy, 2005). Nurses working in JCAHO-accredited facilities generally are aware of the JCAHO national patient safety goals; however, those working in non-JCAHO-accredited facilities may not be as familiar with the patient safety goals, but nurses can apply the goals in the workplace and in clinical practice.

Risk Reduction

The risk of errors involving look-alike, sound-alike medications may be reduced by implementing precautions throughout the various stages of medication production, dispensing,

For Critical-Access Hospitals, Hospitals, and Office-Based Surgery Centers

- cisplatin and carboplatin
- doxorubicin liposome and daunorubicin liposome and conventional forms of doxorubicin and daunorubicin
- Taxol® (Bristol-Myers Squibb, Princeton, NJ) and Taxotere® (Aventis Pharmaceuticals Inc., Bridgewater, NJ)
- vinblastine and vincristine
- lipid-based amphotericin products and conventional forms of amphotericin
- hydromorphone and morphine
- concentrated liquid morphine products and conventional liquid morphine products
- ephedrine and epinephrine
- fentanyl and sufentanil
- insulin products

For Ambulatory Care, Assisted Living, Behavioral Health Care, Disease-Specific Care, Home Care, and Long-Term Care

- Avandia® (GlaxoSmithKline, Research Triangle Park, NC) and Coumadin® (Bristol-Myers Squibb)
- Celebrex® (Pfizer Inc., New York, NY), Celexa® (Forest Pharmaceuticals, Inc., St. Louis, MO), and Cerebyx® (Pfizer Inc.)
- clonidine and Klonopin® (Roche Pharmaceuticals, Nutley, NJ)
- Lamisil® (Novartis Pharmaceuticals Corp., East Hanover, NJ) and Lamictal® (GlaxoSmithKline)
- Serzone® (Bristol-Myers Squibb) and Seroquel® (AstraZeneca, Wilmington, DE)
- Zyprexa® (Eli Lilly and Company, Indianapolis, IN) and Zyrtec® (Pfizer Inc.)
- concentrated liquid morphine products and conventional morphine products
- hydromorphone injection and morphine injection
- insulin products

Figure 2. Potentially Problematic Medication Names

Note. Based on information from Joint Commission on Accreditation of Healthcare Organizations, 2005a.

preparation, and administration. First, manufacturers and regulatory authorities need to be vigilant when naming, packaging, and supplying new medications and formulations (Aronson, 2004). However, attention to naming and packaging medications is not an “end all” solution, as illustrated by the attempts made to decrease patient deaths caused by accidental injection of concentrated potassium chloride solution. Black caps were placed on potassium chloride beginning in 1991 to signal nurses to use caution with the medication, and the color black was prohibited from use in packaging other medications. However, no change was documented in the number of deaths that occurred from concentrated potassium chloride administration. To determine why the black caps did not fix the problem, researchers observed nurses and discovered that concentrated potassium chloride vials often were stocked adjacent to floor stocks of the diuretic furosemide. Nurses did not mistake the potassium chloride vial for something else; they simply thought that they were picking up furosemide (confirmation bias). Another type of error reduction strategy was needed, and a simple, inexpensive solution was implemented in healthcare facilities in 1998.

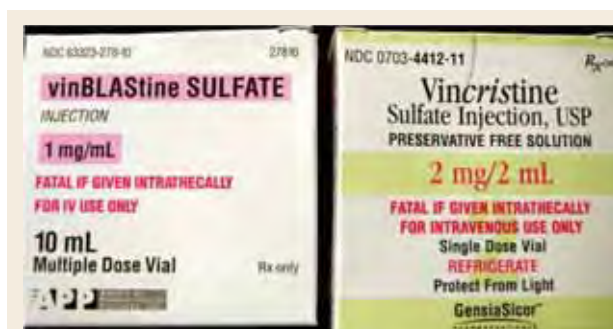
Concentrated potassium solutions were removed from patient care areas, and deaths from inadvertent injection of potassium chloride declined from 12 in 1997 to 2 in the two-year period from 1998–1999 (JCAHO, 1998, 1999, 2000).

Packaging changes have been successful in addressing some of the problems associated with look-alike, sound-alike chemotherapy agents. For instance, the Platinol®-AQ (Bristol-Myers Squibb) labeling and packaging were redesigned by its manufacturer to enhance safety (Kenagy & Stein, 2001). Another example is a change in the labeling of vincristine and vinblastine to highlight the differing syllables in the names of the two medications (see Figure 3).

Medication safety experts advocate that packaging standards, including a standardized font size and label layout, should be adopted by the pharmaceutical industry. Considerable debate has ensued about the use of color-coding injectable medication caps and labels; some authors assert that prohibiting all color would be safest because doing so would eliminate the practice of relying on color and require people to read labels (Kenagy & Stein, 2001).

Prescribers need to be aware of look-alike, sound-alike medications and check the names of medications they are prescribing that are unfamiliar. Chemotherapy agents should be prescribed by their full names, not by their nicknames, and should never be abbreviated. Prescribers also can specify both the generic and trade names of look-alike, sound-alike medications (especially newly released medications) to reduce potential confusion. Including the purpose of a prescribed medication is an inexpensive and efficient strategy to assist pharmacists in screening orders for appropriate dose, indication, and duration. Prescribers and pharmacists or others preparing medications should have patient information, including diagnoses and current medications, readily available so that the information can be considered when the name of a new medication is unclear. Prescribers also can alert patients to the potential for mix-ups, especially with medications that are known to be problematic in terms of name confusion.

Institutional policies should outline procedures for verbal and telephone medication orders. Verbal orders for chemotherapy are unacceptable; instead, chemotherapy orders should be faxed, electronically mailed, entered into computers, or



Note. Tall man (uppercase) lettering is used in the word “vinblastine” and italics are used in the word “vincristine” to distinguish the products from one another.

Figure 3. Distinguished Lettering in Drug Labels

written in block letters. When receiving verbal orders for other medications, nurses should ask prescribers to spell the names of unfamiliar medications and read back the orders, including the spelling of drug names, to confirm that orders are heard and interpreted correctly.

Computerized prescriber order entry (CPOE), automated oncology software programs, and bar coding may reduce the potential for look-alike, sound-alike errors (Mekhjjan et al., 2002; Neuenschwander et al., 2003). However, the impact of technology on clinical outcomes and cost issues needs to be studied further (Berger & Kichak, 2004). Although several studies support CPOE system use, researchers have documented that the systems facilitate 22 types of medication error risks that they attributed to fragmented CPOE screens, confusion between types of screens (e.g., ordering, inventory), separation of functions that result in dosing errors, and inflexible ordering formats (Koppel et al., 2005). In addition, care needs to be taken with voice and speech recognition systems because they have been reported to substitute wrong drug names ("Speech Recognition Systems," 2002).

CPOE and chemotherapy entry software programs have the potential to reduce look-alike, sound-alike medication errors during the prescribing phase of the medication-use process. Bar coding may reduce errors that occur during the medication-dispensing phase. Another approach to reduce dispensing errors is remote order entry and video verification. At a rural hospital, a Web cam is used to transmit electronic images of medications removed from the pharmacy shelf. A pharmacist at another location enters the orders and reviews the electronic images to verify that the correct medications have been selected from the pharmacy stock (Woodall, 2004).

Look-alike, sound-alike medications should not be stored alphabetically by name. They should be stored out of order or in an alternate location (JCAHO, 2001). Depending on the medication, consider limiting the stock supply (e.g., stock only concentrated liquid morphine instead of also stocking other morphine concentrations) or stocking an alternative medication without nomenclature problems and eliminate a look-alike, sound-alike medication from the formulary. The ISMP (2002b) suggested that, when adding a new product to the formulary, the possibility of name confusion should be considered and a few clinicians should be asked to handwrite the product name and directions as they would appear in a typical order. The mock orders then can be given to nurses, pharmacists, technicians, and unit secretaries to read out loud and interpret. The exercise is very helpful in evaluating recently approved medications because they often are mispronounced, and mispronunciation of a medication name may sound like the name of another medication already in use.

Interactive or "pop-up" alerts in computer systems can be used to generate warnings about look-alike, sound-alike medications during prescribing and dispensing. Ideally, alerts should be auditory as well as visual (ISMP, 2002b). Tall man lettering (i.e., uppercase letters), italics, and bold type can be used on labels and stock bins of medications to draw attention to a certain part of a medication's name (e.g., **CIS**platin, vincristine). Caution labels placed on bins containing look-alike, sound-alike medications also reduce the potential for error. Pharmacists and others who prepare medications, such as nurses in small office

practices, need to double check the names of all medications and provide generic names and, when different from the generic names, the trade names of the medications on their labels. Providing both names on the label ensures consistency among the medication orders, medication preparation documents, and medication labels and helps to prevent misinterpretation of medication orders (JCAHO, 2001). Two independent checks should be made during the medication-dispensing process: One person interprets and enters or processes the order, and another views the printed label against the original order and the medication vial (ISMP, 2002b). Linda McCoy, PharmD, (personal communication, April 27, 2005), director of clinical patient safety at Good Samaritan Hospital in Phoenix, AZ, recommended first placing the medication vial on a person's left side and checking it against the order, as opposed to the other way around, and then switching the locations to perform the second check. This maneuver forces a closer inspection of medication orders and vials and reduces the potential for confirmation bias.

High-Risk Chemotherapy Error Prevention

Healthcare providers can identify chemotherapy agents at high risk for inadvertent interchange used in their institutions and develop specific strategies to reduce the likelihood that errors with the medications will occur. Four of the 10 look-alike, sound-alike name pairs listed in JCAHO (2005a) Table I are chemotherapy agents, and one of the name pairs is cisplatin and carboplatin. Severe toxicity and at least one death have occurred when cisplatin was inadvertently administered instead of carboplatin (doses appropriate for carboplatin exceed the maximum safe dose of cisplatin) (Charlier, Kintz, Dubois, & Plomteux, 2004; Choi et al., 2002). Specific safety strategies that can be implemented include using both generic and trade names when prescribing cisplatin and carboplatin; storing these agents in nonadjacent bins with alert labels or storing carboplatin under its trade name, Paraplatin® (Bristol-Myers Squibb); establishing maximum dose warnings for both agents in computer and manual systems; performing a dose range check of prepared doses; using the manufacturer's safe-handling recommendations and stickers for cisplatin; and having two people verify the correct medication and dose prior to its administration (JCAHO, 2005a).

Similarly, paclitaxel has been confused with docetaxel, and vinblastine has been confused with vincristine. Fatal errors have occurred when patients erroneously received vincristine at the higher vinblastine dose. Maximum dose warnings, staff education, storage of the agents in nonadjacent areas, and prohibiting abbreviation of the drug names may help to reduce errors associated with these look-alike, sound-alike chemotherapy agents (Schulmeister, 2004).

Other chemotherapy agents at high risk for confusion include liposomal and conventional formations of daunorubicin and doxorubicin. The products are not interchangeable; liposomal formation dosing guidelines differ significantly from conventional dosing. Staff involved in the ordering, preparation, and administration of the products need to be aware of the differences between conventional and liposomal formations. JCAHO

(2005a) recommended that lipid-based products should not be stored in automated dispensing cabinets or patient care areas. Pop-up computer alerts can be used to confirm liposomal formulations, and warning labels on stock bins combined with nonadjacent storage may reduce errors involving these agents.

Referring to liposomal products by trade rather than generic names (e.g., Doxil® [Ortho Biotech Products, L.P., Bridgewater, NJ] instead of doxorubicin liposomal, DaunoXome® [Gilead, Cambridge, United Kingdom] instead of daunorubicin liposomal) may help to decrease confusion with the agents. Trade names often are more distinct than generic names of medications (Anton, Cox, & Ferner, 2002). Monoclonal antibodies are another example of agents with similar generic names (e.g., gemtuzumab, rituximab, trastuzumab); however, their trade names are quite distinct from one another (Mylotarg®, Wyeth Pharmaceuticals Inc., Philadelphia, PA; Rituxan®, Genentech, Inc., South San Francisco, CA; and Herceptin®, Genentech, Inc., respectively).

Patients should receive written information about medications, including each medication's indication. They should be encouraged to question any medication they receive and never hesitate to ask about the cost of a medication, because a higher or lower fee may occur as a result of an incorrect medication being prescribed or dispensed. Patients should be advised to be alert for clues that might suggest that an inadvertent medication interchange has occurred, such as the different appearance of a medication, a greater or lesser number of pills in a vial than expected, directions on prescription vials that differ from what healthcare providers have said, and different colors or amounts of medication in syringes (ISMP, 2002a).

Summary

The names of several medications are strikingly similar looking (orthographic) or similar sounding (phonologic) and have been called the “nightmare of the medical profession” (Rataboli & Garg, 2005, p. 13). The potential for errors caused by look-alike, sound-alike medications may be reduced by using generic drug names, CPOE, and computer alerts; limiting the type or number of dose formulations of high-risk medications; placing warning labels on stock bins; and storing high-risk medications in nonadjacent areas. Nurses, especially those who prepare chemotherapy in addition to administering it, play a major role in preventing or averting look-alike, sound-alike medication errors. To reduce the potential for this type of error, nurses also need to maintain awareness of problematic product names and implement the error prevention recommendations advocated by the ISMP (www.ismp.org), FDA (www.fda.gov), and USP (www.usp.org).

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Do You Wonder Where Drug Names Come From?

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Did you ever hear someone else stumble over a new drug name and wonder, "Is that how you say that?" Alvocidib, bevacizumab, cetuximab, defibrotide . . . pronunciation of the more than 33,000 trademarked names and 9,000 generic names used in the United States (Lambert, Chang, & Lin, 2001) can be tricky. When you examine the method behind the apparent madness, you'll find that generic names are clues about the agents' mechanism of action, and perhaps their sources.

First, let's differentiate between nonproprietary (i.e., generic names) and proprietary (i.e., brand names and trademarks) drug lexica. Generic names average 14.4 letters and 5 syllables. Usually, they are more confusing than proprietary names, which average 10.4 letters and 3.53 syllables (Gundersen, 1998).

Generic Jargon

The U.S. Adopted Names (USAN) Council uses strict criteria to develop generic names suitable for multiple settings. A drug or biologic agent's sponsor can suggest a generic name, but if the USAN Council considers the suggestion inappropriate, it suggests a new name. The World Health Organization's International Nonproprietary Name Committee is the final approving authority (Gundersen, 1998; USAN Council, 2005). Lexicon problems can be complex because chosen names may be words in other languages or may even be offensive.

Because people differentiate similar names by the first few letters, stems of drug names (e.g., "cep-" that plagued the cephalosporin class with errors) have been abandoned. Some current naming restrictions include the following.

- "Rac-" can be used only for a racemic mixture.
- "Dex-" and "lev-" can be used only for dextro- [R(+)] or levo- [S(-)] rotating enantiomers.
- "Ar-" and "es-" are reserved for the R(-) and S(+) isomers of the levorotatory and dextrorotatory forms, respectively.
- Generic drug names do not begin with the letters H, J, K, or W because the letters either do not exist in some of the 130 countries that use USANs or have different sounds in various languages.

- Names do not begin with X and Z because they often sound alike.
- Stems such as "brev," "vel," and "mal" are not used because of their implications (i.e., brevity, velocity, bad).

U.S. Adopted Names

The USAN (i.e., the drug name) should be short, easy to pronounce, and euphonic (Wick, 2004). Misleading or confusing sounds or syllables should be avoided.

Names are based on stems (syllables common to agents sharing pharmacologic actions) (Wick, 2004). For example, the stem "-tinib" refers to tyrosine kinase inhibitors. A list of stems is available at www.ama-assn.org/ama1/pub/upload/mm/365/usanstmlist_10_19_05.doc.

Example: Monoclonal Antibodies

Monoclonal antibodies (MABs) are one of the lexicon's greatest challenges. Because of the sheer number of drugs, finding simple, informative, and unique names has become increasingly difficult and led to many tongue-twisting names. The USAN Council does have a method to bestow names, however, and differences between agents become obvious when you know the system. The suffix "-mab" is used to identify a MAB or fragment (e.g., rituximab). The animal source is identified by a vowel or two-letter pair in the middle of the word (i.e., a = rat, e = hamster, i = primate, o = mouse, u = human, xi = chimera, and zu = humanized). The target disease or condition also is identified within the drug name. "-Vir-" is used for viruses, "-bac-" for bacterial, "-lim-" for immune, "-les-" for lesions, "-cir-" for cardiovascular, and "-tu-" for tumor. Therefore, adalimumab is an immunomodulating humanized MAB, rituximab is a chimeric MAB, and trastuzumab is a humanized MAB, with the last two agents used in tumors (Wick, 2004).

You can find similar explanations for erythropoietins, interferons, interleukins, and somatotropins on the USAN Web site at www.ama-assn.org/ama1/pub/upload/mm/365/usanstmlist_10_19_05.doc.

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