

## Toward a Uniform System for Naming Vaccines and Polyclonal Immune Globulins\*

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**ABSTRACT** This *Stimuli* article identifies inconsistencies and problems with the nonproprietary names of US-licensed vaccines and immune globulin products. It proposes systematic naming conventions and provides examples. Standardization in naming different types of vaccines, e.g., live and conjugated vaccines and antigenic valence is especially important for patient safety. This *Stimuli* article also proposes a scheme of supplementary words that more simply describe vaccine adjuvants and carrier proteins in order to unclutter container and package labels. International harmonization in this matter is warranted. If these nomenclature guidelines are implemented, they may improve the clarity and consistency of vaccine naming conventions, enhance simplicity and consistency, and diminish ambiguity. Standardizing vaccine and polyclonal immune globulin naming can reduce opportunities for medication errors. This will be especially important as combination vaccines become more common. After discussion and refinement, these guidelines may be adopted by USP and others immediately for new vaccines and immune globulin products and should be phased in for existing products.

### INTRODUCTION

The challenge of naming ingredients and dosage forms/products is a continuing one. The first *USP* of 1820 called for ways to “distinguish . . . articles by convenient and definite names, such as may prevent trouble or uncertainty in the intercourse of physicians and apothecaries.” In the late 1970s students struggled to memorize and legibly write generic names like *diphenylhydantoin* and *dioctyl sodium sulfosuccinate*. Practitioners were delighted when health authorities revised these tongue-twisters to the simpler proper or nonproprietary names known today: *phenytoin* and *docusate sodium*.

Unfortunately, the names of some of today’s vaccines have grown to cumbersome length. Worse, the length is measured in words, not mere syllables. Eight vaccine names involve 10 or more words. Some vaccine names could potentially create clinical misunderstanding and error due to inconsistencies and mistaken emphasis. These problems developed unintentionally—probably because of a series of isolated and uncoordinated decisions—in the absence of a systematic naming framework. The science of systematics (taxonomy) for vaccines and allied articles is the topic of this *Stimuli* article. Systematics involves classification, nomenclature and identification.

In the United States a complicated set of responsibilities leads to the naming of medications. The US Adopted Names (USAN) Council designates nonproprietary names for drug and biological substances (active pharmaceutical ingredients) following processes endorsed by the Food and Drug Administration (FDA) (1). The USAN Council is sponsored by the American Medical Association (AMA), the American Pharmacists Association (APhA), and USP and serves the health professions by selecting simple, informative, and unique nonproprietary names for medication ingredients by means of logical nomenclature classifications based on pharmacological

and/or chemical relationships. When a USAN name exists, USP uses that name as the official compendial title for the drug substance. USP’s Nomenclature Expert Committee also begins with the USAN name, if one exists, as it independently develops the compendial title for the drug product. The compendial name used to title *USP* monographs by law generally becomes the established name that must be displayed in labeling (2–3). FDA equates established names for drugs with proper names for biological products (4). Comparable methods are used in the United Kingdom, Japan, and elsewhere (1–7). The World Health Organization (WHO) and its International Nonproprietary Names (INN) program work to harmonize names around the globe, although evolving interpretations may result in exceptions to the various rules.

This article discusses problems with current vaccine and polyclonal immune globulin names and proposes a set of naming guidelines for each category for consideration by the USAN Council and by regulators and compendial authorities. This effort assumes that the ideal name contains no words unnecessary in selecting the proper product from a shelf or in drug administration. Superfluous words clutter product labels, especially single-dose vials and prefilled syringes. Shorter names allow larger font sizes, which makes visual identification easier.

Length is especially important with vaccine and antibody names because federal regulation requires that the full proper (nonproprietary) name appear on the label in print at least as large as the product’s proprietary name (8). Curiously, this situation is the opposite of the case for drug names, where the proprietary name is permitted to be larger than the (usually short) established name (9). Long names make it more difficult for the eye to focus on pivotal information.

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**CURRENT NOMENCLATURE**

No single source of nonproprietary vaccine names for the US has been published. To create such a list (Table 1), the author first consulted two FDA Web sites and corroborated

them against FDA-approved prescribing information at manufacturers' Web sites (10–12). In cases of conflicting information, emphasis was given to the captions of prescribing information, especially if long strings were repeated in manufacturers' formal documents.

**Table 1. Nonproprietary Names of Vaccines Licensed by FDA, May 2007**

Name	Sponsors/Distributors
<i>Anthrax Vaccine Adsorbed</i>	Emergent BioSolutions
<i>BCG Vaccine*</i>	Organon USA; Sanofi Pasteur
<i>Diphtheria &amp; Tetanus Toxoids Adsorbed For Pediatric Use</i>	Sanofi Pasteur
<i>Diphtheria &amp; Tetanus Toxoids &amp; Acellular Pertussis Vaccine Adsorbed</i>	GlaxoSmithKline; Sanofi Pasteur
<i>Diphtheria &amp; Tetanus Toxoids &amp; Acellular Pertussis Vaccine Adsorbed, Hepatitis B (Recombinant) and Inactivated Poliovirus Vaccine Combined</i>	GlaxoSmithKline
<i>Haemophilus b Conjugate Vaccine (Diphtheria CRM197 Protein Conjugate)</i>	Wyeth
<i>Haemophilus b Conjugate Vaccine (Meningococcal Protein Conjugate)</i>	Merck
<i>Haemophilus b Conjugate Vaccine (Tetanus Toxoid Conjugate)</i>	Sanofi Pasteur
<i>Haemophilus b Conjugate Vaccine (Meningococcal Protein Conjugate) &amp; Hepatitis B (Recombinant) Vaccine</i>	Merck
<i>Hepatitis A Vaccine, Inactivated</i>	GlaxoSmithKline; Merck
<i>Hepatitis A Inactivated and Hepatitis B (Recombinant) Vaccine</i>	GlaxoSmithKline
<i>Hepatitis B Vaccine (Recombinant)</i>	GlaxoSmithKline; Merck
<i>Influenza Virus Vaccine, 20YY-20YY Formula</i>	GlaxoSmithKline; Novartis
<i>Influenza Virus Vaccine, Live, Intranasal, 20YY-20YY Formula</i>	MedImmune
<i>Influenza Virus Vaccine (Zonal Purified, Subvirion), 20YY-20YY Formula</i>	Sanofi Pasteur
<i>Influenza Virus Vaccine (Zonal Purified, Subvirion), No Preservative, 20YY-20YY Formula</i>	Sanofi Pasteur
<i>Japanese Encephalitis Virus Vaccine Inactivated</i>	Sanofi Pasteur
<i>Measles Virus Vaccine, Live</i>	Merck
<i>Measles, Mumps, and Rubella Virus Vaccine, Live</i>	Merck
<i>Measles, Mumps, Rubella and Varicella (Oka/Merck) Virus Vaccine Live</i>	Merck
<i>Meningococcal (Groups A, C, Y and W-135) Polysaccharide Diphtheria Toxoid Conjugate Vaccine</i>	Sanofi Pasteur
<i>Meningococcal Polysaccharide Vaccine, Groups A, C, Y and W-135 Combined</i>	Sanofi Pasteur
<i>Mumps Virus Vaccine Live</i>	Merck
<i>Pneumococcal Vaccine, Polyvalent</i>	Merck
<i>Pneumococcal 7-valent Conjugate Vaccine (Diphtheria CRM197 Protein)</i>	Wyeth
<i>Poliovirus Vaccine Inactivated</i>	Sanofi Pasteur
<i>Quadrivalent Human Papillomavirus (Types 6, 11, 16, 18) Recombinant Vaccine</i>	Merck
<i>Rabies Vaccine</i>	Novartis; Sanofi Pasteur
<i>Rabies Vaccine Adsorbed</i>	Emergent BioSolutions
<i>Rotavirus Vaccine, Live, Oral, Pentavalent</i>	Merck
<i>Rubella Virus Vaccine Live</i>	Merck
<i>Smallpox Vaccine, Dried, Calf Lymph Type</i>	Wyeth
<i>Tetanus &amp; Diphtheria Toxoids Adsorbed for Adult Use</i>	Massachusetts Biological Laboratories; Sanofi Pasteur
<i>Tetanus Toxoid For Booster Use Only</i>	Sanofi Pasteur
<i>Tetanus Toxoid Adsorbed</i>	Massachusetts Biological Laboratories; Sanofi Pasteur
<i>Tetanus Toxoid, Reduced Diphtheria Toxoid and Acellular Pertussis Vaccine, Adsorbed</i>	GlaxoSmithKline; Sanofi Pasteur
<i>Typhoid Vaccine Live Oral Ty21a</i>	Berna Products
<i>Typhoid Vi Polysaccharide Vaccine</i>	Sanofi Pasteur
<i>Varicella Virus Vaccine Live (Oka/Merck)</i>	Merck
<i>Yellow Fever Vaccine</i>	Sanofi Pasteur
<i>Zoster Vaccine, Live (Oka/Merck)</i>	Merck

\* Use caution not to confuse BCG Vaccine, which is used to prevent tuberculosis, with BCG Live (Intravesical or For Intravesical Use), which is used to treat bladder cancer.

Sources: Derived from references 1, 5–7, plus prescribing information posted at sponsor/distributor Web sites.

Next, the list presented in *Table 1* was reviewed to identify inconsistent and ambiguous wordings, which were grouped into thematic categories. Based on these issues, the author developed systematic naming guidelines that consistently identify the disease prevented, physical state, antigenic valency, and viability. The goal of the guidelines is to generate names that are accurate, simple, consistent, parsimonious, and unambiguous both in the context of current vaccines and vaccines that could be licensed in the future (12).

Similarly, the list of nonproprietary polyclonal immune globulin names appears in *Table 2* (11–12). This list similarly was reviewed to identify inconsistent and ambiguous wording. These findings were used as the basis to suggest more systematic naming guidelines. Such guidelines may reduce opportunities for medication errors involving these products.

**Table 2. Nonproprietary Names of Polyclonal Immune Globulins Licensed by FDA, May 2007**

Name	Sponsors/Distributors
<i>Anti-thymocyte Globulin (Rabbit)</i>	Genzyme
<i>Antivenin (Crotalidae) Polyvalent</i>	Wyeth
<i>Antivenin (Latrodectus mactans)</i>	Merck
<i>Antivenin (Micrurus fulvius)</i>	Wyeth
<i>Botulism Antitoxin</i>	Sanofi Pasteur
<i>Botulism Immune Globulin Intravenous (Human)</i>	California Department of Health Services
<i>Crotalidae Polyvalent Immune Fab (Ovine)</i>	Protherics
<i>Cytomegalovirus Immune Globulin Intravenous (Human)</i>	CSL Behring
<i>Digoxin Immune Fab (Ovine)</i>	GlaxoSmithKline, Protherics
<i>Hepatitis B Immune Globulin (Human)</i>	Cangene, Nabi, Talecris
<i>Immune Globulin (Human)</i>	Talecris
<i>Immune Globulin Intravenous (Human)</i>	Baxter, Grifols, Octapharma, Talecris, CSL Behring
<i>Immune Globulin Intravenous (Human), 10% Solution</i>	Baxter
<i>Immune Globulin Intravenous (Human), 10%, Caprylate/Chromatography Purified (IGIV-C)</i>	Talecris
<i>Immune Globulin Subcutaneous (Human)</i>	CSL Behring
<i>Lymphocyte Immune Globulin, Anti-thymocyte Globulin (Equine)</i>	Pfizer
<i>Rabies Immune Globulin (Human)</i>	Sanofi Pasteur, Talecris
<i>Rho(D) Immune Globulin (Human)</i>	CSL Behring, Ortho, Talecris
<i>Rho(D) Immune Globulin Intravenous (Human)</i>	Cangene
<i>Tetanus Immune Globulin (Human)</i>	Talecris
<i>Vaccinia Immune Globulin Intravenous (Human)</i>	Cangene

Sources: Derived from references 1, 6, and 7, plus prescribing information posted at sponsor/distributor Web sites.

### PROPOSAL FOR UNIFORM NAMING GUIDELINES

The two FDA Web sites contain inconsistencies between themselves and FDA-licensed product literature (10–12). The *USP Dictionary of USAN and International Drug Names* omits several US-licensed vaccines (e.g., *Typhoid Vi Polysaccharide Vaccine* and *Varicella Virus Vaccine Live*) and tends to truncate the full names found elsewhere (1, 10–12).

The nonproprietary names of FDA-licensed vaccines inconsistently use the words *combined*, *inactivated*, *live*, *virus*, and terms designating antigenic valency, microbial strain, produc-

tion media, and target population. Other names include the words *adsorbed*, *recombinant*, and *conjugate*. *Table 3* summarizes the inconsistencies and potential problems (with relevant examples), accompanied by suggested ways to resolve these issues. The following text provides more detail about the issues identified and proposed recommendations that might be included in guidelines.

**Table 3. Problems with Current Vaccine Names and Suggested Naming Guidelines**

Category	Situation with Current Nomenclature • Example	Suggested Naming Guidelines • Example
Live Vaccines	Some live vaccines do not reflect their live characteristic in the nonproprietary name. Placement of the word <i>Live</i> is inconsistent in other names. <ul style="list-style-type: none"> <li>• <i>Smallpox Vaccine, Dried, Calf Lymph Type</i> [a live vaccine]</li> <li>• <i>Yellow Fever Vaccine</i> [a live vaccine]</li> <li>• <i>Measles Virus Vaccine, Live</i></li> <li>• <i>Typhoid Vaccine Live Oral Ty21a</i></li> </ul>	Include <i>Live</i> in all applicable vaccine names as the last word in the name.
Inactivated Vaccines	Some inactivated (i.e., subunit) vaccines contain <i>Inactivated</i> in the nonproprietary name, but most do not. <ul style="list-style-type: none"> <li>• <i>Hepatitis A Vaccine, Inactivated</i></li> </ul>	Omit <i>Inactivated</i> from vaccine names. Describe inactivated character in prescribing information.
Viral Vaccines	Some viral vaccines contain <i>Virus</i> in the nonproprietary name, but most do not. <ul style="list-style-type: none"> <li>• <i>Japanese Encephalitis Virus Vaccine Inactivated</i></li> <li>• <i>Hepatitis A Vaccine, Inactivated</i> [a viral vaccine]</li> </ul>	Omit <i>Virus</i> from vaccine names, unless part (prefix, suffix) of another word (e.g., Papillomavirus).
Microbial Strain	Some vaccines describe the microbial strain in the nonproprietary name, but most do not. <ul style="list-style-type: none"> <li>• <i>Typhoid Vaccine Live Oral Ty21a</i></li> <li>• <i>Zoster Vaccine, Live (Oka/Merck)</i></li> <li>• <i>Typhoid Vi Polysaccharide Vaccine</i></li> <li>• <i>Yellow Fever Vaccine</i></li> </ul>	Omit microbial strain from vaccine names. Describe strains in prescribing information. <ul style="list-style-type: none"> <li>• <i>Typhoid Vaccine Oral Live</i></li> </ul>
Polysaccharide Vaccines	Some polysaccharide vaccines contain <i>Polysaccharide</i> in the nonproprietary name, but others do not. <ul style="list-style-type: none"> <li>• <i>Haemophilus b Conjugate Vaccine (Meningococcal Protein Conjugate)</i></li> <li>• <i>Pneumococcal Vaccine, Polyvalent</i></li> <li>• <i>Typhoid Vi Polysaccharide Vaccine</i></li> <li>• <i>Meningococcal (Groups A, C, Y, and W-135) Polysaccharide Diphtheria Toxoid Conjugate Vaccine</i> [includes both polysaccharide and conjugate designators]</li> </ul>	Include <i>Polysaccharide</i> in nonproprietary vaccine names only if the vaccine is not conjugated to a protein. Omit otherwise. <ul style="list-style-type: none"> <li>• <i>Pneumococcal Polysaccharide 23-Valent Vaccine</i></li> <li>• <i>Haemophilus b Conjugate Vaccine</i></li> </ul>
Antigenic Valency	Description of antigenic valency is inconsistent, in some cases missing or ambiguous. <ul style="list-style-type: none"> <li>• <i>Poliovirus Vaccine Inactivated</i> [a trivalent product]</li> <li>• <i>Pneumococcal Vaccine, Polyvalent</i></li> <li>• <i>Quadrivalent Human Papillomavirus (Types 6, 11, 16, 18) Recombinant Vaccine</i></li> </ul>	Describe the antigenic types or serogroups included in the product. Omit the term <i>x-valent</i> from nonproprietary vaccine names, unless not apparent from other portions of the name. If <i>x-valent</i> is included in the name, describe valency numerically, toward the end of the name. For example: <ul style="list-style-type: none"> <li>• <i>Human Papillomavirus Types 6, 11, 16, 18 Vaccine</i></li> <li>• <i>Pneumococcal Polysaccharide 23-Valent Vaccine</i></li> <li>• <i>Poliovirus Trivalent Vaccine</i></li> <li>• <i>Influenza Trivalent Vaccine Intranasal Live</i></li> </ul>
Recombinant Antigens	Vaccines made using recombinant processes consistently include <i>Recombinant</i> in parentheses although there is little clinical value to doing so. <ul style="list-style-type: none"> <li>• <i>Hepatitis B Vaccine (Recombinant)</i></li> </ul>	Omit description of recombinant characteristics in nonproprietary names. Describe recombinant characteristics in prescribing information.
Production Media	Some vaccines describe production media in the nonproprietary name, but most do not. <ul style="list-style-type: none"> <li>• <i>Smallpox Vaccine, Dried, Calf Lymph Type</i></li> </ul>	Omit name of production media from nonproprietary vaccine names unless needed for specific safety reasons (e.g., primary tissue culture). Describe production media in prescribing information.

**Table 3. Problems with Current Vaccine Names and Suggested Naming Guidelines** (Continued)

Category	Situation with Current Nomenclature • Example	Suggested Naming Guidelines • Example
Adjuvants	Vaccines containing aluminum salts as adjuvants consistently include the word <i>Adsorbed</i> in their nonproprietary names. But <i>Adsorbed</i> does not describe the compound upon which the vaccine is adsorbed. • <i>Tetanus Toxoid Adsorbed</i>	Adopt a simple supplementary word for each adjuvant. See <i>Table 4</i> for suggestions. • <i>Tetanus Alhox Vaccine</i>
Conjugated Vaccines	Vaccines containing polysaccharide antigens conjugated to a bacterial protein contain the full name of the carrier protein, even though this could lead to errors. • <i>Haemophilus b Conjugate Vaccine (Tetanus Toxoid Conjugate)</i> • <i>Meningococcal (Groups A, C, Y and W-135) Polysaccharide Diphtheria Toxoid Conjugate Vaccine</i>	Adopt a simple supplementary word reflecting each unique conjugate protein. See <i>Table 5</i> for suggestions. • <i>Haemophilus b Conjugate Vaccine</i> • <i>Meningococcal Conjugate Vaccine (Groups A, C, Y, W-135)</i>
Combination Vaccines	Two combination vaccines contain <i>Combined</i> in the nonproprietary name, but most do not. The combined character of these vaccines is self-evident. • <i>Diphtheria &amp; Tetanus Toxoids &amp; Acellular Pertussis Vaccine Adsorbed, Hepatitis B (Recombinant) and Inactivated Poliovirus Vaccine Combined</i> • <i>Meningococcal Polysaccharide Vaccine, Groups A, C, Y and W-135 Combined</i>	Omit <i>Combined</i> from nonproprietary names of vaccines.
Multiple Uses of Vaccine within a Name	Some vaccines contain the word <i>Vaccine</i> multiple times, but most use it only once. • <i>Diphtheria &amp; Tetanus Toxoids &amp; Acellular Pertussis Vaccine Adsorbed, Hepatitis B (recombinant) and Inactivated Poliovirus Vaccine Combined</i>	Do not include the word <i>Vaccine</i> more than once in nonproprietary vaccine names. • <i>Diphtheria, Tetanus, Acellular Pertussis, Hepatitis B, and Poliovirus Trivalent Alhox Vaccine</i>
Diphtheria & Tetanus Toxoid Products	These products are inconsistent in description of target populations and dosage: • <i>Diphtheria &amp; Tetanus Toxoids Adsorbed for Pediatric Use</i> • <i>Tetanus &amp; Diphtheria Toxoids Adsorbed for Adult Use</i> • <i>Tetanus Toxoid, Reduced Diphtheria Toxoid, and Acellular Pertussis Vaccine, Adsorbed</i>	Target populations should not be included as part of nonproprietary names, although manufacturers may wish to describe target populations on container labels. Reduced-dosage diphtheria-toxoid products should include this annotation within the nonproprietary name. Manufacturers may wish to include abbreviations such as <i>DTaP</i> , <i>DT</i> , <i>Td</i> , and <i>Tdap</i> on container labels, because of unique issues with these products.
Therapeutic Vaccines	BCG vaccines are inadequately named to differentiate products used to treat bladder cancer from products used to prevent tuberculosis. • <i>BCG Live (Intravesical)</i> • <i>BCG Vaccine</i>	If a product is intended for therapy only, not for prophylaxis, include <i>Therapeutic</i> in the product name (e.g., <i>BCG Therapeutic Intravesical Live</i> ). If a product is indicated for both prophylactic and therapeutic uses, include <i>Vaccine</i> in the product name (e.g., <i>Bacille Calmette-Guerin Vaccine Live</i> ).
Route of Administration	No problems identified.	If route of administration is other than by injection (e.g., oral, intranasal), include the route in the nonproprietary name. • <i>Typhoid Vaccine Oral Live</i> • <i>Influenza Trivalent Vaccine Intranasal Live</i>

**Table 3. Problems with Current Vaccine Names and Suggested Naming Guidelines (Continued)**

Category	Situation with Current Nomenclature • Example	Suggested Naming Guidelines • Example
Punctuation	The use of commas and parenthetical marks is inconsistent in nonproprietary vaccine names.	Omit commas and parentheses from nonproprietary vaccine names, unless describing a vaccine to prevent 3 or more diseases.
Examples combining several of the proposed naming guidelines	<p><b>Current names:</b></p> <ul style="list-style-type: none"> <li>• <i>Haemophilus b Conjugate Vaccine (Meningococcal Protein Conjugate) &amp; Hepatitis B Vaccine (Recombinant)</i></li> <li>• <i>Hepatitis A Inactivated and Hepatitis B (Recombinant) Vaccine</i></li> <li>• <i>Meningococcal (Groups A, C, Y, and W-135) Polysaccharide Diphtheria Toxoid Conjugate Vaccine</i></li> <li>• <i>Diphtheria &amp; Tetanus Toxoids &amp; Acellular Pertussis Vaccine Adsorbed, Hepatitis B (recombinant) and Inactivated Poliovirus Vaccine Combined</i></li> </ul>	<p><b>Proposed revisions:</b></p> <ul style="list-style-type: none"> <li>• <i>Haemophilus b Conjugom &amp; Hepatitis B Vaccine</i></li> <li>• <i>Hepatitis A and Hepatitis B Vaccine</i></li> <li>• <i>Meningococcal Conjudif Groups A, C, Y, W-135 Vaccine</i></li> <li>• <i>Diphtheria, Tetanus, Acellular Pertussis, Hepatitis B, and Poliovirus Trivalent Vaccine Alhox</i></li> </ul>

### Live Vaccines

The terms *Live* and *Inactivated* are commonly used to indicate whether a vaccine contains living organisms. Because live vaccines may be contraindicated in some immune-compromised patients, the *Live* designation must be known for patient safety. The word *Live* is inexplicably absent from the nonproprietary names for yellow fever vaccine and smallpox vaccine, which both contain living organisms. Nonproprietary names for vaccines are not consistent in placement of the word *Live*. In most names *Live* is the last word. Consistent placement of *Live* as the last word in the name would standardize and improve vaccine nomenclature.

### Inactivated Vaccines

Some inactivated (i.e., subunit) vaccines contain the word *Inactivated*, but most do not. In contrast to live vaccines, no extra clinical precautions apply to inactivated vaccines. At one time specification of *Poliovirus Vaccine Inactivated* was useful in differentiating that product from oral, live, attenuated poliovirus vaccine, which is no longer distributed in the United States. There is insufficient clinical value to include the word *Inactivated* within names, providing practitioners could be assured that all vaccines containing living organisms used the word *Live*. An argument can be made to retain the word *Inactivated* for poliovirus vaccine, because live, attenuated poliovirus vaccine continues to be used internationally for oral use.

### Viral Vaccines

Some vaccines providing protection against viruses include the word *virus* in their names, but others do not. Review of available labeling identified no case in which the word *virus* was needed for the safe use of a vaccine (e.g., *Measles Virus* versus *Measles*). Thus, there appears to be little reason to in-

clude *virus* as a distinct word in nonproprietary vaccine names. When *-virus* is an accepted suffix to a viral name (e.g., poliovirus, papillomavirus, etc.), it should be retained.

### Microbial Strains

Some vaccine names list the viral or bacterial strain used in the manufacturer of a vaccine, but most do not. Little value comes from specifying the strain unless this information is needed to differentiate products for safety reasons (e.g., strains of differing degrees of viral or bacterial attenuation). No such situation currently exists within the United States. These characteristics are already provided in prescribing information. To simplify labels, therefore, microbial strain designators should be omitted, unless they are needed for patient safety reasons.

### Polysaccharides

Some polysaccharide vaccines contain the term *Polysaccharide* in the name, but others do not. The difference is not explained by whether or not the polysaccharide vaccine is conjugated to a protein. Unconjugated polysaccharide vaccines tend to be less efficacious in young children, but conjugation removes the clinical need for *Polysaccharide* to be included as part of the vaccine name. Thus, the term *polysaccharide* should be included in vaccine names only if the vaccine is not conjugated to a protein.

### Antigenic Valency

Nonproprietary vaccine names variously omit or include the products' valency. Poliovirus vaccines are trivalent products, protecting against viral types 1, 2, and 3, but this is not reflected in the nonproprietary names. Injectable influenza vaccines are specified as trivalent, but the intranasal influenza vaccine does not currently identify its trivalent nature. *Pneumococcal Vaccine, Polyvalent*, is imprecise because it does not

indicate the 23 capsular types included. *Quadrivalent Human Papillomavirus (Types 6, 11, 16, 18) Recombinant Vaccine* mentions valency in the first word, leading the vaccine to be alphabetized among the Qs, not the most likely place in a list to find human papillomavirus vaccine. Further, quadrivalent is a redundant descriptor because the four types are named parenthetically. Despite the confusion their decision is likely to cause, the European Medicines Evaluation Agency (EMA) has assigned common names to two distinct rotavirus vaccines that do not disclose their differing valencies (13, 14). Nomenclature should explicitly describe a product's valency. If phrasing such as *x-valent* is included in a name, valency should be specified numerically (e.g., 23-valent, not polyvalent), toward the end of the name. Names could omit the word *valent* (or variations of this word) unless it was not self-evident from other portions of the name.

### Recombinant Antigens

When FDA licensed hepatitis B vaccine produced in genetically reengineered yeast cells in 1986, it included (*Recombinant*) in the vaccine's nonproprietary name. But does this parenthetical word provide any value beyond cluttering up vaccine labels? The public certainly has a right to know whether a vaccine is produced via recombinant methods. But a vaccine's recombinant origin has no particular bearing in clinical practice and takes up label space. The information about recombinant origin could be clearly described in a vaccine's initial description in the prescribing information without inclusion in a nonproprietary name.

### Production Media

Some vaccine names specify the cell type or cell strain in the production media used to manufacture vaccine viruses. An FDA Web site, but not the prescribing information, differentiates two poliovirus vaccines: *Poliovirus Vaccine Inactivated (Human Diploid Cell)* and *Poliovirus Vaccine Inactivated (Monkey Kidney Cell)*(10). These parenthetical phrases reflect true differences between vaccines, but there is little or no clinical application for this information. Paper immunization records typically contain too little space for transcription of these extra words. As with recombinant sourcing, it may be more valuable to omit mention of production media from nonproprietary vaccine names, unless they are needed for specific safety reasons. An example in which this is the case would be primary tissue culture, such as *Smallpox Vaccine, Dried, Calf Lymph Type*.

### Adjuvants

Vaccines containing aluminum salts as adjuvants consistently include the word *Adsorbed* in their nonproprietary names. But the term *adsorbed* does not describe the compound upon which the vaccine is adsorbed. Once nonaluminum adjuvants are licensed in the United States, a method will be needed to differentiate and describe which adjuvant is included in which vaccine. Like the system that USAN recently adopted for insulin analogs (e.g., aspart, glargine, glulisine, and lispro) and conjugated therapeutic proteins (e.g., diftiox) (1, 12), Table 4 proposes simple suffix names for adjuvants based on phonemes for each adjuvant's constituents or common name.

Table 4. Proposed Vaccine Adjuvant Nomenclature\*

Adjuvant	Possible Supplementary Words
Aluminum hydroxide	Aldrox or Alhox
Aluminum hydroxyphosphate sulfate	Alfosul
Aluminum phosphate	Alfos or Alfosate
Heat-labile toxin of <i>E. coli</i>	Eltec or Heltec
Immunostimulating complexes	Iscn, Iscobi, Iscotri, Iscotet, Iscopen, etc, in sequence
MF59	Mifnine or Mofnin
Monophosphoryl lipid A (MPL)	Mofol or Mofola
AS02 (which contains QS21, MPL, and other constituents)	Qumofol or Qusmof
AS04 (which contains aluminum, MPL, and other constituents)	Almofol or Almof

\* Adjuvants described further in reference 7.

### Conjugated Vaccines

Most *Haemophilus*, meningococcal, and pneumococcal polysaccharide vaccines are now formulated by conjugating the capsular polysaccharides to various bacterial proteins. Their current names include three to four words describing this protein, occupying a substantial amount of label space. The *Haemophilus influenzae* type b vaccine names redundantly contain the word *conjugate* twice each. More troubling, the wording could lead to product-selection errors in a clinic. These protein descriptors inadvertently mention a disease

against which the vaccine does not protect (i.e., diphtheria, tetanus, meningococcal). This presents the opportunity for a clinician to select a vial from a shelf based on seeing "tetanus toxoid conjugate," even though the vaccine protects against *Haemophilus influenzae* type b and offers no protection against tetanus. To simplify these labels, a succinct word should be identified for each conjugate protein, as is the case for contemporary insulin products. Like other USAN schemes (1, 12) Table 5 proposes words for the current protein carriers based on phonemes for each protein's common name plus either a *Conju-* prefix or a *-juga* stem.

**Table 5. Proposed Carrier Protein Nomenclature**

Conjugated Protein	Possible Supplementary Words
Diphtheria CRM197 Protein	Conjucrim or Crimjuga
Diphtheria Toxoid	Conjudif or Difjuga
Meningococcal Outer Membrane Protein	Conjumom or Momjuga
Tetanus Toxoid	Conjutet or Tetjuga

### Combination Vaccines

Two nonproprietary vaccine names conclude with the word *Combined*. But numerous other vaccine products that protect against multiple diseases do not include the word *combined* in the nonproprietary name (e.g., *Measles, Mumps, and Rubella Virus Vaccine, Live*). The combined character of vaccines is self-evident from other words within the name. Explicit mention of combined status is unnecessary.

### Multiple Uses of Vaccine

Some combination vaccines contain the word *Vaccine* multiple times within the nonproprietary name. Most combination vaccines use it only once. Nonproprietary names can be simplified by using the word *Vaccine* just once. Adopting a standard location for *Vaccine* as the last word in the name (unless followed by an unusual route of administration or *Live* characteristic) is also warranted.

### Diphtheria & Tetanus Toxoid Products

*Diphtheria & Tetanus Toxoids & Acellular Pertussis Vaccine Adsorbed (DTaP)* is given to children until their seventh birthday, at which time *Tetanus & Diphtheria Toxoids Adsorbed for Adult Use (Td)* is used, even though 7 to 17-year olds are not typically considered adults. For the few young children who should not receive pertussis vaccine (12), *Diphtheria & Tetanus Toxoids Adsorbed for Pediatric Use (DT)* is the appropriate product. To help prevent pertussis in adolescents and adults, two brands of *Tetanus Toxoid, Reduced Diphtheria Toxoid, and Acellular Pertussis Vaccine, Adsorbed (Tdap)* were licensed in 2005 (12). As these examples indicate, target populations can appear in vaccine names. Although manufacturers may choose to describe a target population on container labels, populations should not be part of the nonproprietary name.

Both *Td* and *Tdap* contain a reduced dose of diphtheria toxoid relative to *DTaP* and *DT*, hence the lower-case letter *d* in their abbreviations. The nonproprietary name of *Tdap* specifies the lower dose, but the name of *Td* does not. When a higher or lower dose is available, the name of the lower dose (e.g., *Td*) should be revised to include the word *Reduced*.

In the four examples the similarity of wording has led clinicians to rely on the abbreviations *DTaP*, *Td*, *DT*, and *Tdap* for more concise communication. Medication-error experts gener-

ally discourage use of abbreviations in health care settings, but this may be one of the few cases in which abbreviations could prevent more medication errors than they cause (15–18). Because of the similarity of the words in these nonproprietary names, it may be prudent for manufacturers to include these abbreviations on container labels even though the abbreviations should not be part of the nonproprietary name. Because toxoids are a subset of vaccines, these products could be simplified further by omitting the word *Toxoid*, as is the practice in the *European Pharmacopeia* (19, 20).

### Therapeutic Vaccines

Bacille Calmette-Guerin (BCG) products are inadequately named to differentiate the products used to treat bladder cancer (*Tice BCG*, Organon USA; *TheraCys*, Sanofi Pasteur) from vaccines used to prevent tuberculosis. Including *Therapeutic* in a product name (e.g., *BCG Therapeutic Live*) could solve this problem. If a product is indicated for both prophylactic and therapeutic uses, the term *Vaccine* would be included in the product name (e.g., *BCG Vaccine Live*). The BCG acronym should be spelled out.

### Route of Administration

This review identified no problems in nonproprietary names related to route of administration. For completeness, *Table 3* proposes a guideline for routes of administration other than injection to be included in nonproprietary names.

### Punctuation and Length

Today's nonproprietary names have no consistent style for use of commas to set off sections of the names. Current names are reproduced faithfully in the tables. But in the interests of simplicity, neither commas nor parenthetical marks should be used within nonproprietary vaccine names, except for vaccines that prevent three or more diseases.

### Length

The nonproprietary names in *Table 1* range in length from 2 to 17 words, with a mean of 6.4 ( $\pm$  3.2) words. Adopting the guidelines proposed in *Table 3* would shorten the length of nonproprietary vaccine names to a mean of 4.7 ( $\pm$  2.1) words (data not shown).

Among polyclonal immune globulin products, fewer inconsistencies in nomenclature were noted. *Table 6* proposes guidelines for naming future polyclonal immune globulins and suggests a few revisions to current names in order to abide by these guidelines. Adopting the guidelines proposed would shorten the length of nonproprietary immune globulin names from 4.3  $\pm$  1.4 words to 4.2  $\pm$  0.7 words (data not shown).

**Table 6. Proposed Naming Guidelines for Immune Globulins, with Corresponding Revisions to Current US-Licensed Names**

- Include plasma source parenthetically. Change from Antivenin (*Micrurus fulvius*) to Antivenin *Micrurus fulvius* (Equine).
- Omit type specificity unless needed clinically. Change from *Botulism Antitoxin* to *Botulism Antitoxin Types A&B* (Equine).
- Include specific route of administration if other than intramuscular (e.g., intravenous, subcutaneous). No revisions needed.
- Standardize Crotalidae products to place Crotalidae first. Change from *Antivenin (Crotalidae) Polyvalent* to *Crotalidae Antivenin Polyvalent* (Equine).
- Omit product concentration from nonproprietary names. Describe product concentration in prescribing information. Change from *Immune Globulin Intravenous (Human), 10% Solution* to *Immune Globulin Intravenous (Human)*.
- Omit production processes from nonproprietary names. Describe production processes in prescribing information. Change from *Immune Globulin Intravenous (Human), 10%, Caprylate/Chromatography Purified* to *Immune Globulin Intravenous (Human)*.
- Simplify *Lymphocyte Immune Globulin, Anti-thymocyte Globulin (Equine)* to *Anti-thymocyte Globulin (Equine)*.

## DISCUSSION

Many authors have described the importance of simple, unambiguous names in preventing medication errors (2–7, 15, 16, 21). These descriptions address compounds whose nonproprietary names involved only a single word. The reductions suggested here may not be enough to entice clinicians away from use of trade names and abbreviations, but they should simplify container labels, making product-selection errors less common (15, 16, 22–24).

Concatenating long strings of words—the status quo—is not the only choice in designing new vaccine names. The USAN Council's earlier experience with assembling coded names for monoclonal antibodies (e.g., palivizumab, infliximab, etc.) is instructive (1, 12, 25). In that scheme, syllables indicate the antibody source (e.g., murine, human, etc.) and the target or disease state of the antibody's indication (e.g., tumor, bacteria, etc.). Table 7 speculates about what a corresponding system for vaccines might look like and shows syllables dedicated to the number of antigens, the vaccine's viability, and the immunologic target.

**Table 7. Prototype One-Word Vaccine Nomenclature System, Based on Coded Syllables**

- First syllable, chosen by the drug's sponsor to distinguish this product from others.
- Second syllable, based on a Latin stem indicating the number of microbial antigens [e.g., -un-, -bi-, -tri-, -qua(d)-].
- Third syllable, describing the live or subunit character of the vaccine [e.g., -li-, -su(b)-].
- Fourth syllable, describing the microbial or other target of the vaccine [e.g., -ba- for bacteria, -vi- for virus, -he- for *Helicobacter*, -sta- for *Staphylococcus*].
- Ending syllable, constant, to reflect the vaccine drug class [i.e., -vak].
- Examples, using the first syllables of my children's names as the first syllable:
  - Emunlibavak, a univalent live bacterial vaccine
  - Anbisuvivak, a divalent subunit viral vaccine
  - Ertrilihevak, a trivalent live vaccine against *Helicobacter*
  - Pequasustavak, a quadrivalent subunit vaccine against *Staphylococcus*.

Some of the issues cited may seem trivial, but some proposed changes are essential for accurate and unambiguous communication. The guidelines for live vaccines, conjugated vaccines, and antigenic valence seem especially important for patient safety.

In the interests of harmonization, the guidelines proposed here should be considered by the INN program at WHO, by the USAN Council, FDA, and other similar bodies. In contrast to the American nomenclature described above, *EP* shows more consistency in vaccine and polyclonal immune globulin names (19, 20). Complete harmony is essentially impossible because many of these names vary according to the vernacular. As just one example, measles would be listed as Masern in Germany, rougeole in France, sarampión in Spain, mazelen in the Netherlands, morbillo in Italy, and rúbéola in Portugal.

In the United States, the apparent next step would be for consideration by the USAN Council, working with the pharmaceutical and biotechnology industry. Agreement about sequencing the parts of nonproprietary names will be needed. Once a final version is adopted, manufacturers should adopt the nomenclature guidelines for new products as soon as possible to promote clarity about their products' contents and guide clinicians and customers regarding the intended uses of these products.

But there is a cost to change. In the case of changing the names established for current vaccines and immune globulins, these would take the form of publishing new prescribing information, new container labels, new promotional literature, and the like. None of the changes proposed here is so urgent that existing document inventories should be sent to the recycling pile due to rearranging words in an existing nonproprietary name. FDA and manufacturers could come to an agreement to phase in name changes over a period of 5 to 10 years, perhaps as other product revisions are implemented.

Efforts to standardize vaccine abbreviations through the Vaccine Identification Standards Initiative (VISI) have been described elsewhere (17, 18). In brief, the Centers for Disease Control & Prevention (CDC) collaborated with the biologics industry to develop uniform guidelines for vaccine and polyclonal immune globulin packaging, labeling, and recording to enhance the safety of immunization.

If these guidelines are adopted, they are expected to improve the quality and clarity of vaccine packaging by enhancing simplicity and consistency and removing ambiguity. Standardizing vaccine and immune globulin labeling will reduce opportunity for medication errors. This will be especially important as combination vaccines become more common. After discussion and refinement guidelines such as these should be adopted immediately for new vaccines and polyclonal immune globulin products entering the US market, and they should be gradually phased in for existing products and for global use.

#### REFERENCES

1. USP. *USP Dictionary of USAN and International Drug Names*. Rockville, MD: US Pharmacopeial Convention, Inc., 2006.
2. 21 United States Code §352e.
3. 21 Code of Federal Regulations §299.4.
4. FDA. *Guidance for Industry: Product Name Placement, Size, and Prominence in Advertising and Promotional Labeling*. 1999. [www.fda.gov/cder/guidance/1955dft.pdf](http://www.fda.gov/cder/guidance/1955dft.pdf). Accessed 12 June 2007.
5. Kopp-Kubel S. International Nonproprietary Names (INN) for pharmaceutical substances. *Bull WHO*. 1995;73:275–279.
6. Aronson JK. Medication errors resulting from the confusion of drug names. *Expert Opin Drug Saf*. 2004;3:167–172.
7. FDA. Drug name confusion: preventing medication errors. *FDA Consumer*. 2005;39 (Jul–Aug). [www.fda.gov/fdac/features/2005/405\\_confusion.html](http://www.fda.gov/fdac/features/2005/405_confusion.html). Accessed 14 May 2007.
8. 21 Code of Federal Regulations §610.62
9. 21 Code of Federal Regulations §201.10(g).
10. FDA. Center for Biologics Evaluation & Research. Vaccines licensed for immunization and distribution in the US. [www.fda.gov/cber/vaccine/licvacc.htm](http://www.fda.gov/cber/vaccine/licvacc.htm). Accessed 14 May 2007.
11. FDA Center for Biologics Evaluation & Research. Current licensed establishments and products, listed by product. [www.fda.gov/cber/ep/part3.htm](http://www.fda.gov/cber/ep/part3.htm). Accessed 14 May 2007.
12. Grabenstein JD. *ImmunoFacts: Vaccines & Immunologic Drugs 2007*. 32nd rev. St. Louis: Wolters Kluwer Health, September 2006.
13. Committee for Medicinal Products for Human Use. Summary of positive opinion for RotaTeq (Common name: rotavirus vaccine, live, oral). London: European Medicines Agency, 21 April 2006. [www.emea.europa.eu/pdfs/human/opinion/13321806en.pdf](http://www.emea.europa.eu/pdfs/human/opinion/13321806en.pdf). Accessed 14 May 2007.
14. Committee for Medicinal Products for Human Use. Summary of opinion for Rotarix (Common name: rotavirus vaccine, live attenuated). London: European Medicines Agency, 27 April 2006. [www.emea.europa.eu/pdfs/human/opinion/40891905en.pdf](http://www.emea.europa.eu/pdfs/human/opinion/40891905en.pdf). Accessed 14 May 2007.
15. Grabenstein JD, Proulx SM, Cohen MR. Recognizing and preventing errors with immunologic drugs. *Hosp Pharm*. 1996;31:791–794,799,803–804.
16. *Medication Errors*. Cohen MR, ed. 2nd ed. Washington, DC: American Pharmacists Association, 2006.
17. Centers for Disease Control and Prevention. Vaccine Identification Standards Initiative. [www.cdc.gov/nip/visi](http://www.cdc.gov/nip/visi). Accessed 14 May 2007.
18. Grabenstein JD. The vaccine identification standards initiative (VISI): towards clearer labels and common nomenclature. *Hosp Pharm*. 2002;37:58–64,67–68,71–74.
19. European Directorate for the Quality of Medicines. *European Pharmacopeia*. Edition 5.8. Stasbourg, France: EDQM; June 2006.
20. European Directorate for the Quality of Medicines. *Pharmacopée Européenne*. Edition 5.8. Stasbourg, France: EDQM; juin 2006.
21. Lambert BL, Lin S-J, Tan HK. Designing safe drug names. *Drug Safety*. 2005;28:495–512.
22. Centers for Disease Control and Prevention. Unintentional administration of varicella virus vaccine—United States, 1996. *MMWR*. 1996;45:1017–1018.
23. Cohen MR. ISMP medication error report analysis: Adacel (Tdap) and Daptacel (DTaP) confusion. *Hosp Pharm*. 2006;41:1023–1024.
24. Committee on Identifying and Preventing Medication Errors. Aspden P, Wolcott J, Bootman JL, Cronenwett LR, eds. *Preventing Medication Errors: Quality Chasm Series*. Washington, DC: Institute of Medicine, National Academy Press, 2007:279–280.
25. USAN Council. List #351: Monoclonal antibodies. *Clin Pharmacol Ther*. 1993;54:114–116.