

# Semantics of Drug Nomenclature

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Sir,

Semantics is a branch of linguistics concerned with studying the meanings of words and sentences. The main purpose is to facilitate information sharing, to create common ontologies and to enhance the reasonability of context use. Today, semantics is widely used in knowledge representation and information sharing. Drugs being complex chemical structures require simple nomenclature for day to day use. Drug nomenclature has evolved gradually. Historically, fascination, curiosity and serendipity or just 'gut-feelings' have been involved in naming drugs. A systematic approach has only, recently been adopted. Accordingly, drugs used as medicines have at least three different names.<sup>[1]</sup>

- *The chemical name*—whose form generally follows the rules issued by the International Union of Pure and Applied Chemistry (IUPAC).
- *The approved (official or generic) name*—which is usually the World Health Organisation's recommended International Non-proprietary Name (rINN). However, it may be other approved name—for example, the British Approved Name (BAN), Dénomination Commune Française (DCF), Japanese Accepted Name (JAN), or United States Adopted Name (USAN). Thus a chemical (R)-1-(3,4-dihydroxyphenyl)-2-methylaminoethanol is known as adrenaline (BAN) or epinephrine (rINN).
- *The proprietary (brand or trade) name*—which is the name given by a pharmaceutical manufacturer. For example, atorvastatin is marketed in India as Atorva, Lipikind and

many others but is marketed as Lipitor in USA.

## Generic Naming

Semantics of drug nomenclature provides understanding of factors (Demographic, social, religious and anecdotal) which culminate into such nomenclature. The present system of generic nomenclature is about 60 years old. These names are easy to pronounce by health care providers and are euphonic. The USAN Council selects a particular generic name for a new chemical entity with therapeutic potential. The USANs are recommended to the WHO's International Nonproprietary Names (INN) Program which finally recommends generic name of the drug, which is used worldwide.

Earlier, drugs were named after gods, prevailing sociocultural practices, source of drug, in the name of scientists contributing its development and anecdotal discoveries. It is interesting to know the source of origin of names of some common drugs:

- Morphine: It took its name from the Greek god of dreams Morpheus (Greek: *Μορφεύς*)
- The name *Atropa* is derived from that of the Greek goddess Atropos, one of the three Greek fates or destinies who would determine the course of a man's life by the weaving of threads that symbolized his birth, the events in his life and finally his death; with Atropos cutting these threads to mark the last of these. The name "belladonna" comes from the Italian language, meaning "beautiful lady" originating either from its usage as cosmetic for the face,

or, more probably, from its usage to increase the pupil size in women.

- The name *warfarin* stems from its discovery at the University of Wisconsin, incorporating the acronym for the organization which funded the key research (*WARF*, for *Wisconsin Alumni Research Foundation*) and the ending *-arin*, indicating its link with coumarin.
- *Aspirin*: German chemist Heinrich Dreser coined *Aspirin* from Latin SPIREA (ultima) "sweat-meadow" plant from which it was obtained. The initial "a" signifies acetylation; and terminal "in" is a common chemical ending used in those days.
- *Anandamide*: Is an endogenous cannabinoid neurotransmitter. The name is taken from the Sanskrit word *ananda*, which means "bliss, delight".
- *Ajmaline* is an alkaloid that is class Ia antiarrhythmic agent. It is often used to bring out typical findings of ST elevations in patients suspected of having Brugada syndrome. A new antiarrhythmic *Lorajmine* is derived from ajmaline. Ajmaline was first isolated from the roots of *Rauwolfia serpentina*. It was named ajmaline, after Hakim Ajmal Khan, one of the most illustrious practitioners of Unani medicine in South Asia.
- *Bacitracin*: The drug's unique name derives from the fact that it was isolated by John T. Goorley from a girl named Tracy: "*One strain isolated from tissue debrided from a compound fracture of the tibia was particularly active. We named this growth-antagonistic strain for the patient, "Tracy I." When cell-free filtrates of broth cultures of this bacillus proved to possess strong antibiotic activity and to be non-toxic, further study seemed warranted. We have called this active principle "Bacitracin".*<sup>[2]</sup>
- *Heroin*: Felix Hoffmann, of Bayer in Elberfeld, Germany created heroin as a medicine eleven days after inventing aspirin. Afraid of the possible side effects of aspirin, Bayer registered heroin (probably from heroisch, German for heroic, chosen because in field studies people using the medicine felt "heroic") as a trademark.
- *Ziconotide*: A Peptide similar to that of **conotoxin peptide**, found to be neuronal

analgesic by blocking neuronal calcium channels.

- *Antipain* is a protease inhibitor. Its name is actually a contraction of anti-papain, since it inhibits the action of papain, an enzyme found in papayas.
- *Asunaprevir*: The infix *-sun-* recognizes contribution of a scientist Li-Qiang *Sun* in developing hepatitis C vaccine.

Some of the earlier eponyms are still in vogue such as Lugol's Iodine (5% iodine in 10% potassium iodide), Whitfield's ointment (3% salicylic acid and 6% benzoic acid in simple ointment base), Abbey's salt (a mixture of tartaric acid, magnesium sulphate and sodium bicarbonate with sugar), Condly's Lotion (potassium permanganate solution), Albright's solution (140 Gm citric acid, 75 Gm sodium citrate and 25 Gm potassium citrate used for renal tubular acidosis) and Dakin's solution (4% boric acid and 5% sodium hypochlorite).

Currently, generic names are framed from the combination of syllables from chemical names. **Paracetamol** or **acetaminophen** is a short name of *N-acetyl-p-aminophenol*. Technically, a generic name has three components- stem, infix and a prefix. The stem is usually as suffix which identifies the chemical nature of drug; as "-ine" in morphine (alkaloid); "-in" in digoxin (glycoside); "-ol" in phenol (alcohol). Nowadays the suffixes identify the pharmacological groups/actions of drugs. The examples of such stems (suffixes) are "-caines" (local anesthetics); "-prils" (ACE-inhibitors), "-prazoles" (Benzimidazole antisecretory drugs- omeprazole and others); "-olols" (beta blockers); "-alols" (alpha and beta blocker such as labetalol); "-sartans"; "-dipines" (Dihydropyridine calcium channel blockers such as amlodipine); "-floxacin" and "-azoles" identify drugs of a particular class. The infix sub classifies a drug and a prefix differentiates drug from its class.<sup>[3]</sup>

Example: *Sildenafil* has a suffix *"-afil"* which is class characteristic of PDE-5 inhibitors, an infix *"den"* that indicates that *sildenafil* and *verdenafil* have similar action. The prefix *Sil-* or *Ver-*

identifies individual drug in its class. Occasionally stem is a prefix as “cef-” in cephalosporin antibiotics.

A notable point is that, INN names usually do not have such letters (h, j, k, w) which lead to pronunciation problems in different language speaking countries.

### Naming Biological

A name of a monoclonal antibody drug can be seen as a sequence of prefix, infix (target, disease and source of origin) and a stem (a suffix -mab). Some examples of monoclonal antibodies are given below:

Monoclonal Antibody Name	Infix Target	Infix Source	Suffix
Transtuzumab Gemtuzumab	tu-Tumor	zu-humanized	-mab
Infliximab Basiliximab	li-Immune system	xi- chimeric	
Omalizumab Daclizumab	li-Immune cells	zu-humanised	
Palivizumab	vi-viral	zu-humanised	
Denosumab	s-Bone cells	u-human	
Rituximab	tu-Tumor	xi-chimeric	
Icrucumab	c-cardiovascular	u-human	
Guselkumab	k-interleukin	u-human	
Fosinumab	n-nerve	u-human	
Blintumomab	tum-Tumor cells lymphocytes	o-murine	

Similarly other biologicals are named. A suffix “tinib” identifies a drug as tyrosine kinase inhibitor (Canertinib); an infix further subclassifies drug as TK bruton’s (“bru” as in Ibrutinib) or mitogen activated protein kinase (“me” as in salumetinib) inhibitors. A prefix “Peg-” indicates “pegylation” (polyethylene glycol complex) as in pegaptanib, peginterferons.

There are a number of drugs whose British approved names (BAN) are different from United State Approved Names (USAN). For example, Adrenaline (BAN) is termed as epinephrine (USAN), Glibenclamide (BAN) is gliburide (USAN) and salbutamol (BAN) is albuterol (USAN).

### The Brand Name

While generic nomenclature uses a scientific approach, the brand or proprietary name is

outcome of more of an art than science. The objective is to identify an unambiguous and simple name which prescribers can easily memorize and write. Initially brand names were allotted by “gut-feeling” and intuitions of the manufacturers. Chlorpromazine was released in the market in 1953 by Rhône-Poulenc and given the trade name *Largactil*, derived from *large* "broad" and *acti* "activity".<sup>[4]</sup> Similarly, *Salvarsan* (Arsphenamide) name was given by Paul Ehrlich in 1907 that means an arsenic for *salvation* of human.

A shorter and easy to remember name is given by the innovating company in consultation with USAN council and must be approved by FDA in USA. It becomes a trade mark after registration and is a copy right of that company. The Brand name often has linguistic connotations. The most important is that there should not be controversy of any kind in the brand name given. Naming a drug by a particular brand name is important for its success as many a blockbuster drugs reveal. The name *Cialis* for sildenafil stands for *ciel*-means sky in French and connotes a phrase-‘sky is the limit’. Similarly, the name *Viagra* for sildenafil is derived from powerful niagra falls or *vi(r)* means *manhood* and *agra* means *fertile field* (Latin). *Paxum* is the brand name of diazepam. *Pax* means peace in Latin. A great care is taken to avoid letters which have linguistic difficulties or difficult to remember by prescribers. The fricative letters such as X, F, S, Z indicate speed. A number of blockbusters have names having “X” as prefix, infix or suffix (Xanax, Nexium, Clarinex). The letter “X” is flamboyant, means high tech and investigative or research (cf. X-Rays, X-files). Similarly, letter “Z” is boldly visible and phonetically powerful; so used in Zithromycin, Zyloric, Zocon, Zupar and Zinetac. Thus, use of these letters in brand names provides inbuilt and hidden power to the products. The Letter “A” is considered feminine as in Fiona (Raloxifen), Orlica (Orlistat), Progeva (progesterone), Utrova (Follitropin) and Ferrinova (iron).<sup>[5]</sup>

A number of weird and funny names appear for street drugs used for recreation, such as *purple*

*hearts* (d-amphetamine and amobarbital mixture), *Krokodil* (a mixture of des-morphine and cleansing oil misused for getting a kick- skin becomes rough and scaly as of crocodile), *Angel dust* (phencyclidine), *Mushroom* (psilocybin), *Crack* (cocaine), *Fantasy* (gamma hydroxybutyrate), *Acid* (LSD), *Grass* (marijuana), *Ecstasy or Molly* (MDMA-methylene dioxy methyl amphetamine), *Beans* (mescaline), *crystal* (Methyl amphetamine) and *Smack* or *brown sugar* (heroin). These names allure a novice who falls prey to them.

*Shakespeare said, "What's in a name" call a rose by any other name would smell as sweet"*! It seems that time has defied this conviction so far as drug nomenclature is concerned. Today, we identify the nature and action of a drug just by knowing its name! This also reduces the chance of prescribing errors and duplications.

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