

REVIEW ARTICLE

Current usage of nomenclature for parasitic diseases, with special reference to those involving arthropods

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Abstract. Terminological confusion has been aggravated by efforts to develop a standardized nomenclature for parasitic diseases (SNOPAD) arising from the proposal by Kassai *et al.*, 1988) for a standardized nomenclature of animal diseases (SNOAPAD). To restabilize international nomenclature of parasitic diseases it is recommended that, whenever appropriate, names should follow the 'International Nomenclature of Diseases' (IND) compiled by the Council for International Organizations for Medical Sciences (CIOMS/WHO, 1987). For diseases not included in IND, familiarity should guide the choice of name: traditional English language names of diseases should be preferred, e.g. 'malaria', 'scabies' or, for parasitic diseases having no traditional name, the taxonomic name of the causative organism should be applied, e.g. '*Brugia timori* microfilaraemia'; '*Plasmodium malariae* infection'; '*Simulium* allergy' – instead of the generic derivatives proposed by SNOPAD, i.e. brugiosis, plasmodiosis and simuliidosis, respectively. For names of new diseases or those rarely mentioned, the suffix -osis would normally take precedence. Generally, the name of choice for any disease in any language should be the vernacular term, with commonest English usage preferred for international communication, and publications should include synonyms in the list of keywords.

Key words. SNOPAD, SNOAPAD, animal diseases, disease nomenclature, etymology, human diseases, -iasis, infectious diseases, international, medical terminology, nomenclature, -osis, parasitic diseases, parasitology, standardized nomenclature, World Health Organization.

The development of SNOPAD

Towards the end of the 20th century, three major international committees proposed that all names for parasitic diseases should, if constructed from the generic name of the causative organism, end uniformly in -osis. The proposal was instigated by the World Association for the Advancement of Veterinary Parasitology (WAAVP), who established a committee to reduce confusion in the terminology of parasitic diseases of animals. Their recommendation for SNOAPAD, a 'Standardized Nomenclature for Animal Parasitic Diseases' (Kassai *et al.*, 1988), had been discussed and accepted in the general assembly of the WAAVP at a conference in Montreal,

in 1987 (J. Eckert, pers. comm.), and was adopted by the Council. It was further adopted by the Council of the World Federation of Parasitologists (WFP) at ICOPA 7, Paris, in 1990, so became SNOPAD, the 'Standard Nomenclature for Parasitic Diseases'. A joint meeting of the Councils of the WFP, EFP (European Federation of Parasitologists) and WAAVP confirmed their acceptance of the recommendations. These later discussions are apparently unpublished, although minutes are said to be available (Burt, 1994). There is no report that these later Council decisions were ever presented to the memberships for ratification. It seems that the only formal public discussion of the matter, outside WAAVP, was at the EMOP VII meeting in Parma in 1996. At that meeting, Eckert (1996) claimed to have adopted SNOPAD in two German-language textbooks, but with the -osis suffix changed to -ose, which invalidates the supposed uniformity of SNOPAD. Gordon & Neenan (1996) analysed the names used in various

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Table 1. The application of SNOPAD showing that the -osis endings are rarely used in languages other than English

Dominant English language name	SNOPAD recommendation	Recently used names in selected journals		
		French	Portuguese	Spanish
Microsporidiosis	Microsporosis		Microsporidiose	(Microsporidiosis)
Trypanosomiasis	Trypanosomosis	Trypanosomose	(Tripanossomiase)	(Trypanosomiasis)
Leishmaniasis	Leishmaniosis	Leishmaniose	Leishmaniose	(Leishmaniasis)
<i>D. fragilis</i> infection	Dientamoebosis	Dientamoebiose		
Amoebiasis (U.K.)/ Amebiasis (U.S.A.)	Entamoebosis	Amibiase	Amebiase	(Amebiasis)
Toxoplasmosis	Toxoplasmosis	Toxoplasmose	(Toxoplasmose)	Toxoplasmosis
Balantidiasis	Balantidiosis			Balantidiasis
Schistosomiasis	Schistosomosis	Schistosomose	Esquistossomose	(Esquistosomiasis)
Paragonimiasis	Paragonimosis		Paragonimiase	(Paragonimiasis)
Echinococcosis	Echinococcosis			Equinococosis
Trichuriasis	Trichuriasis			Tricocefalosis (This is a very old term, not very frequent any more)
Trichinosis	Trichinellosis			Triquinosis
Strongyloidiasis	Strongyloidosis		Estrongiloidiase (Ancilostomíase)	(Estrongiloidiasis)
Hookworm disease	Ancylostomosis			
Toxocariasis	Toxocarosis			Toxocariasis
<i>Lagochilascaris</i> infection			Lagochilascariase	
Dirofilariasis	Dirofilariosis	Dirofilariose		
Filariasis	Onchocercidiosis/ wuchereriosis/brugiosis	Filariose	Filariose	(Filariasis)
Onchocerciasis	Onchocercosis	Onchocercose		(Oncocercosis)
Pediculosis	Pediculosis			Pediculosis

These names are gathered from recent issues of journals held in the Donald Mason Library of the Liverpool School of Tropical Medicine. Unfortunately, no recent text was available in any other language. In this selection, only three names in English (highlighted) and two in languages other than English conform with SNOPAD.

Names and notes in parentheses are contributed by correspondents.

databases, and compared these with SNOPAD. Although the results are not included in the abstract, Dr Gordon has shown me his poster, which confirms and amplifies the information in the tables below. Kassai (1996) opened a round table discussion, honourably noting negative as well as positive reactions to SNOPAD, and highlighting the suggestion that familiarity rather than uniformity-of-ending should be preferred. Unfortunately, the results of that discussion are not recorded in the Proceedings.

Reactions to SNOPAD

Following the initial publication by Kassai *et al.* (1988), the recommendation was first brought to wider public notice when *Parasitology Today* published two letters and an article in its support (Baker, 1989; Burt, 1994; Kassai & Burt, 1994) and the editors of two veterinary journals began to impose the new terminology. The editor of *Parasitology Today* emphasized that she would not accept SNOPAD (Saklatvala, 1994) and published a reasoned rejection (Ashford, 1994).

The editor of the *Annals of Tropical Medicine and Parasitology* canvassed editors of other relevant journals,

and found little support for the changes, and a great deal of antipathy towards them (Wallbanks, 1995). Most editors were 'vehemently opposed to SNOPAD', and were 'disinclined to inflict it on readers'. Only two of 30 editors were prepared to impose SNOPAD on their contributors.

It was to be hoped that this flurry of correspondence in the mid-1990s would have caused the proponents of SNOPAD to withdraw their proposal, or let the idea be forgotten. Unfortunately this has not happened. There has been a marked polarization between the veterinary literature, some parts of which continue to use and even impose SNOAPAD, and the medical and zoological literature, which usually ignores SNOPAD. This is exemplified by Eberhard's (2000) review questioning the new terminology used in the textbook of *Veterinary Helminthology* by Kassai (1998) and the response of Eckert (2001) supporting it. Editors of a textbook on zoonoses (Palmer *et al.* 1998) tried to impose SNOPAD, but not every contributing author complied. The monograph on 'Fasciolosis' by Dalton (1999) is perhaps the only book so far following SNOPAD in its title. The second *International Congress of Leishmania and Leishmaniosis* [sic], 20–24 May 2001 in Crete, adopted the SNOPAD term, which has been used by only 1.45% of authors publishing on leishmaniasis (Table 3).

Table 2. The effect of SNOAPAD: comparison of names used in databases, for some important diseases

Name Stem	Suffix	Kassai <i>et al.</i> (1988)	SCI, 1998–2001
Fasciol	iasis	292	88
	osis	12	56
Fasciol*		854	414
Taen	asis	106	32
	osis	0	7
	iasis	0	0
	idosis	0	0
Taeni*		767	803
Trichin	osis	102	88
Hypoderm	ellosis	123	76
	elliasis	39	0
Trichin*		624	392
	osis	25	13
	atosis	13	1
Hypoderm*		241	372
Ostertagi	asis	92	7
	osis	11	3
	sis	100	10
Ostertagi*		399	236
Ancylostom	iasis	69	2
	osis	0	1
	atosis	0	0
Ancylostom*		244	112
Cysticerc	osis	323	327
	iasis	25	0
Cysticerc*		499	393
Ascar	iasis	250	78
	osis	0	1
	idosis	5	2
Ascar*		986	737
Varro	osis	1	2
	atosis	12	3
Varro*		370	225

Column 2 is the average of the four databases quoted by Kassai *et al.* (1988). Column 3 is taken from the Science Citation Index (Web of Science) database, on 12 Feb 2001, for the years 1998–2001.

The figures for Ostertagiasis/iosis in Kassai *et al.* (1988) are confused by typographical errors, so may be inaccurately reflected here. Comments on Table 2:

Fascioliasis and taeniasis show some increase in the use of the SNOAPAD format, which has led to an increase in nomenclatural diversity.

Trichinellosis and trichinelliasis have both lost ground to trichinosis, although trichinellosis is the SNOAPAD recommendation.

Ancylostomiasis is less frequently referred to by any name derived from the generic name *Ancylostoma*. This is presumably because the less ambiguous term 'hookworm disease' has become more widely used in medical literature.

Cysticercosis has superseded cysticerciasis; neither of these is derived from a valid taxonomic name, so these names should be outside the SNOAPAD recommendations.

Hypodermosis is the only significant example where the SNOAPAD recommendations have both gained ground and led to a decrease in nomenclatural diversity: The usage of, hypodermatosis has declined from 34% to 7%.

indicates a 'wildcard', for example, ascar searches the database for any word beginning with ascar... It remains true that a search of a database using the truncated name of the organism and a 'wildcard' produces far more 'hits' than any disease name. This is only a problem in instances such as taeni* and hypoderm*, which are the roots of many words unrelated to parasitology.

Objections to SNOAPAD

The World Health Organization (CIOMS/WHO, 1987) published a comprehensive list of English names and synonyms for human diseases caused by parasites. This nomenclature is used in the International Classification of Diseases (WHO, 1992), endorsed by the 43rd World Health Assembly. The authors emphasize that 'the main criterion for the selection of recommended names is existing usage', and most of the names recommended do conform with normal usage. The invention of neologisms is explicitly discouraged. For parasitic diseases of humans then, a very satisfactory nomenclature exists, which predates SNOAPAD. (Although the two documents share two reviewers, neither mentions the existence of the other!).

The lack of open debate on the proposed terminology is mentioned above. In an extensive correspondence with senior parasitologists and editors in 1994, and again in 2001, almost the only support I found was from the people who were involved in the proposal of SNOAPAD.

Although the recommendations are not explicitly restricted to English language literature, this has been the effect. A brief survey of recent issues of parasitological journals in languages other than English (Table 1) is sufficient to confirm that few, if any, other language users have adopted the SNOAPAD recommendations. Editors of journals in languages other than English (quite rightly) allow a wide diversity of suffixes. The suffix -osis is normal in German and alternates with -asis in Spanish; -ose is normal in French, Italian and Portuguese, though in the last -ase is also frequent; in both Portuguese and Spanish the spelling of the generic name stem is commonly adapted to conform with vernacular pronunciation.

The original SNOAPAD committee ignored a salient fundamental feature of the English language, that there are no prescriptive rules; see Baugh & Cable (1993) for discussion of the failure of early attempts to regulate English. English is characterized by anarchy, and this is one of its most valuable features. Rules in English, such as they are, describe customary usage, and there is no body with the authority to prescribe correct usage, certainly not the WAAVP, nor the WFP, nor the EFP. Most of the proposed changes, from -iasis to -osis contravene this rule, because familiar and well-accepted terms would have to be replaced with unfamiliar, sometimes wholly new, terms. In further contrast to the CIOMS/WHO nomenclature, the original SNOAPAD list represents an orgy of neologistic inventiveness. Among the 72 suggested names for diseases caused by arthropods (Kassai *et al.*, 1988), a search of the Science Citation Index revealed that only nine had been used between 1995 and March 2001.

The objections above are rather theoretical. The most serious initial objection to the new rules, however, was much more practical: that they would create confusion rather than uniformity. A quick look at BIDS (Medline) in November 2000 showed this to have been the case.

Toxocarosis, for example, has retained supremacy over toxocarcosis. Prior to 1990 there was no confusion at all. Toxocarosis first appeared in 1990 with already 18% of the usage. In subsequent years, toxocarosis fluctuated between 0 and 31% of the usage, with no clear upward trend. Over the

Table 3. The effect of SNOPAD on commonly used names for human diseases which, in English, customarily differ from SNOPAD. Those marked *have arthropod vectors or intermediate hosts

English name	Hits	SNOPAD version	Hits
Protozoal diseases		Protozooses	
Trypanosomiasis*	711	Trypanosomosis	142
Leishmaniasis*	2685	Leishmaniosis	69
Giardiasis	233	Giardiosis	17
Trichomoniasis	257	Trichomonosis	14
Amoebiasis (U.K.)	96	Entamoebosis	0
Amebiasis (U.S.A.)	272		
Malaria*	8364	Plasmodiosis	0
Balantidiasis	7	Balantidiosis	2
Helminthic diseases (‘		Helminthoses	
Schistosomiasis	1696	Schistosomosis	12
Fascioliasis	160	Fasciolosis	96
Paragonimiasis*	50	Paragonimosis	4
Diphyllobothriasis*	7	Diphyllobothriosis	2
Taeniasis	60	Taeniosis	14
Ascariasis	152	Ascariosis	8
		(Ascariosis)	2
Trichuriasis	25	Trichuriasis	2
Capillariasis	24	Capillariosis	2
<i>Dipylidium caninum</i> *	26	Dipylidiosis	0
Trichinosis	143	Trichinellosis	123
Trichiniasis	1		
Trichinelliasis	1		
Strongyloidiasis	146	Strongyloidosis	13
Enterobiasis	12	Enterobiosis	1
Toxocariasis	113	Toxocarosis	37
		(Toxocarosis)	7
Filariasis*	800	Onchocercidosis Brugiosis	0
Mansonelliasis*	4	Mansonellosis	4
		Wuchereriosis	1
Loiasis*	56	Loaosis	0
Dirofilariasis*	108	Dirofilariosis	21
Onchocerciasis*	558	Onchocercosis	8
Dracunculiasis*	54	Dracunculosis	2
Diseases caused by arthropods		Arthropodoses	
Demodecosis	3	Demodicosis	97
Myiasis	212	Dipterosis	0
		Myiosis	1
		Myosis (sic)	30
		Hypodermosis	29
		Hasterophilosis	1
		Oestrosis	11
		Cephenemyiosis	1
Pthiriasis	0	Phthiriosis	0
Phthiriasis	3	Pthirosis	0
Scabies	414	Sarcoptosis	0
Tungiasis	14	Tungosis	1

Figures are taken from a search for terms used in titles, abstracts and keywords, of Science Citation Index (Web of Science) on 13 February 2001, for the years 1995–2001. Many disease names are uncontroversial: among those for arthropod-related infections (marked*), babesiosis (351 hits) clearly dominates babesiasis (7 hits) and pediculosis (69 hits) is preferred to pediculiasis (2 hits). In this selection, trichiniasis, trichinelliasis and demodecosis are clearly unpopular and should be discouraged. However, only demodecosis should be replaced by the SNOPAD-concordant equivalent. Many other arthropod-based terms ending -osis were proposed for SNOPAD by Kassai *et al.* (1988) but have apparently never been used in the literature (e.g. Ceratopogonidosis, Culicidosis, Muscidosis, Pulicosis, Simuliidosis) and it remains unclear what they would mean (e.g. allergy to, bites of, contact with the insect concerned). Note that the adoption of SNOPAD names is sometimes confused, as evidenced by the occasional use of ascariosis, and toxocarosis. Myiasis is not based on any valid taxonomic name and is listed in SNOPAD, as is malaria, as an acceptable vernacular alternative (to calliphoridosis). The use of myosis or, more correctly (?), myiosis has no evident justification. Phthiriosis is listed by Kassai *et al.* (1988), based on incorrect spelling of the generic name, *Phthirus* for *Pthirus*.

10 years between 1990 and 1999, toxocariasis was used in the titles, keywords or abstracts of 165 articles, and toxocarosis in just 39.

Even with diseases where there was some confusion initially, traditional terms have prevailed: fascioliasis (1998–99): 58, fasciolosis 33. For most diseases the confusion has been too limited to be more than a nuisance: leishmaniasis 863, leishmaniosis 29; taeniasis 20, taeniosis 2, and amoebiasis 29, amoebosis 0.

Trichinella infection was one source of confusion on which the search for uniformity was justified. In 1998 and 1999, trichinosis was used 44 times, while the 'SNOPAD-concordant' trichinellosis lagged slightly, with a score of 38.

A more formal analysis is given in Tables 2 and 3. In Table 2, the list of diseases included as examples by Kassai *et al.* (1988) is accompanied by a summary of their analysis of database references, compared with more recent usage. The commentary confirms that, in most instances where there has been any change in nomenclature subsequent to the SNOPAD recommendations, this has added to nomenclatural diversity rather than promoting uniformity.

Table 3 shows that none of the name changes for important human diseases recommended by SNOPAD has been widely adopted. Thus, overall, the results of SNOPAD have been minimal and negative.

The way forward?

The SNOPAD recommendations have only been adopted by a small number of authors and editors, and this has led to confusion and even conflict (I know of five occasions of conflict between authors and editors on this matter, and there must have been many more). The recommendations have clearly been counterproductive, and should be withdrawn. However, the original problem addressed by the SNOAPAD committee, that of database searches, remains serious, and has even been exacerbated by SNOPAD.

A simple solution is proposed, which would require little effort, and would relieve the confusion.

For parasitic infections that occur in humans, the CIOMS/WHO nomenclature should be used whenever appropriate.

For infections which are not included in the above, authors should be encouraged either to use truly vernacular names, such as nagana, malaria, scabies, when these are commonly accepted and sufficiently well defined, or to name the causative organism precisely, in the conventional taxonomic manner.

When it is necessary to use a name derived from the taxonomic name of the causative organism, authors and editors should check, by searching the most relevant database, which is the most commonly used name for the disease in the relevant language and context, and should use that name in their texts.

Whatever name is used in the text, synonyms should then be listed as keywords, in various languages if appropriate. This practice, which is sometimes done already, facilitates searches considerably and ensures maximum retrieval of an article.

Finally, on the rare occasions when the preferred option is unclear, or when a new name is required, the -osis suffix should be recommended.

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