



## REVIEW OF RESEARCH

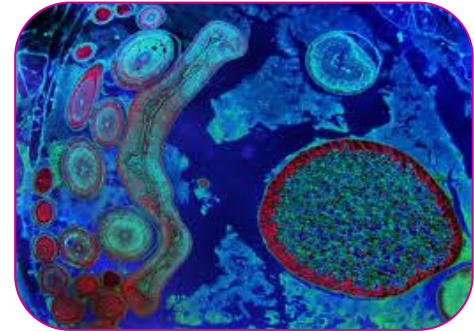
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### PARASITIC DISEASES: COHABITATION WITH INCONSISTENCY

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#### ABSTRACT

*In fact, SNOAPAD is nothing more and nothing less than a guideline based on carefully reasoned and clearly defined principles for those colleagues dissatisfied with the existing heterogeneous and inconsistent nomenclatural usage, who wish to rely on a uniform and proper disease nomenclature.*

**KEYWORDS:** Parasitic diseases; SNOAPAD; SNOAPAD; History Contents

#### 1. INTRODUCTION

Nomenclature is more than just a system of names, it includes also provisions for their formation and use. If we look at how that definition applies to the nomenclature of parasitic diseases, it is clear that in this case the development was a spontaneous process as there were no established provisions or principles for coining names of diseases based on the taxonomic name of the parasite. This has resulted in an inconsistent disease terminology largely (but not solely) due to the indiscriminate use of several suffixes for the formation of names to denote parasitic diseases. Remember: consistency in terminological usage is an important requirement of intellectual hygiene and clear communication for any field of science!

#### 2. EVOLUTION AND OBJECTIVES OF SNOAPAD

In contrast to the basically homogenous terminology of bacterial and fungal diseases, a heterogeneous usage exists in the nomenclature of parasitic diseases or infections. For naming a disease entity, caused by parasitic agents, different names are being used, such as trypanosomosis and trypanosomiasis, fasciolosis, fascioliosis and fascioliasis, etc.

The existing usage of inconsistent disease terminology prompted the World Association for the Advancement of Veterinary Parasitology (WAAVP) to establish a Terminological ad hoc Committee in 1985, and to develop principles for a Standardised Nomenclature of Animal Parasitic Diseases (SNOAPAD). The Committee had members from France (Euzéby), Germany (Hiepe), Greece (Himonas), Hungary (Kassai), Spain (Cordero del Campillo) and the U.S.A. (Gaafar), and a wide range and composition of external reviewers from 17 countries of the world had expressed their criticism and consent before the principles of the standardised disease nomenclature were publicly launched (Kassai et al., 1988).

Although the SNOAPAD guidelines were originally meant for those concerned in veterinary parasitology, the proposal was found logical and sensible (first by Baker, 1989) to be adopted also for human parasitic diseases. Thus, in 1990 during ICOPAVII, at the Council Meeting of the World Federation of Parasitologists the representatives of member societies unanimously endorsed the SNOAPAD principles for

all parasitic infections. Since that time the reference to 'Animal' was dropped, thereby changing the acronym to SNOAPAD (Kassai and Burt, 1994).

The major rationales for the SNOAPAD initiatives are listed below in Table 1. The main principles to be used in SNOAPAD are outlined in Table 2. The essential rule put forward by the SNOAPAD was very simple: construction of disease names by adding the suffix '-osis' to the stem of the name of the parasite taxon.

**Table 1**

**Major rationales for the SNOAPAD initiatives**

Codifies the rules of formation of disease names coined from the taxonomic names  
 Supports nomenclatural homogeneity by providing a standard list of disease names  
 Promotes adoption of the 'one disease – one name' concept  
 It is consistent with disease nomenclature in bacteriology and mycology  
 Facilitates electronic information handling and literature retrieval  
 Meets the requirement of intellectual hygiene of a consistent terminological usage

**Table 2**

**Major principles of SNOAPAD**

When disease names are formed from the taxonomic name of the parasite, use solely and uniformly suffix '-osis' (in plural '-oses') of the varieties of suffixes ('-osis', '-iosis', '-asis', '-iasis') currently in use for coining terms to denominate a disease or infection

The suffix '-osis' is to be added to the stem of the name of the parasite taxon, which, in general, is formed from the nominative case of the taxa by the omission of the last one or two letters (e.g. Trypanosoma, trypanosomosis, Sarcocystis, sarcocystiosis, Fasciola, fasciolosis, Trichostrongylidae, trichostrongylidosis, Ascaris, ascariosis, Trichinella, trichinellosis, Hypoderma, hypodermosis)

Professional languages are living, organic formations. Thus, any suggestions of a nomenclatural reform, even the most rational one, cannot be imposed obligatorily on members of the professional community. Although no immediate general agreement was expected, it was hoped that the SNOAPAD proposal would become known over time, and that the benefits arising from adoption of a uniform and standard disease nomenclature would lead to its increasing popularity. However, 18 years after the inauguration of the SNOAPAD/SNOPAD, nomenclatural heterogeneity continues to exist both in primary and secondary literature (e.g. databases). Many colleagues are pragmatists, and use terms which they have always used, and which they think are in common use. One should remember what Robert Burns said: 'The best laid schemes o' mice and men Gang aft a-gley'.

**3. Objections to SNOAPAD**

The SNOAPAD guideline has gained support and criticism, as well as much indifference. Besides warm welcome of support (Baker, 1989; Breza, 1989; Burt, 1994; Urquhart et al., 1996; Cordero del Campillo and Martínez Fernández, 2001; Eckert, 2001) SNOAPAD also generated some marked opposition (Ashford, 1994; Wallbanks, 1995; Eberhard, 2000). Professor Ashford from the Liverpool School of Tropical Medicine, perhaps the most avowed opponent of the move for a uniform disease nomenclature, carried out extensive correspondence with 'senior parasitologists and editors' in 1994 and in 2001 in order to discredit and disqualify the SNOAPAD principles. He and his counterparts have found the whole issue of SNOAPAD to be troubling. Ashford voiced his dissenting opinion in print by claiming that 'the recommendations (by SNOAPAD) have clearly been counterproductive, and should be withdrawn' (Ashford, 2001a). Major objections to SNOAPAD are summarized in Table 3.

The adoption of consistency in an inconsistent nomenclatural usage entails alterations. It is a human trait that switching from the use of one term to the other may generate discomfort feeling. However, much of the criticism has been based upon misunderstanding and misinterpretation of a well reasoned proposal,

and reflects limited knowledge of the history of nomenclature of parasitic diseases. It is therefore expedient, here, to take a look back at the development of the existing nomenclatural usage.

### Table 3

#### Major objections to the SNOPAD principles

Disregards familiarity and customary usage  
 Has created greater inconsistency rather than less  
 May corrupt a fundamental tenet of the English language  
 Has polarized the parasitologists' community  
 There is no need for a uniform disease nomenclature

#### 4. Early history of disease nomenclature

There are different ways of naming host conditions caused by infections with parasites, one of which is the construction of disease names from the name of the parasite taxon by using suffixes. We must realise that the available set of '-osis', '-iosis', '-asis' and '-iasis' – all of which are suffixes of Greek origin – are entirely synonymous, meaning a status of inflammation and consequently that of a disease. The actual usage largely depends on tradition, educational imprinting, euphony, personal preferences and shows great variation.

In 1959 the JAVMA<sup>1</sup> devoted an Editorial to the problems of nomenclature of parasitic diseases (Whitlock, 1959). In that, Whitlock wrote: 'the indifferent usage of '-osis' and '-iasis' came into parasitology with Flemming's translation of Neumann's "Parasites and Parasitic Diseases of Domestic Animals" in 1892' (Neumann, 1892). 'By the early 1940s it was apparent that people coining new names were applying either '-osis' or '-iasis' on the basis of euphony instead of a logical or historical reason.' According to Whitlock (1959) '... the parasitologists, in essence, go along with other etiological sciences – such as bacteriology, mycology – and use '-osis' to indicate disease due to parasites in coining new terms.' He said: 'the historical precedent is so clear that one has little choice but to name new parasitic diseases with the '-osis' suffix'. He also proposed names ending in '-iasis' for a special function, i.e. for distinguishing asymptomatic forms of parasitic infections from those with clinical manifestations (Whitlock, 1955, 1959). The difficulties inherent in the distinction between the two forms of parasitic infections make it easy to understand why Whitlock's dichotomous classification of disease names did not gain much popularity in practice. In the first six decades of the 20th century terms ending in '-osis' dominated the disease nomenclature, so only that usage can be considered as truly 'traditional'. From a quick look at the standard textbooks of distinguished parasitologists of that time such as those written by Neveu-Lemaire (France), Brumpt (France), Wetzel (Germany), Madsen (Denmark), Gordon (Australia) and Kotla'n (Hungary), etc. it is clear that these authors did not feel necessary to use the suffix '-iasis' for coining disease names, unless exceptionally.

The principles of the SNOPAD guideline are based on that tradition, thus the qualification of the nomenclature corresponding to that traditional usage to be 'nonsensical exhortations' (Ashford, 2001b) is undeserving and truly nonsensical. Several authors have attempted to establish concepts of a uniform and proper disease terminology on the basis of '-osis' terms (Skrjabin, 1937, 1946; Kotla'n, 1960, 1961; Cordero del Campillo, 1976; Cordero del Campillo and Mart'inez Fern'andez, 2001). However, these initiatives have largely been neglected. The indiscriminate, 'neo-traditional' use of different suffixes for coining disease names from the taxonomic name of the parasite become more customary in the second half of the last century, especially in the Anglo-Saxon region and in the field of medical parasitology, leading to the existing heterogeneity in spelling.

In order to fulfil the role of an up-to-date dictionary of parasitic diseases, the volume of Parasitic Diseases of the series of International Nomenclature of Diseases (IND) was published in 1987 by the CIOMS and WHO (CIOMS, 1987). In that, terms such as fascioliasis, taeniasis, trichinellosis, etc. are used, but – not surprisingly – no names for most parasitic infections of animals are mentioned. The 'existing' or 'general usage' was claimed to be the only major criterion for the inclusion of a term into the list of names

recommended by the IND. Existing usage, however, shows great variation from country to country, school to school, editor to editor, etc. Clearly, it was the lack of well established rules of formation of disease names that compelled the authors of the parasitological issue of the IND to depend on such illdefined selection criteria as the ‘existing’ or ‘general usage’.

The question arises, by what method can customary nomenclatural usage or familiarity be dispassionately assessed?

**5. Assessment of customary usage: by what method?**

One way of looking at the customary usage of a disease name is to ask a database and count the number of records. This way I have compared the frequency of disease names ending in ‘-osis’ or ‘-iosis’ and ‘-asis’ or ‘-iasis’, respectively, in two databases in the period from 1 January 1999 to 12 December 2003. The titles, abstracts and keywords were searched in CAB Abstracts (database of the Centre for Agricultural and Biosciences International) and Medline. Ten often mentioned genera were selected with the result that in over 96% of the records disease names coined by the suffix ‘-iasis’ occurred (Table 4, Part A). Clearly, in these cases the ‘-asis’ or ‘-iasis’ terms are far more familiar. If we look at another set of 10 parasite genera, it will be seen that in almost all records disease names ending in ‘-osis’ were used (Table 4, Part B). In these instances the ‘-osis’ or

**Table 4**  
**Comparison of frequency of disease names ending in ‘-osis’ or ‘-iosis’ and -asis or ‘-iasis’ in two databases (CAB and Medline) in the period 1999–2003**

Taxon name of the agent	Disease names coined by			
	‘-osis’, ‘-iosis’		‘-asis’, ‘-iasis’	
	CAB	MEDLINE	CAB	MEDLINE
<b>Part A</b>				
<i>Leishmania</i>	60	60	2096	2137
<i>Trypanosoma</i>	130	102	941	781
<i>Giardia</i>	12	9	450	366
<i>Trichomonas</i>	11	11	320	179
<i>Schistosoma</i>	13	8	2083	1595
<i>Taenia</i>	20	17	168	131
<i>Strongyloides</i>	14	10	217	247
<i>Onchocerca</i>	11	11	377	348
<i>Loa</i>	0	0	53	52
<i>Dracunculus</i>	3	1	49	52
Total (%)	274 (3.9)	229 (3.7)	6754 (96.1)	5888 (96.3)
<b>Part B</b>				
<i>Cryptosporidium</i>	769	745	0	1
<i>Microsporidium</i>	158	206	0	5
<i>Sarcocystis</i>	77	157	0	0
<i>Babesia</i>	416	326	2	1
<i>Piroplasma</i>	34	19	0	0
<i>Pneumocystis</i>	231	41	0	0
<i>Toxoplasma</i>	1290	1465	1	0
<i>Echinococcus</i>	1060	1290	2	3
<i>Hypoderma</i>	33	16	2	0
<i>Pediculus</i>	108	67	0	1
Total (%)	4176 (99.83)	4332 (99.75)	7 (0.17)	11 (0.25)
<b>Part C</b>				
<i>Leptospira</i>	503	613	0	0
<i>Listeria</i>	293	288	0	0
<i>Mycobacterium</i>	71	183	0	0
<i>Salmonella</i>	827	437	1	1
<i>Legionella</i>	16	189	0	0
<i>Brucella</i>	883	911	0	0
<i>Chlamydia</i>	94	47	2	4
<i>Rickettsia</i>	34	62	0	1
<i>Mycoplasma</i>	138	38	0	0
<i>Borrelia</i>	532	548	0	1
Total (%)	3391 (99.91)	3316 (99.79)	3 (0.09)	7 (0.21)

Titles, abstracts and keywords were searched.

-iosis’ terms are far more familiar. However, in cases of many other, perhaps less frequently mentioned genera, most of them being parasites of animal hosts, the distribution between hits of ‘-osis’ and ‘-iasis’ terms varies greatly rendering the assessment of frequency of usage problematic and uncertain. Therefore, I decided to take a more troublesome but perhaps more informative approach to assess the actual usage of types of disease names in a field wider than that accessible through the web.

**6. Survey of nomenclatural usage in the European countries**

A survey was made of the usage of names of diseases in textbooks and compendia related to parasitology published since 1990 in Europe (Kassai, 2005). The survey covered national language books used largely in veterinary and medical parasitology training courses. Colleagues from 25 countries were requested to provide data. There were two categories: (A) books adopting disease names coined from taxon names by the suffix ‘-osis’ consistently, and (B) books using terms ending in ‘-osis’ and ‘-iasis’ inconsistently. Details of the survey are presented in Table 5.

Responders from 21 countries reported bibliographic data from a total of 126 books or manuals. Of these books 93 (73.8%) adopted consistent ‘-osis’ disease terminology and 33 (26.2%) used a mixture of disease names ending in ‘-osis’ and ‘-iasis’ inconsistently. While the list is far from being complete, and classification was subjected to the personal judgement of the colleagues taking part in the survey, it was clearly shown that books adopting a consistent ‘-osis’

**Table 5**  
**Survey of usage of names of parasitic diseases in books published since 1990 in the European countries (Kassai, 2005)**

Country	Language	Suffixes for		Number of books or compendia adopting disease names coined from taxon names by suffix			Information provided by
		-osis	-iasis	-osis only	-osis and -iasis	Total	
Austria, Germany, Switzerland	German	-ose	-iase	8	4	12	Eckert, J.; Hiepe, Th.
Bulgaria	Bulgarian	-osa	-iasa	8	5	13	Georgieva, D.
Czech Rep., Slovak Rep.	Czech Slovak	-oza	-iaza	9	0	9	Lukesová, D.; Scholz, T.; Čorba, J.
Denmark	Danish	-ose	-iase	2	1	3	Monrad, J.
Finland	Finnish	-oosi	-aasi	0	2	2	Nikander, S.
France, Switzerland	French	-ose	-iase	7	?	7	Euzeby, J.
Greece	Greek	-ύόç	-έαόç	3	0	3	Sotiraki, S.
Hungary	Hungarian	-osis	-iasis	6	3	9	Kassai, T.
Italy	Italian	-osi	-iasi	5	6	11	Genchi, C.
Norway	Norwegian	-ose	-iase	14	?	14	Gjerde, B.
Poland	Polish	-oza	-iaza	6	1	7	Wedrychowicz, H.
Romania	Rumanian	-oza	-iaza	5	2	7	Fazakas, B.
Russia, Belarus	Russian	-oz	-iaz	5	0	5	Bessonov, A.
Serbia, Montenegro	Serbian	-oza	-ijaza	6	0	6	Djurković, O.; Petrović, Z.
Spain	Spanish	-ose	-iase	5	3	8	Cordero del Campillo, M.
Sweden	Swedish	-os	-ias	1	?	1	Christensson, D.
United Kingdom	English	-osis	-iasis	3	6	9	Several
Total				93	33	126	

Number of countries invited to the survey 25, responded 21. Of the total number of 126 books analysed, in 93 (73.8%) from 20 countries disease names suffixed by ‘-osis’ are used consistently, and in 33 (26.2%) a mixture of terms suffixed by ‘-osis’ and ‘-iasis’ are in use. The question mark refers to sites where data have not been provided. disease terminology are more prevalent and are in use in at least 20 countries in Europe (Kassai, 2005). Remember, textbooks have an authoritative function!

## 7. Do we need a uniform and standard disease nomenclature?

The SNOPAD rules were aimed at achieving a uniform and standard disease nomenclature. The response of the opposition was no for uniformity and yes for standardisation. In contrast to Ashford (2001a) who believes that there is no need at all for a uniform disease nomenclature, all informants of the European survey claimed that a uniform nomenclature is useful and necessary. Even Professor Ashford recognises the need for a standard list which would suggest a single recommended name for every pathological entity induced by parasites.

## 8. Other charges to SNOPAD

A major charge, expressed by Ashford (1994) that what the uniform ‘-osis’ disease nomenclature proposes is a ‘travesty of the English language’, moreover, ‘it may corrupt a fundamental tenet of the English language’, took us by surprise. The unambiguous usage of terms such as toxoplasmosis, cryptosporidiosis, babesiosis, echinococcosis, etc. also by the colleagues being fortunate enough to have English as their mother tongue – not excluding even Professor Ashford (!) –, seems to be strong evidence against the notion that disease names ending in ‘-osis’ suffer from genuine incompatibility with the English language. This is further substantiated by the highly consistent and general usage of the English names of bacterial diseases ending in ‘-osis’ (Table 4, Part C). Professor Ashford may be right to say that ‘a salient fundamental feature of the English language, that there are no prescriptive rules’ and ‘English is characterized by anarchy, and this is one of its most valuable features’. He concluded there was no need for any rule for formation of disease names in the English (Ashford, 2001a). However, in an artificial language, such as nomenclature of parasitic diseases, the value of inconsistency or ‘anarchy’ is highly doubtful. Agreement with the SNOPAD concept is more obvious in the field of veterinary than of the medical parasitology and tropical medicine.

## 9. What next?

Pros and cons regarding the SNOPAD concept have been discussed at various international conferences in search for a consensus. SNOPAD was believed to be especially useful in teaching programmes and promoting effective usage of computerized retrieval services. In the absence of well defined and established rules of formation of disease names there is nothing to prevent the appearance and infiltration of neologisms such as echinococciasis, cryptosporidiasis, trichiniasis, hypodermiiasis, etc. just to recall a few of recent examples from the controlled vocabulary of databases or from other sources.

The SNOPAD terminology was adopted by the Office International des Epizooties—(OIE, World Organisation of Animal Health) which currently comprises 164 member countries. Information is published in the OIE Bulletin every 3 months and in World Animal Health annually. The Animal Health and Production Compendium of CAB International (2003) also adopted the SNOPAD disease nomenclature. SNOPAD was intended to assist publishers who recognised the benefits of homogenous nomenclatural usage, and were to adopt that point in their editorial policy. There are some SNOPAD-conform and SNOPAD-refusing journals, besides those which are SNOPAD-indifferent. As an example of the former group, let me cite the Guide for Authors of Veterinary Parasitology: ‘For the denomination of parasitic diseases or infections, authors are requested to follow the Standardized Nomenclature of Animal Parasitic Diseases (SNOAPAD) . . .’. However, the stance of most editorials reflects the free spirits (or the peaceloving attitude) allowing either versions of disease names to be used according to the penchant of the individual authors. Editorials, database producers and the teaching staff of the higher education hold the key to further progress provided they are open to see the advantages of using a single name of worldwide currency for each disease entity (Kassai, 2005). The power of common sense conservatism is illustrated by the general term ‘lymphatic filariasis’ commonly used for denominating human disease which is caused by nematodes not of the genus *Filaria*, but by those of the genera *Wuchereria* and *Brugia*, which do not belong even to the family Filariidae but to Onchocercidae. Since all the related genera do belong to the superfamily Filarioidea, an etymologically correct disease name, filarioidosis, derived from that higher taxon name has been offered instead of filariasis (Kassai, 1999, 2002). Nevertheless, in the general usage preference is given to familiarity over etymological

correctness, thus the established 'lymphatic filariasis' ('bancroftian' and 'malayan filariasis') continues to be in use, thus avoiding the feeling of 'terminological confusion'.

It is to be recognized that there are a relatively low number (around 20) of '-iasis' terms commonly used indeed, such as leishmaniasis, schistosomiasis, taeniasis, filariasis and others (Table 4, Part A), the use of which will hardly be discontinued just for the sake of uniformity.

## 10. Differential disease names

An aspect of disease terminology, not covered by the SNOAPAD, concerns the use of differential disease names. We are in the need of such terms whenever clear reference is required regarding which of the several congeneric species of parasites is the causative agent of an infection, *Echinococcus granulosus* or *Echinococcus multilocularis*, *Fasciola hepatica* or *Fasciola gigantica*, etc.

Conventionally, differential disease names consist of two words. The first one is the disease name, and the second word is the singular genitive of the species name of the parasite, e.g. echinococcosis granulosi, echinococcosis multilocularis, fasciolosis hepaticae, fasciolosis giganticae.

## 11. CONCLUSION

In a recent survey it has been revealed that the majority (73.8%) of 126 national language parasitological textbooks or compendia from 21 countries of Europe published since 1990 adopted consistent '-osis' disease terminology and the rest (26.2%) used a mixture of disease names ending in '-osis' and '-iasis' inconsistently.

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