J. clin. Path., 1975, **28**, 746-749

A practical system of bacterial nomenclature

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SYNOPSIS It is unlikely that any serious attempt will be made to standardize bacterial nomenclature on a national or international scale until the implementation of the proposed revision of the International Code of Nomenclature of Bacteria on 1 January 1980. In the meantime, the lack of such standardization poses major problems in communication between the laboratory and the clinician and also causes difficulties in the latter's reading of the bacteriology literature. The present communication proposes interim regional voluntary standardization of bacterial nomenclature as a solution, and outlines a system of nomenclature which could be used on such a regional basis. The system is specifically designed to demonstrate clearly the relationships between bacteria.

Soon after the start of microbiology proficiency testing in Ontario, it became clear that part of the problem in assessing laboratory performance arose from the use of widely differing systems of bacterial taxonomy and nomenclature by the participating laboratories. Not only did adjacent laboratories use varying nomenclature for the same organism, but it was obvious that some laboratories used inconsistent terminology for the same organism on different occasions. A primary concern was the effect of these inconsistencies on the monitoring of microbiology proficiency testing with a computer program, but they would undoubtedly also confuse a clinician receiving reports from several laboratories in the same city. The present system, designed primarily to facilitate data retrieval in proficiency testing programs, is presented as a useful channel for informing both laboratory physicians who issue reports and clinicians who read them of internationally accepted changes in bacterial taxonomy and nomenclature.

The System

The system is published in a loose-leaf manual comprising a preface, a two-page guide to the system, four pages of contents, 80 pages with approximately 700 coded organisms, and a seven-page index. A copy of the manual was distributed to every laboratory in Ontario under the code name OSIMIB (The Ontario System for the Identification of Medically Important Bacteria).

In compiling the OSIMIB manual, several sources were used, including Cowan and Steel's *Manual for the Identification of Medical Bacteria* (1965)[1], Edwards and Ewing's *Identification of Enterobacteriaceae* (1972) and the *Anaerobic Bacteriology Manual* of Sutter *et al* (1972). Although the best features of the nomenclature used in all of the above works were freely adopted, the preliminary arrangement of organisms into sections within the manual was based mainly on the principles used in the new edition of *Bergey's Manual of Determinative Bacteriology* (1974). In the latter, only those genera which are closely related are grouped into families, and the temptation to create artificial 'families' has been avoided. Organisms which do not fit exactly into a family are grouped together on the basis of morphology, Gram-staining, and growth under aerobic and anaerobic conditions. Using these criteria, the OSIMIB manual is divided into 14 defined sections and a 15th section for organisms of uncertain taxonomic position. Table I, which is from the manual's contents section, illustrates this approach.

The main features in the OSIMIB code are shown in tables II and III. The five-digit code was designed to ensure maximum flexibility. At the species level, the appearance of 1 as the terminal digit denotes what was considered the most appropriate epithet, for example, 31131 *Pseudomonas cepacia*. There is no implication that this was always taxonomically the 'correct' term although every effort has been made to ensure that this was so where agreement was general. Sometimes, however, even the experts disagree, and in these instances, the terminology

Received for publication 24 March 1975.

[1]A second edition (1974) is now available and was used in minor revisions of OSIMIB.

Section 1:	
GRAM-NEGATIVE AEROBIC BACILLI	2
PSEUDOMONADACEAE (Code 31100)	
Pseudomonas (Code 31110)	3
GRAM-NEGATIVE AEROBIC BACILLI NOT BELONGING TO THE PSEUDOMONADACEAE	
Alcaligenes (Code 31510)	4
Brucella (Code 31610)	5
Bordetella (Code 31710)	6
Francisella (Code 31810)	7
Section 2:	
GRAM-NEGATIVE FACULTATIVE ANAEROBIC BACILLI	8
VIBRIONACEAE (Code 41100)	
Vibrio (Code 41110)	9
Aeromonas (Code 41310)	10
Plesiomonas (Code 41510)	11
ENTEROBACTERIACEAE (Code 42100, 43100, 44100)	
Escherichia (Code 42110)	12
Shigella (Code 42310)	13
Edwardsiella (Code 42410)	14
Salmonella (Code 42510)	15
Arizona (Code 43110)	18
Citrobacter (Code 43210)	19
Klebsiella (Code 43310)	20
Enterobacter (Code 43510)	21
Serratia (Code 43710)	22
Pectobacterium (Code 43910)	23
Proteus (Code 44110)	24
Providencia (Code 44310)	25
Yersinia (Code 44510)	26
GRAM-NEGATIVE FACULTATIVE ANAEROBIC BACILLI NOT BELONGING TO THE VIBRIONACEAE OR ENTEROBACTERIACEAE	
Pasteurella (Code 45110)	27
Chromobacterium (Code 45510)	28
Flavobacterium (Code 45710)	28
Haemophilus (Code 45910)	29

Table I *An illustrative extract from the contents section of the OSIMIB Manual*

most widely accepted in Ontario at the present time was used.

Discussion

The use of OSIMIB as part of a computerized system for data retrieval in microbiology proficiency testing will be discussed elsewhere. From its inception, however, the system was intended also to have a major educational component which is the subject of the present communication.

The need for a system to clarify bacterial nomenclature is obvious. Although the subject has always been controversial, more problems have arisen recently due to growing prominence of Gram-negative bacteria in nosocomial infection and increasing sophistication in the classification of these bacteria. *Serratia marcescens*, for example, was previously known among other terms as *Chromobacterium prodigiosum*, and the organism now known as *Serratia liquefaciens* was previously called *Enterobacter liquefaciens* and before that *Aerobacter* subgroup *C*. Again, *Ps. cepacia* has been known as *Ps. multivorans*, *Ps. kingii* or E01. The ultimate in confusion is illustrated by the genus Acinetobacter (table IV) which is the repository for the internationally unacceptable genera Bacterium, Herrellea, and Mima, besides containing two species formerly classified as Moraxella. It is felt that a system like OSIMIB, with a clear presentation of bacterial

Code	*Information*	*Examples*
5 digits with a terminal 1	a 'Most appropriate'[1] species name	43711 *Serratia marcescens*
	b Salmonella serogroup	42521 Salmonella serogroup B
	c Lancefield group of streptococci	52121 Lancefield Group A streptococcus
	d Runyon group of mycobacteria	71121 Runyon's Group 1 mycobacteria
4 digits with one terminal zero	Genus	43710 Serratia, NOS[2]
3 digits and two terminal zeros	Family	31100 Pseudomonadaceae
2 digits and three terminal zeros	General descriptive term	a 15000 bacilli, Gram-positive
		b 19000 cocci, Gram-positive
		c 23000 spirochaetes

Table II *General principles of the OSIMIB code*

[1]See text under 'The System'
[2]Not otherwise specified

Code	*Information*	*Examples*
5 digits with a terminal 1[1]	Most appropriate[2] species name	31131 *Pseudomonas cepacia*
5 digits with terminal digits 2 to 9	a Synonyms of the 'most appropriate' species name	a 31132 *Pseudomonas multivorans*
		b 31133 *Pseudomonas kingii*
		c 31134 E01
	b Strains or sub-types of organisms which do not have species status	a 43312 Friedlander's bacillus
		b 42324 Newcastle bacillus
Change in the penultimate digit	Change in species	31111 *Pseudomonss aeruginosa*
		31121 *Pseudomonas fluorescens*
		31131 *Pseudomonas cepacia*

Table III *Use of the OSIMIB code in demonstrating relationships between bacteria*

[1]See Table I for other uses of this coding
[2]See text under 'The System'

47710	*Acinetobacter*, NOS
47711	*Acinetobacter calcoaceticus*
47712	*Acinetobacter anitratus*
47713	*Bacterium anitratum*
47714	*Moraxella lwoffii* var *glucidolytica*
47715	*Herellea vaginicola*
47716	*Achromobacter antitratum*
47721	*Acinetobacter lwoffii*
47722	*Moraxella lwoffii*
47723	*Mima polymorpha*

Table IV *Use of the OSIMIB code with the genus Acinetobacter*

synonyms, could be of major importance in aiding medical personnel not only to reconcile reports from different laboratories in any area but also to equate bacterial terminology encountered in the literature with that used by their local laboratories.

In addition, it is anticipated that OSIMIB will facilitate standardization of bacterial nomenclature by diagnostic laboratories in Ontario. Initially, the 300 or so participants in the Ontario Laboratory Proficiency Testing Program will select their choice of synonym for any organism from OSIMIB and then, following publication and distribution of the test results, laboratories using names which are either erroneous, outdated or seldom used elsewhere in the province will be persuaded to adopt a more commonly used OSIMIB synonym. Having reached this point, total standardization can be considered, but the obstacles here will prove formidable until the proposed revision of the International Code of Nomenclature of Bacteria with its Approved Lists of Names of Bacteria is implemented on 1 January 1980. At the present time even reputable taxonomists fail to agree in many cases. Thus, for example, *Klebsiella aerogenes*, which is the most commonly isolated Klebsiella species in Britain, is one of five species which would be called *K. pneumoniae* in North America. Again, one widely used reference work on the Enterobacteriaceae (Edwards and Ewing, 1972) allocates Arizona to a genus with *Arizona hinshawii* being the type species; this is unacceptable to both the authors of the 8th edition of *Bergey's Manual* (1974) and the International Enterobacteriaceae Subcommittee who classify this group of organisms in the genus Salmonella with *Salmonella arizonae* as the type species. In this atmosphere, the concept of a universally acceptable system of bacterial nomenclature seems utopian even although the International Committee on Systematic Bacteriology is devoted to its accomplishment. Nevertheless, standardization must be attempted in order to permit the collating of reports from different laboratories, and it may well be that a temporary expedient is to standardize nomenclature by the voluntary collaboration of bacteriologists on a *regional* basis using a system based, as far as possible, on a well-recognized compilation such as *Bergey's Manual* (1974). Once agreement was reached on the most acceptable terminology, clinicians in the area could be notified of this decision and also of the alternative terminology, so that their own local nomenclature would have a more global perspective.

In Ontario, the use of OSIMIB as a tool in proficiency testing, which in turn is related to laboratory licensing, may in itself stimulate both laboratory and clinically orientated physicians to support standardization of bacterial nomenclature. It is hoped, in addition, that this communication will also stimulate the adoption of similar educative systems in areas which are not engaged in proficiency testing. The use of a system like OSIMIB is not restrictive. It may be thought of as a dictionary of bacterial taxonomy and nomenclature whose acceptance does not imply that one must use, or be immediately familiar with, every word in the text but which will allow one to understand people supposedly speaking the same language; like a dictionary, it will be used less frequently as one becomes more conversant with the language.

I am grateful to Dr Dorothy C. H. Ley for introducing me to microbiology proficiency testing in Ontario. The systems implementation of the code was carried out by Mr Shaul Ezer. Dr R. G. E. Murray kindly permitted access to the proofs of the 8th (1974) edition of *Bergey's Manual* and gave invaluable advice during the preparation of OSIMIB. Dr J. L. Whitby, the other members of the Ontario Laboratory Proficiency Testing Program in Microbiology[1], and Mr Brian L. Black reviewed the manuscript. The assistance of Miss Sue Dorse in the proof-reading of OSIMIB was invaluable. This work was in part supported by Ontario Ministry of Health Grant, D.M. 131—'Regional Quality Control Program for Microbiology'.

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[1]Dr S. McDonald, H. Richardson, Dr. H. Sepp, Dr S. Toma, and Dr D. Wood

Addendum

The new edition of Cowan and Steel employs essentially the same principle as OSIMIB, viz, it chooses what it considers the most acceptable name, admits that this is 'often, but not necessarily, the nomenclaturally correct name', and lists common synonyms so that 'everyone concerned—the bacteriologist, the clinician, and the health official—should all understand what organism is being reported'.

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