

What's in a Name? Nomenclature Changes and the Potential Impact on Microbiology

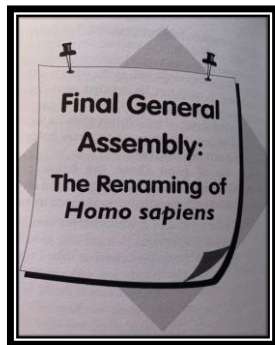
Patricia Tille Ph.D. MLS(ASCP) AHI(AMT) FACS
Professor and MLS Graduate Program Director
University of Cincinnati

1

2

Learning Objectives

- Describe the nomenclature changes that are evident in bacteriology, parasitology and mycology
- List the potential impact that nomenclature changes may have on diagnostic testing and patient treatment.
- Explain the impact that technology has had on not only the evolution of the taxonomic system in microbiology but how that influences the use of testing platforms in the laboratory.



Names are now validated to the extent that the requirements of the Code are met and assessment that the science is good. Even then, what lasts is determined by general acceptance... What is left to us these days, as we experience the ferment of ideas concerning the melding of phenotypic and molecular approaches to description, is to see that the education of microbiologists includes effective exposure to the nature and problems of bacterial taxonomy.

- R.G.E. Murray, ASM News, December 1988.
- The Other End of the Microscope: The Bacteria Tell Their Own Story
- A Fantasy by: Elmer W. Koneman, M.D.

3

4

Nomenclature Changes

- Why are we seeing them?
- To what depth are we seeing them?
- Where are they occurring primarily?

C. difficile

- *Clostridium difficile*
 - Established genus in 1880
- *Clostridiodes difficile*

- What is the reasoning for the name change?
- Is this really what it should be? Or is there a better suited name?
- What about industry?
- What about clinical practice?

5



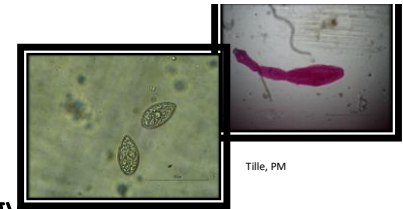
Taxonomic Organization and Establishment

- *Clostridium* spp.
- Taxonomy was traditionally based on phenotypic characteristics
 - Psychrophiles, thermophiles and acidophiles
 - G + C content 21 to 54%
- Evolution to More Extensive Molecular Technologies
 - DNA Hybridization
 - 16S rRNA
 - DNA sequencing
- Process
- Began in 1994, type species of the genus *Clostridium*, *C. butyricum*
 - And it is not over... more to come...

6

Clinically: What will this do?

- *S. argenteus* seems to cause similar disease (*S. aureus*)
 - Prevalence, disease and mortality
 - Skin and soft tissue infections
 - Lacks yellow pigment
 - Demonstrates a 12-15 fold increase in expression of quorum sensing loci that are found in *S. aureus*
 - Molecular mechanisms still not fully elucidated
- *S. schwiezeri* has not been reported as a cause of infection.
 - Produces alpha toxin, like *S. aureus*



Parasitology

Life is like a box of chocolates or in this case parasites!

13

14

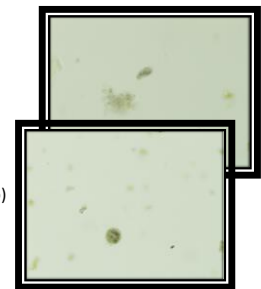
Different Place and Time

- Morphology
 - Still extremely focused on identification and demonstration of the organisms
- Molecular Technology
 - Lack of the need
 - Lack of the technology (even where there is need)
 - Lack of per personnel
 - Difficulty in the development of methodologies

15

Parasitology Changes

- *Balantidium coli*
 - *Neobalantidium coli*
- *Giardia lamblia*
 - *Giardia duodenalis*
- *Entamoeba* (Round and Round we go)
 - *E. histolytica*/*E. dispar* group
 - *E. moskovskii*
 - *E. bangladeshi*
 - *E. histolytica*



Tille, PM

16

Parasitology Changes

- New Discoveries (Changing the clinical perception)
 - *Dientamoeba fragilis*
- New species
 - *Leishmania* spp.
 - *Trichinella* spp.
 - *Brugia* spp. (Filarial worms)
 - *Taenia* spp.
 - *Diphyllobothrium* spp.
 - *Echinococcus granulosus* (now a complex)

17

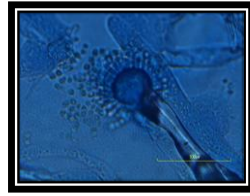
Clinical Relevance in Parasitology

- Transmission routes
- Control methods
- Diagnostics may improve
 - Rule in or rule out other diseases
- Treatment options
- Economic Development
 - Livestock Health Improvement
 - Food preparation

18

Fungi

What about the fungus among us and the changing patient population?



Tille, PM

19

Subcutaneous

- Dematiaceous (Melanized Groupings)
 - How do we limit this?
- Approximately 33 plus genera (many with new names)
- From superficial to systemic
- It has been recommended that in medical mycology the term dematiaceous only be applied to rapidly growing members of the *Ploesporales* (*Alternaria*, *Bipolaris*, *Curvularia*, *Exosporohilum*, and *Hongkongmyces*).
- Mycetoma, Chromoblastomycosis and Phaeohyphomycosis
- Let me show you a few...

21

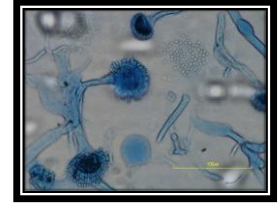
Atypical and Para fungal Agents

- *Pneumocystis carinii* to *Pneumocystis jirovecii*
- There are five species
- Morphology is similar to the protozoa
- Clinically it responds to antiprotozoal drugs but not to antifungal drugs in patients
- DNA says it is a fungus
- Multiple types of molecular analyses
 - None FDA approved
- There are several other Para fungal agents
 - Tropical and subtropical

23

Mycology

- Diagnostic Challenges
 - Slow growth
 - Biochemical differentiation poor
 - Lack of expertise
 - Lack of new technology
 - Molecular
 - Discovering new organisms
 - Reclassifying others
 - Are they pathogenic or not?
 - Patient population changes
 - Immunocompromised
 - Increase in use of anti-fungal medications
 - Superficial, subcutaneous, systemic



Tille, PM

20

Is it an Infection?

- *Exophiala bergeri*
- *Exophiala dermatitidis*
- *Exophiala jeanselmei*
- *Exophiala oligosperma*
- *Exophiala xenobiotica*
- *Exosporohilum rostratum*
- *Knufia epidermidis*
- *Lasiodiplodia theobromae*
- *Macrophomina phaseolina*
- *Neoscytalidium dimidiatum*
- *Sporothrix pallida*

- *Alternaria alternata*
- *Alternaria infectaria*
- *Bipolaris oryzae*
- *Cladophialophora bappii*
- *Cladophialophora croceopis*
- *Cladophialophora saturnica*
- *Cladarrhinum bulbilium*
- *Cladogonium cladogonioides*
- *Cladogonium oxysporum*
- *Curvularia lunata*
- *Curvularia senegalensis*
- *Curvularia spicifera*
- *Diaporthe longicolla*
- *Diaporthe phaseolorum*
- *Diaporthe phoenicicola*

Etc. etc. etc.

22

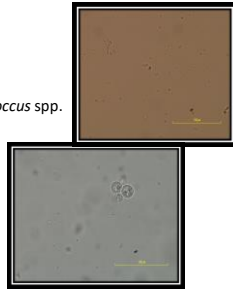
Molds and Environmental

Diagnostics has not kept up with the needs of the patient.

24

Yeast

- Approximately 8 new genera
- Many stem from previous grouping in *Cryptococcus* spp.
 - Reorganized, multiple species
 - Non-neoformans being recognized as pathogens.
- *Candida* spp. (> 200)
- Mortality rates can be more than 50%
- *Candida albicans* complex
 - *C. albicans*, *C. dublinensis*, *C. africana*
- *C. auris* (emerging pathogen)
 - Multi drug resistant
 - Unable to identify (traditional methods)



Tille, PM

25

Differentiating among the *Candida* spp. in the clinical mycology laboratory is vital as susceptibility to antifungal agents can no longer be reliably predicted due to mutations in drug targets and the acquisition of resistance determinants.

Bailey and Scott's, 15th Edition

26

Virology

- Diagnostics have not changed
- Minor movement and creation of new families
 - Seven to ten DNA families
 - Fourteen to twenty-one RNA families
- Bunyaviridae
 - Hantaviridae

27

Molecular Virology

- Serotypes to Genotypes
- 52 to 85 adenoviruses
 - Genotypes more closely related to virulence and clinical symptoms
 - Serotype and genotype differentiation not required unless immunological response is varied based on virulence.
- Species A – G
 - Subspecies example B1 and B2

28

Caliciviridae

- Norwalk-like virus, *Noroviruses*
 - Genogroups 1-IV
- Sapporo-like virus, *Sapporoviruses*
 - Genogroups 1-V
- Each genogroup then has a genetic cluster
- Multiplex assays detect them in the major groupings (Genera)
 - No differentiation noted at this time.

29

Coronaviridae

- Five genera (RNA viruses)
 - Collectively referred to as coronaviruses (CoVs)
- SARS and MERS
 - Severe acute respiratory syndrome-related coronavirus
 - Middle East respiratory syndrome-related coronavirus
 - Covid-19 (Sars-CoV2)
- Diagnostics
 - Multiplex assays are available for the rapid detection of the human endemic species of corona-virus

30

Virology

Diagnostically—Significant progress

Main challenge relies in treatment and therapeutic monitoring

31

Lions and Tigers and Bears... Oh MY!

- *Staphylococcus*
 - 45 species and 21 subspecies
 - 49 species and 25 subspecies
- *Streptococcus (Enterococcus)*
 - Are now different families
 - 14 additional genera that are confused with streptococci in the clinical laboratory
 - *Enterococcus* 57 species alone.
- *Bacillus*
 - This has been the largest genus, >100 related genera and species
- *Corynebacterium*
 - More than 8 new potentially clinically relevant species
 - 8 closely related genera

33

Fixing the Outliers....

- CDC groups
 - CDC 1c, O3 and on and on....
 - Classified more appropriately
 - CDC group 2 a
- Organisms that did not grow well, or other unique characteristics
 - Anaerobes
 - *Mycobacterium* spp.
 - *Mycoplasma* spp.
 - Spirochetes
- Distinctions that may or may not be relevant
- *Elizabethkingia meningosepticum* (and then there were three)
 - *E. miricola*
 - *E. anophelis*

35

Wrapping it up!

Bacteriology, Parasitology, Mycology and Virology

32

Giraffes and Elephants and Kangaroos... Oh MY!

- *Nocardia*, *Streptomyces*, *Rhodococcus*, and Similar Organisms
 - Approximately 12 new related genera
- *Enterobacteriaceae* no longer (Enterobacterales)
 - Seven families
 - *Enterobacteriaceae*, *Erwiniaceae*, *Pectobacteriaceae*, *Yersiniaceae*, *Hafniaceae*, *Morganellaceae*, *Budiviaceae*.
 - *Shigella* versus *E. coli*
 - Slight changes
 - *Klebsiella aerogenes (Enterobacter aerogenes)*
 - Subspecies
 - Increase in species in many genera
 - Identification of new species (*Proteus* spp.)

34

“the organism ID is not important; it is the sensitivity profile that matters.”

Have you ever heard a laboratorian say?

What about a primary care provider?

36

Antimicrobial Sensitivities

- How does the new technology and new naming system have an affect on antimicrobial sensitivity...and patient treatment.
- It does matter...
- The panels are designed based on recommended drug regimens for specific organism types
- Antibiogram accuracy
 - Mixed results if the organism identifications have been inaccurate

37

What's in a name? Taxonomic

- Phenotypic
- Genotypic
- Polyphasic Taxonomy
- Molecular Advancements
- PCR (polymerase chain reaction)
- Multi-locus sequence typing
- Ribosomal RNA (16s rRNA)
- Whole Genome Sequencing
- Testing platforms
- Biochemical, proteomic and genomic

38

What is in a name? Diagnostics

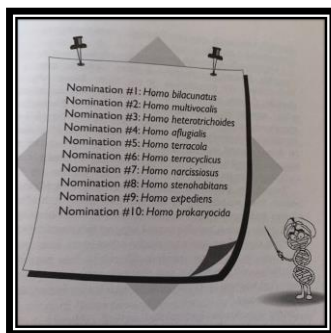
- Improvement in diagnostic methods
 - Faster, newer, more accurate
- Improvement in surveillance
 - Faster, newer, more accurate
- Improvement in patient treatment
 - Accurate organism, accurate treatment
- Improvement in patient outcomes
 - Rapid, accurate treatment, better outcomes
- Long term benefits
- Improve health care costs
- Reduce mortality

39

“the purpose of scientific names of organisms is unambiguous communication”.

2007, a Comment in The Lancet Infectious Diseases laid out the case for using *Pneumocystis jirovecii* as the cause of pneumocystis pneumonia, rather than *Pneumocystis carinii*.

40



41

Escherichia coli then proclaimed, “Be it known, then that *Homo multivocalis* shall be placed in the formal records as the prokaryotes” new name for *Homo sapiens*, as duly nominated and passed this assembly.”

- The Other End of the Microscope: The Bacteria Tell Their Own Story
- A Fantasy By Elmer W. Koneman, M.D.

Questions?

42