Molecular serotyping of *Escherichia coli*, transitioning wasn't supposed to be this hard

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http://sites.psu.edu/gutbugs
Penn State *E. coli* Reference Center (Dept. Food Science)

- Established in 1967, Dr. Paul Glanz
- >80,000 isolates collected over 50 years
  - 353 species or origins
  - 282 countries or regions
  - ~2,800 genome sequences, >4,000 by 2019
- Diagnostic tests: serotyping, PCR panels
- 2015, 2017 International *E. coli* molecular serotyping conference
- [https://foodscience.psu.edu/research.centers/ecoli](https://foodscience.psu.edu/research.centers/ecoli)
- @PSU_EcoliRefCtr
Serotype/Serogroup of *Escherichia coli*

- **O groups**
  - O1-O181, OX182-OX188
  - No O31, O47, O67, O72, O94, or O122

- **H groups**
  - H1-H56
  - No H13 or H22; H10=H50

- **K groups**
  - 60 recognized
  - K or KX designations
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SeqSero 1.0

Salmonella Serotyping by Whole Genome Sequencing

Reads (paired-end & interleaved)  Reads (paired-end)  Reads (single-end)  Genome Assembly

*The following formats are supported for raw reads input: .fastq.gz(preferred), .fastq and .era.

Please select your input file:

Browse...  No file selected.

Submit

- [http://www.denglab.info/SeqSero](http://www.denglab.info/SeqSero)
- GalaxyTrakr

About Salmonella serotypes...

Citation: Zhang et al. 2015

Salmonella serotype determinants databases

Copyright 2014 © Deng Lab.
Four tools for *E. coli* serotyping

- SeroTypeFinder
- Microbial Genomics 2016, available on GitHub
Issues with current platform

• Lack of concordance between molecular definitions
Issues with current platform

• Lack of concordance between molecular definitions
• Same antigenic O group encoded by distinct O-AGCs
Issues with current platform

- Lack of concordance between molecular definitions
- Same O group encoded by different loci
- Little agreement in defining and naming new molecular types
Issues with current platform

• Lack of concordance between molecular definitions
• Same O group encoded by different loci
• Little agreement in defining and naming new molecular types
  • Public databases identify >50 new molecular O groups (David Lacher, US Food and Drug Administration)
Issues with current platform

• Lack of concordance between molecular definitions
• Same O group encoded by different loci
• Little agreement in defining and naming new molecular types
• Some O groups lack molecular markers
  • O14 – Enterobacterial Common Antigen (ECA)
  • O57 – Gene cluster has yet to be identified
Issues with current platform

• Lack of concordance between molecular definitions
• Same O group encoded by different loci
• Little agreement in defining and naming new molecular types
• Some O groups lack molecular markers
• Integrating into nomenclature of other Enterobacteriaceae
  • All *Shigella* O groups except one are found in *E. coli.*
E. coli/Shigella molecular serotyping working group

Nov 7-8, 2017
University Park, PA

• Discussion/goals for 2018-2019:
  • What should be the criteria for defining a new O type in molecular era?
  • Protocol for receiving community input when defining new O type?
  • Who serves as repository for reference strains?
  • Who serves as repository for master list of approved designations?
  • How should new names be assigned and by whom?
  • How to handle discrepancies between classical and molecular O typing?
1. Sara Christianson, Head of Reference Services Lab, Public Health Agency of Canada
2. Linda Chui, Professor, University of Alberta Canada. Molecular Program Leader, Provincial Laboratory for Public Health in Alberta, Canada
3. Adrian Cookson, Senior Scientist, AgResearch, Palmerston North, New Zealand
4. Chobi DebRoy, Retired Director of the E. coli Reference Center, Penn State
5. Sabine Delannoy, Research Scientist, Laboratory for Food Safety, French Agency for Food, Environment, and Occupational Health and Safety, France.
6. Mark Eppinger, Associate Professor, University of Texas-San Antonio
7. Patrick Fach, Senior Research Scientist, Laboratory for Food Safety, French Agency for Food, Environment, and Occupational Health and Safety, France
8. Peter Feng, Research Microbiologist, US Food and Drug Administration (FDA)
9. Eleco Franz, Department Head, Epidemiology of Gastroenteritis and Zoonoses, RIVM, Centre for Infectious Disease Control (The Netherlands)
10. Pina Fratamico, Research Microbiologist, Molecular Characterization of Foodborne Pathogens Lab, United States Department of Agriculture (USDA)
11. Angelika Fruth, National Reference Center for Salmonella and Other Enteric Pathogens, Robert Koch Institute, Germany
12. Jayanthi Gangiredla, Staff Fellow, FDA
13. Jeroen Geurtsen, Head Molecular Bacteriology, Janssen (Netherlands)
14. Peter Hermans, Head Bacteriology Epidemiology, Janssen (Netherlands)
15. Atsushi Iguchi, Associate Professor, Faculty of Agriculture, University of Miyazaki
16. Claire Jenkins, Head of E. coli Reference Services, Public Health England
17. James Johnson, Minneapolis VA Medical Center and University of Minnesota Department of Medicine, USA
18. David Lacher, Research Microbiologist, FDA
19. Chad Laing, National Microbiology Laboratory at Lethbridge, Public Health Agency of Canada
20. Susan Leonard, Research Biologist, FDA
21. Mark Mammel, Research Microbiologist, FDA
22. Stefano Morabito, Senior Scientist and Deputy Director, European Union Reference Laboratory for coli Veterinary Public Health and Food Safety Departments, Istituto Superiore di Sanitá, Italy
23. Brian Morrow, Head Molecular Biomarkers, Janssen (USA)
24. David Needleman, Molecular Biologist, USDA
25. Isha Patel, Staff Fellow, FDA
26. Jan Poolman, Vice President Bacterial Vaccines Research & Early Development, Janssen (Netherlands)
27. Peter Reeves, Professor of Microbiology, The University of Sydney
28. Beth Roberts, Technician, Penn State E. coli Reference Center
29. Flemming Scheutz, The International Escherichia coli and Klebsiella Centre, Denmark
30. Nancy Stockbine, Chief of the Escherichia and Shigella Reference Unit, Division of Foodborne, Waterborne, and Environmental Diseases, US Centers for Disease Control
31. Chris Whitehouse, Acting Director, Division of Molecular Biology, FDA
32. Göran Widmalm, Professor of Bioorganic Chemistry, Department of Organic Chemistry, Arrhenius Laboratory, Stockholm University
Progress to date

• All databases consolidated into shared folder (in progress)
• Meeting presentations
• Decision that molecular types should supersede traditional typing
• Publication on proposed molecular method by 2019
Concluding thoughts

- Serotyping has, or is transitioning to genomic methods;
- Transitioning isn’t always going to be easy;
- Lasting progress only possible with global input from stakeholders;
- We hope to leverage success towards similar questions
  - Shiga toxin subtyping (stx2);
  - Intimin (eae)
- Potentially reestablish Enterobacteriaceae Working Group
Acknowledgments

Dudley Lab:
- Dr. Lingzi Xiaoli
- Hillary Figler
- Rebecca Abelman
- Andrea Keefer
- Sydney Majowicz

E. coli/Shigella Molecular Serotyping Working Group, especially:
- Chobi DebRoy
- Flemming Scheutz
- David Lacher
- Atsushi Iguchi
- Nancy Strockbine

United States Department of Health and Human Services
Food and Drug Administration
Center for Safety and Applied Nutrition

National Institute of Allergy and Infectious Diseases

Penn State College of Agricultural Sciences

Johnson & Johnson Pharmaceutical Companies of Johnson & Johnson