



Advanced Molecular Detection: An Overview

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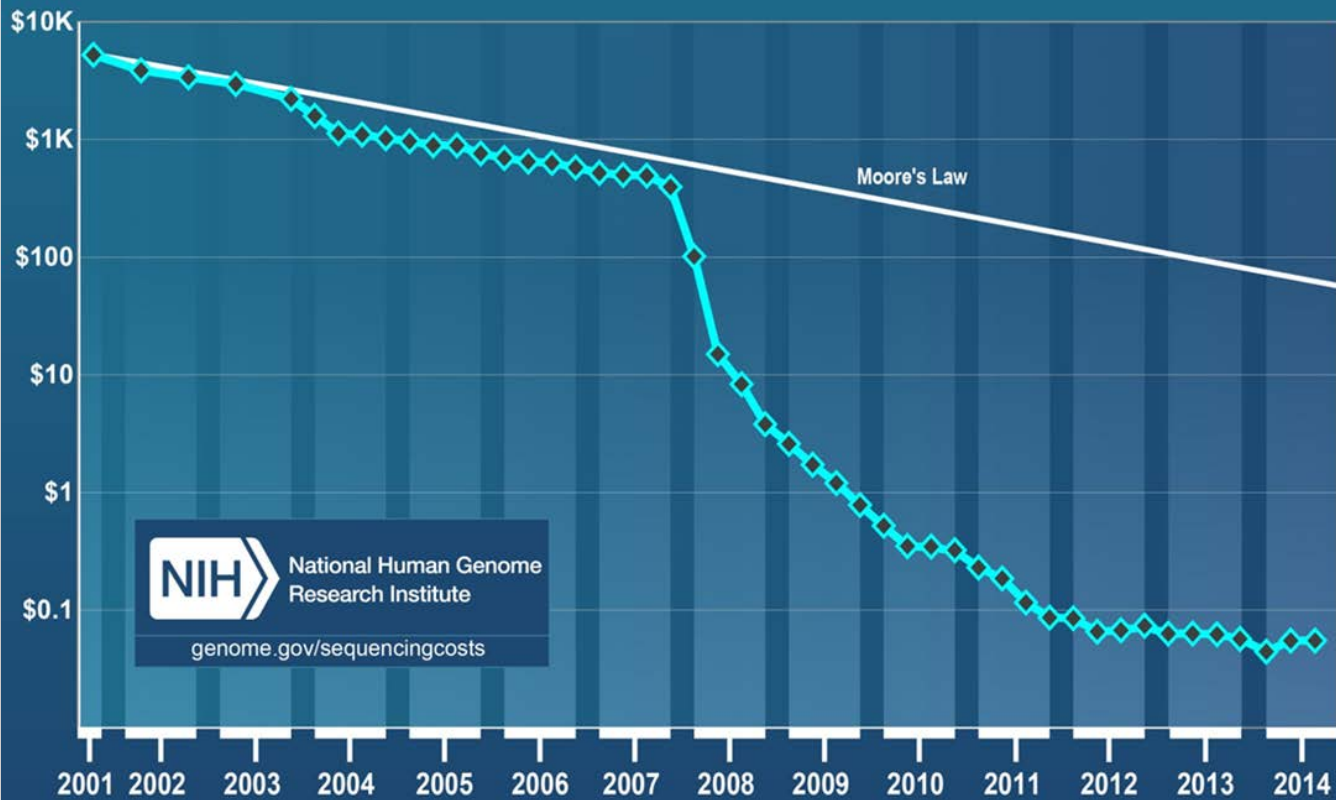


Today's Agenda

- ❑ AMD Overview at CDC – Greg Armstrong, CDC
- ❑ AMD Application in Three Domains
 - Enhancing Influenza Surveillance with AMD – John Barnes, CDC
 - GHOSTing Hepatitis C Outbreaks—Yury Khudyakov, CDC
 - Evaluation of whole genome sequencing for genotyping of *Mycobacterium tuberculosis* – CDC
- ❑ AMD technology in the public health laboratory:
Opportunities and challenges – Pete Shult, Wisconsin State
Laboratory of Hygiene
- ❑ Discussion



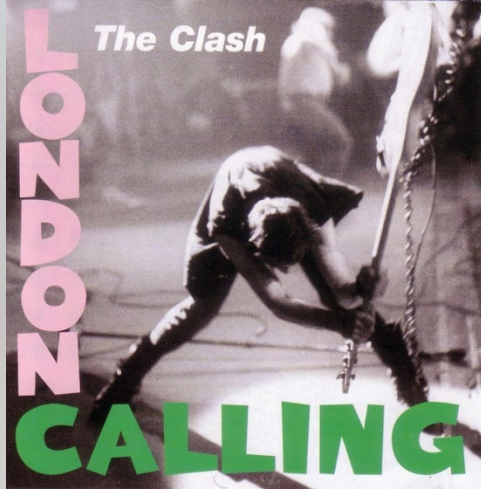
Cost per Raw Megabase of DNA Sequence



Source: NCBI (<https://www.genome.gov/sequencingcosts/>)



Future of Sequencing?



Evolution of AMD

2011: Bioinformatics Blue Ribbon Panel

In order to keep up with technologies that have revolutionized the science that is so critical to public health, CDC must develop a bioinformatics program, otherwise we will become obsolete, and then irrelevant.



The screenshot shows the Public Health Informatics Institute website. The header includes the logo and navigation links: About, What We Do (selected), How We Work, and Resources. The breadcrumb trail reads: Home » What We Do » Practice Support » Bioinformatics Blue Ribbon Panel. The main heading is "Projects". A yellow box highlights the "Bioinformatics Blue Ribbon Panel" project. The text below describes the project's goal: "The Institute worked with the CDC Office of Infectious Diseases Bioinformatics Steering Committee to convene a Bioinformatics Blue Ribbon Panel (BBRP) composed of ten recognized leaders and experts in the field of laboratory information technology, informatics and/or bioinformatics from federal entities, academia, and a non-profit organization. The goal of the project is to use recommendations from the panelists to assist CDC to begin crafting a bioinformatics vision and strategy for the next five years, and to help CDC understand how to develop and sustain the necessary bioinformatics infrastructure to support effective laboratory and epidemiologic science."

Evolution of AMD

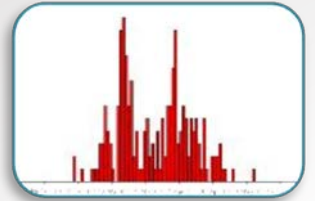
2014: Advanced Molecular Detection and Response to Infectious Disease Outbreaks (AMD) initiative approved by Congress

- 5-year, \$30m-per-year program to modernize genomics and bioinformatics
- Core goals:
 - Improve **pathogen detection and characterization**
 - Develop **new diagnostics** to meet public health needs
 - Support genomic and **bioinformatics** needs in state and local health departments
 - Implement enhanced, sustainable, **integrated information systems**
 - Develop tools for prediction, modeling and **early recognition of emerging infectious threats**



What is AMD?

- ❑ Next-generation sequencing (NGS)
- ❑ Bioinformatics and high performance computing
- ❑ Application to public health
 - Integration with epidemiologic data
 - Effective use of this data
 - Providing open access when possible



AMD Impact on Public Health

- ❑ Improved surveillance
- ❑ Improved outbreak detection and response
- ❑ Improved vaccines



AMD Impact: Surveillance

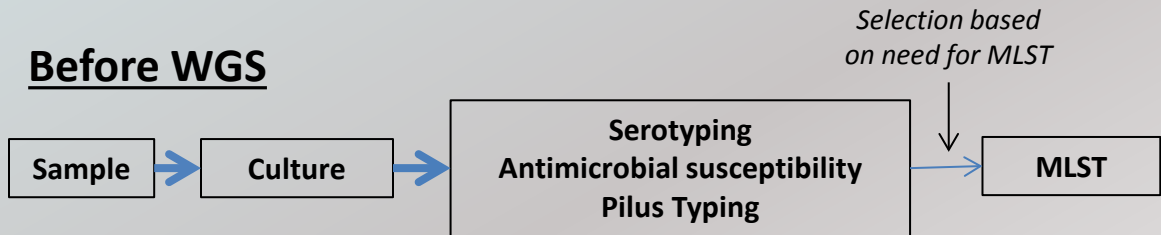
Model	Examples	Challenges
50 states+	PulseNet	<ul style="list-style-type: none">• 80+ different jurisdictions• CDC/FDA coordination• Information management
Reference Labs	Flu, TB, GC, Hepatitis, URDO	<ul style="list-style-type: none">• Defining model for each
Sequencing mostly at CDC (for now)	Malaria, Cyclospora, Meningococcus, Pneumococcus, Hib, Anthrax, Brucella, Burkholderia, Filoviruses, Arboviruses, Pertussis, Legionella, Respiratory Viruses, Coccidioides, Tick-Borne Pathogens, Dengue	<ul style="list-style-type: none">• Less direct impact on day-to-day operations at state and local level



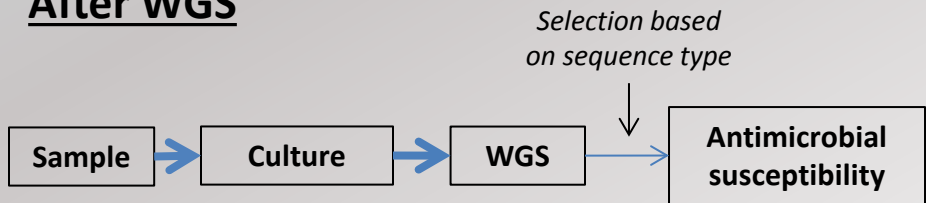
Impact on Efficiency

Pneumococcal Isolate Processing Pipeline

Before WGS



After WGS



Advantages

- *Faster*
- *Cheaper*
- *Less labor-intensive (i.e., less prone to human error)*
- *More data*
- *Better data*
- *More public data*
- *More easily exportable*





Impact of AMD: Vaccine Preventable Diseases

- ❑ Examples
 - Influenza
 - Invasive pneumococcal disease
 - Others: pertussis, measles, rubella, rotavirus, polio

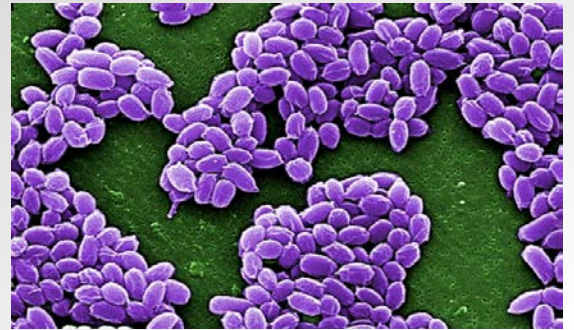
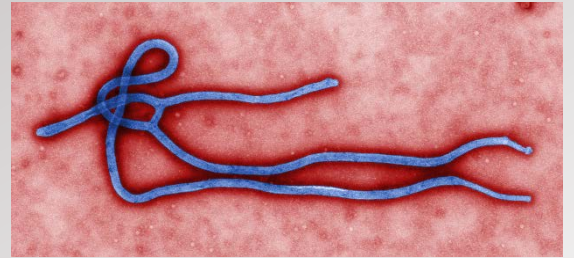


Impact of AMD: Outbreak Detection and Response

- ❑ Examples
 - PulseNet
 - TB
 - Hepatitis C
 - HIV
 - Unexplained respiratory diseases

Other Areas Supported by AMD

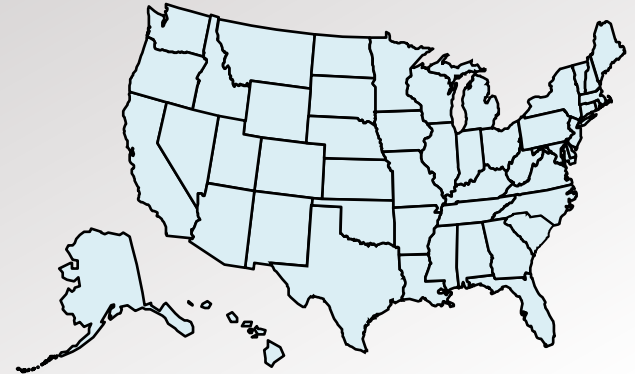
- ❑ MicrobeNet
- ❑ Reference services
 - Uncommon infections
 - Certain select agents
- ❑ Metagenomics
 - Microbiome
 - CIDT





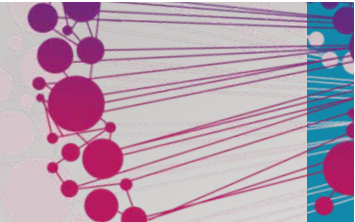
AMD: Next 3 Years

- CDC
 - Complete transition to NGS in high priority areas
 - Continue transition in medium priority areas
 - Further push data integration
- State and local health departments
 - PulseNet
 - NGS capacity in other areas
 - Standardization
 - Sample prep
 - Bioinformatics tools





www.cdc.gov/amd
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The findings and conclusions in this presentation are those of the author and do not necessarily represent the official position of the CDC