

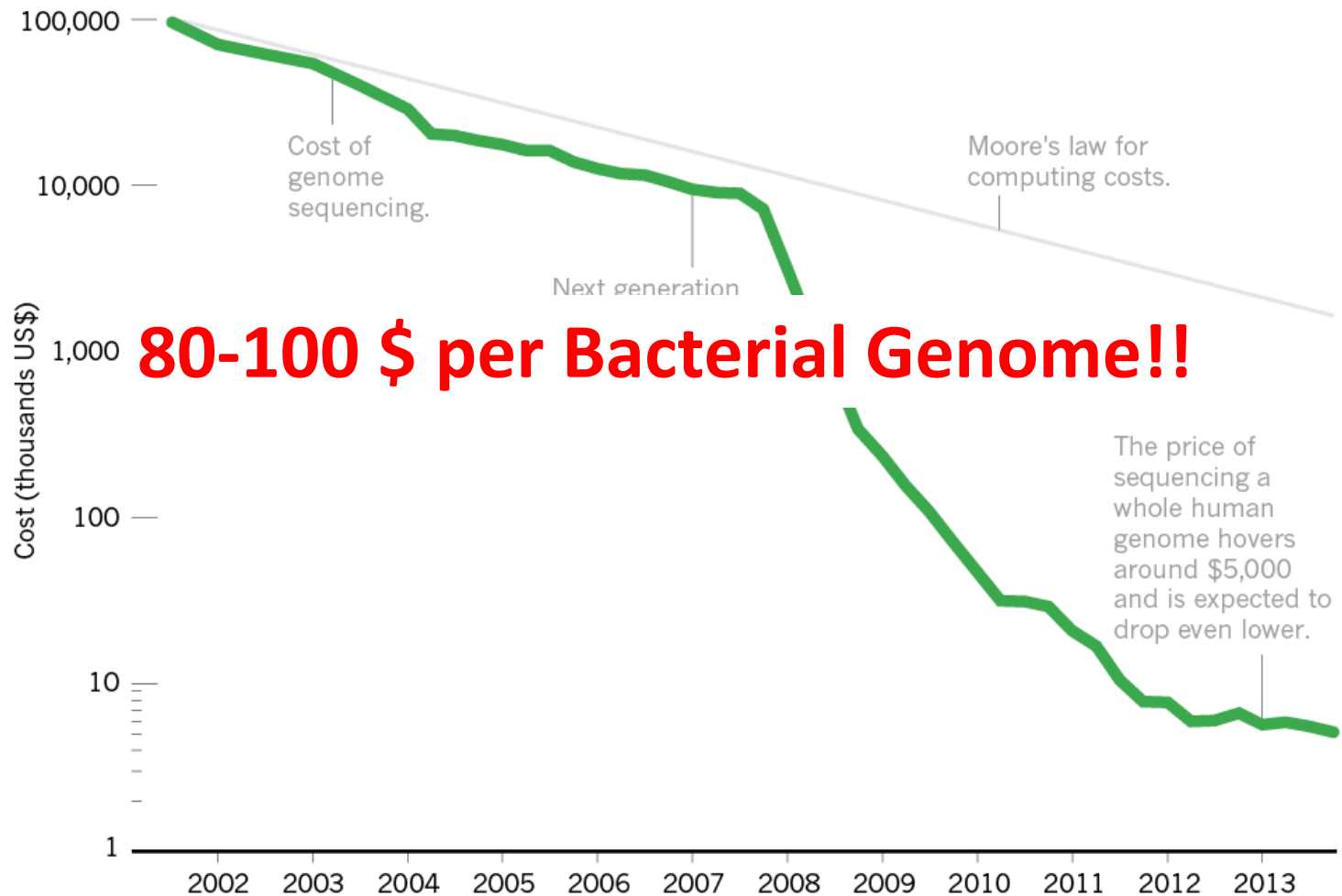
9th Annual Workshop of the  
National Reference Laboratories for  
*E. coli* in the EU  
20-21 October, 2014

**Session 2.**

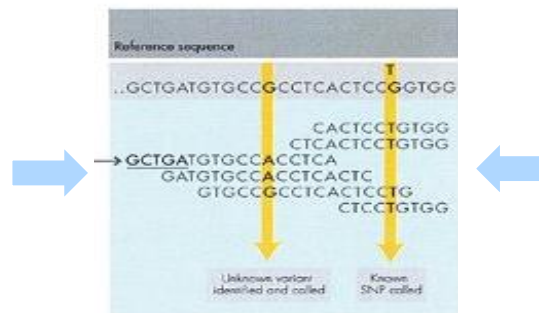
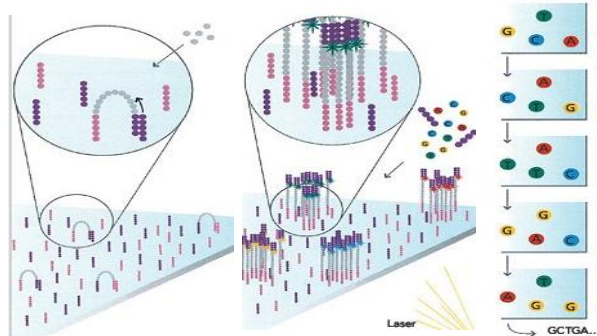
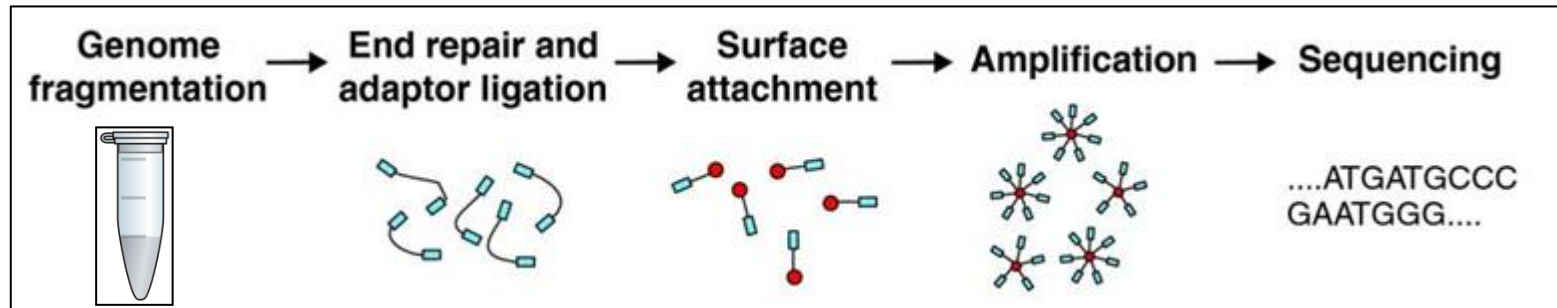
**Next Generation Sequencing (NGS):**  
International initiatives and  
application in surveillance and  
outbreak investigations

# Falling fast

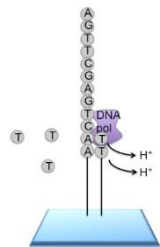
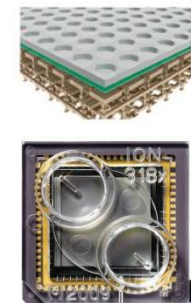
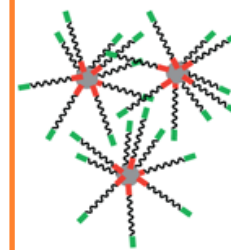
In the first few years after the end of the Human Genome Project, the cost of genome sequencing roughly followed Moore's law, which predicts exponential declines in computing costs. After 2007, sequencing costs dropped precipitously.



# Next generation sequencing



Short Reads  
200bp-400bp



pH variation once a new nucleotide is incorporated

# NGS: A growing interest



## Trends

Worldwide ▾ 2004 - present ▾ All categories ▾ Web Search ▾



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▸ Top Charts

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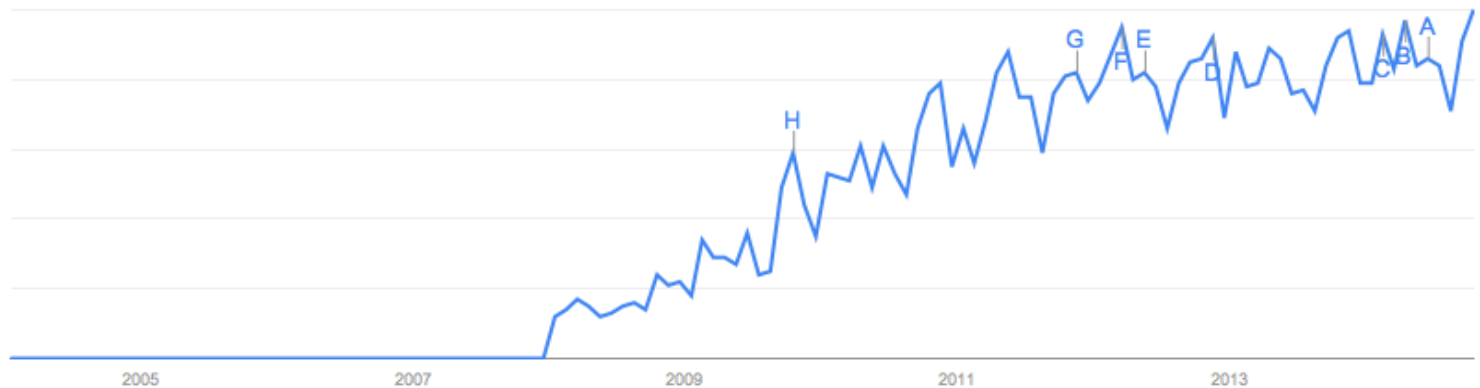
Next generation sequencing

Search term

+ Add term

## Interest over time ?

☒ News headlines ☐ forecast ?



# NGS: Regional interest



► View change over time ?

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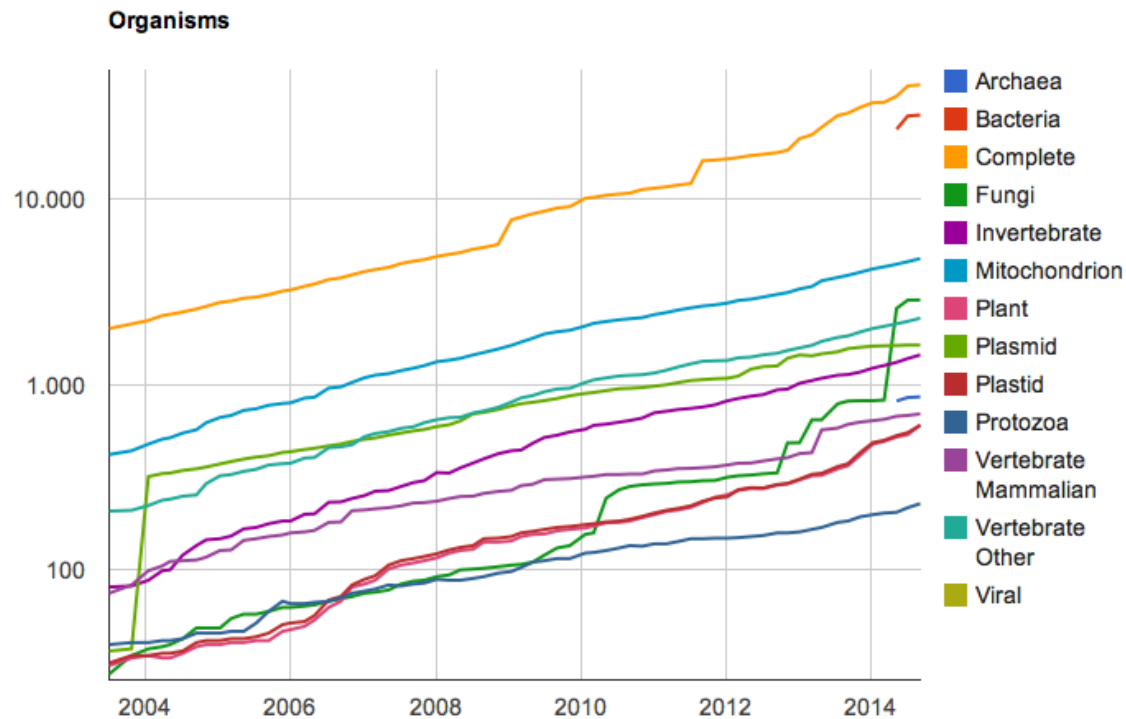
Region | Town/City

South Korea	100	<div><div></div></div>
India	49	<div><div></div></div>
United States	33	<div><div></div></div>
Germany	30	<div><div></div></div>
United Kingdom	27	<div><div></div></div>
Australia	26	<div><div></div></div>
Italy	23	<div><div></div></div>

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# Sequence data at NCBI

### Organism growth





# 100K Genome Project



## 100K Foodborne Pathogen Genome Project

Food safety, which is a very complex series of events, is the responsibility agriculture, public health, and medicine that requires bold and revolutionary efforts to ensure. The 100K Pathogen Genome Project is a landmark consortium that addresses the persistent food safety concerns by engaging world-wide partners to create a publicly available genetic database of the most common foodborne disease causing microbes. As our food supply becomes a global industry food safety becomes a worldwide mandate. This project will revolutionize the methods used in agriculture by bringing a new paradigm to public health to empower precise and robust molecular testing in the food chain – from the farm to the kitchen table.

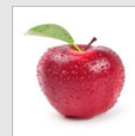
Despite efforts to reduce foodborne illness, outbreaks from Salmonella, Campylobacter, enteropathogenic E. coli, Listeria monocytogenes, Vibrio, and Shigella continue to occur worldwide. The recent E. coli O104:H4 outbreaks in Europe highlights the need for this approach as it was determined that genetic exchange led to a chimeric genome that was far more pathogenic than either of the other two organisms. In spite of extensive efforts to increase regulation and develop early warning diagnostics for improved public health monitoring definitive foodborne illness interventions remains elusive in large part due to the lack of sufficient information about microbial diversity. The 100K pathogen genome sequencing project will use next generation sequencing approaches to enable new diagnostic and public health approaches for use in novel solutions in the management of foodborne disease to facilitate improved public health.

Continual genetic evolution of pathogens is hindering our ability to consistently detect and mitigate these organisms in food, the environment, and livestock, which interfere with our preparedness to defend the food supply. This project will sequence 100,000 genomes of important pathogens to increase food security.

### QUICKLINKS

[Food Labs Conference Speaker](#)

Dr. Weimer will discuss the 100K Genome Project as part of the Food Labs Conference, taking place March 19-20, 2013. For information on the conference, please go [here](#).





# Global Microbial Identifier


ABOUT GMI

PEOPLE

WORKGROUPS

NEWS &amp; EVENTS

CONTACT

## Global Microbial Identifier

### What is to be gained

GMI envisions a global system of DNA genome databases for microbial and infectious disease identification and diagnostics. Such a system will benefit those tackling individual problems at the frontline, clinicians, veterinarian, etc., as well as policy-makers, regulators, and industry. By enabling access to this global resource, a professional response on health threats will be within reach of all countries with basic laboratory infrastructure.

#### Updated GMI7 programme

### Global Microbial Identifier

7th Meeting  
11 - 12 September 2014, York, UK

For full details of the event and the preliminary programme, please visit [www.fera.co.uk/events/GMI2014](http://www.fera.co.uk/events/GMI2014)



#### Watch video on GMI



Video on GMI by David J. Lipman, NCBI, presented at an information meeting at the European Parliament on January 23, 2013.



#### NEWSLETTERS FROM THE GMI STEERING COMMITTEE

All



02 September 2014  
198 people from 34 countries will be participating in the GMI7 Meeting at FERA in York, England 11-12...



02 September 2014  
GMI7 satellite meeting - applications for plant pathogens



02 September 2014  
Implementing Whole Genome Sequencing to support public health surveillance in Argentina

#### Become a member of GMI



To ensure involvement and progress

#### Major outputs



The GMI Working Group 4 has





## Projects and collaborations

PulseNet's evaluation of NGS as a potential tool for surveillance and outbreak investigations has many projects and collaborators, shown below.

Projects	Collaborations
Sequence strains from recent and historical outbreaks as well as strains not associated with outbreaks both in house and with collaborators	CDC internal partners, FDA, device manufacturers, academic institutions such as UC Davis in the <a href="#">100K Foodborne Pathogens Project</a>
Evaluate molecular subtyping schemes based on whole genome sequencing that provide the best clustering	Partners from universities, PulseNet participants in the states, PulseNet International and other public health laboratories abroad
Determine what genetic cues (sequences) from clinical samples such as stool can be used to identify and cluster bacteria causing foodborne illness	
Develop standardized laboratory and data analysis workflows	International partners for developing standards for whole genome sequencing and analysis, such as <a href="#">the Global Microbial Identifier initiative</a> and bioinformatics software manufacturing partners

Many groups are producing genome sequences, including CDC's [Enteric Diseases Laboratory Branch](#), the [CDC Biotechnology Core Facility](#), collaborative projects with device manufacturers, and collaborative projects with federal agencies and academic institutions.

# Standardization



« Food products – Microbiology »

ISO/TC 34/SC 9

Date:

**2014-08-27**

Doc. Number:

**N 1676**

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**US Proposal for Standardization of Whole-Genome Sequencing (WGS) for Food Microbial Typing and Genomic Characterizations of foodborne microorganisms**

EU financed a 20 M€ Project in the PHC7 call




Expert Group on

Introduction of next generation typing methods for Food- and Waterborne Diseases

Terms of Reference, version 1.0, 24 July 2014

MEETING REPORT

technical consultation on harnessing genomics for epidemiological surveillance

Paris, 1–2 October 2013

# Preparedness in the *E. coli* network

- The EU RL carries out research involving the use of NGS and is involved in the most of the mentioned initiatives
  - Quite a few NRL already have access to the technology
- 
- A training course on the use of open source Bioinformatics has been included in the 2015 Workprogram (planned next summer)
  - Standard modules will be deployed for the training program of the EU RL VTEC