



PulseNet is a national laboratory network that connects foodborne illness cases to detect outbreaks. PulseNet uses DNA fingerprinting, or patterns of bacteria making people sick, to detect thousands of local and multistate outbreaks. Since the network began in 1996, PulseNet has improved our food safety systems through identifying outbreaks early. This allows investigators to find the source, alert the public sooner, and identify gaps in our food safety systems that would not otherwise be recognized.

1982 *E. coli* O157:H7 is first recognized as a significant human pathogen.



1984 Pulsed-field gel electrophoresis (PFGE), the current gold standard for DNA fingerprinting, is developed by Schwartz and Cantor.



1993 *E. coli* O157:H7 causes a major outbreak in the Western US states.

1994 CDC and several state health laboratories demonstrate the utility of PFGE for detecting and investigating outbreaks of foodborne disease.

1996

- » CDC launches PulseNet with the APHL, federal partners, and the original area public health laboratories in Massachusetts, Minnesota, Texas, and Washington.
- » The first PulseNet training for standardized PFGE and analysis of patterns is organized at CDC. The area laboratories and the U.S. Department of Agriculture Food Safety and Inspection Service (USDA) laboratories attend.



1997

- » The concept of PulseNet takes shape in discussions between CDC, the Association of Public Health Laboratories (APHL), state public health laboratories and federal partners.
- » CDC provides \$150,000 to PulseNet to conduct an initial project demonstrating its effectiveness.

1998 PulseNet is honored by the Vice President of the United States at a White House ceremony.

1999 PulseNet wins the Innovations in American Government Award, recognizing excellence and creativity in the public sector.



2000 PFGE analysis software is provided by APHL to all existing PulseNet laboratories allowing the creation of organized databases.

2001 PulseNet becomes a nationwide system: all 50 state public health laboratories are trained and certified in PFGE.



2002 PulseNet wins the prestigious Innovations in American Government Award for the second time.

2004 CDC pilots the *Listeria* Initiative in 10 states to aid in the investigation of listeriosis clusters detected by PulseNet, decreasing the time from detection to stopping the outbreak.

2005

- » Manufacturers introduce the first commercially available next-generation DNA sequencing system. Next-generation sequencing technologies will shape the future of PulseNet and accelerate outbreak detection.
- » PulseNet integrates multiple locus variable number tandem repeat analysis (MLVA) as a genotyping tool for *E. coli* O157:H7 and *Salmonella enterica* serotype Typhimurium.

2006 PulseNet links contaminated bagged spinach to a large multistate outbreak of *E. coli* O157:H7, prompting a nationwide recall. The outbreak sickens 225 people in 27 states and causes 39 cases of kidney failure and 5 deaths.



2009 PulseNet links peanut butter and peanut products to a multistate outbreak of *Salmonella* Typhimurium. The infection sickens over 700 people in 46 states and causes 9 deaths. More than 3,000 types of peanut-containing products are recalled.



2010 Whole genome sequencing is used for the first time in an ongoing outbreak investigation. PulseNet performs real-time sequencing on three samples from a *Vibrio cholerae* outbreak that killed thousands in Haiti.

2011

- » PulseNet begins analyzing data using bioinformatics, which combines biology, computers, and information technology in a single discipline to answer pressing public health questions.
- » 250 historic isolates of Shiga-toxin producing *E. coli* (STEC) are sequenced to prove the utility of whole genome sequencing for surveillance of foodborne pathogens.
- » Congress passes the FDA Food Safety Modernization Act (FSMA) and directs CDC to expand national foodborne disease surveillance systems.

2013 PulseNet scientists begin using whole genome sequencing methods, along with enhanced disease investigation, to study foodborne illnesses caused by *Listeria*.



2014

- » CDC launches the "Transforming Public Health Microbiology - PulseNet and Beyond" project under the Advanced Molecular Detection (AMD) initiative, which aims to consolidate most foodborne pathogen identification and characterization activities into a single, fast, and efficient whole genome sequencing process.
- » The *Listeria* whole genome sequencing study, that began in 2013, receives the Department of Health and Human Services (HHS) Innovates Secretary's Pinnacle award for implementing an innovative strategy to address an emerging public health challenge.

2015

- » The *Listeria* study receives the CDC Director's Award for Innovation
- » CDC routinely uses whole genome sequencing for investigating foodborne illnesses caused by *Listeria*, *Campylobacter*, Shiga toxin-producing *E. coli*, and *Salmonella*.

2016

- » Whole genome sequencing is used for routine surveillance of *Listeria*, *Campylobacter*, and Shiga toxin-producing *E. coli* (STEC).
- » PulseNet can analyze *Salmonella* whole genome sequencing data to investigate outbreaks.
- » The American Journal of Preventive Medicine publishes an economic evaluation that suggest that PulseNet prevents at least 270,000 illnesses from *Salmonella*, *E. coli*, and *Listeria* and saves \$500,000 US dollars every year.



2017

- » Whole genome sequencing will be used for routine surveillance of *Salmonella* in states that have the capacity to conduct sequencing.
- » PulseNet will be able to analyze *Vibrio* and *Shigella* whole genome sequencing data.

2018

- » PulseNet will be able to analyze *Yersinia* and *Cronobacter* whole genome sequencing data.
- » All 50 state public health laboratories will be using whole genome sequencing for routine surveillance.
- » Whole genome sequencing will become the new PulseNet gold standard for subtyping pathogens that cause foodborne illness.

2020 and Beyond

PulseNet will use highly sophisticated approaches designed to identify and subtype foodborne pathogens directly from complex clinical samples, without bacterial cultures. The favored approach, known as metagenomics, has the potential to allow extraction of pathogen-specific DNA sequence information directly from complex samples such as stool.

Before PulseNet

5 years

10 years

20 years

The Future of PulseNet



U.S. Department of Health and Human Services
Centers for Disease Control and Prevention