



Canadian Food
Inspection Agency

Agence canadienne
d'inspection des aliments

Canadian Food Inspection Agency



Our vision:

To excel as a science-based regulator, trusted and respected by Canadians and the international community.

Our mission:

Dedicated to safeguarding food, animals and plants, which enhances the health and well-being of Canada's people, environment and economy.

Genomics in the service of regulatory food inspection

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Canada

CFIA Food Microbiology Sampling plans

Approximately 12,500 samples analyzed in CFIA Food Microbiology testing laboratories (2013-14)

Meat – 5100 samples

Fish – 2200 samples

Dairy – 1150 samples

Processed Fruit and Veg – 200 samples

Fresh Fruit and Veg – 1200 samples

Egg – 1600 samples

Imported and Manufactured Foods – 460 samples



Reasons for testing

Compliance

- Detection
 - Identification
- Typing
 - Public health databases
 - Nature of contamination (persistent vs. sporadic)

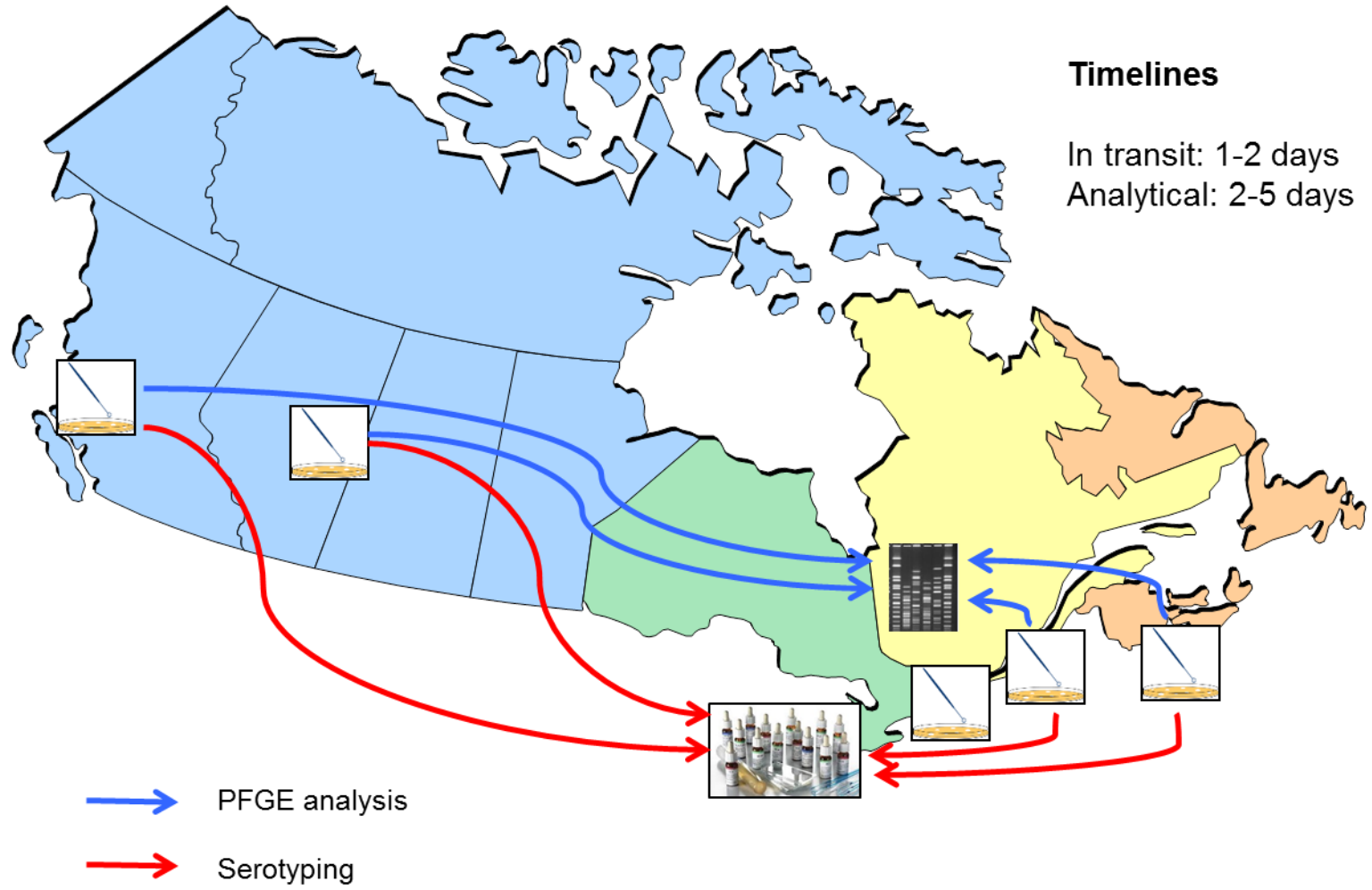


Outbreak investigation

- Source attribution
- Scope of contamination
- Hazard mitigation

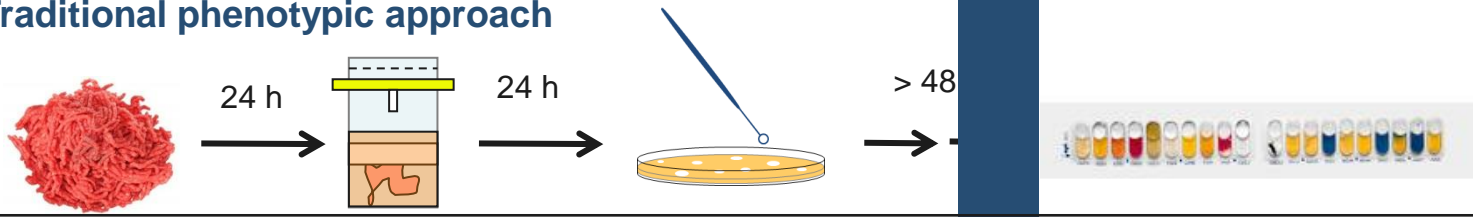


Current food microbiology testing paradigm: dependence on reference centers

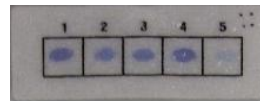


Case study: *E. coli* O157:H7 outbreak investigation

Traditional phenotypic approach



First generation genomics



MFLP-22

< 6 h



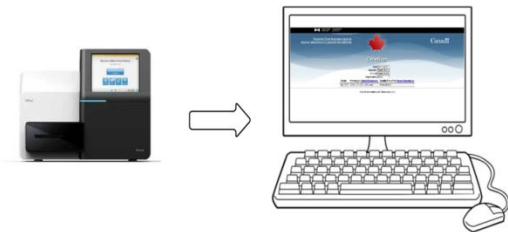
Next generation genomics

Now!

< 9 h

ATCCGTACGTA
AAGGGCCTAG
CTTGGACTTTG
GGGATCGCTA

GeneSippr



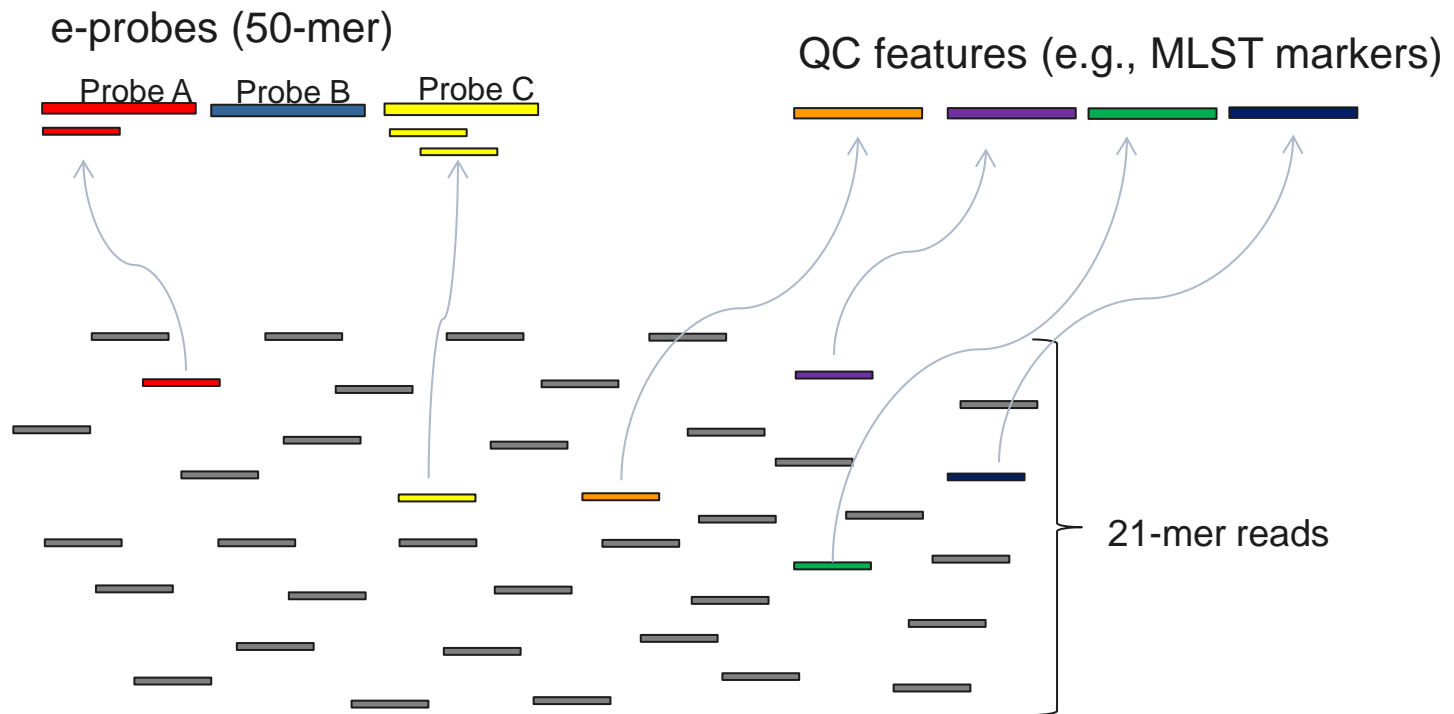
2013

- 11 confirmed illnesses (cluster)
 - Common food identified (frozen burgers)
- Early assessment of product contamination
 - >700 boxes of burgers collected for analysis
 - Frozen burgers (national retail chain)

Health risk assessment

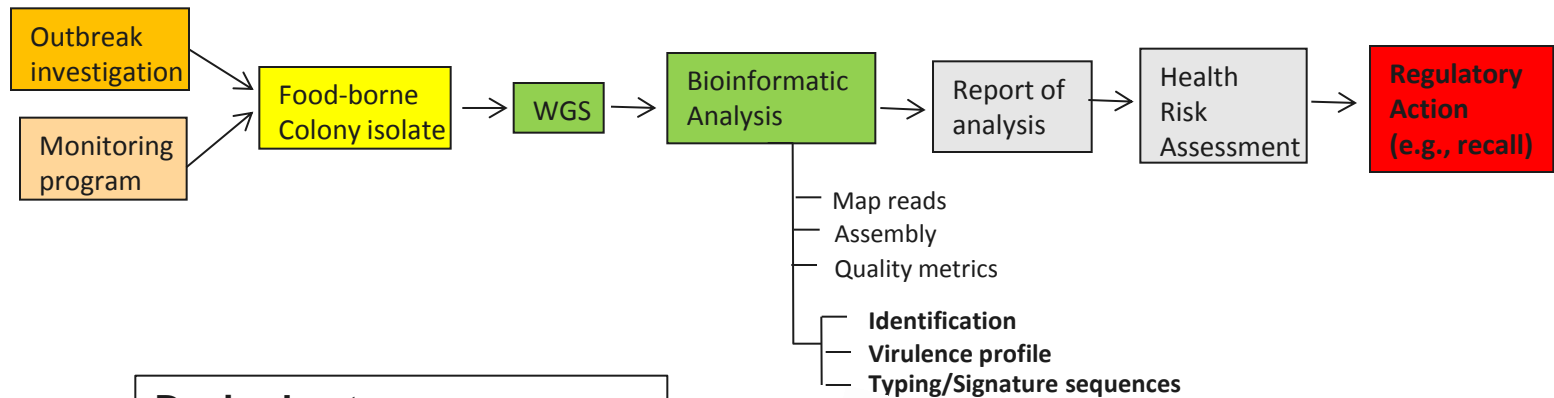
Product recall

GeneSippr – mapping reads to e-probes



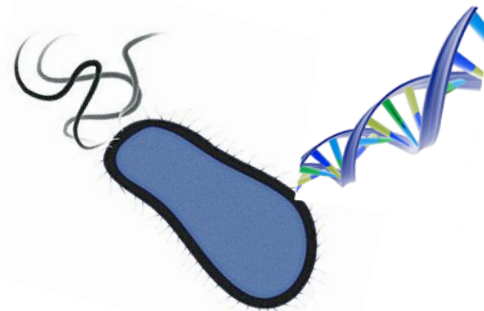
- Identification
- Virulence profiling
- Ad hoc queries
- Ultimate “multiplexation”
- Typing
- Databasing

Integration of WGS in regulatory food microbiology



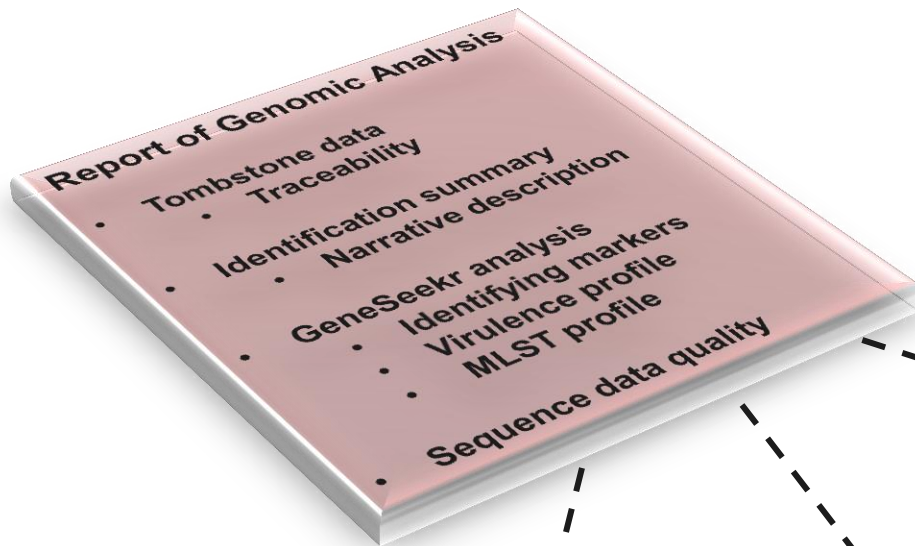
Desired outcomes

- Comprehensive analysis
- Definitive identification
- Risk profiling
- **Timely interventions**



e.g., Enterohemorrhagic *E. coli* O26:H11, stx2a, ST7

Genomic analysis of food isolates



Ex. 1: *Salmonella*

- Marker identification
 - *stn*, *invA*
- MLST/SNP analysis
- Serotyping
 - MLST (Achtman scheme)
 - SISTR
- AMR marker analysis
 - e.g., DT104 ACSSuT

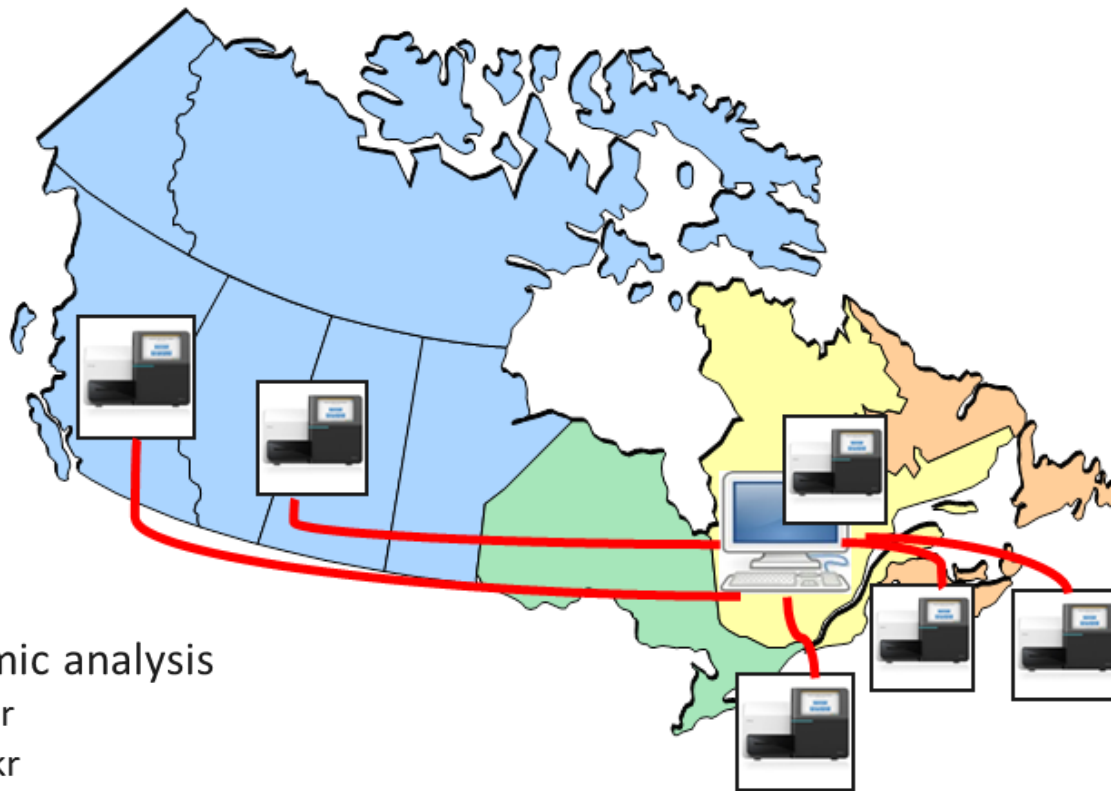
Ex. 2: Shiga-toxigenic *E. coli*

- Marker identification
 - *eae*, *stx1*, *stx2*, *wzx*, *uidA*
- Shigatoxin subtyping
 - e.g., *E. coli* O26:H11 ***stx2_c***
- MLST/SNP analysis

Ex. 3: *Listeria monocytogenes*

- Marker identification
 - *hlyA*, *inlJ*, *IGS*
- MLST/SNP analysis
 - Historical isolate matching
 - Chicken and egg isolates (same PFGE and MLST)
 - >275 SNP difference

Proposed Integrated CFIA Genomics Food Lab Network



- On-site genomic analysis
 - GeneSippr
 - GeneSeekr
 - Typing
- Instantaneous communication
 - Reporting
 - Data transfer and uploading to centralized databases



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Bioinformatician:

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