

ONE HEALTH WGS

For food borne outbreak investigation



CONTENT

- Surveillance and outbreak investigation of food borne diseases - responsibilities
- INNUENDO platform as tool for One Health WGS
- Examples

RESPONSIBILITIES IN OUTBREAK INVESTIGATION, FINLAND

Municipality:

- Main responsibility, local outbreak Investigations
- Outbreak investigation group
- Laboratory investigations from cases and suspected food

Public Health, THL:

- Responsible for nationwide or large outbreak investigations
- **Laboratory based surveillance and typing** of isolates from humans

Finnish Food Authority:

- Responsible for trace-back, food safety control
- **Laboratory investigations**, food & environmental samples, **typing** of isolates

Regional state administrative agency:

- Consulting and supervision role

WGS BASED SURVEILLANCE, ONE HEALTH, FINLAND, 2019

Pathogen	WGS, human isolates, THL	Other methods, THL	WGS, food, feed, environmental isolates, Food Authority	Other methods, Food Authority
Listeria	All isolates	None	Outbreaks only	PFGE
STEC	All domestic isolates	PCR-confirmation, O157 and "big six" latex agglutination	All food isolates, animal isolates if human case detected in the same farm	PCR-confirmation: stx1/2, eae, serotypes O26, O103, O104, O111, O145, O157
Salmonella	Domestic Typhimurium & Enteritidis, Outbreaks	Serotyping, MLVA, phage typing, AST	Outbreaks only	Serotyping, MLVA, phage typing, AST
Campylo	Outbreaks only	None	Outbreaks only	PFGE
Yersinia	Outbreaks only	Biochemical tests, microscopy, CR-MOX	Outbreaks only	Biochemical tests, PFGE

AIM: SHARED WGS ANALYSIS

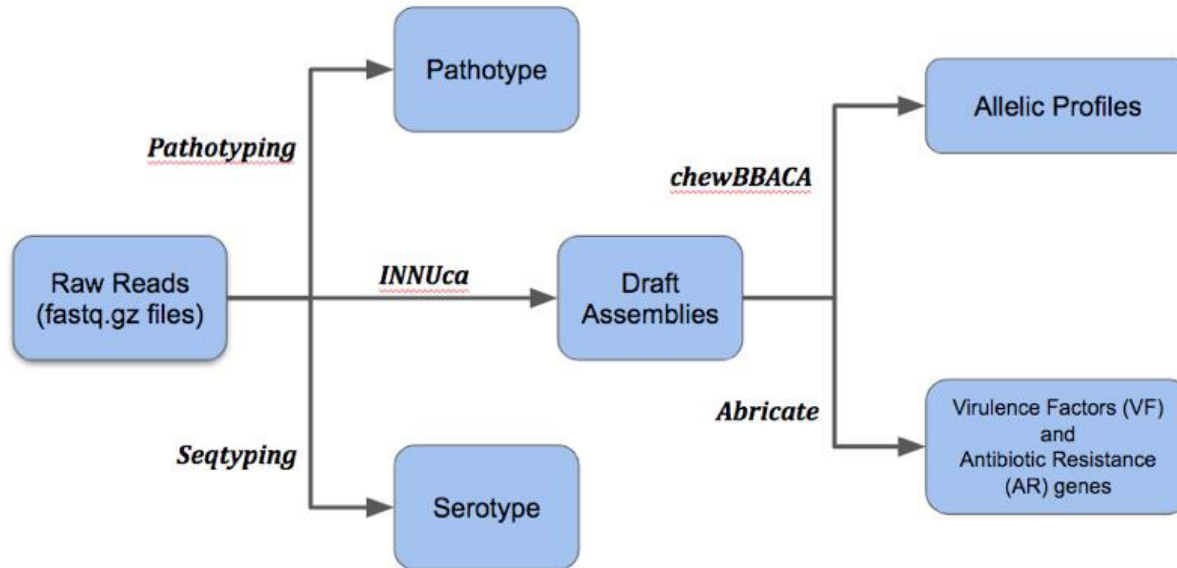
- Between THL and Finnish Food Authority
- To enhance surveillance and outbreak investigation

→ INNUENDO project 2016-2018

WHAT IS INNUENDO?

- Comprehensive platform to share sequence and defined/agreed epi data from different institutes
- Open source software
- Web-based, species specific analytical pipelines
 - E. coli, Salmonella, Campylobacter, Y. enterocolitica (in use in THL/Food Authority)
 - Also needed: Listeria, S. aureus etc.
- Species specific genomic nomenclature
 - Level 1 (outbreak), level 2 (long term surveillance), level 3 (~MLST)
- Visualization of clusters

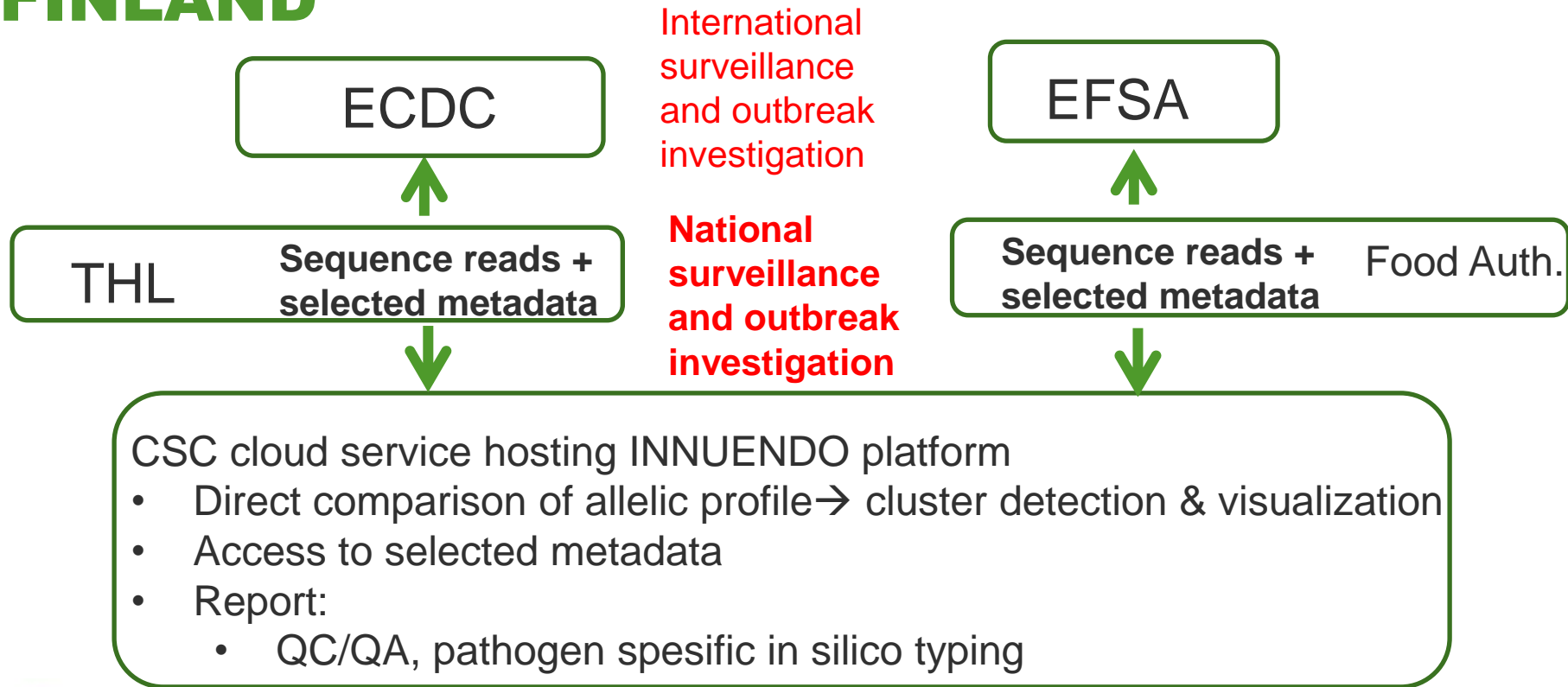
INNUENDO V1.0 FOR E. COLI



WHAT IS INNUENDO?

- QA/QC and de novo assembly, INNUca <https://github.com/B-UMMI/INNUca>
- Allelic profile assignment, ChewBBACA, <https://github.com/B-UMMI/chewBBACA>
- AMR and virulence factor detection, ABRicate, <https://github.com/tseemann/abricate>
 - VirulenceFinder, ResFinder, Card, VfDB, PlasmidFinder
- Serotyping (from reads), ReMatch, <https://github.com/B-UMMI/ReMatCh>
 - E.coli serotyping by Seq_typing, https://github.com/B-UMMI/seq_typing
- Salmonella serotyping by SISTR, https://github.com/peterk87/sistr_cmd)
- Pathotyping, E. coli and Y. enterocolitica, https://github.com/B-UMMI/patho_typing
- Visualization, PHYLOViZ online, <http://online2.phyloviz.net/>

ANALYSIS INFRASTRUCTURE, ONE HEALTH, FINLAND



Sequencing data flow

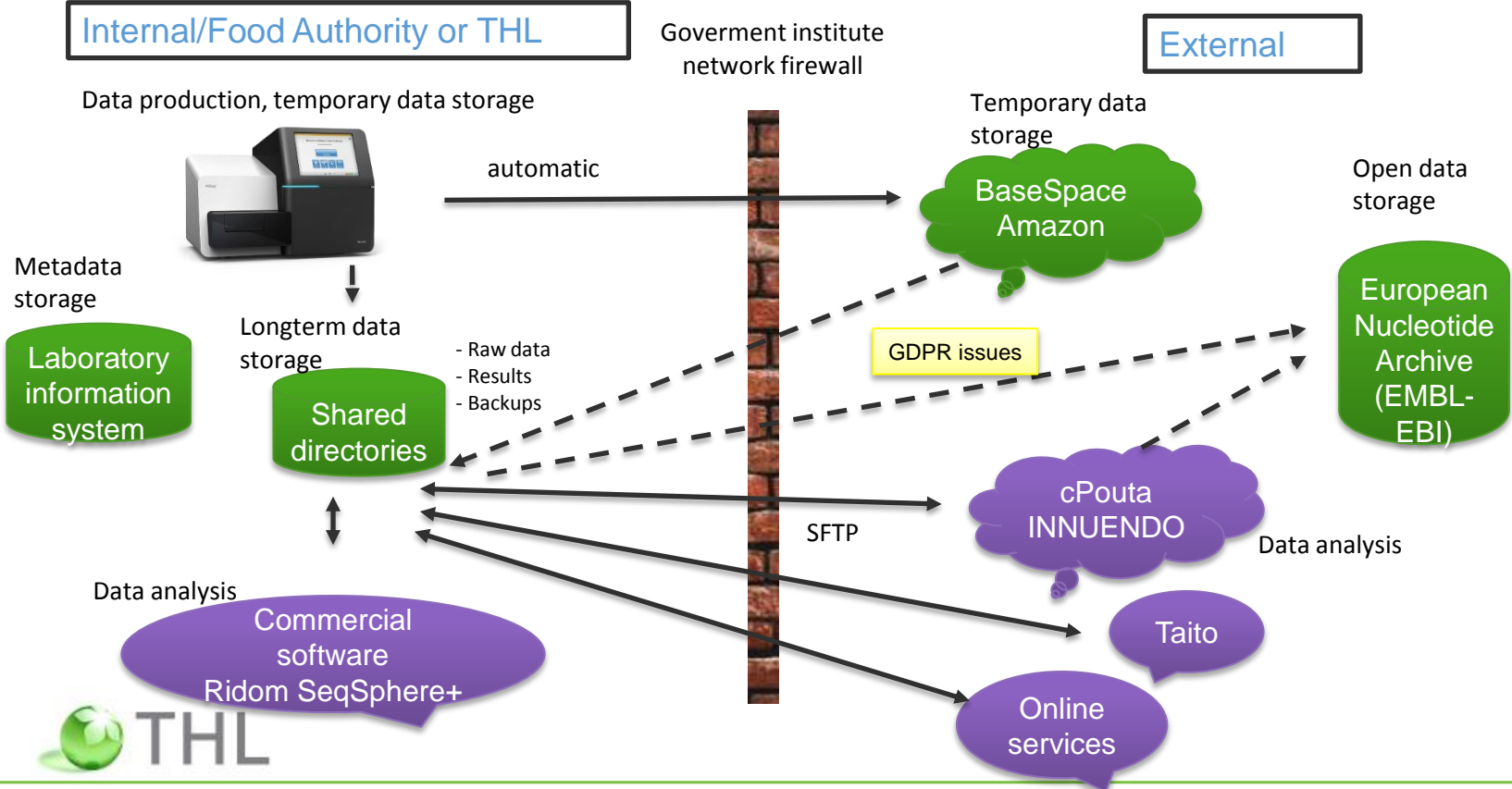


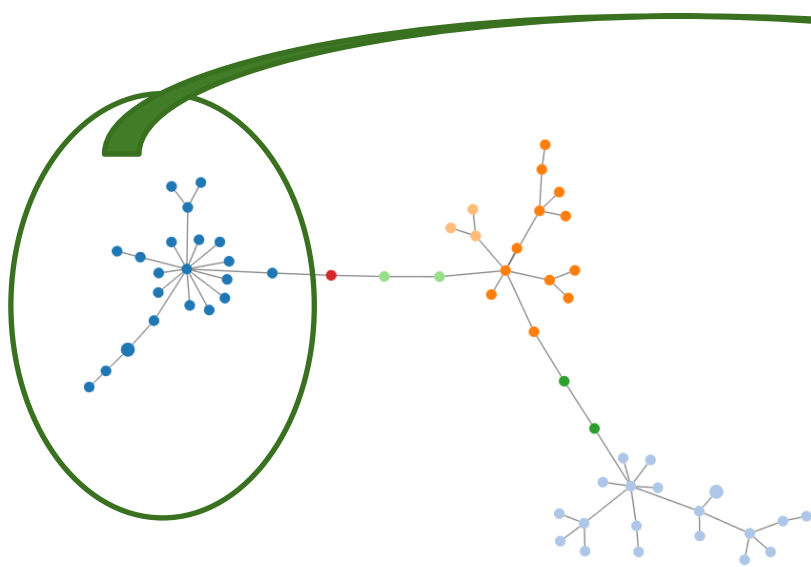
Figure: Anniina Jaakkonen, Finnish Food Authority

CSC PROVIDES CLOUD SERVICES

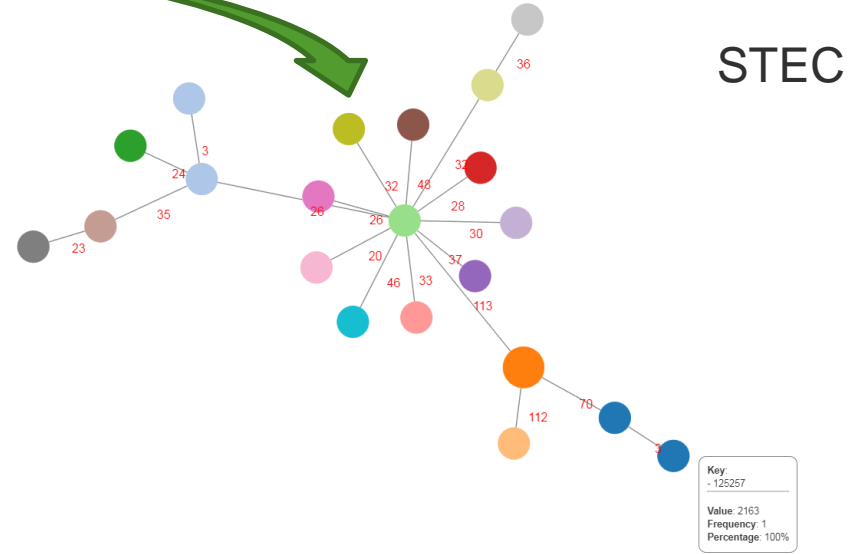
- CSC is a Finnish center of expertise in ICT that provides ICT expert services
 - Maintains and develops a top-notch computing environment and modeling, computing, and information services for higher education institutions, research institutions and industrial companies.
 - Researchers can use the largest collection of scientific software and databases in Finland.
- **cPouta** is the main production “Infrastructure as a Service” cloud at CSC.
 - Allows CSC customers to run virtual machines connected to the Internet
 - Application data and software must be uploaded either via the Internet or copied from CSC's existing shared storage or applications.
- **ePouta** cloud service is a secured certified environment for handling sensitive data

<https://www.csc.fi/>





Coloured by level 3 nomenclature (~MLST)
 7 categories
 Profile size: 2818
 Cluster cut-off: 14 allele differences
 (0,5 %)



STEC

Coloured by level 1 nomenclature
 19 categories
 Profile size: 3255
 Cluster cut-off: 16 allele differences
 (0,5 %)

CHALLENGES & ACHIEVEMENTS

- Sustainability in IT-infrastructure, bioinformatics support, and further development of INNUENDO???
- SOPs between 2 institutes
- Practical and fast in routine surveillance and outbreak investigation
- Enhanced One Health collaboration
- Portability to other laboratories
- Publicly available, free of charge

MORE INFORMATION

- Final report in EFSA web pages
 - doi:10.2903/sp.efsa.2018.EN-1498
- Project Website: <http://www.innuendoweb.org/>
- Technical description: <https://innuendo.readthedocs.io/>
- Publications:
 - chewBBACA :Microb Genom. 2018 Mar 15. doi: 10.1099/mgen.0.000166.
 - PHYLOViZ Online: Nucleic Acids Res. 2016 Jul 8;44(W1):W246-51. doi: 10.1093/nar/gkw359
- Contact persons
 - [Jani Halkilahti](#) (THL), [Anniina Jaakkonen](#) (Finnish Food Authority)



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