EFSA's Scientific Colloquium on the Use of Whole Genome Sequencing (WGS) of food-borne pathogens for public health protection

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OUTLINE

- Background
- Aims and objectives
- Questions for discussion
- Ongoing work
- Preliminary conclusions

BACKGROUND

- EFSA 10th Anniversary Conference: **The creation of a centralised microbial WGS database is needed** to predict the outcome of pathogen-host interactions.

- SCoFCAH 2012 V**ision paper on the development of databases for molecular testing of foodborne pathogens**: EFSA to establish database for data from isolates in food, feed and animals. Start with PFGE and MLVA data and then gradually include other methods, such as WGS.

- EFSA has **formally agreed to collaborate closely** with **ECDC** and **EURLs** on providing scientific analyses of molecular typing of FB pathogens.

BACKGROUND

- EFSA **mandate from DG SANCO to provide technical support** on building a molecular typing database for FB pathogens (food and animal data), to be operational in pilot phase as from **01/2015** .
  - database, data dictionary, operational tools and periodic analysis (joint) of data.

- The **BIOHAZ** Panel opinions on **"**Evaluation of **molecular typing methods** for major food-borne microbiological hazards and their use for **attribution modelling**, **outbreak investigation** and **scanning surveillance".**
  - Focus on food and feed-borne zoonotic bacteria.

BACKGROUND

- Open Call for tenders on '*Closing data gaps for performing RA on L. monocytogenes in RTE foods*' molecular characterisation employing WGS of strains from different compartments along the food chain, inc. humans (**evaluation of offers currently ongoing**).

- **June 2014:** EFSA organised the **Scientific Colloquium on the use of WGS of foodborne pathogens for public health protection. Overall objective:**

Support and drive EFSA's efforts in the collection of molecular typing data by proactively anticipating the specific requirements and challenges of WGS data.

AIMS AND OBJECTIVES

DG 1: WGS of foodborne pathogens in action

- **Q1. M**ethods available: cost, speed, accuracy, convenience, practicality and feasibility.
- **Q2. M**eans available for data interpretation: accuracy of different approaches, and the ways in which plain language reports can be generated for public health action.
- **Q3. D**ata curation and storage to ensure continuity of existing datasets. How to derive information from WGS data to predict e.g. serotype, phagetype, PFGE type, MLST, resistome, virulome ?

AIMS AND OBJECTIVES

DG2: Curation and analysis of WGS data: bioinformatics solutions

- **Q1. C**hallenges linked to quality evaluation, annotation, interpretation and storage of data, from raw data to genome assembly and analysis results.
- **Q2. H**armonisation of approaches used for data analysis, including development of analysis pipelines and software (e.g. open source *vs.* commercial) and the feasibility of international standards for data analysis.
- **Q3. B**enefits of specialised online databases for sharing WGS data and associated metadata, and algorithms for real-time data analysis and visualisation.

AIMS AND OBJECTIVES

DG3: Cross-sectorial coordination and international cooperation

- **Q1. C**hallenges to integrate WGS into routine monitoring & surveillance, and outbreak preparedness within and across sectors ?
- **Q2. C**oordination of efforts between the food, veterinary and human health sectors.
- **Q3. S**peed and opportunities for collaboration to develop and validate cross-sectorial WGS applications (i.e. human, animal and food). Challenges with capacity building and transition management in introducing new technologies *vs.* traditional typing methods.

WHAT NEXT ?

Ongoing work

- Drafting summary report to be published in the EFSA Colloquium series by the end of 2014:
  - Consultation to all participants (ca. 90): will be given opportunity to comment on complete merged draft.

PRELIMINARY CONCLUSIONS DG 1

Q1. Methods available

- WGS techniques are continuously evolving (Life technologies PGM Ion torrent, Illumina MiSeq, 3rd generation sequencing techniques)
- Setting up sequencing pipeline *vs.* outsourcing sequencing and data analysis to commercial/PH laboratories
- Need to define appropriate quality metrics (including data analysis): EQA programs, role of EURLs
- Need to establish guidelines for use of WGS in detection of FB pathogens (rules on the minimal coverage of genomic data, reproducibility, accuracy)
- Costs: for WGS, for data analysis, suggestions for decreasing costs.

PRELIMINARY CONCLUSIONS DG 1

Q2. Interpretation of data for different applications

- SNP calling *vs.* comparisons of allelic variants (gene-by-gene comparison). Plurality of approaches; depends on precise question
- Not clear yet which method most suitable in food safety
- Need for outcome reported in plain language widely understandable and interpretable
- Need for communication with policy makers
- Harmonisation across sectors

PRELIMINARY CONCLUSIONS DG 1

Q3. Curation and storage of data

- Uncurated approach (e.g. GenBank) not suitable for food safety and public health purposes
- WGS data should be publically available in real-time together with some metadata
- Interoperability of databases and backward and forward compatibility to other sequence based datasets
- Ensure continuity of existing and future databases

PRELIMINARY CONCLUSIONS DG 2

Q1. Quality evaluation, annotation, interpretation and storage of data

- Need for standard protocols and quality metrics (sample preparation, DNA concentration/quality, library preparation, data processing, analysis and storage)
- Quality assessment metrics may depend on technology
- Currently no gold standard for analysis
- Storage and management of large FASTQ files
- Multi-disciplinary forums, case studies, ring trials
- For PH purposes: SOPs for accreditation purposes

PRELIMINARY CONCLUSIONS DG 2

Q2. Harmonisation of approaches for data analysis

- Effective international surveillance depends on common nomenclature
- Harder to define nomenclature based on K-mer/SNP approaches
- Different groups hosting identical pipelines locally *vs.* single location for analysis
- Open source freely available *vs.* closed source commercial software
- Commercial software should not be "black boxes"
- Workflow managers/schedulers, e.g. Galaxy: web-based access to individual tools
- Ever-growing need for computing power

PRELIMINARY CONCLUSIONS DG 2

Q3. Online genomic databases, data sharing and real-time data analysis and visualisation

- Database interoperability to facilitate analysis algorithm development
- Single global database *vs.* federated distributed multi-level databases
- Encryption is needed for secure data transfer of data and metadata
- Sharing of microbial data and analysis driven by One Health perspective *vs.* differing rules for data ownership and release within different sectors
- National differences in data release *vs.* need for agreement and harmonisation of policies
- Any database or resource is only as good as the data that it contains, and how easy it is to access that data

PRELIMINARY CONCLUSIONS DG 3

- **Q1. Integrate WGS into routine monitoring & surveillance, and outbreak preparedness**
  - Concerns related to sharing related epidemiological data
  - Food and veterinary sector handle sensitive data (misuse can have adverse economic impact)
  - First attempt: new molecular typing database of foodborne pathogens (enhance outbreak preparedness at EU level)
  - Many international and national initiatives: difficult to have overview of applicability to routine monitoring and surveillance

PRELIMINARY CONCLUSIONS DG 3

Q2. Coordination of efforts between the food, veterinary and human health sectors

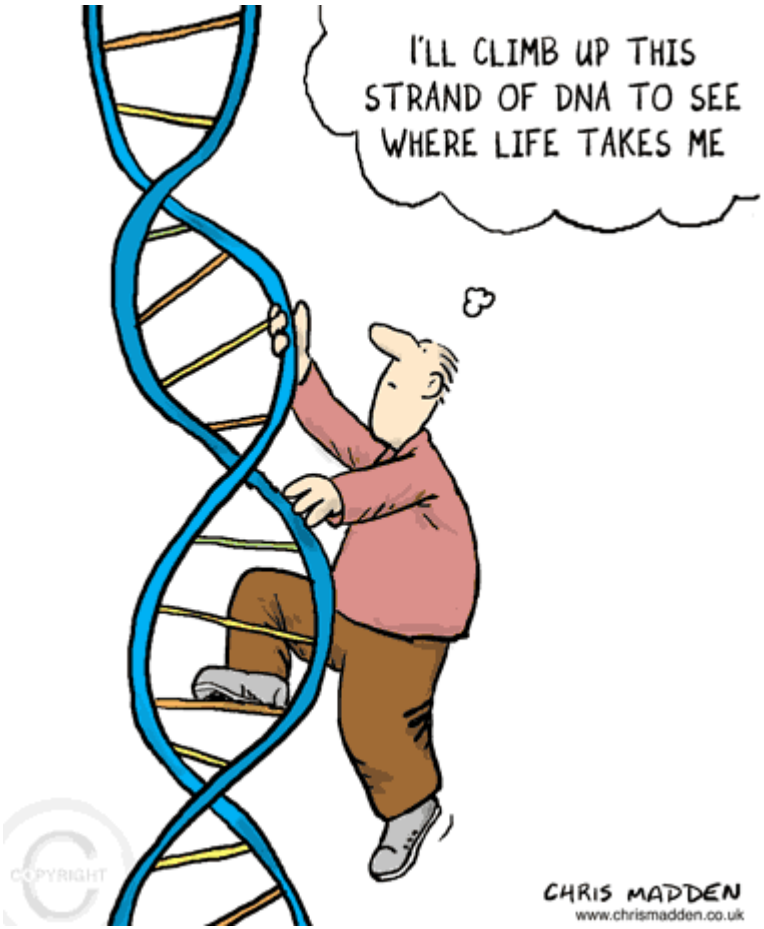
- EC's Vision paper: starting point to develop vision on data sharing across sectors, communities and professional disciplines
- Reporting sequence data alone useless for surveillance and scientific purposes
- Ongoing discussions at ECDC/EFSA level in the context of common joint molecular typing database for PFGE/MLVA
- Minimum dataset to be shared

PRELIMINARY CONCLUSIONS DG 3

Q3. Development and validation of applications across sectors; transition management challenges

- Proof of concept studies needed to demonstrate added PH value, e.g. international FB outbreak/epidemic situations
- Don't underestimate training needs
- EURLs play a crucial role in supporting the transition from old to WGS methods in the food sector
- Close collaboration of EURLs with PH laboratory networks. Cooperative network around EFSA and ECDC
- Start now the investments in national capacities (equipment, application tools and competence building)
- Replacement of old techniques requires comparative analytical and epidemiological validation studies
- Open a discussion with policy makers on the potential impact of WGS development on EU legislation

Questions?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