87th Advisory Forum Meeting
Parma, 15-16 March 2023

APPLYING OMICS AND BIOINFORMATICS APPROACHES

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APPLICATION OF OMICS AND BIOINFORMATICS IN RISK ASSESSMENT

EVENT REPORT

APPROVED: 13 November 2018

doi:10.2903/sp.efsa.2018.EN-1512

EFSA Scientific Colloquium 24 – 'omics in risk assessment: state of the art and next steps

European Food Safety Authority

and Jaime Aguilera[1], Margarita Aguilera-Gomez[2], Federica Barrucci[1], Pier Sandro Cocconcelli[3], Howard Davies[4], Nancy Denslow[5], Jean Lou Dorne[1], Lutz Grohmann[6], Lieve Herman[7], Christer Hogstrand[8], George E. N. Kass[1], Peter Kille[9], Gijs Kleter[10], Fabien Nogué[11], Nick J. Plant[12], Matthew Ramon[1], Reinhilde Schoonjans[1], Elisabeth Waigmann[1] and Matthew C. Wright[13]

TECHNICAL REPORT

APPROVED: 05 September 2021

doi:10.2903/sp.efsa.2022.e200506

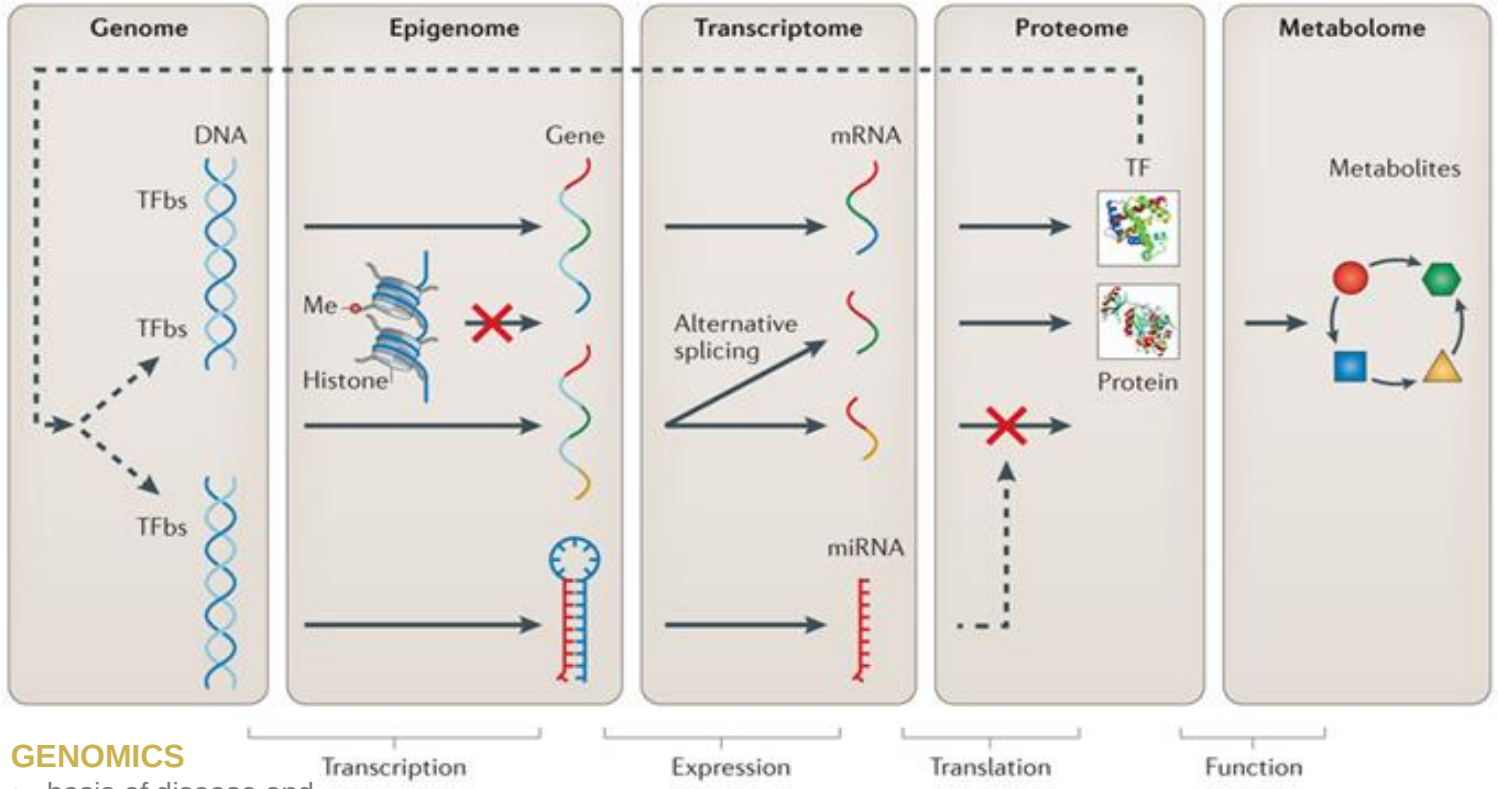
Theme (Concept) paper - Application of OMICS and BIOINFORMATICS Approaches: Towards Next Generation Risk Assessment

European Food Safety Authority (EFSA), Giovanni Iacono, Beatriz Guerra, George Kass, Konstantinos Paraskevopoulos, Juliane Kleiner, Claudia Heppner, Marta Hugas

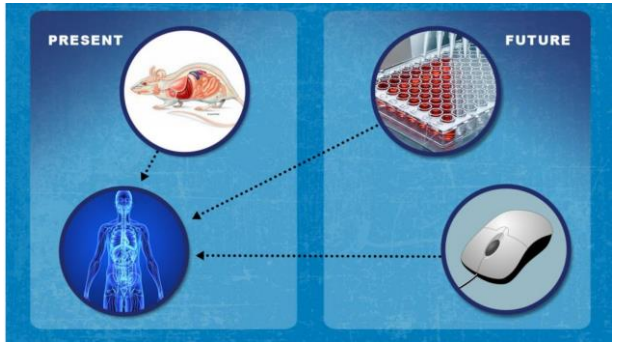
https://efsa.onlinelibrary.wiley.com/doi/epdf/10.2903/sp.efsa.2022.e200506

- By 2030 to **apply omics and associated bioinformatic approaches** in relevant risk assessments (RA)
- RA that will be **leaner, automated** and **based on the mechanisms** behind **adverse effects**, greatly enhancing our **ability to assess food/feed-related hazards** and **risks**.

OMICS FOR RISK ASSESSMENT



- Information on properties and/or functional status of an organism
- Information on impact of external factors on an organism



Source: U.S FDA

Ritchie et al., 2014 16, 85-97
Nature Reviews | Genetics

GENOMICS

- basis of disease and disease resistance
- characterization food borne pathogens
- comparative genomics

TRANSCRIPTOMICS

- chemically induced changes in gene expression (e.g. Cd stress in plants)

METABOLOMICS

- plant responses to abiotic stress
- nutritional profile of food and feed
- new biomarkers

EPIGENOMICS

- Insight how external factors e.g. environmental stressors affect epigenetic processes
- use of epigenetic biomarkers

PROTEOMICS

- biomarkers in toxicology
- molecular signature of a disease

ROADMAP: APPLYING OMICS AND BIOINFORMATIC APPROACHES

- Enhance capability for mechanism-based scientific advice
- Harmonization and implementation of omics and bioinformatic approaches across food regulatory domains;
- Exploit publicly available big data from high-throughout approaches
- Provide agreed open-source/open-access bioinformatic tools in dialogue with stakeholders
- Facilitate data/expertise sharing through partnerships

Consortium

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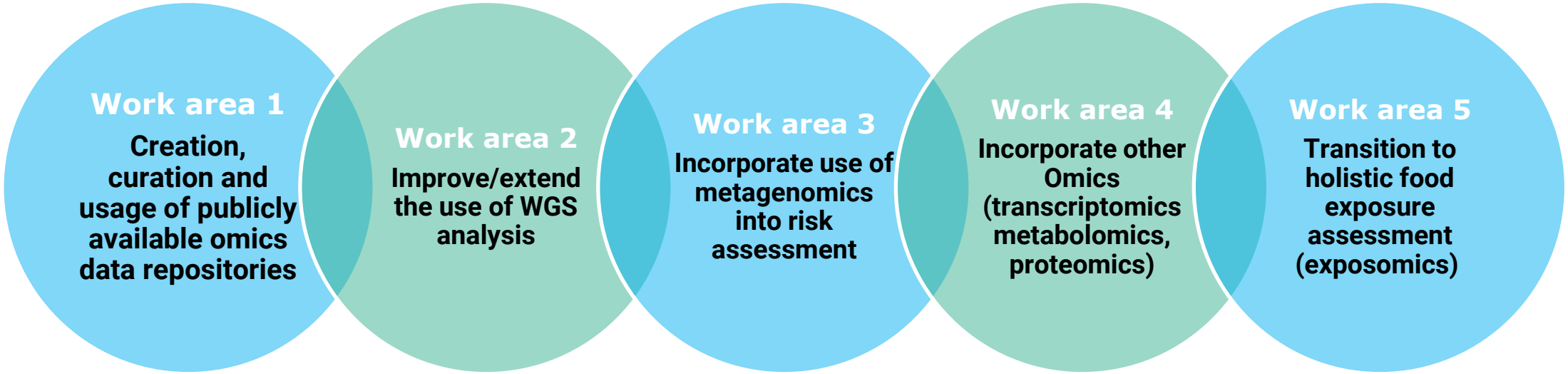
Kick off meeting: 9 March 2023
Final roadmap: 1st Q 2024

ROADMAP: APPLYING OMICS AND BIOINFORMATIC APPROACHES



ROADMAP: WORK AREAS - WHAT AND WHY?

Work area 1

Creation, curation and usage of publicly available omics data repositories

- Promote development and usage of Omics databases for e.g.
  - Faster and more comprehensive RA of plants, microorganisms, innovative/novel foods
  - Aid identification and characterisation of compounds that could constitute emerging risks

Work area 2

Improve/extend the use of WGS analysis

- In currently applied areas (e.g. foodborne outbreak, AMR monitoring)
- Extend to other areas (e.g. animal/plant health)

Successful example: genomics data from WGS

ROADMAP: WORK AREAS - WHAT AND WHY?

Work area 3

Incorporate use of metagenomics

- Incorporate use of metagenomics into RA for animal, human and environmental health, e.g.:
  - Assessment of food additives or novel foods on human microbiome
  - Impact of contaminants, pesticides on biodiversity (i.e. bacterial soil communities)
  - Detection, monitoring and surveillance of microorganisms and genetic traits (e.g. AMR, pathogens)

Work area 4

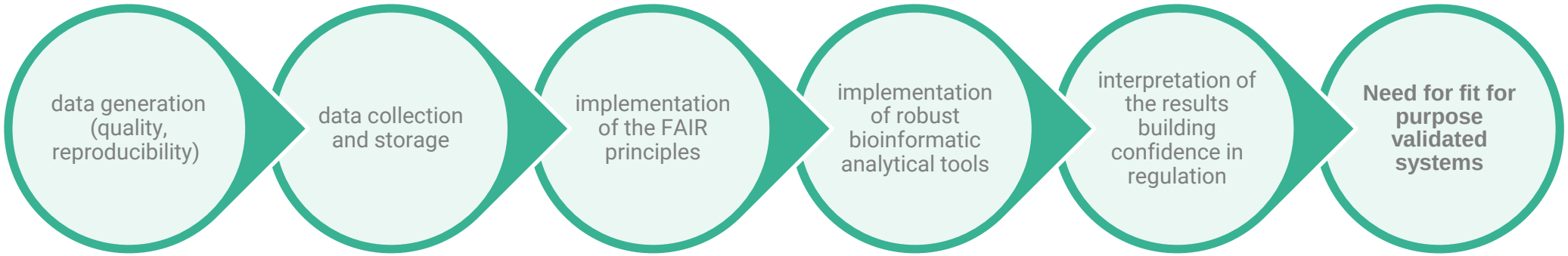
Incorporate other Omics (transcriptomics metabolomics, proteomics)

- Improved/HP characterisation of protein adverse effects like toxicity/allergenicity
- More comprehensive safety assessment of complex GMOs such as SynBio products (e.g. RNA seq for target/off-target genes search)
- Enhanced assessment of food/feed including safety of consumption, nutritional properties & intake

ROADMAP: WORK AREAS - WHAT AND WHY?

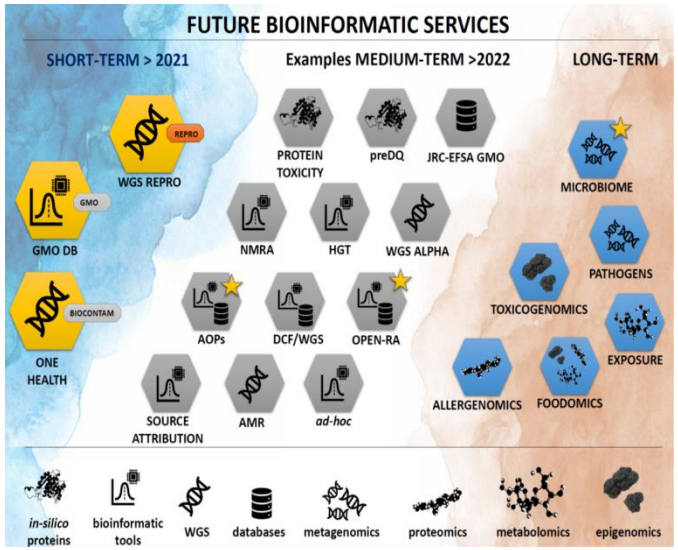
- To check for mass consumption of specific metabolites in wastewater samples
- On blood samples to quantitatively assess food exposure
- Identify novel biomarkers for the mass screening of contaminants, nutrients, exposures

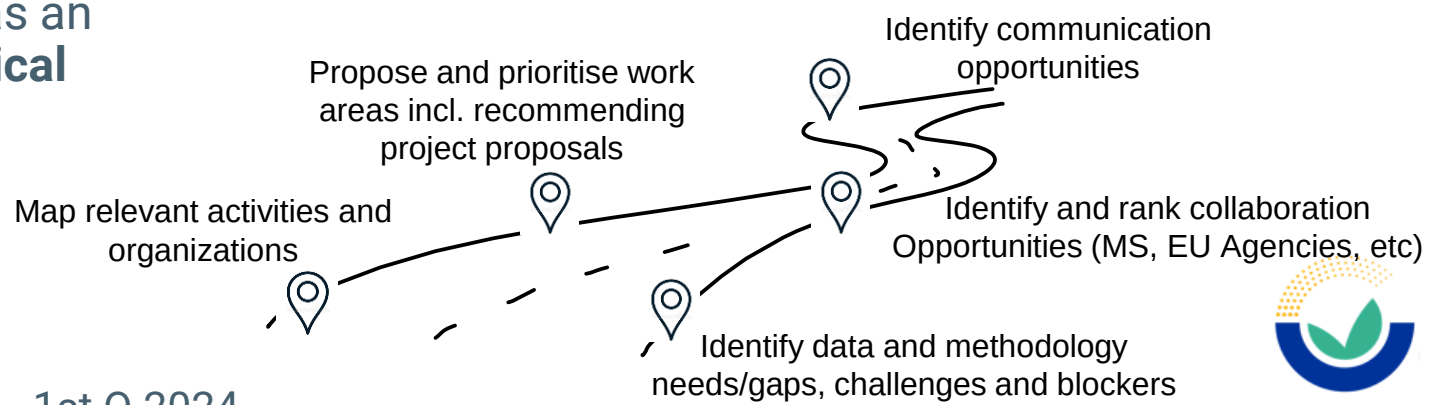
OMICS: CHALLENGES AND UNCERTAINTIES FOR A WIDER USE



ROADMAP: HOW TO MOVE INTO THE FUTURE

- Rapid advances in **Omics technologies** allow **rapid and high resolution** analysis of cellular and organ responses to **chemical injury**.
- Supported by powerful **bioinformatics tools**, Omics data can **predict**:
  - adverse effects
  - dose reference points to set health-based guidance values
- Promising applications as part of NAM approaches (in vitro).
- Omics technologies are widely recognised as an important contributor of the **future of chemical risk assessment.**





EXAMPLES OF EFSA PROJECTS

NAMs roadmap projects 2022-23

NAMS4NANO

Develop NAMs Data Integration approaches

Toxicokinetic assessment

ADME4NGRA

Develop advanced *in vitro/in silico* ADME models

AOP development

Adverse Outcome Pathways e.g. for developmental neurotoxicity

AI4NAMS

AI-based data search, extraction, harmonisation and integration

Complementary projects

GP/EFSA/ED/2022/01: NAM projects in the areas of AOP development and transcriptomics for risk assessment (call for proposal in 2 steps)

Published: 4 Julio 2022 *Deadline:* 10 Octubre 2022 - 23:59 (CEST) Expired

Contract award expected May 2023

Transcriptomics

Tox pathway analysis to predict target organ toxicity

Toxicogenomics

Inference of Chemical Grouping from Processed OMICS Data

Transcriptomics, Metabolomics, epigenomics

Implementation of a Multi-OMICs and Inter-species Workflow using Quantitative in Vitro Data

Omics&Bioinf In chemical RAs

MULTI-OMICS CALL – OPPORTUNITY TO WORK TOGETHER

Implementation of a Multi-OMICs and Inter-species Workflow using Quantitative in Vitro Data

You tube video

1. Content
2. Outreach to organisations

Multi-omics call (link)

- The overarching goal of the project is to define, validate and apply a **standardised workflow** (experimental and computational) for deriving reliable human reference points and health-based guidance values (HBGVs)
- To use cutting edge in-vitro approaches, namely **Organ-on-chip** (OoC) platforms and multiple **OMICs** endpoints (transcriptomics, metabolomics, and epigenomics).

Open call

Closing date: **22.5.23**

€ 3.0 Mio

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