Research Infrastructure on Consumer Health and Food Intake using E-science with Linked Data Sharing

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The dietary behaviours of 9 billion people in 2050 determine not only their physical health, mental and social well-being, but also the sustainability of the food system that produces these diets within planetary boundaries.

The future of our planet is on our plates.
Societal trends

Digitalisation
  o Data platforms, linked open data, standards
  o Apps, sensors, wearables

Personalisation
  o Individual feedback structures
  o Quantified self

Globalisation
  o Global markets and global SDGs
  o Internet

Integration
  o Fragmentation in sectoral policies and practices to be overcome

Citizen science
  o Citizens become engaged in research
Connecting food, nutrition and health
The consumer as link between the Agrifood and Health sectors

Societal challenges
- Food security
- Food safety
- Sustainability
- Climate change

Food Policy Environment
Social Environment

Nutrition and health
- Demographic change
- Wellbeing

Consumer
- why & what do we eat?
- how does it affect health?

Agrofood sector
- public
- private

Health sector
- public
- private
'DISH' model: 4 key building blocks of food, nutrition and health research
Key needs for Food, Nutrition & Health RI

**Need for RI**

Emerging RIs

GloboDiet

EuroFIR

No RI connecting DISH pillars

No RI specific for F&H domain

BBMRI

CESSDA

EATRIS

ECRIN

ELIXIR

EBI

ESS

MetaboHUB

SHARE

**Innovation**

Need = connecting pillars overarching

**Public-private**

Agri food sector

Health care sector

Public-private

Need for RI

Emerging RIs

No RI connecting DISH pillars

No RI specific for F&H domain

Innovation
Problem → Potential

- Existing datasets not sufficient for understanding consumer behaviour, product development, public health policies
- Every day, consumers & businesses generate “big data”
- Potential to link & analyse data & respond to societal challenges

RICHFIELDS is exploring integration of data generated by:

- **Consumers**, e.g. apps, sensors
- **Businesses**, including retail, e-commerce, insurance; e.g. sales
- **Research**, including EU and International; e.g. surveillance data, personalised nutrition
Phase 3
Design of the research infrastructure
ICT, Business model, Governance, Ethics

Phase 1
Data generated by consumers
Purchase, Preparation, Consumption

Phase 2
Connecting business and research generated data
Business, Existing research infrastructures
<table>
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<tr>
<th>Descriptive Criteria</th>
<th>Scientific Criteria</th>
<th>Technical Criteria</th>
<th>Legal/Ethical Criteria</th>
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<td><strong>What is it?</strong></td>
<td><strong>Is it useful?</strong></td>
<td><strong>Can we access it?</strong></td>
<td><strong>Can we use it?</strong></td>
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<td>Data Types</td>
<td>Lifestyle Data</td>
<td>Is data accessible?</td>
<td>Terms of use</td>
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<td>Home page</td>
<td>Situational Characteristics</td>
<td>Types of Access</td>
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<td>Contact Information</td>
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<td>Data Formats</td>
<td>Data ownership</td>
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<tr>
<td>Supported platforms</td>
<td>Product Characteristics</td>
<td>Authentication</td>
<td>Data usage vendor</td>
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<td>Paid Services</td>
<td>External Device</td>
<td>Price</td>
<td>Personal information</td>
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<tr>
<td>Medical Device</td>
<td>Data integration with partner tools</td>
<td>Amount</td>
<td>Types of personal information</td>
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<td>Preparation Categories</td>
<td>What was purchased/</td>
<td></td>
<td>Public profile</td>
</tr>
<tr>
<td>Price of IOS app</td>
<td>prepared/consumed?</td>
<td></td>
<td>Privacy settings</td>
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<td>Languages</td>
<td>What was purchased/</td>
<td></td>
<td>Device data</td>
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<td>Itunes user rating</td>
<td>prepared/consumed?</td>
<td></td>
<td>Types of device data</td>
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<tr>
<td>Itune Genre</td>
<td>What was prepared?</td>
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<td>Cookies</td>
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<td>Current IOS apps</td>
<td>Act or Intention?</td>
<td></td>
<td>Web beacons</td>
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<tr>
<td>Minimum Android</td>
<td>Units of purchase/</td>
<td></td>
<td>Data storage</td>
</tr>
<tr>
<td>version</td>
<td>preparation/</td>
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</tr>
</tbody>
</table>

- Terms of use
- Privacy Policy
- Data ownership
- Data usage vendor
- Personal information
- Types of personal information
- Public profile
- Privacy settings
- Device data
- Types of device data
- Cookies
- Web beacons
- Data storage
<table>
<thead>
<tr>
<th>Knowledge &amp; understanding</th>
<th>Pre-food purchase</th>
<th>Point-of-sale</th>
<th>Post-purchase</th>
<th>Pre-food preparation</th>
<th>Point-of-preparation</th>
<th>Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Searching for experiences</td>
<td>• Searching for offers</td>
<td>• Comparing products &amp; prices</td>
<td>• Store/ restaurant search/ locator</td>
<td>• Sharing knowledge &amp; experience</td>
<td>• Searching for information</td>
<td></td>
</tr>
<tr>
<td>Planning &amp; organisation</td>
<td>• Creating shopping lists</td>
<td>• Booking services</td>
<td>• Budgeting</td>
<td>• Documenting/ recording food</td>
<td>• Meal/ menu planning</td>
<td>• Recipe management</td>
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<tr>
<td>Food purchase</td>
<td>• Placing an order</td>
<td>• Transactions</td>
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<tr>
<td>Meal preparation / cooking</td>
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<td>Food intake</td>
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<td></td>
<td>Documenting/ recording food for:</td>
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<td>• Behaviour change</td>
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</table>
### Conclusions for food purchase apps

- Promising possibilities to utilize purchase app data for mHealth purposes
- Lack of information exists in many cases, thus justifying a clarification from app vendors regarding data accessibility, data ownership and associated public privacy issues.
## Food Preparation

### Categories are:
- Planning and organisation
- Knowledge & understanding
- Meal preparation/cooking

### Types of determinants:
- Individual (i.e. demographic, psychological)
- Interpersonal (i.e. social, cultural)
- Environmental (i.e. product, micro, meso/macro)

### Majority of apps that allowed data access did not provide information on the issue

### Not all apps had “terms of use” documentation

### Most provided a privacy policy document

### Where a “terms of use” document existed, thirdy of apps had no information on data ownership

### Descriptive Criteria
**What is it?**

### Scientific Criteria
**Is it useful?**

### Technical Criteria
**Can we access it?**

### Legal/Ethical Criteria
**Can we use it?**

### Conclusions for food preparation apps
- Potential to answer questions relating to Individual Psychological determinants, such as food beliefs, habits and self-regulation in relation to food. However, the limited availability of contextual data means that much of this data is detached from the user.
- The interconnectedness of the apps presents new opportunities to further enrich the collected data from external sources. There is the potential to create ‘links’ between multiple app usages from a single user, particularly social media.

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[Image]
Food diaries are the most common form of data collection, often allowing for multiple inputs including generic food items, packaged products, or images.

Food consumption data is interlinked with various types of relevant contextual data related to behavioural motivation, physical activity, health and fitness.

The majority of apps lack technical documentation necessary for data export and integration.

Similar lack of documentation related to the implemented terms of use and privacy policies.

While users are usually the owners of their data, vendors are granted an irrevocable and royalty free exploitation license.

Conclusions for food consumption apps

- Due to its magnitude, diversity and interconnectedness, user-documented food consumption data offers a promising opportunity for a better understanding of habitual food consumption behaviour and its determinants.

- Unstandardized or undocumented food intake assessment procedures, data exchange protocols and formats, terms of use and privacy regulations, however, limit possibilities to integrate, process and share user-documented food consumption.
Range of data types being shared

Data sharing context
- Scientists in universities and publically funded research institutes need data to study the relationship between food and health.
- Governments need data to develop and monitor nutrition policies in place to improve food and health.
- Companies that produce or sell foods and drinks (e.g. manufacturers, retail chains, restaurants, food delivery services) need data to do research to develop and improve their products.

Predictors of willingness to share data
- Trust and confidence in organization handling data
- Privacy concerns
- Reasons for sharing
- Values (how you see the world)
- Attitudes to science
- Attitudes to food and health
- Cooking practices
- Perceived health
Landing page FNH-RI

RICHFIELDS RI/PORTAL

Authoritative Materials and Standards

- **Data catalogues and data management protocols**
  Identifying and describing data (Commercial, Public and Research/academic data) and its provenance; Lists of relevant laboratories; best practice documents and data management protocols

- **Research protocols**
  Development, capture and sharing of best practice protocols for the use of connected and ‘big data’ in food-related consumer behavior research.

- **Standardised vocabulary/thesauri**
  Standardisation of vocabulary and development of thesauri to support research activities utilising connected data.

- **Ontologies/Semantic Data models**
  Development of ontologies and semantic data models to support research activities utilising connected data.

- **Training/Consultancy services**
  To assist both the RICHFIELDS data users and data providers to improve the quality of their data usage/capture of determinants of food behavior.

Data Platform/Technology

- **RICHFIELDS Data Platform:**
  Data storage, data linkage and search capabilities; calibration and knowledge generation tools

- **Public Data**
  Public data. Research data

- **Labs**
  Public and private funded research labs

- **Private data**
  Food business, including agriculture, manufacturing and retailers

- **APPs**
  Private or public

Governance

- **Management/Steering Committee** - transparent governance/ethical framework; informing future research agendas
- **User & Stakeholder Network / Forums** - community of researchers/stakeholders
- **Conferences/wider dissemination** - ‘go to’ for food behavior tools, expertise and data
Food, Nutrition & Health RI timeline

FNH-RI Foundation

Growth of Member States and stakeholders involved


Preparatory phase

Design phase

Implementation phase

Research projects: Member State and EU level (H2020, JPI, etc.)

RI building, Member State level and EU level funding

Fully operational Food, Nutrition & Health RI

RI building, Member State level and EU level funding
Food, Nutrition & Health RI Roadmap: phased governance maturity

Preparatory Phase
- “Simple” foundation structure of the 4 core partners to facilitate collaboration through MoUs and projects
- Develop FNH Industry Forum

Initial Phase
- “Simple” foundation linked to consortium agreement
- Includes new partners and new national nodes, Scientific and Industry Forums,
- Dependent on project duration

Implementation Phase
- Mature governance structure based on sustainable structures (legal organisation)
- Building the business model
Food, Nutrition & Health RI Governance principle
Hub and spoke model

The Netherlands: National Institute for Public Health and Environment | Wageningen University and Research Centre | University of Maastricht | University Medical Centre Maastricht | University of Groningen | University Medical Centre Groningen | TNO

Italy: Consiglio Nazionale delle Ricerche (CNR) | Food and Nutrition Research Center of the Italian Agricultural Research Council (CRA NUT) | Parco Tecnologico Padono | Mediterranean Fondation Terina | Fondazione Edmund Mach | University of Bologna

United Kingdom: Quadram | University of Surrey | University of East Anglia | Norfolk – Norwich University Hospital | FoodForce – Network of leading European research provider organisations

Denmark: Technical University of Denmark | University of Copenhagen | Aarhus University | Aalborg University | University of Southern Denmark

France: Institut National de la Recherche Agronomique | University of Claude Bernard Lyon | Centre Européen pour la Nutrition et la Santé | University Paris | International Agency for Research on Cancer

Slovakia: Nitra University (SUA) | National Agriculture and Food Center (NPCC) | AgroBioTech