German Federal Institute for Risk Assessment

FoodChain-Lab: an innovative tool to increase food safety through supply chain analyses

FoodChain-Lab Workshop United Kingdom | 15-16.05.2025

Marion Gottschald, Alexander Falenski, Marco Rügen, Latife Salih, Arne Zerndt, Hanna Hauck, Olaf Mosbach-Schulz, Bernd-Alois Tenhagen

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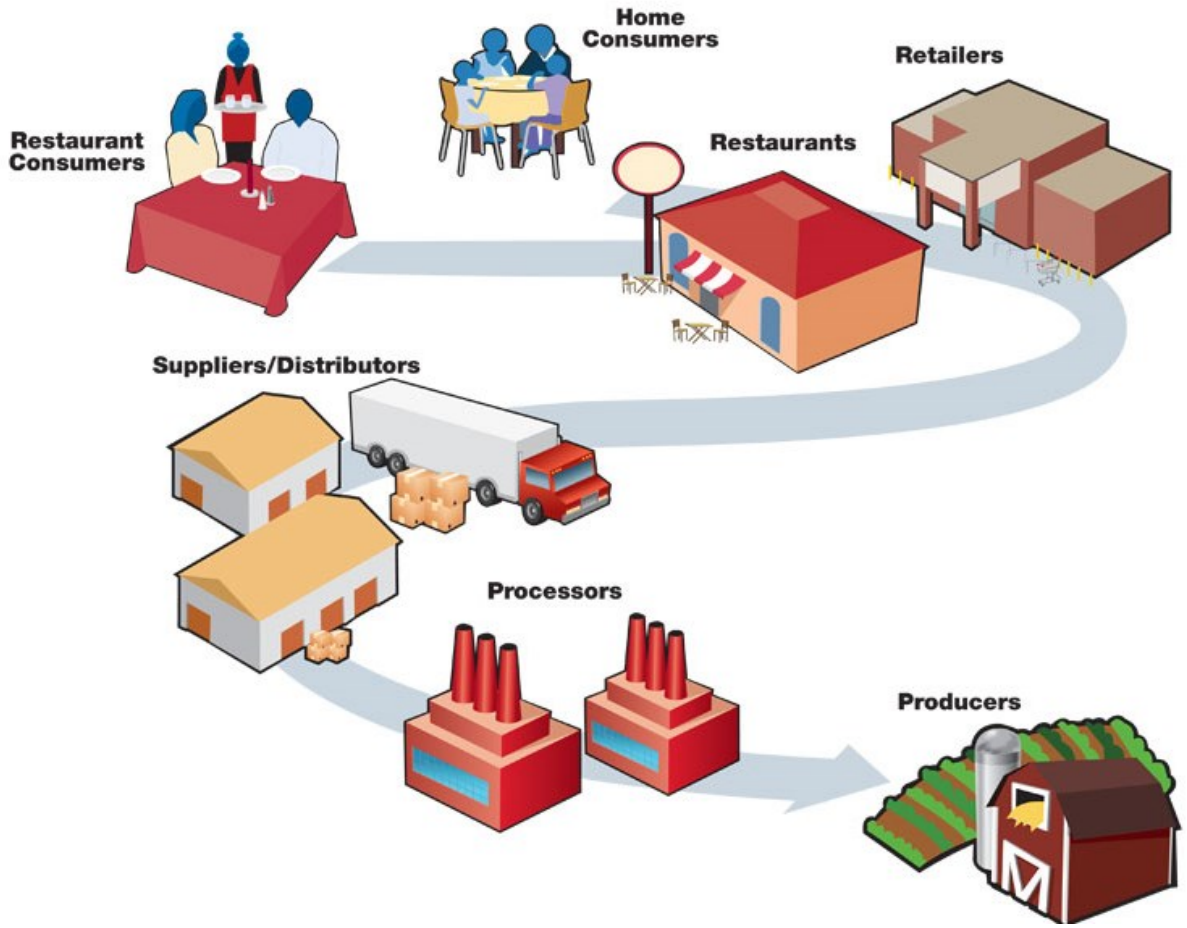
Wishful thinking: Supply chains are simple and linear, right?

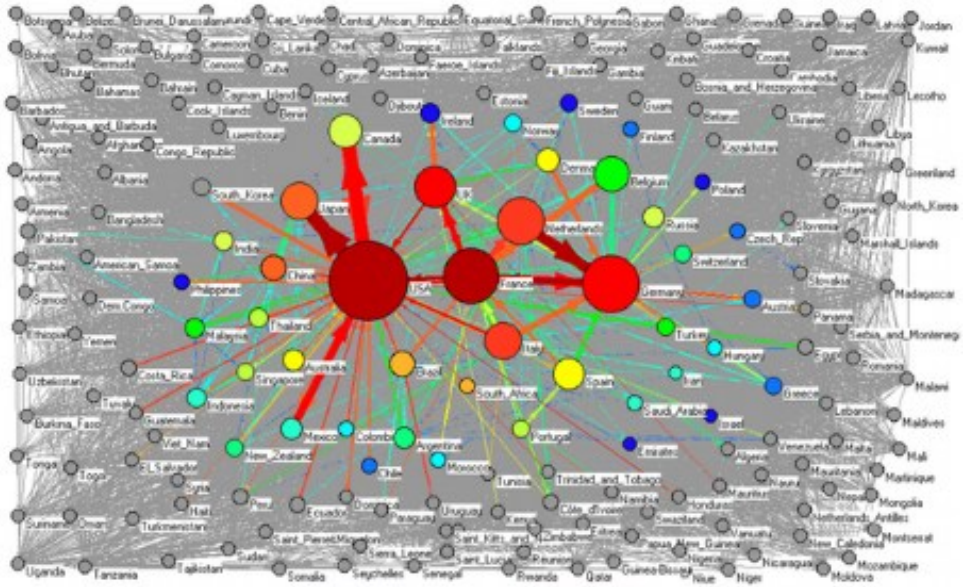


CDC: https://www.cdc.gov/outbreaknet/investigations/ figure_traceback.html

The challenges of complex global food and feed supply chains

Long and complex supply chains

Globalised trade



Large amounts of data

Ercsey-Ravasz M et al. (2012) PLoS ONE 7(5): e37810. doi:10.1371/journal.pone.0037810

Increased complexity of risk assessment and outbreak control

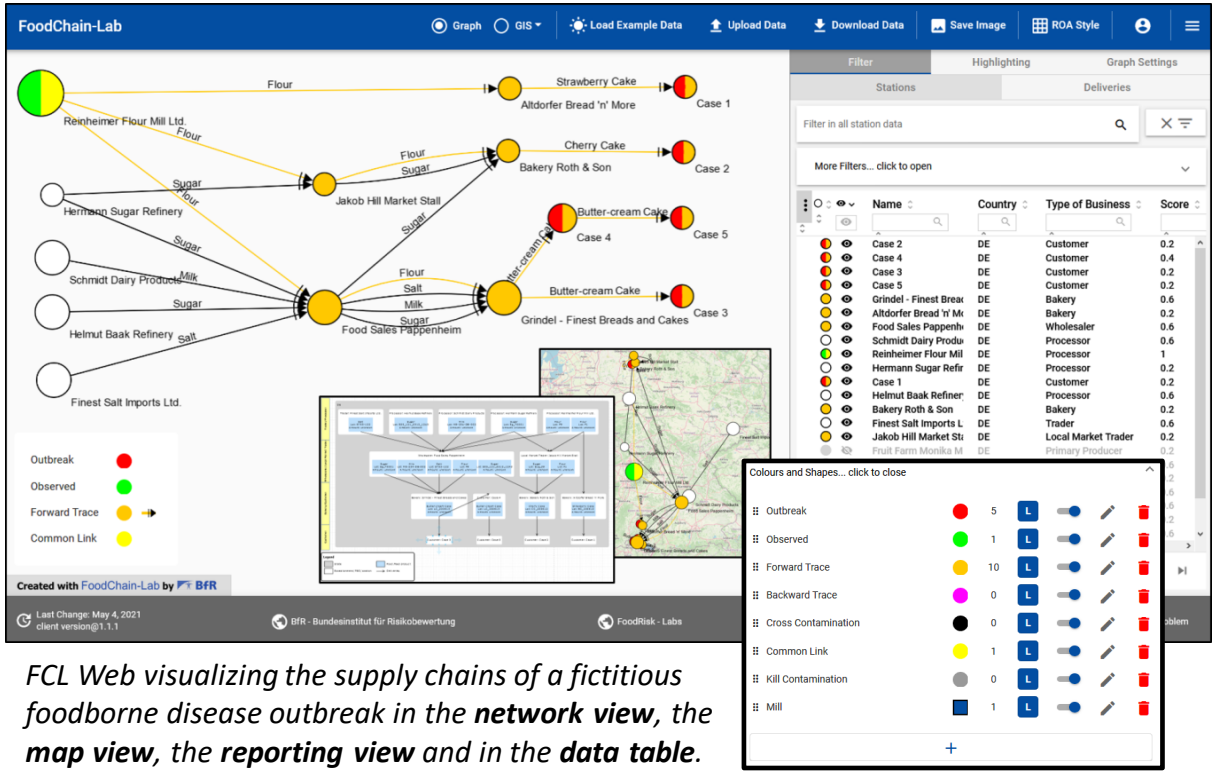
Importance of powerful interoperable software tools e.g. for tracing food and feed

Food Chain Lab
Powered by BfR

BfR

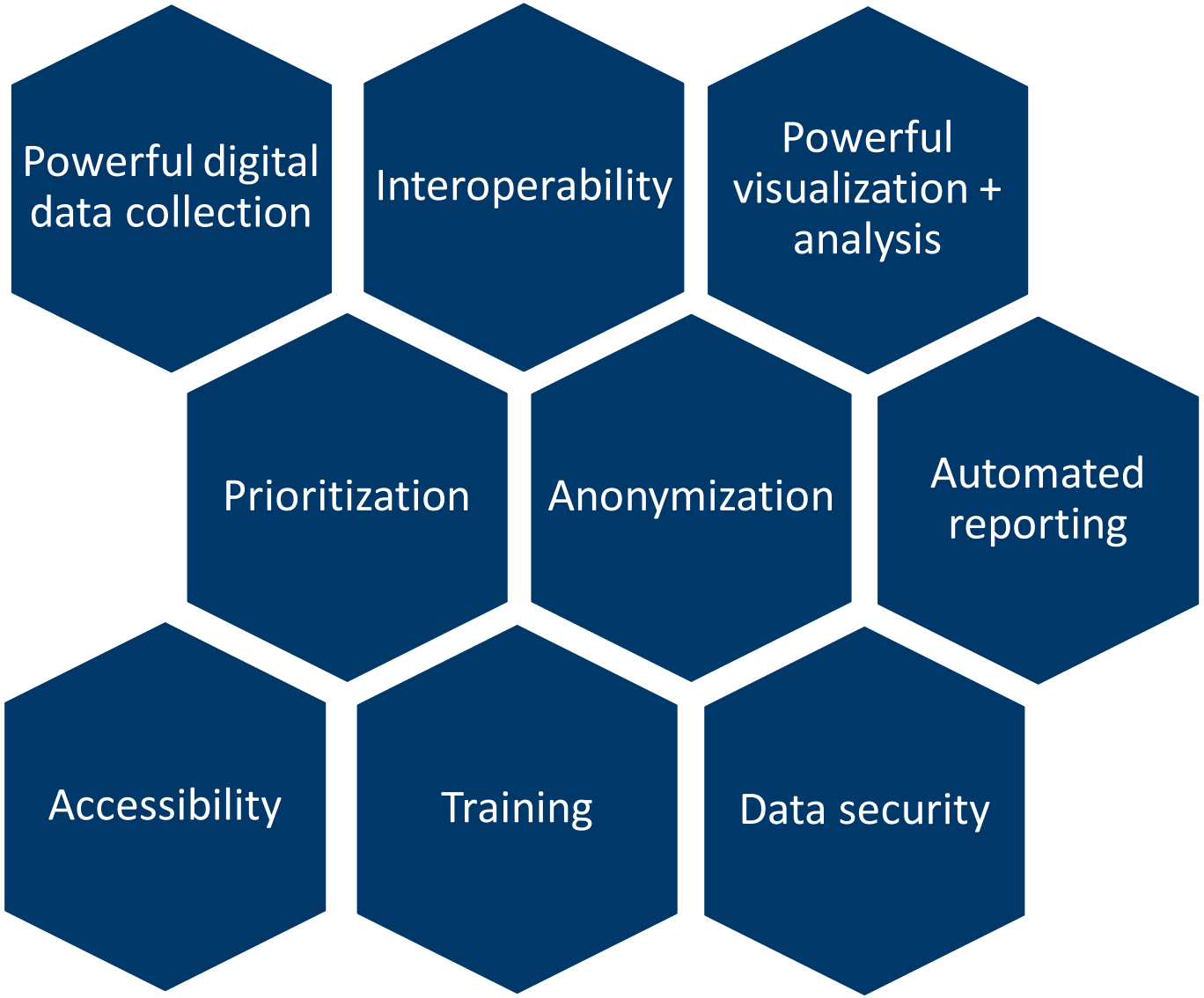
FoodChain-Lab: A tool for supply chain mapping

- Tool to trace back and forward suspicious food items along complex supply chains to help solving foodborne crises (outbreaks, chemical contaminations)
- Step-by-step collecting delivery data for suspicious products and their ingredients
- Combining fragmented information in one visualization + analysis
- Identifying origin of contamination



*FCL Web visualizing the supply chains of a fictitious foodborne disease outbreak in the **network view**, the **map view**, the **reporting view** and in the **data table**.*

Powerful tracing software: What are the needs?



Need: Accessibility

- Free, open access software → **ready-to-use**
- Available as **desktop** and **web application**
  https://foodrisklabs.bfr.bund.de https://fcl-portal.bfr.berlin
- Everybody can register and use it

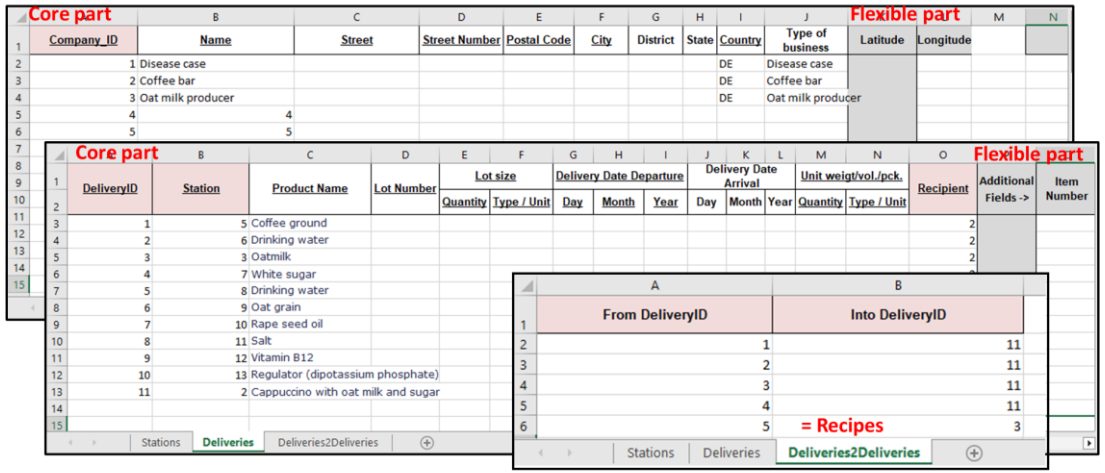
Need: Digital data in pre-agreed formats

Data collection and data extraction:
Structured excel templates as a first step

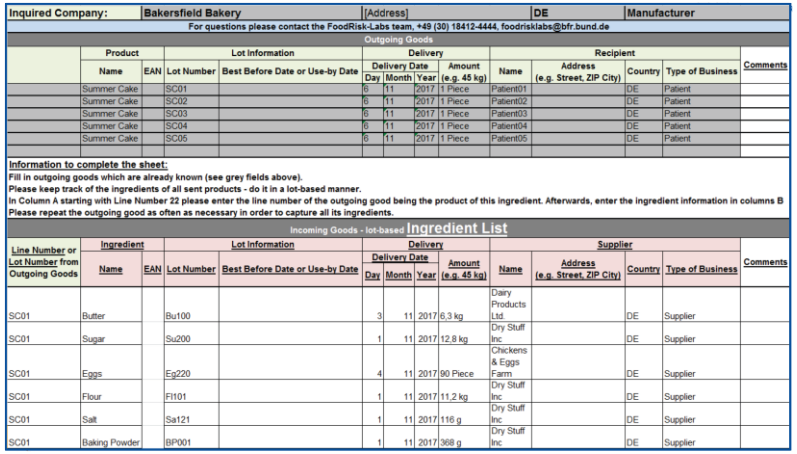
- Ready to use
- Easy to use and easily accessible
- Machine-readable
- Structured but not much standardised

- Tested and applied in real foodborne incidents

Can be customized for UK if needed



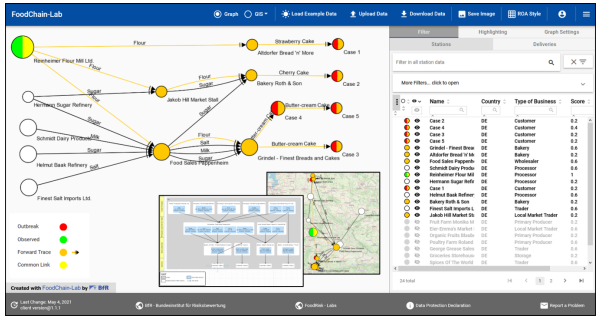
<u>FCL All-in-one template</u>
For data collection + extraction of data of whole incident in one file



<u>FCL backward + forward tracing template</u>
For stepwise data collection e.g. done by inspectors on site or by food business operators

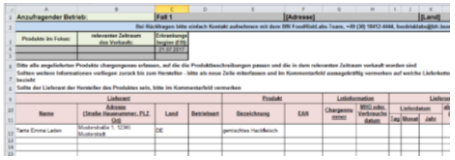
Need: Powerful visualization and analysis

Easy and intuitive data visualization in FCL Web



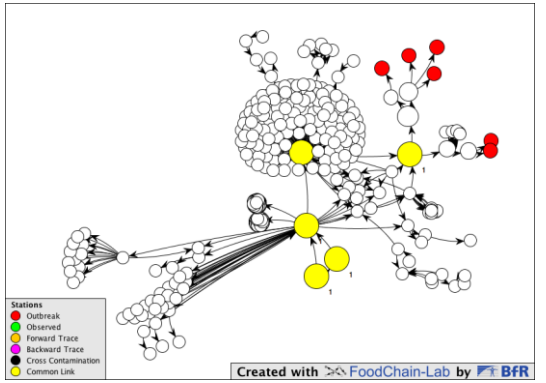
For all users

Data collection



JSON based data exchange

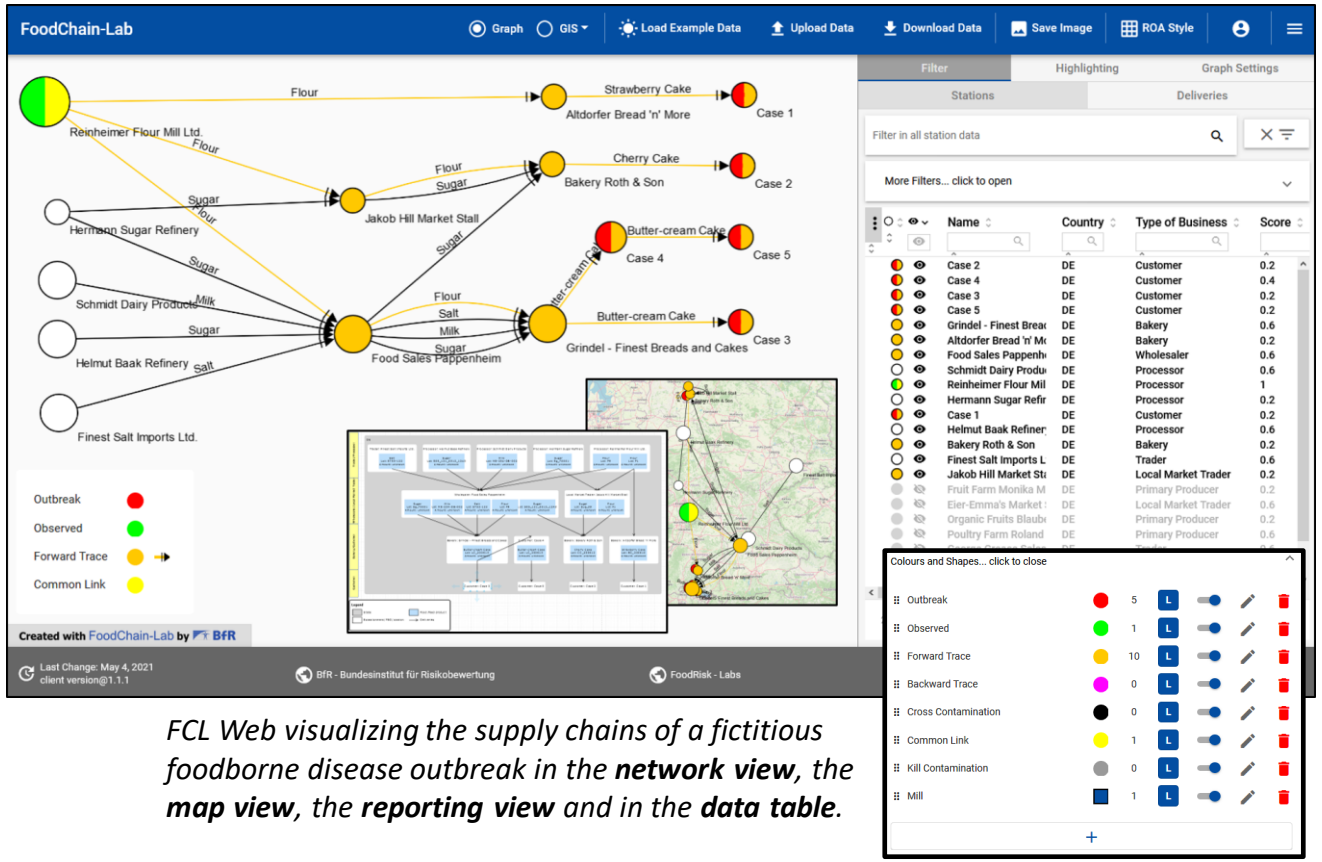
Advanced data analysis within FCL Desktop



More targetted towards data managers and for complex investigations

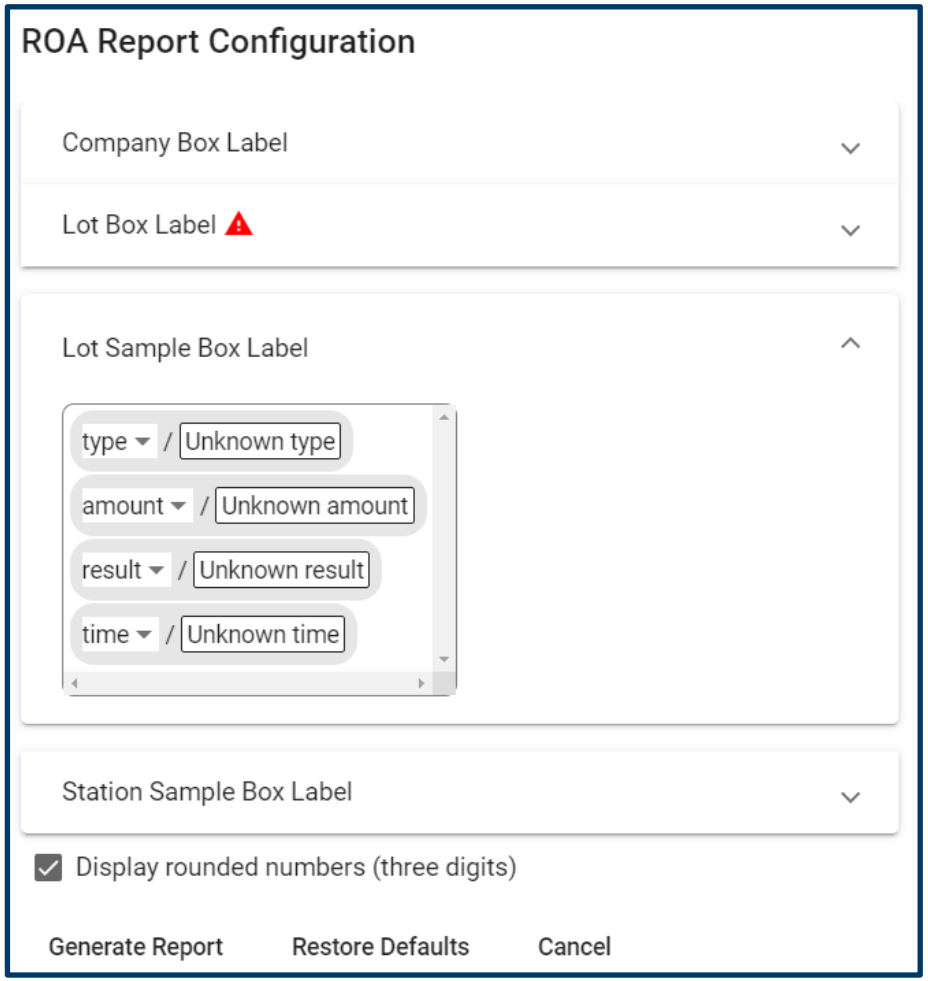
Need: Powerful visualization and analysis

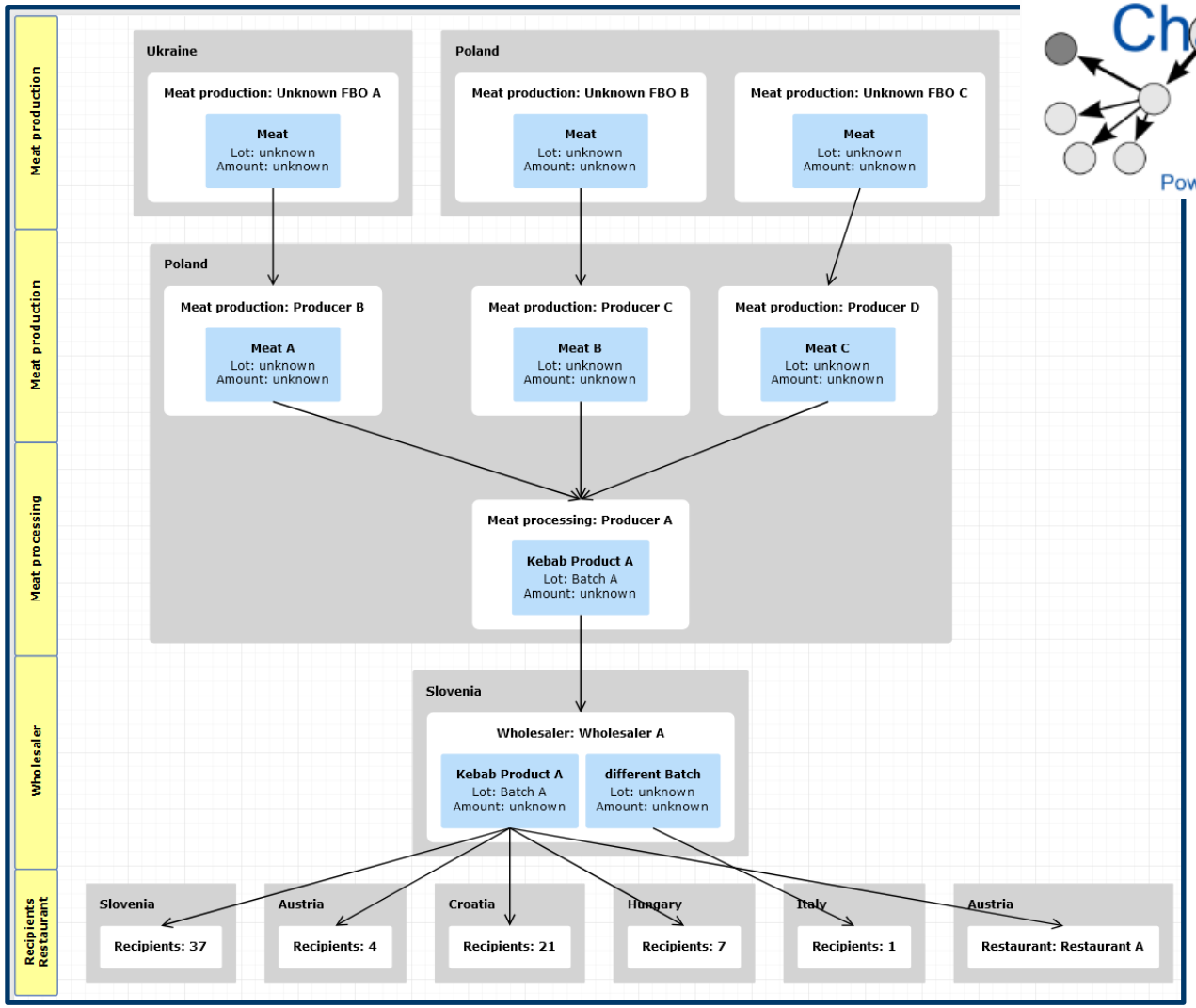
- Automated visualisation of food business operators ◯ and deliveries ↗ as network and on a map
- Visualizations customizable if needed (different layouts, hiding/merging FBOs and deliveries)
- Automated analysis of supply chain network to identify potential common source ● of pathogen/contamination and disease cases ● via scoring algorithm; displaying the trace of a product
- Interactive analysis/reasoning, simulation of hypotheses (e.g. cross contamination
- Helps prioritizing next investigation steps



*FCL Web visualizing the supply chains of a fictitious foodborne disease outbreak in the **network view**, the **map view**, the **reporting view** and in the **data table**.*

Need: Automated reporting

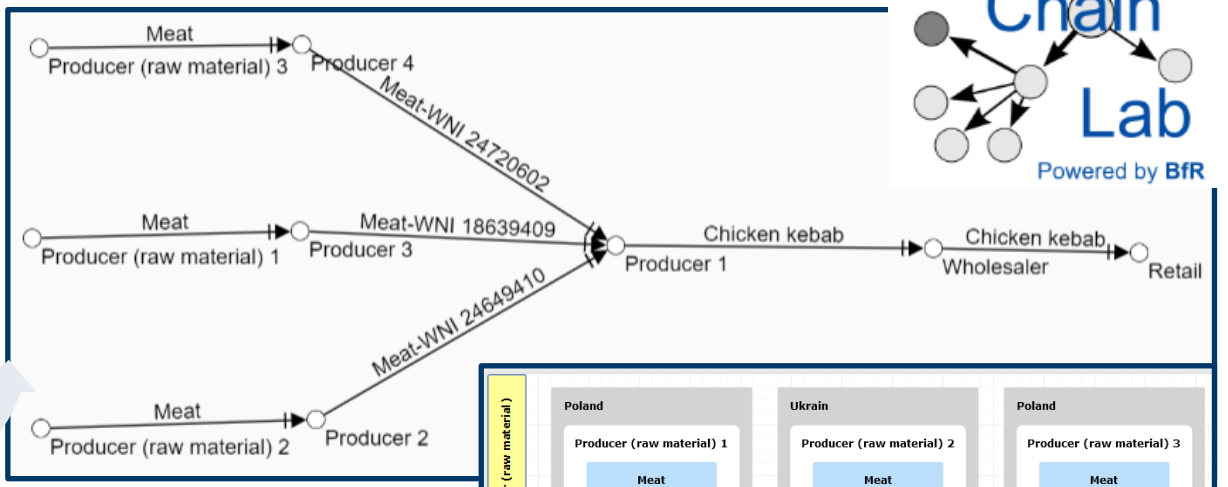


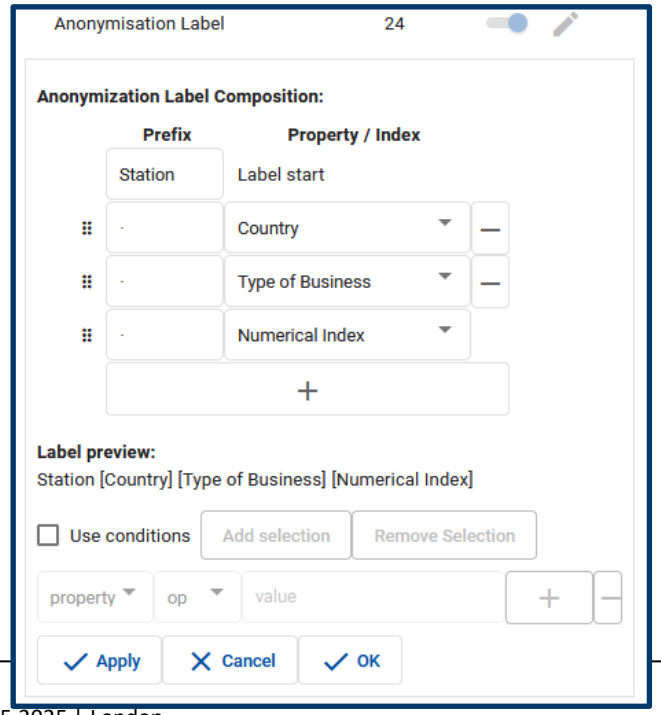


- Automated summary tables → planned
- Statistics on outbreaks (dashboards) → planned

Need: Automated anonymization

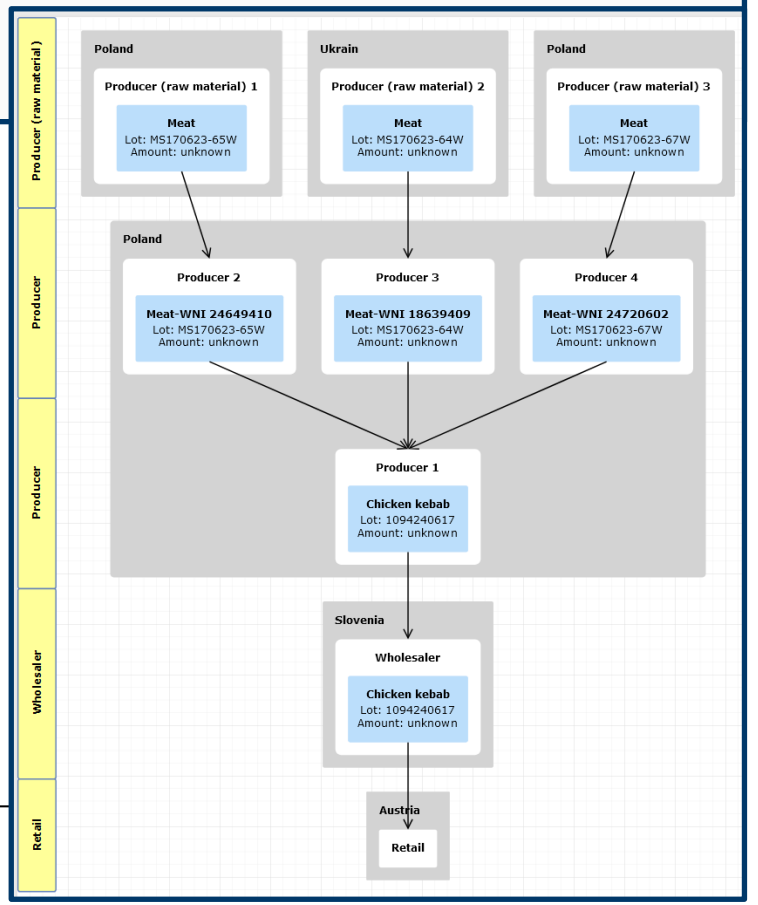
Supply chain network with unanonymized company names (picture removed)





Anonymity code:

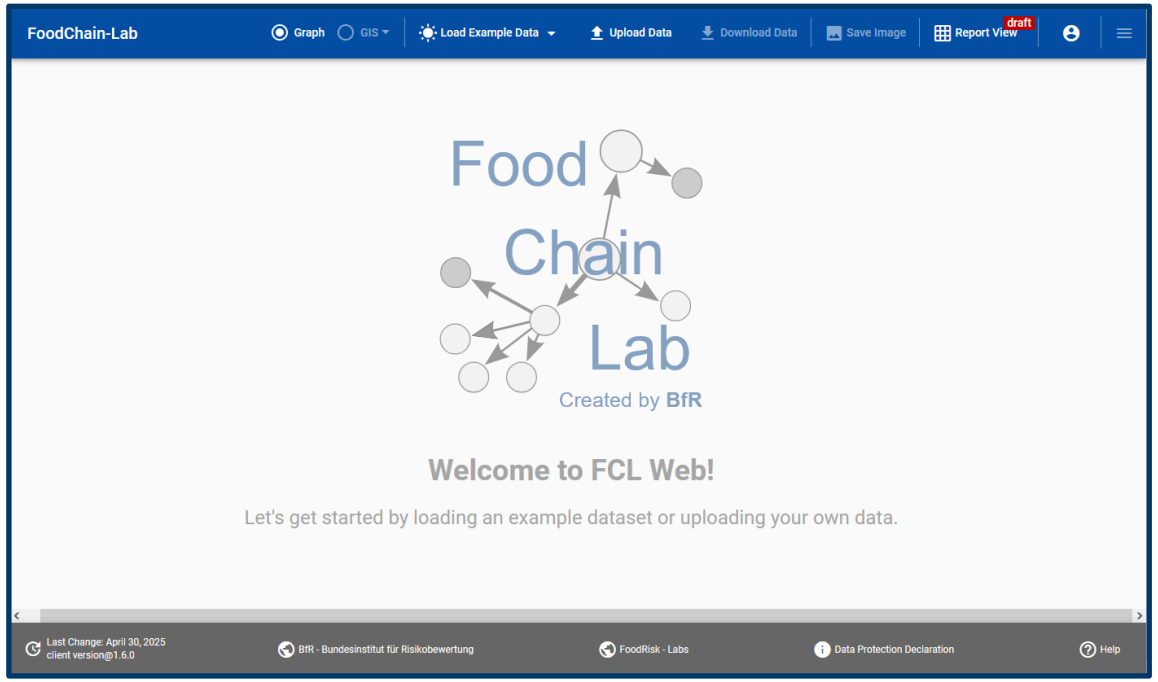
- Customisable!
- Switch on/off
- Available in graph/ map/reporting view



Need: Data security

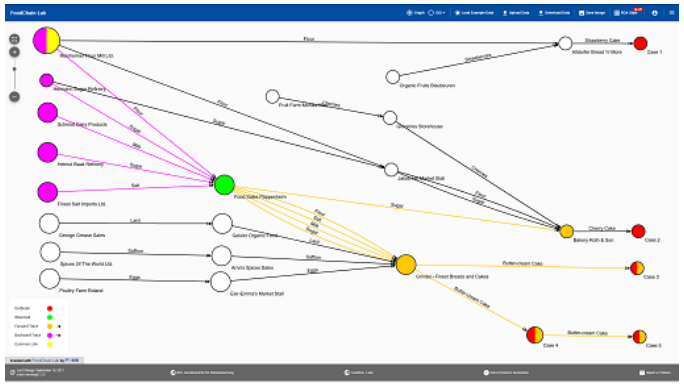
In FCL Desktop and in FCL Web, data always stay on user side!

Need: Easy and intuitive handling



Functionalities in FoodChain-Lab

FCL Web

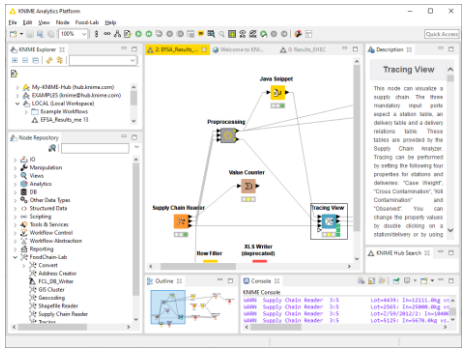


- In a web browser (no installation)
- Data stays local, browser is only for visualisation
- Intuitive handling

Features

- Import of All-in-One (AiO) Template (one at a time)
- -
- -
- Geo coordinates can be added manually via AiO template
- -
- -
- Graph view and GIS view
- Tracing
- Hypothesis generation
- Reporting View for reports
- Advanced, automatic anonymization, customizable

FCL Desktop



- In KNIME (~ 1 GB installation)
- Data is stored locally
- Using KNIME needs to be learned

Features

- Template import (Forward, backward, All-in-One), several at once
- Tracing template generation
- Database with plausibility checks
- Geocoding
- Clustering
- KNIME Data analytics functionalities
- Graph view and GIS view
- Tracing
- Hypothesis generation
- -
- Basic anonymization (random numbers)

FoodChain-Lab – successful applications and impact

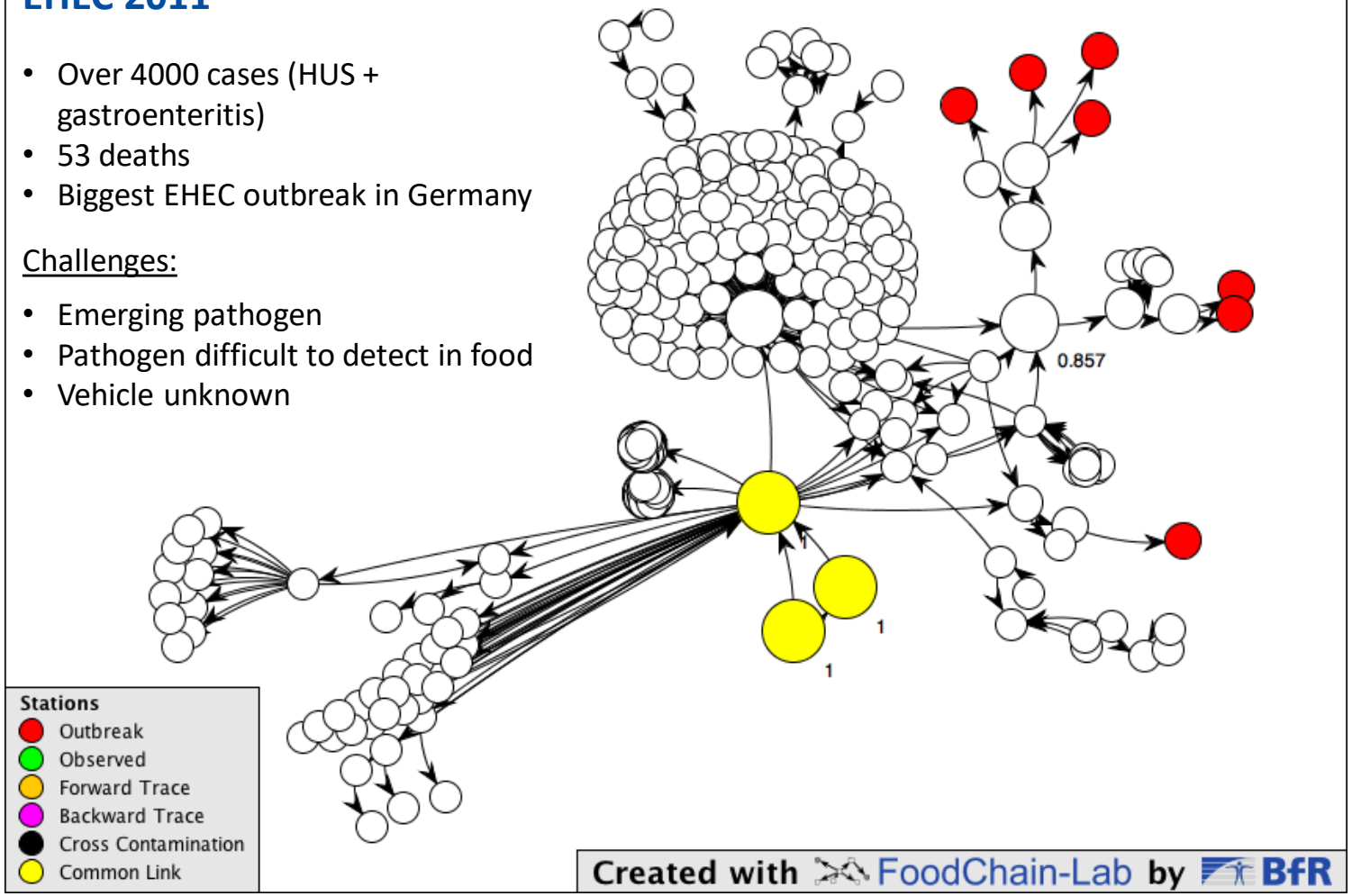
+ crisis exercises

EHEC 2011

- Over 4000 cases (HUS + gastroenteritis)
- 53 deaths
- Biggest EHEC outbreak in Germany

Challenges:

- Emerging pathogen
- Pathogen difficult to detect in food
- Vehicle unknown



Other applications:

DE:
Norovirus 2012, Salm M. 2015,
EHEC 2017, Fipronil 2017

EU:
HAV 2013/14, C. Bot. 2017 (roach), Salm 2017 (sesame)

Autonomous applications:
UK, AT, ES, HU, PL

Free support by FCL team

Interested?
Please contact foodrisklabs@bfr.bund.de

Impact:

FAO/WHO/OIE: FCL part of Tripartite Tool Box (SISOT)

U.S. FDA implemented FCL and FCL Web in data analysis workflow

An outbreak of Shiga toxin-producing *Escherichia coli* O157: H7 associated with contaminated salad leaves: epidemiological, genomic and food trace back investigations‡

A. F. W. MIKHAIL[1], C. JENKINS[1]*, T. J. DALLMAN[1], T. INNS[2,3], A. DOUGLAS[1], A. I. C. MARTÍN[4], A. FOX[1], P. CLEARY[2,3], R. ELSON[1] AND J. HAWKER[2,3]

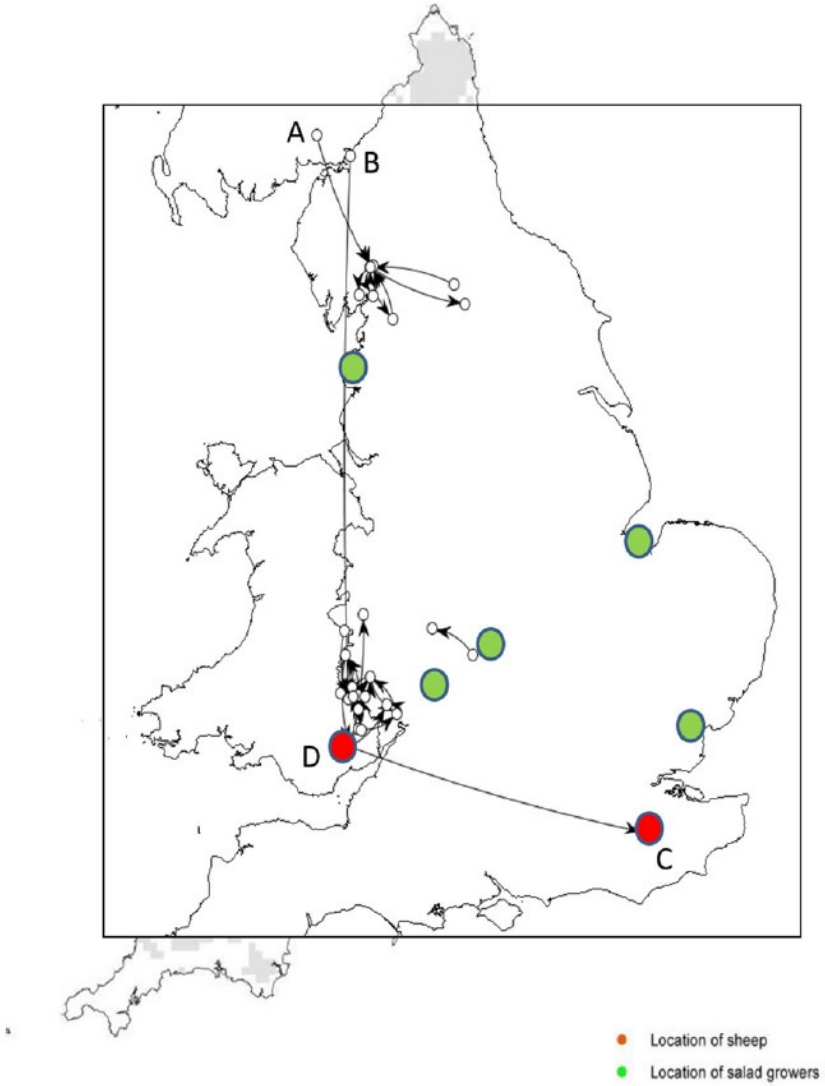
→ Mapping the recent movement of sheep and lambs across the United Kingdom

Novel application of the matched case–control design to compare food supply chains during an *Escherichia coli* O157 outbreak, United Kingdom, 2016

Thomas Inns[1,2,3], Paul Cleary[1,3], Nick Bundle[1,4], Sarah Foulkes[1], Ashley Sharp[5], Lara Utsi[1], Chris McBrien[5], Rehman Teagle[1], Alison Waldram[1], Chris Williams[6], Cathy McCann[1], Rob Smith[6], Sepeedeh Saleh[5], Noel McCarthy[3,7], Roberto Vivancos[1,3,8], Jeremy Hawker[1,3], Valerie Decraene[1]

National outbreak of Shiga toxin-producing *Escherichia coli* O157:H7 linked to mixed salad leaves, United Kingdom, 2016

Maya Gobin[1], Jeremy Hawker[1,2], Paul Cleary[1,2], Thomas Inns[1,2], Daniel Gardiner[1,3], Amy Mikhail[4], Jacquelyn McCormick[4], Richard Elson[2,4], Derren Ready[4], Tim Dallman[2,4], Iain Roddick[1], Ian Hall[5], Caroline Willis[6], Paul Crook[1], Gauri Godbole[3], Drazenka Tubin-Delic[7], Isabel Oliver[1,8]

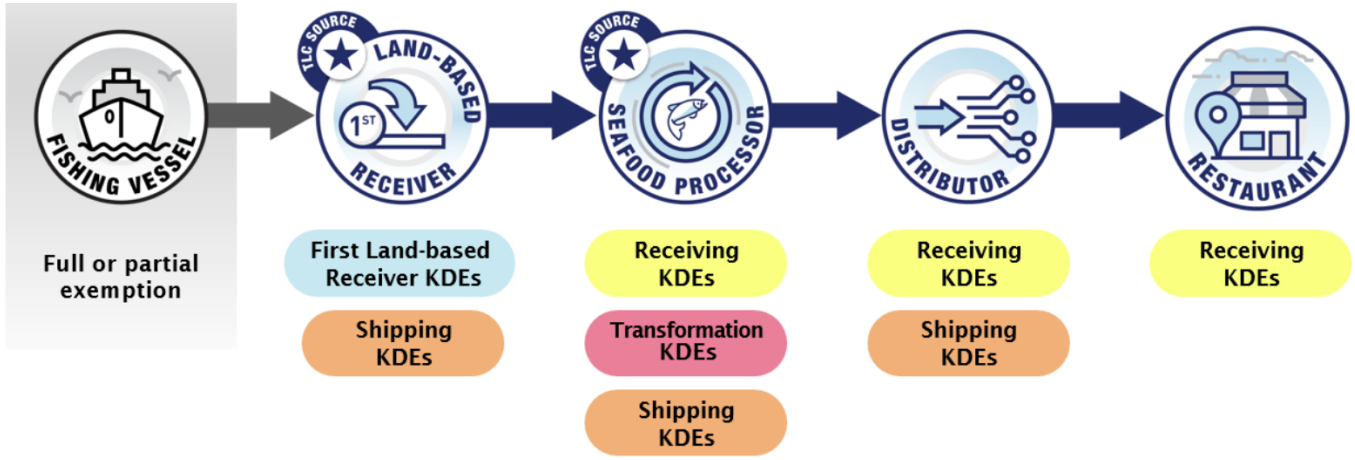


Case study on Salmonella outbreak associated with eggs

Mapping of movements of hospital staff

FDA´s New Era of Smarter Food Safety

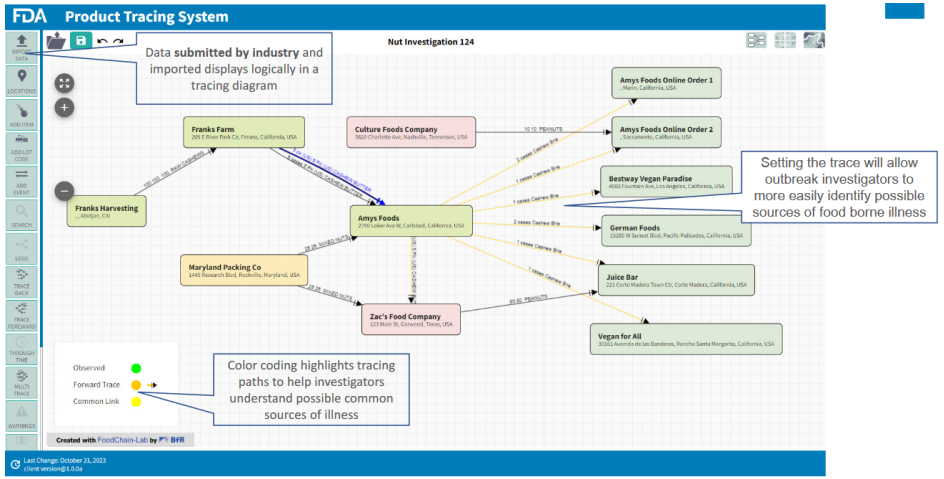
„Food Traceability Rule“ for harmonized data and data sharing



Product Tracing System

- Receive, process and visualize traceability data
- Improve traceback and traceforward analysis
- Government and industry collaboration
- FCL integrated in FDA system

FDA Product Tracing System + Food Chain Lab Powered by BfR



Collaboration between FDA and BfR

Demo video of PTS + FCL in action

https://www.fda.gov/food/new-era smarter-food-safety/product-tracing-system

Looking ahead

Planned developments in FCL

- Improving the Reporting View feature
- Improved reporting through dashboard feature in FCL Web
  - E.g. tables on affected countries, positively sampled products
- Integrating Electronic Product Code Information Services (EPCIS; industry data standard) to accomodate data from food business operators
- Including sample data in the FCL Excel templates

Benefits of using FoodChain-Lab for MS/EU authorities

- Free and open-access software
- Combines stepwise tracing information in one visualization
- All steps of a tracing investigation integrated in one modular framework
  - *Data Management, Data Cleaning, Data Analysis (automated, calculation of scores)*
- Helps during Outbreak Investigation
  - *Identify potential common source of contamination by tracing back and forward suspicious food items*
  - *Assists in brainstorming → test hypotheses and generate new ones*
  - *Helps prioritizing next steps*
  - *Identifies missing data*
- Free support and free trainings in FCL
- Harmonization with/integration of other tools and initiatives

"Progress is impossible without change […]"

George Bernard Shaw

Fast and reliable investigation of foodborne incidents

Thank you for your attention!

German Federal Institute for Risk Assessment

Marion Gottschald

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foodrisklabs@bfr.bund.de
https://foodrisklabs.bfr.bund.de

EFSA-BfR tracing team

BfR: Marion Gottschald, Alexander Falenski, Matthew Salewski, Daria Savvateeva, Marc Lorenzen, Marco Rügen

EFSA: Olaf Mosbach-Schulz

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