

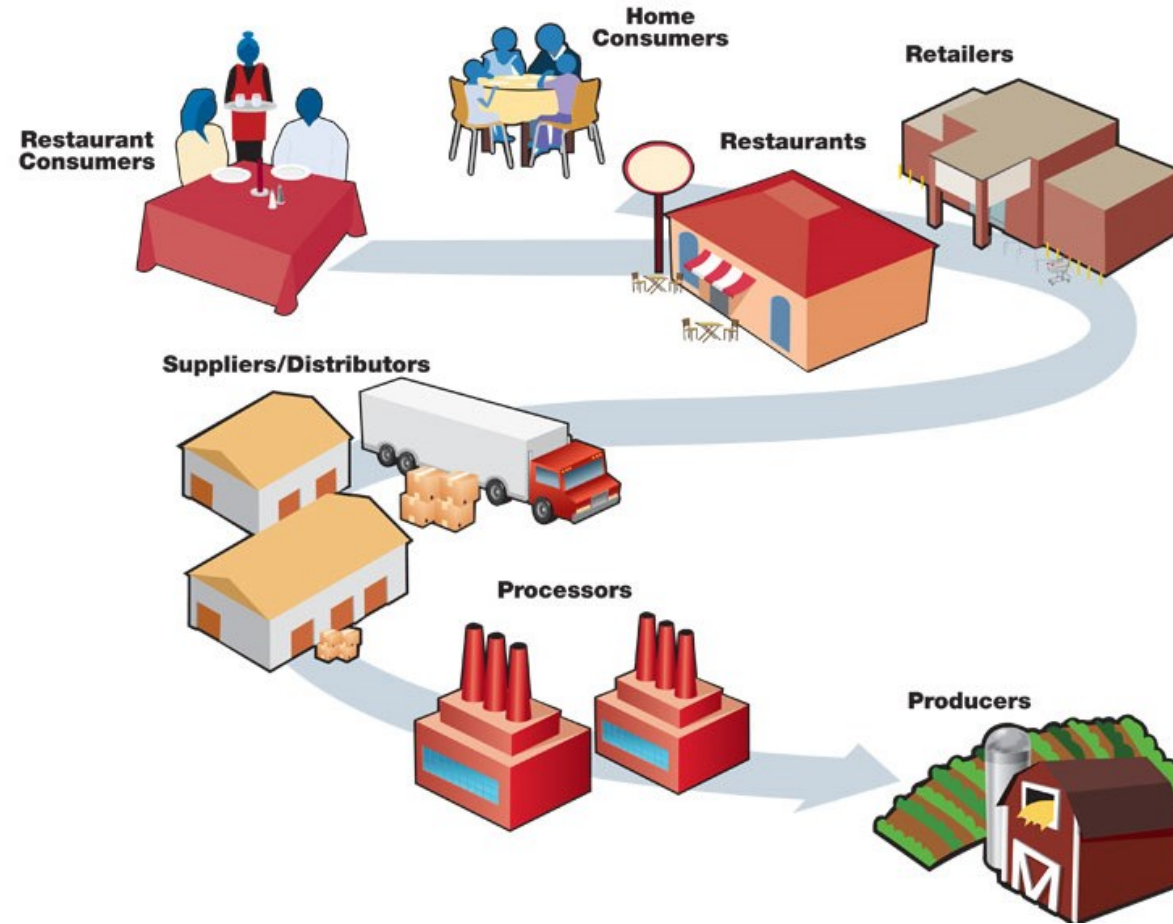
FoodChain-Lab: an innovative tool to increase food safety through supply chain analyses

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

FCL was supported by EFSA-BfR Framework Partnership Agreements (FPA) GP/EFSA/AMU/2016/01 and GP/EFSA/AMU/2020/02, and received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 773830 OH EJP COHESIVE.

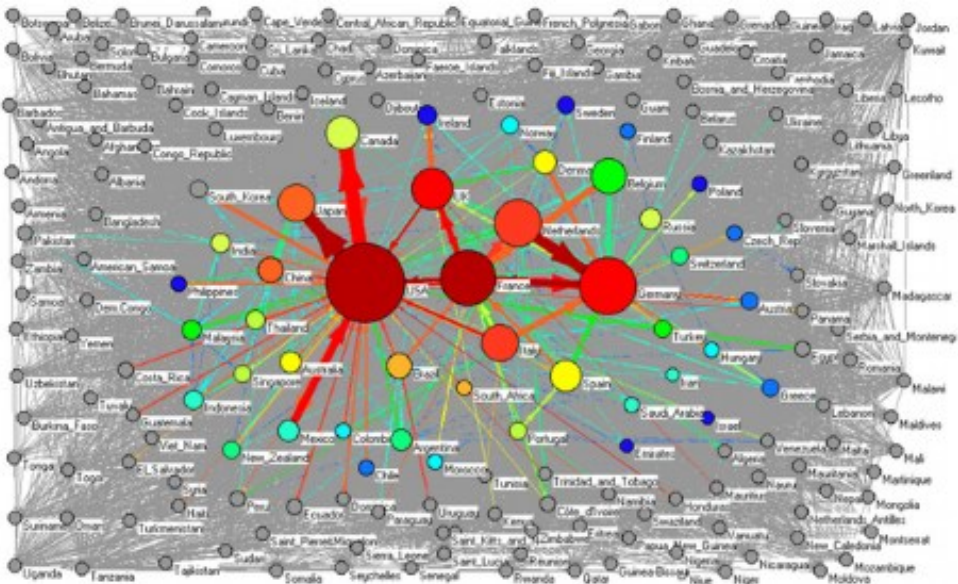
Wishful thinking: Supply chains are simple and linear, right?



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

The challenges of complex global food and feed supply chains

Globalised trade



Long and complex supply chains

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

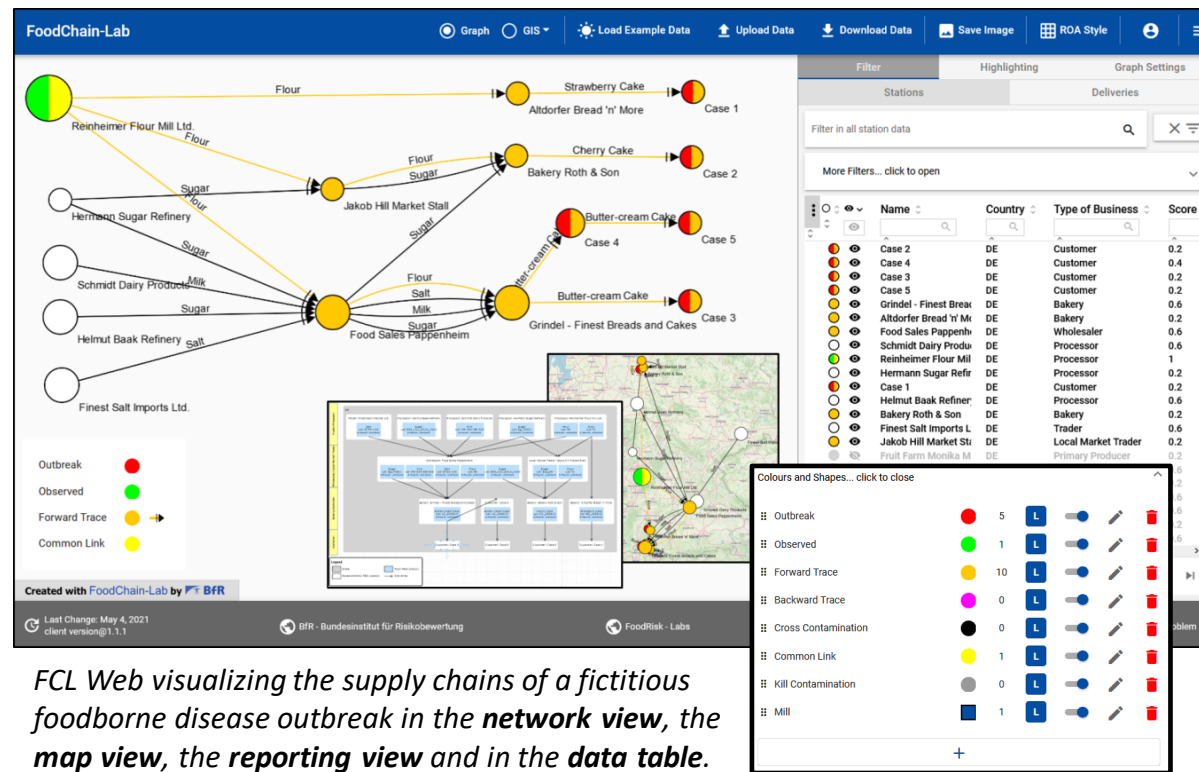


Importance of powerful interoperable software tools e.g. for tracing food and feed

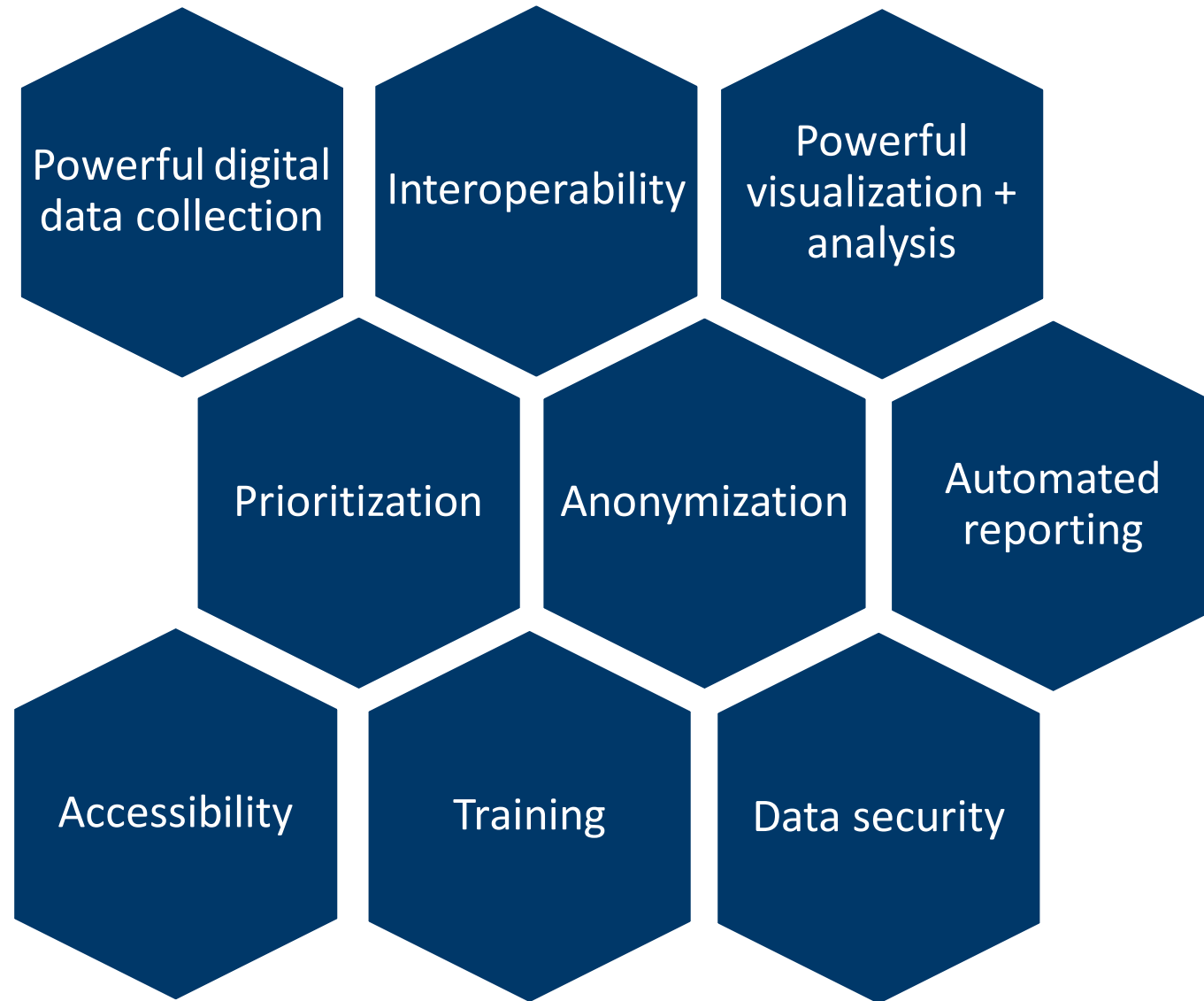


FoodChain-Lab: A tool for supply chain mapping

- 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

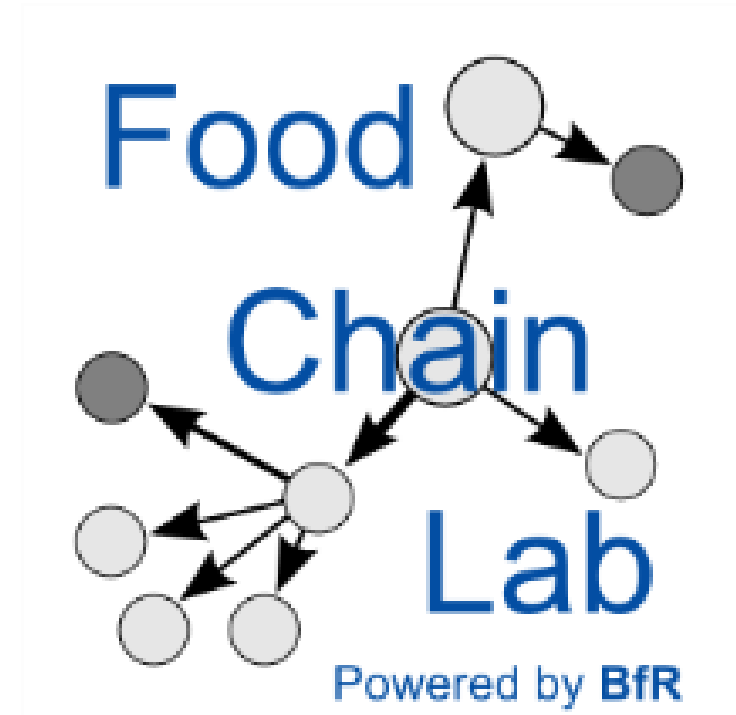


Powerful tracing software: What are the needs?

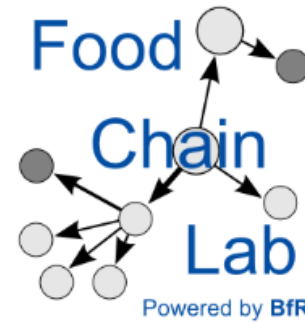


Need: Accessibility

- 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

Core part										Flexible part									
Company ID	Name	Street	Street Number	Postal Code	City	District	State	Country	Type of business	Latitude	Longitude								
1	1	Disease case						DE	Disease case										
2	2	Coffee bar						DE	Coffee bar										
3	3	Oat milk producer						DE	Oat milk producer										
4	4																		
5	5																		

Core part										Flexible part									
DeliveryID	Station	Product Name	Lot Number	Lot size	Delivery Date Departure	Delivery Date Arrival	Unit weight/vol./pck.	Recipient	Additional Fields ->	Item Number									
				Quantity	Type / Unit	Day	Month	Year	Day	Month	Year	Quantity	Type / Unit						
1	1	5 Coffee ground																	
2	2	6 Drinking water																	
3	3	3 Oatmilk																	
4	4	7 White sugar																	
5	5	8 Drinking water																	
6	6	9 Oat grain																	
7	7	10 Rape seed oil																	
8	8	11 Salt																	
9	9	12 Vitamin B12																	
10	10	13 Regulator (dipotassium phosphate)																	
11	11	2 Cappuccino with oat milk and sugar																	

From DeliveryID	Into DeliveryID
1	11
2	11
3	11
4	11
5	11
6	3

= Recipes

FCL All-in-one template
For data collection + extraction of data of whole incident in one file

Can be customized for UK if needed

Inquired Company:

Bakersfield Bakery

[Address]

DE

Manufacturer

For questions please contact the FoodRisk-Labs team, +49 (30) 18412-4444, foodrisklabs@bfr.bund.de

Outgoing Goods

Product	Lot Information			Delivery		Recipient			Country	Type of Business	Comments
	Name	EAN	Lot Number	Best Before Date or Use-by Date	Delivery Date (e.g. 45 kg)	Name	Address (e.g. Street, ZIP City)				
Summer Cake		SC01			6/11/2017	1 Piece	Patient01		DE	Patient	
Summer Cake		SC02			6/11/2017	1 Piece	Patient02		DE	Patient	
Summer Cake		SC03			6/11/2017	1 Piece	Patient03		DE	Patient	
Summer Cake		SC04			6/11/2017	1 Piece	Patient04		DE	Patient	
Summer Cake		SC05			6/11/2017	1 Piece	Patient05		DE	Patient	

Information to complete the sheet:

Fill in outgoing goods which are already known (see grey fields above).

Please keep track of the ingredients of all sent products - do it in a lot-based manner.

In Column A starting with Line Number 22 please enter the line number of the outgoing good being the product of this ingredient. Afterwards, enter the ingredient information in column B

Please repeat the outgoing good as often as necessary in order to capture all its ingredients.

Incoming Goods - lot-based

Ingredient List

Line Number or Lot Number from Outgoing Goods	Ingredient		Lot Information		Delivery		Supplier				Country	Type of Business	Comments
	Name	EAN	Lot Number	Best Before Date or Use-by Date	Delivery Date (e.g. 45 kg)	Name	Address (e.g. Street, ZIP City)						
SC01	Butter		Bu100		3/11/2017	6.3 kg	Dairy Products Ltd		DE	Supplier			
SC01	Sugar		Su200		1/11/2017	12.8 kg	Dry Stuff Inc		DE	Supplier			
SC01	Eggs		Eg220		4/11/2017	90 Piece	Chickens & Eggs Farm		DE	Supplier			
SC01	Flour		Fl101		1/11/2017	11.2 kg	Dry Stuff Inc		DE	Supplier			
SC01	Salt		Sa121		1/11/2017	116 g	Dry Stuff Inc		DE	Supplier			
SC01	Baking Powder		BP001		1/11/2017	368 g	Dry Stuff Inc		DE	Supplier			

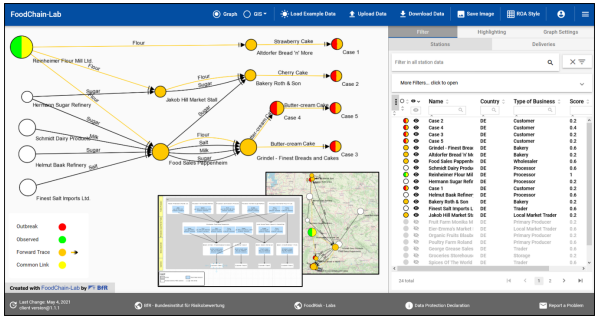
FCL backward + forward tracing template
For stepwise data collection
e.g. done by inspectors on site or by food business operators

Need: Powerful visualization and analysis



For all users

Easy and intuitive data visualization in FCL Web

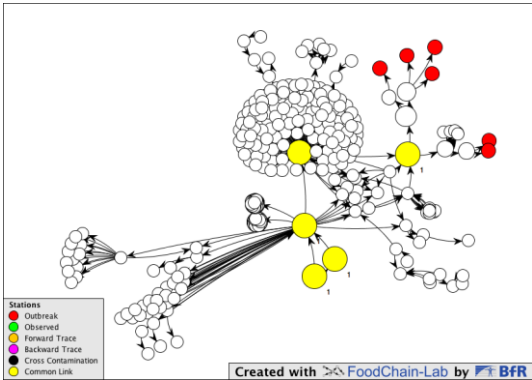


Data collection

Anzahl der Betriebe		Produkt	Land	Bezeichnung	Einheit	Chargennummer	Wahlzahl	Wahlzeitpunkt	Wahlzeitpunkt
1	1	1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3	3	3
4	4	4	4	4	4	4	4	4	4
5	5	5	5	5	5	5	5	5	5
6	6	6	6	6	6	6	6	6	6
7	7	7	7	7	7	7	7	7	7
8	8	8	8	8	8	8	8	8	8
9	9	9	9	9	9	9	9	9	9
10	10	10	10	10	10	10	10	10	10

JSON based data exchange





Advanced data analysis within FCL Desktop

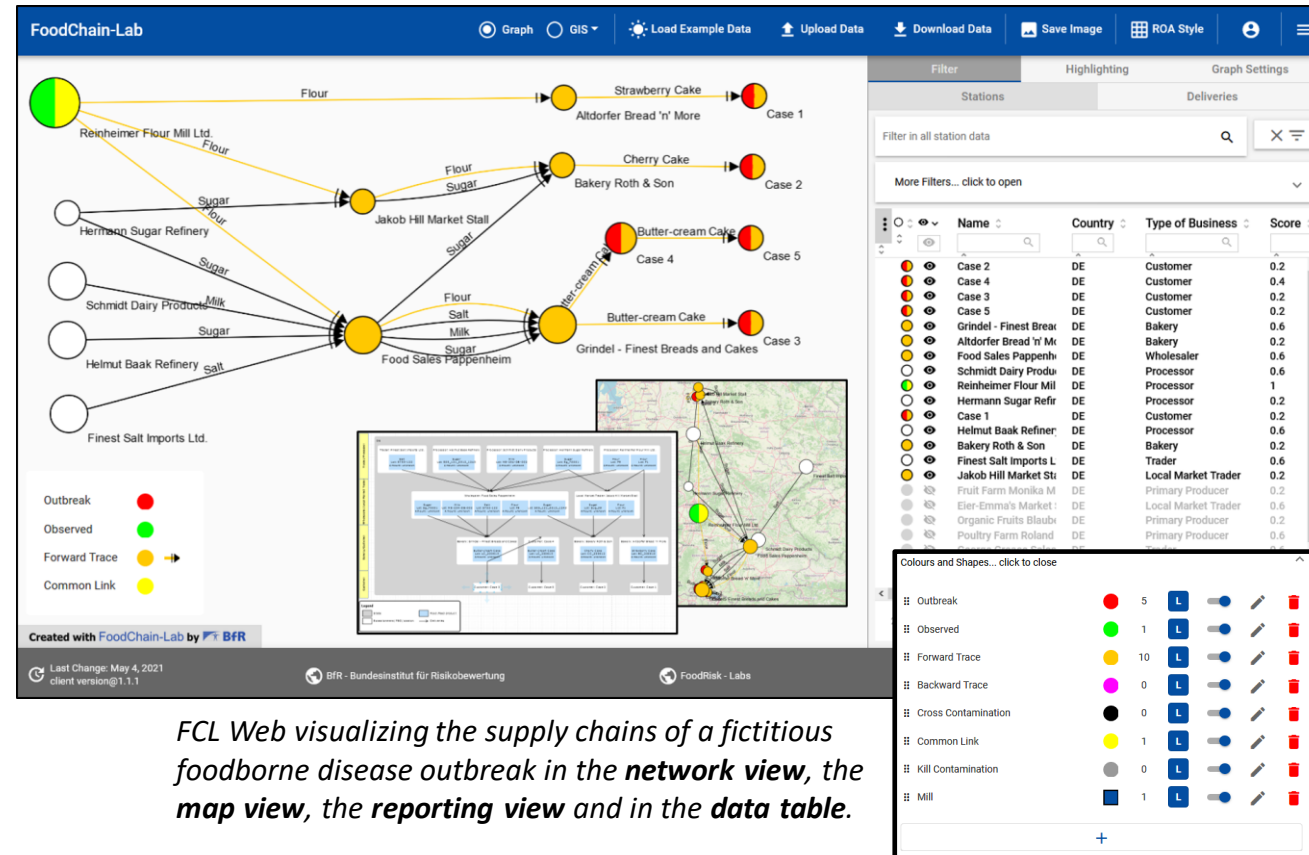


More targetted towards data managers and for complex investigations

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



Need: Automated reporting

ROA Report Configuration

Company Box Label

Lot Box Label

Lot Sample Box Label

type / Unknown type

amount / Unknown amount

result / Unknown result

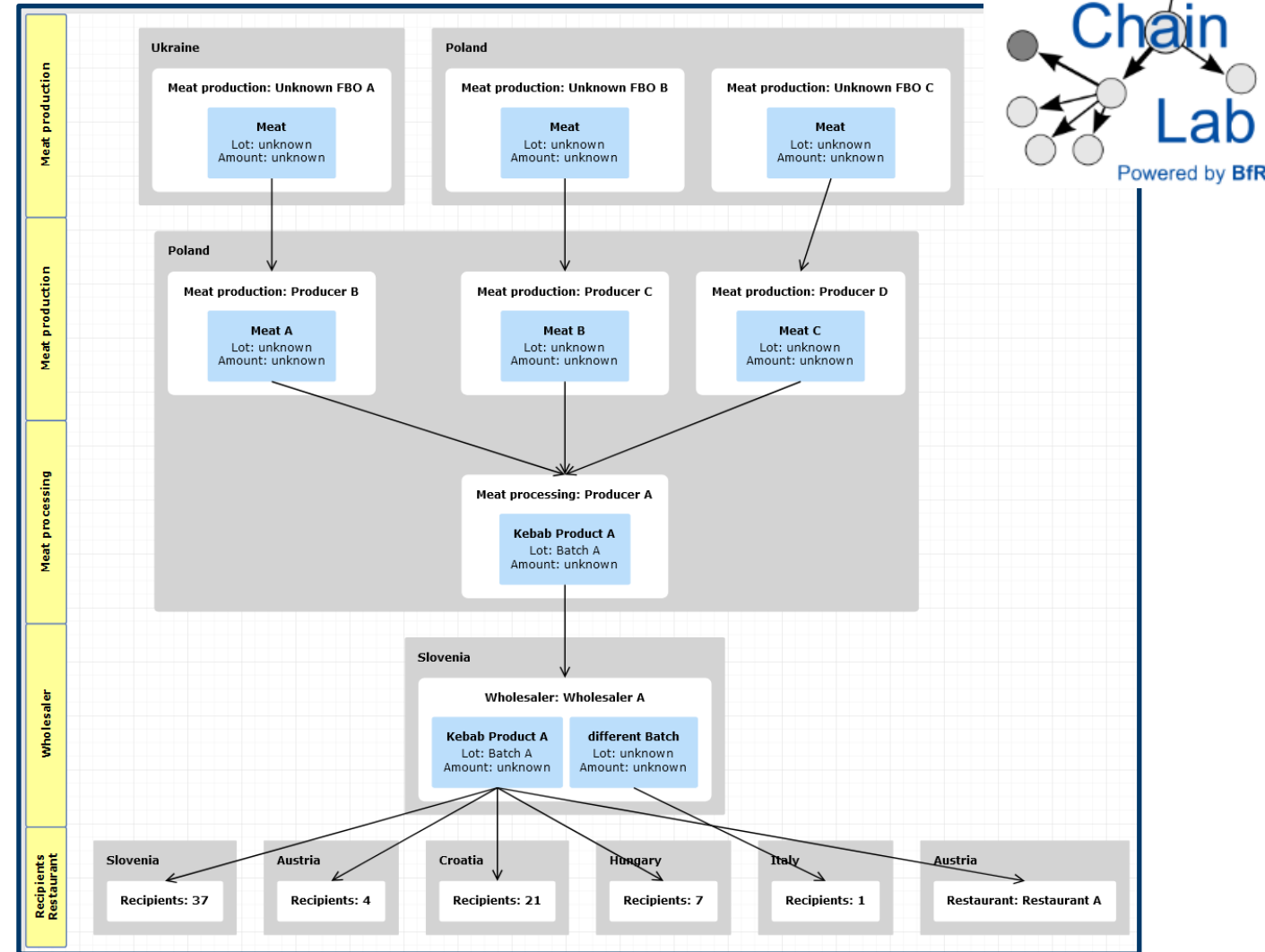
time / Unknown time

Station Sample Box Label

☒ Display rounded numbers (three digits)

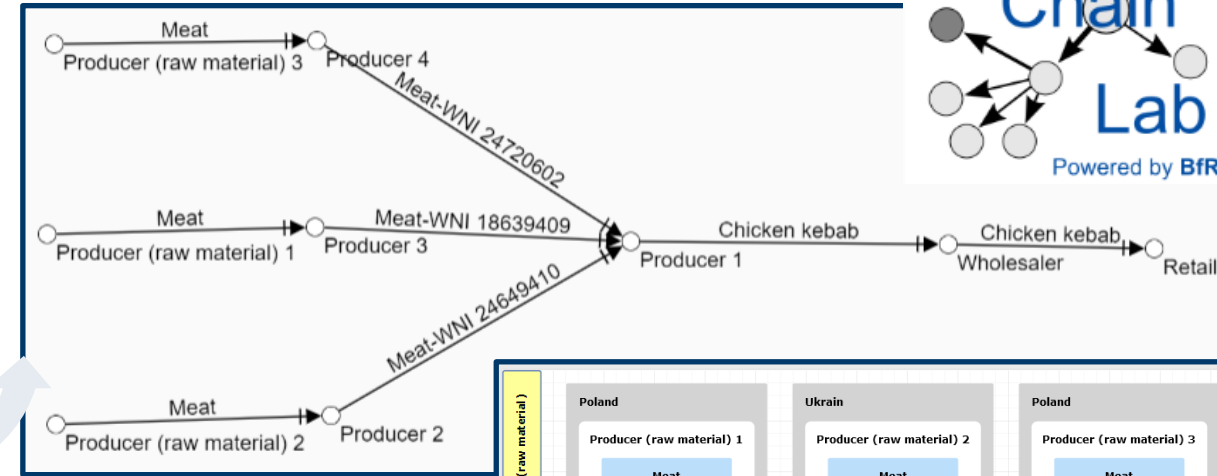
Generate Report
Restore Defaults
Cancel

- 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

Anonymisation Label 24

Anonymization Label Composition:

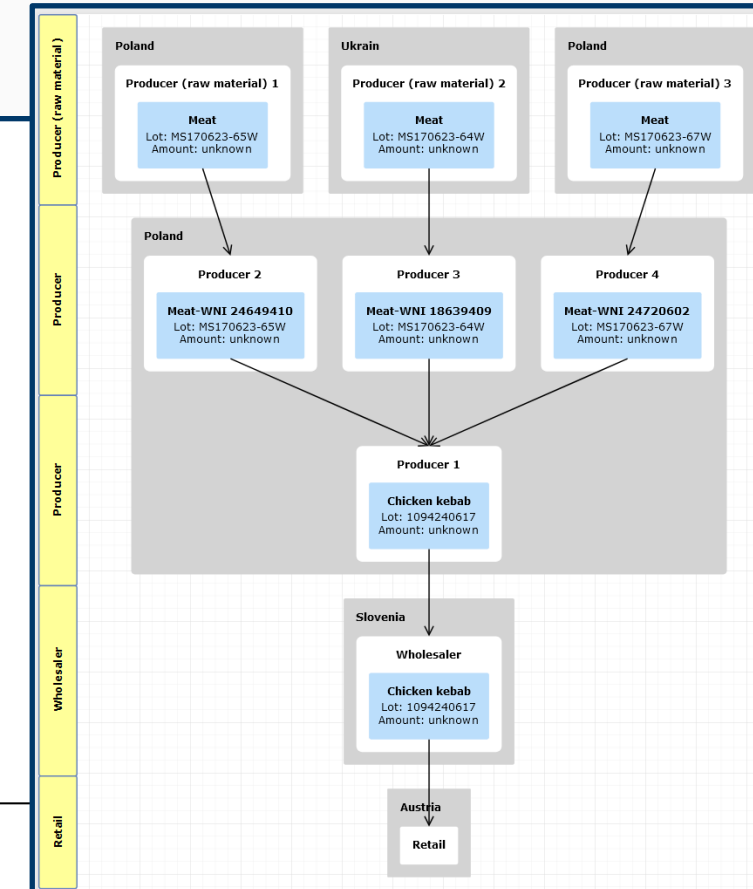
Prefix	Property / Index
Station	Label start
::	Country
::	Type of Business
::	Numerical Index
+	

Label preview:
Station [Country] [Type of Business] [Numerical Index]

☐ Use conditions Add selection Remove Selection

property op value + -

✓ Apply ✗ Cancel ✓ OK

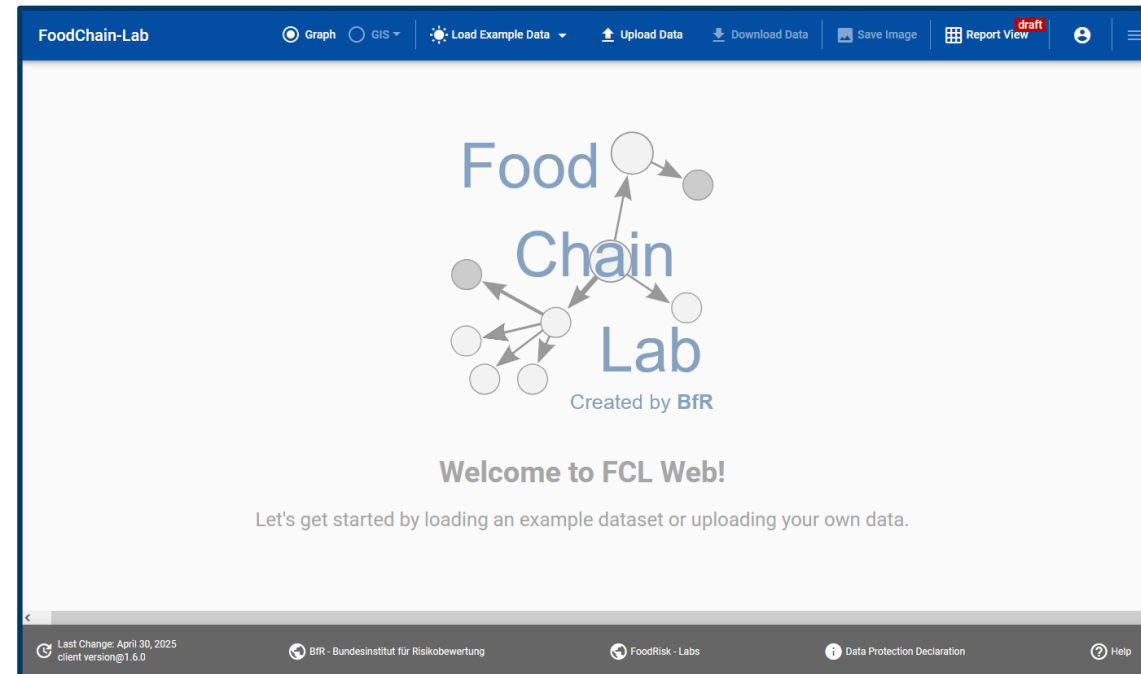


Need: Data security

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

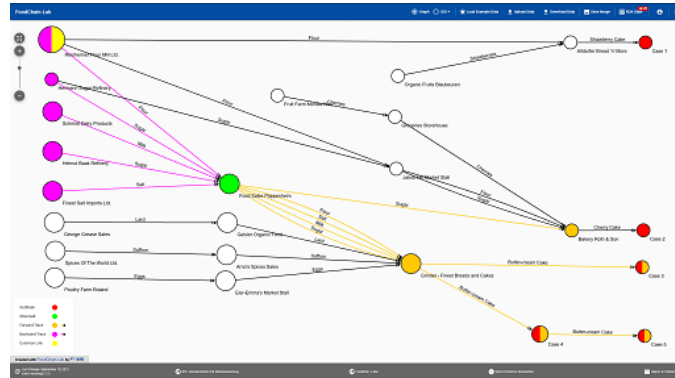


Need: Easy and intuitive handling



Functionalities in FoodChain-Lab

FCL Web

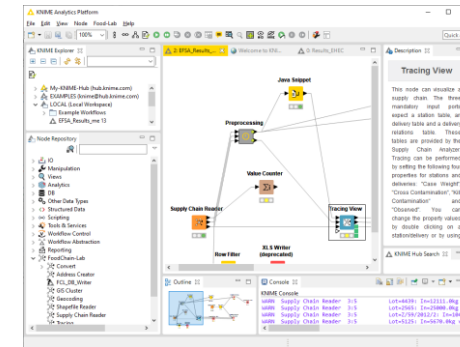


- In a web browser (no installation)
- Data stays local, browser is only for visualisation
- Intuitive handling

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

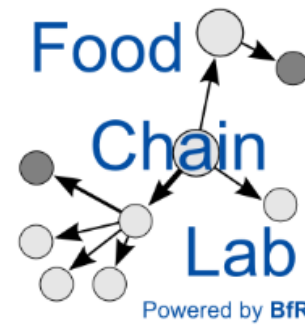
FCL Desktop



- 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)

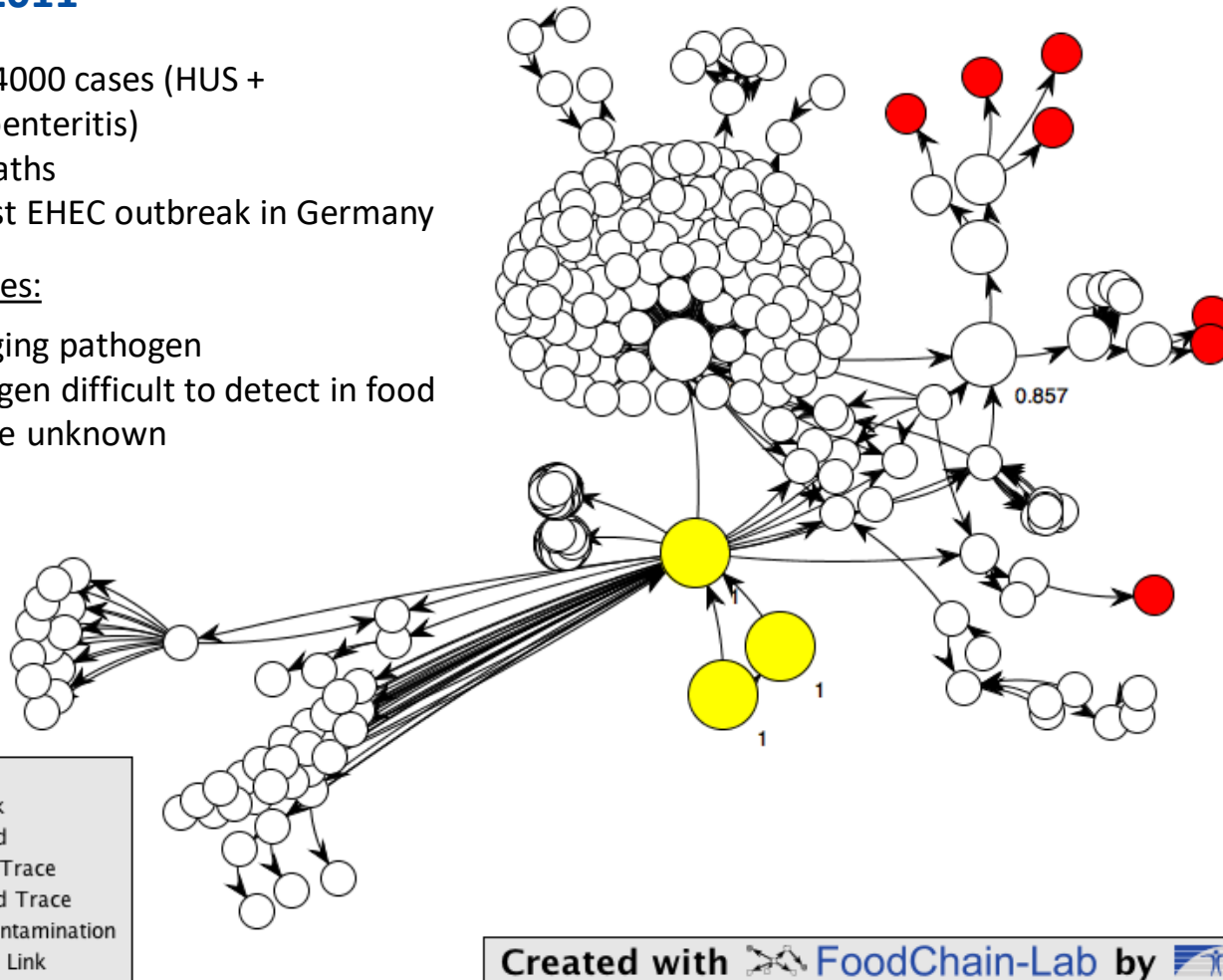


EHEC 2011

- 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. MIKHAIL¹, C. JENKINS^{1*}, T. J. DALLMAN¹, T. INNS^{2,3}, A. DOUGLAS¹,
A. I. C. MARTÍN⁴, A. FOX¹, P. CLEARY^{2,3}, R. ELSON¹ AND J. HAWKER^{2,3}

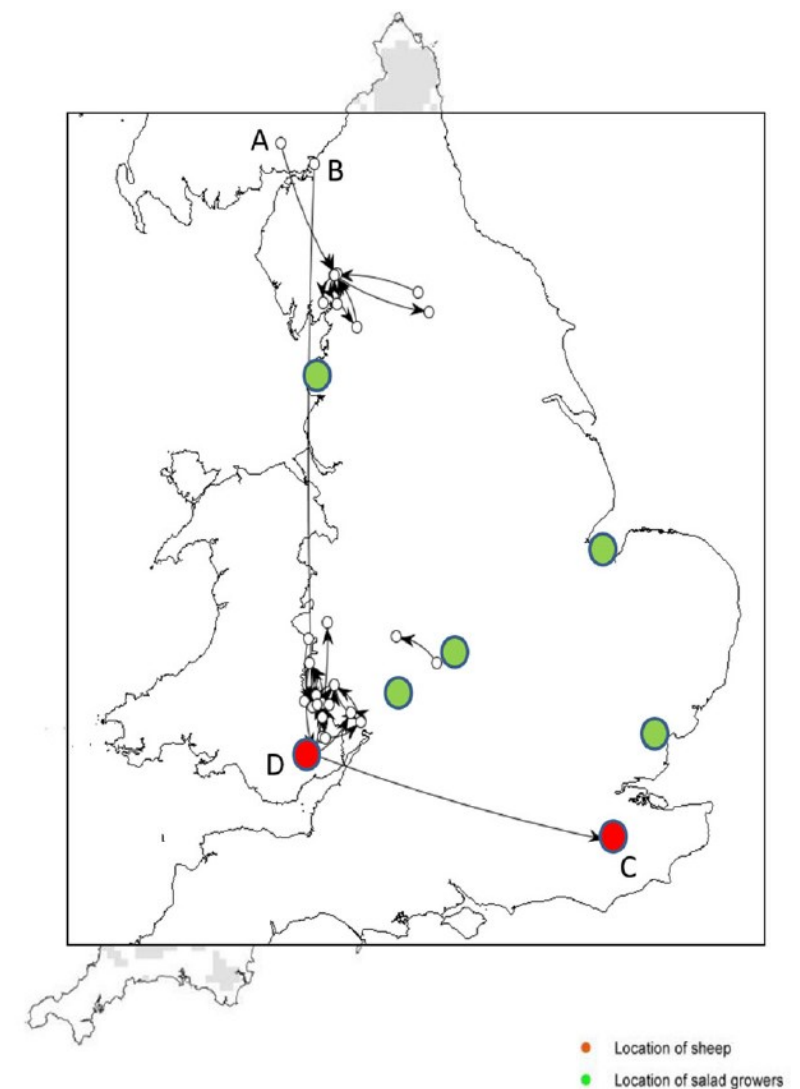
→ Mapping the recent movement of sheep and lambs across the United Kingdom

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 Foulkes¹, Ashley Sharp⁵, Lara Utsi¹, Chris McBrien⁵, Rehman Teagle¹, Allison Waldram¹, Chris Williams⁶, Cathy McCann¹, Rob Smith⁶, Sepeedeh Saleh⁵, Noel McCarthy^{3,7}, Roberto Vivancos^{1,3,8}, Jeremy Hawker^{1,3}, Valerie Decraene¹

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

Maya Goblin¹, Jeremy Hawker^{1,2}, Paul Cleary^{1,2}, Thomas Inns^{1,2}, Daniel Gardiner^{1,3}, Amy Mikhail⁴, Jacquelyn McCormick⁴, Richard Elson^{2,4}, Derren Ready⁴, Tim Dallman^{2,4}, Iain Roddick¹, Ian Hall⁵, Caroline Willis⁶, Paul Crook¹, Gauri Godbole³, Drazenka Tubin-Delic⁷, Isabel Oliver^{1,8}

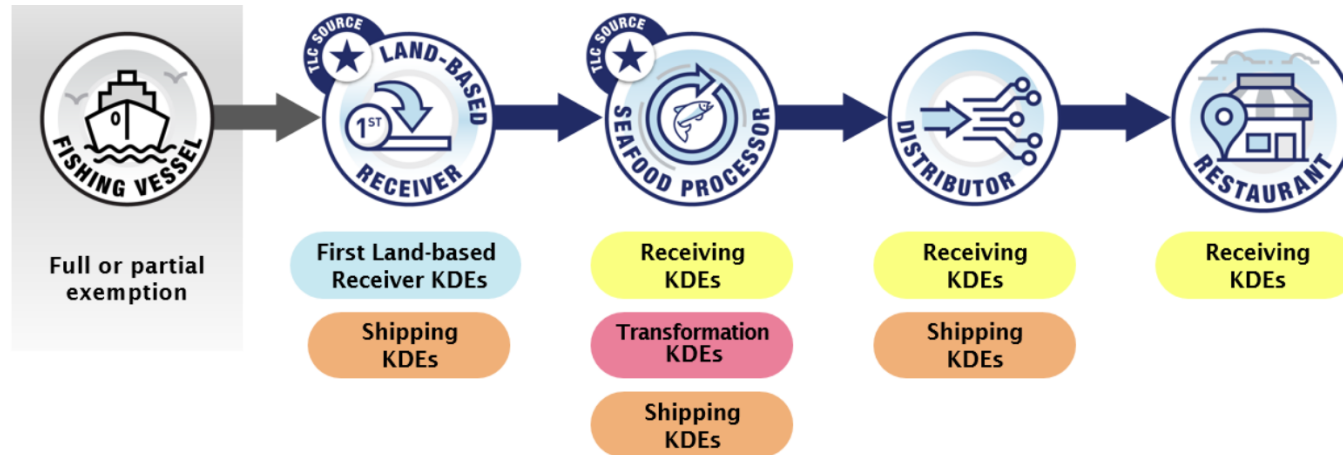


Case study on Salmonella outbreak associated with eggs

Mapping of movements of hospital staff

FDA's New Era of Smarter Food Safety

„Food Traceability Rule“ for harmonized data and data sharing



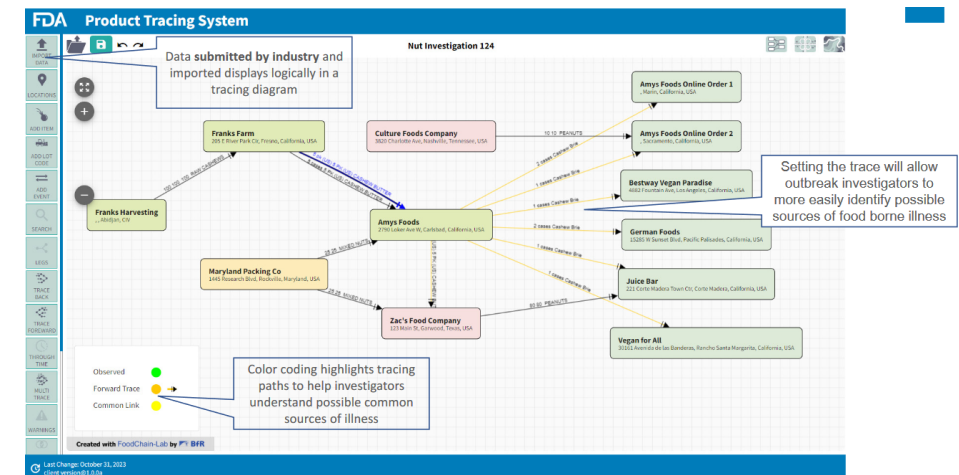
Demo video of PTS + FCL in action

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



Product Tracing System

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



Collaboration between FDA and BfR

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

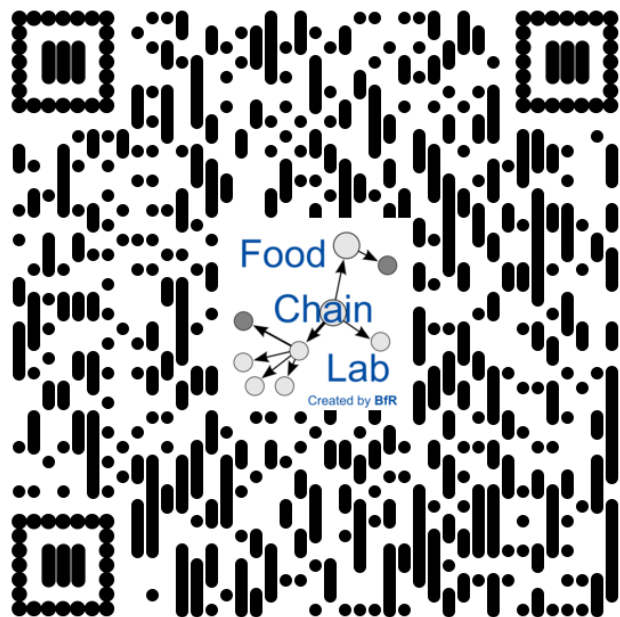
Benefits of using FoodChain-Lab for MS/EU authorities

- 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



Marion Gottschald

**German Federal Institute for
Risk Assessment**

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

Thank you for your attention!



German Federal Institute for Risk Assessment

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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