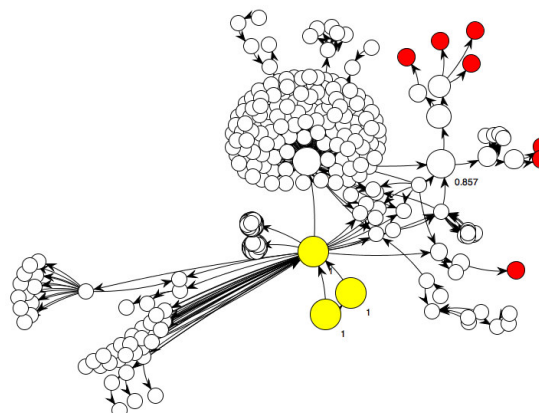


## FoodChain-Lab: an innovative tool to increase food safety through supply chain analyses

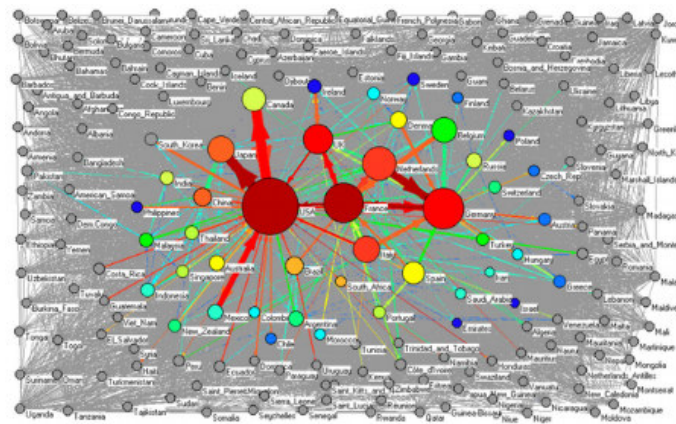
Marion Gottschald, Alexander Falenski, Marco Rügen, Birgit Lewicki, Isaak Gerber, Jakub Fusiak, Dominic Tölle, Annemarie Käsböhrer, Armin Weiser



*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).*

## Why do we need FoodChain-Lab?

### 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 integrative software tools  
e.g. for tracing food and feed**

# Traceability/Tracing

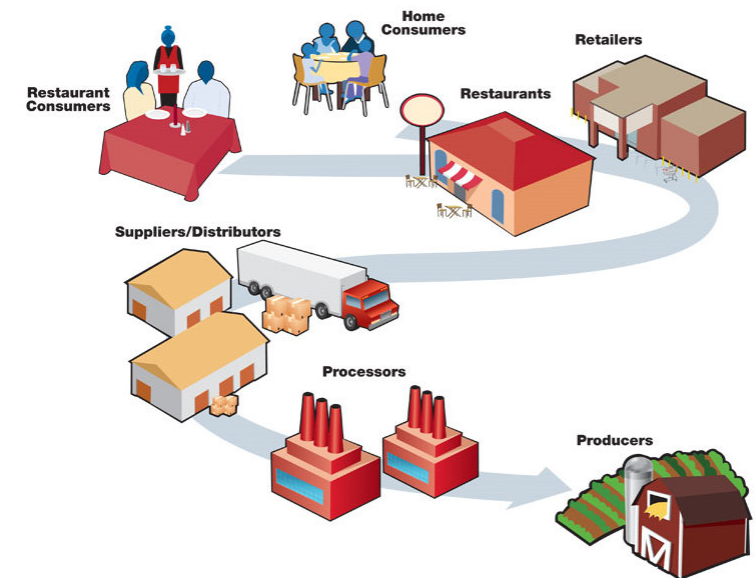
## What is tracing? (Regulation (EC) No. 178/2002, Art. 18)

- 1) ... **at all stages of production, processing and distribution**...
- 2) **Food and feed business operators** shall be able to **identify any food company from** whom they have been **supplied** ...
- 3) ...**to** which their products have been **delivered**.

## Purpose of tracing

- identify source of contamination + distribution of contaminated food
  - warning of consumers
  - remove contaminated food from market
- compare distribution of cases + contaminated food
  - strengthen epidemiological association

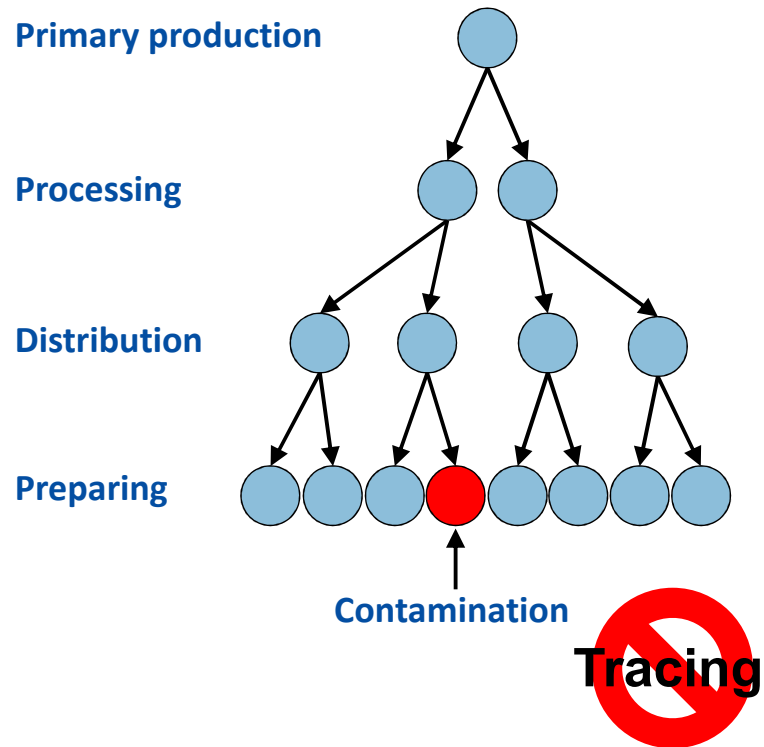
## Tracing the Food Back to the Source



CDC: [https://www.cdc.gov/outbreaknet/investigations/figure\\_traceback.html](https://www.cdc.gov/outbreaknet/investigations/figure_traceback.html)

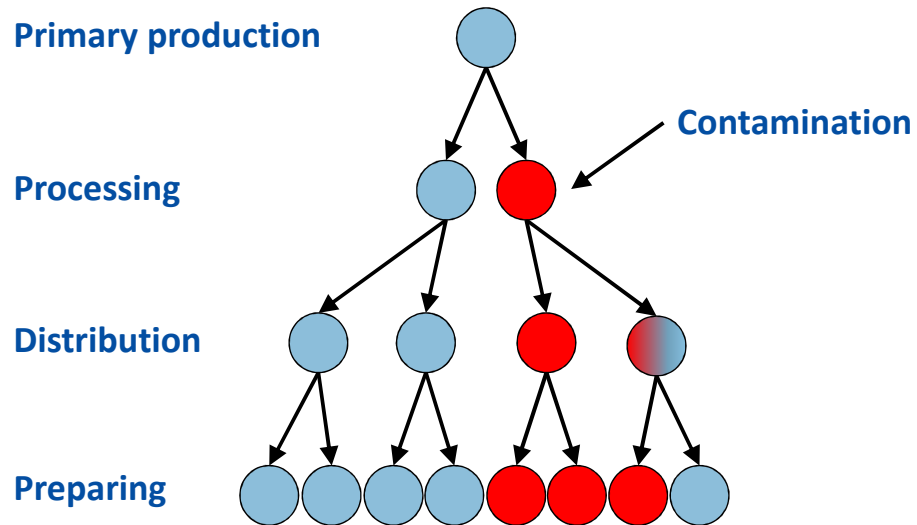
# Tracing in foodborne crises

Foodborne disease outbreak affecting multiple locations/countries



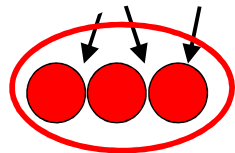
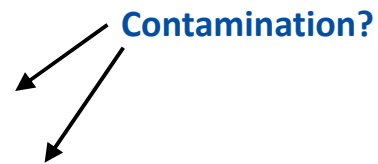
# Tracing in foodborne crises

## Foodborne disease outbreak affecting multiple locations/countries



## Tracing in foodborne crises

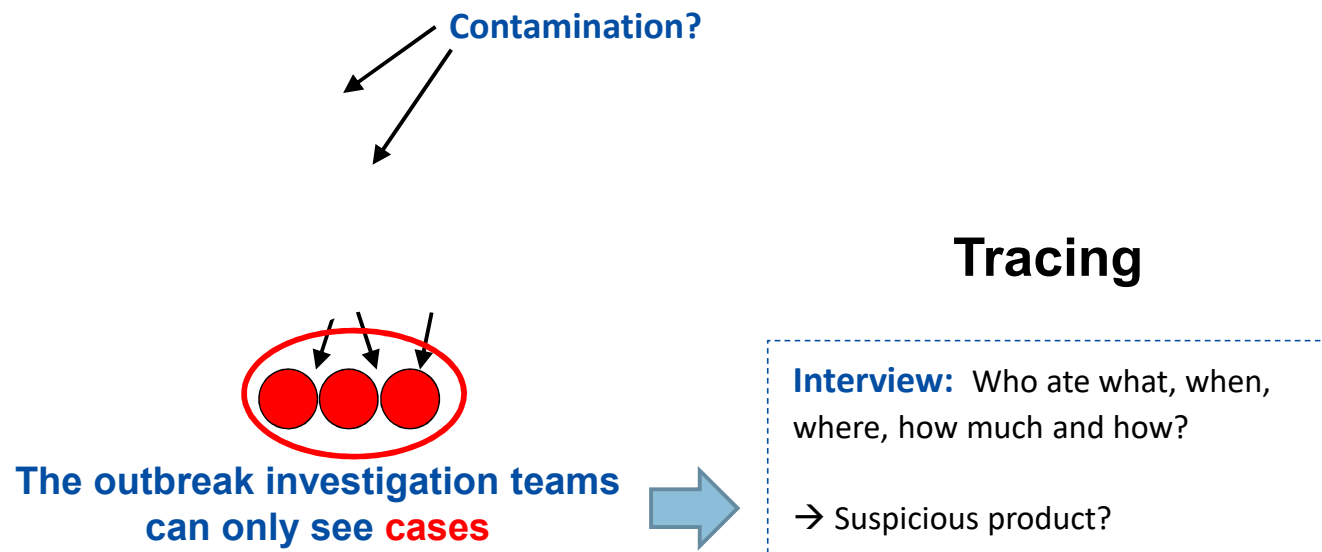
**Foodborne disease outbreak affecting multiple locations/countries**



**The outbreak investigation teams  
can only see **cases****

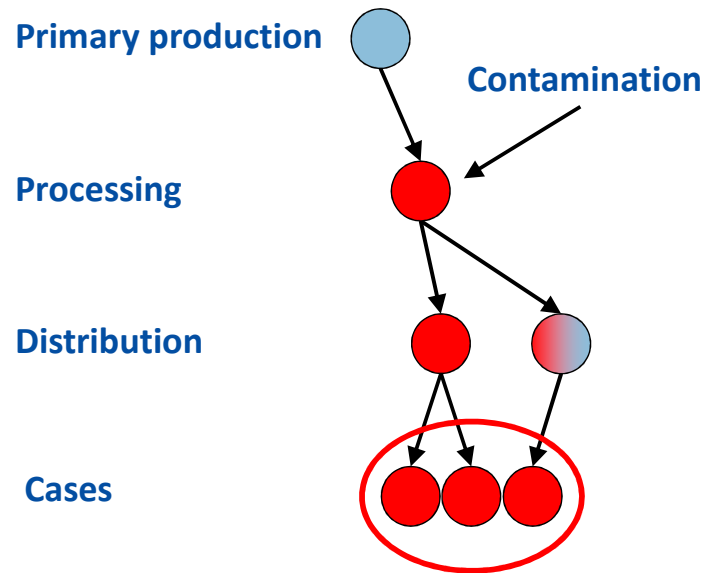
## Tracing in foodborne crises

### Foodborne disease outbreak affecting multiple locations/countries

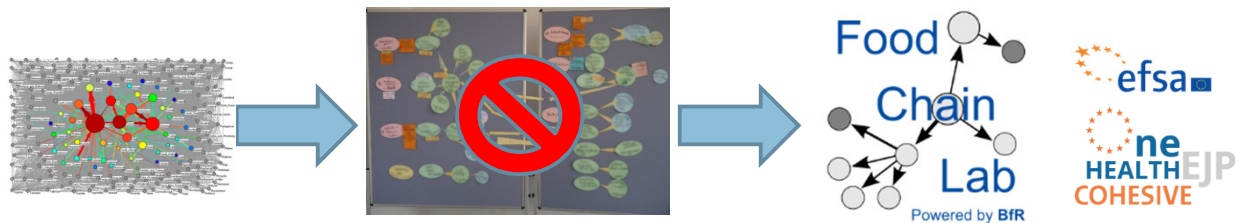


# Tracing in foodborne crises

## Foodborne disease outbreak affecting multiple locations/countries



- Backtracing**
- Step-by-step upstream the supply chain (REGULATION (EC) No 178/2002)
  - Collecting delivery data for suspicious products and their ingredients
  - Combine fragmented information
  - Origin of contamination?









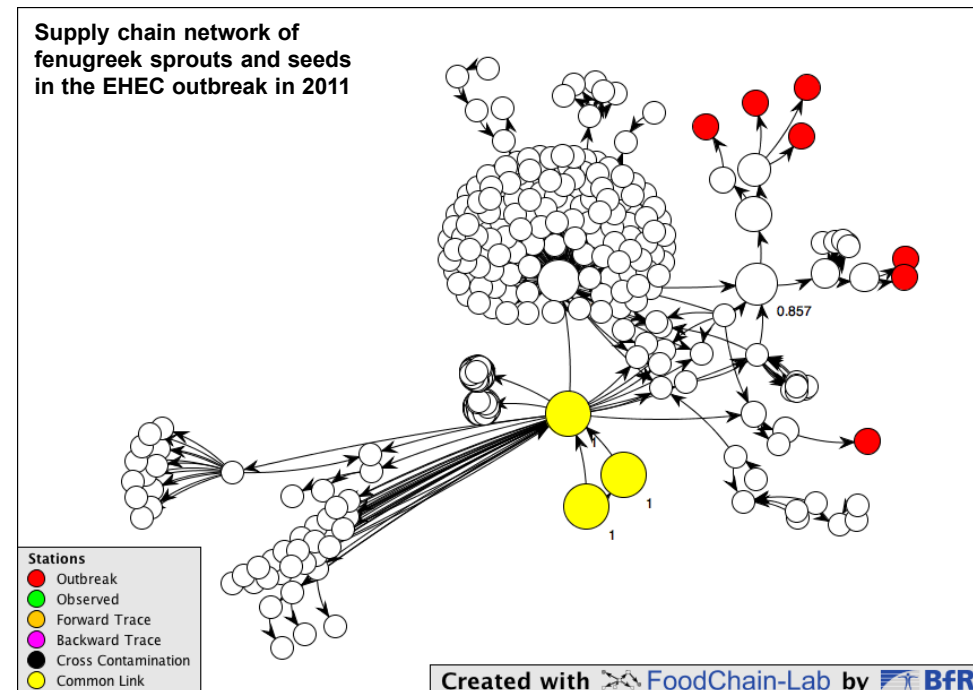
## FoodChain-Lab – What is it?

- Free open source software (<https://foodrisklabs.bfr.bund.de/foodchain-lab/>)
- Tool to trace back and forward suspicious food items along complex supply chains to help solving foodborne crises (outbreaks, chemical contaminations)
- Available as **desktop version** and **web application**

<https://foodrisklabs.bfr.bund.de>  
+ data collection/  
cleaning

<https://fcl-portal.bfr.berlin>  
data collection/cleaning  
coming soon

- Data collection via Excel templates, web-based data collection tool, interface for mass data envisioned
- Automated visualisation of food business operators  and deliveries 
- Automated analysis of supply chain network to identify potential common source  of pathogen/contamination and disease cases 
- Interactive analysis, simulation of hypotheses (e.g. cross contamination)
- Helps prioritizing next investigation steps



# The FoodChain-Lab web application (FCL Web)

North Rhine-Westphalia cooperation

- Tracing data collection tool

Recipient	Product detail	Current dataset:	Commodity relations
Product name: Malt	Product amount: 10000		
Trade name: Vollkornmehl	Amount unit: Stück (ID: null)		
Article number: 47200	Number of trading units: null		
EAN code: null	Trading unit name: null (ID: null)		
Lot: ZM170922	BEID: null null null		
Comment:			

Landesamt für Natur, Umwelt und Verbraucherschutz Nordrhein-Westfalen

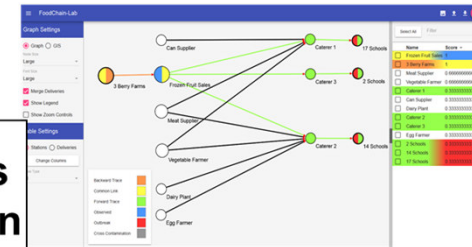
## The Tracing (Web-) Portal <https://fcl-portal.bfr.berlin/>

**Data Collection**  
RASFF  
Local  
Bulk

**Data Analysis & Visualization**

**Reporting**

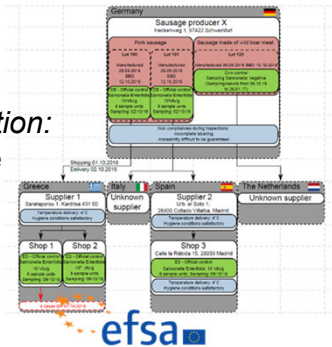
**Sync with Desktop App**



- EFSA-BfR cooperation:
- Tracing web platform including desktop FoodChain-Lab for tracing needs

EFSA-BfR cooperation:

- Reporting module



OH EJP NOVA:

- NOVA gravity model and webtool



# FCL Web – network view, map view, reporting view and data

The screenshot displays the FoodChain-Lab web application interface. At the top, there is a navigation bar with options: Graph, GIS, Load Example Data, Upload Data, Download Data, Save Image, ROA Style, and a menu icon. The main area is divided into several panels:

- Network View:** A central hub-and-spoke diagram showing the supply chain network. Nodes represent various entities like 'Reinheimer Flour Mill Ltd.', 'Hermann Sugar Refinery', 'Schmidt Dairy Products', 'Helmut Baak Refinery', 'Finest Salt Imports Ltd.', 'Food Sales Pappenheim', 'Jakob Hill Market Stall', 'Bakery Roth & Son', 'Grindel - Finest Breads and Cakes', 'Altdorfer Bread 'n' More', and 'Case 1' through 'Case 5'. Edges represent the flow of ingredients like Flour, Sugar, Milk, and Salt.
- Map View:** A geographical map showing the locations of the nodes in the network.
- Reporting View:** A hierarchical flowchart showing the distribution of products from the source to various retail outlets.
- Data Table:** A table listing the nodes with columns for Name, Country, Type of Business, and Score. The table is filtered to show 'Deliveries'.

**Data Table:**

Name	Country	Type of Business	Score
Case 2	DE	Customer	0.2
Case 4	DE	Customer	0.4
Case 3	DE	Customer	0.2
Case 5	DE	Customer	0.2
Grindel - Finest Brea	DE	Bakery	0.6
Altdorfer Bread 'n' M	DE	Bakery	0.2
Food Sales Pappenh	DE	Wholesaler	0.6
Schmidt Dairy Produ	DE	Processor	0.6
Reinheimer Flour Mil	DE	Processor	1
Hermann Sugar Refir	DE		
Case 1	DE		
Helmut Baak Refiner	DE		
Bakery Roth & Son	DE		
Finest Salt Imports L	DE		
Jakob Hill Market St	DE		
Fruit Farm Monika M	DE		
Eier-Emma's Market	DE		
Organic Fruits Blaubr	DE		
Poultry Farm Roland	DE		
George Grease Sales	DE		
Groceries Storehous	DE		
Spices Of The World	DE		

**Colours and Shapes...**

Category	Color	Count	Legend Icon	Toggle	Edit	Delete
Outbreak	Red	5	Red circle	On	✎	🗑️
Observed	Green	1	Green circle	On	✎	🗑️
Forward Trace	Yellow	10	Yellow circle	On	✎	🗑️
Backward Trace	Magenta	0	Magenta circle	On	✎	🗑️
Cross Contamination	Black	0	Black circle	On	✎	🗑️
Common Link	Yellow	1	Yellow circle	On	✎	🗑️
Kill Contamination	Grey	0	Grey circle	On	✎	🗑️
Mill	Blue	1	Blue square	On	✎	🗑️

<https://fcl-portal.bfr.berlin/>

- browser-based
- easy and intuitive user interface,
- Visualisation, analysis and reporting tools
- data stay on client side!

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

# FoodChain-Lab – Successful applications and impact

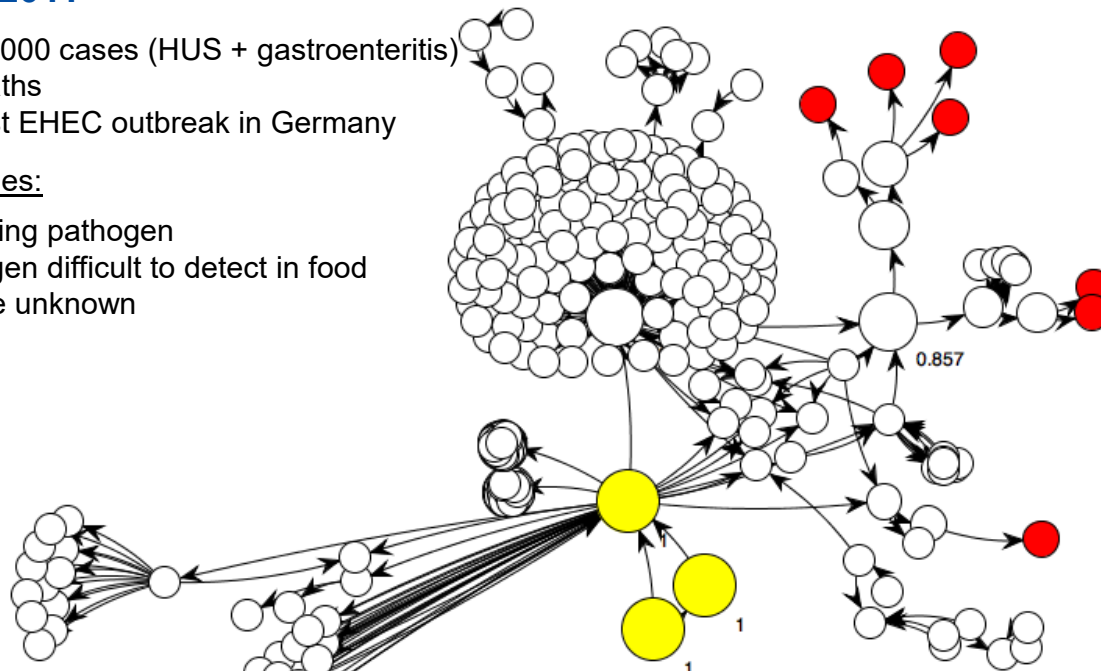


## EHEC 2011

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

### Challenges:

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



Stations	
●	Outbreak
●	Observed
●	Forward Trace
●	Backward Trace
●	Cross Contamination
●	Common Link

Created with FoodChain-Lab by BfR

## Other applications:

DE:

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

EU:

HAV 2013/14, C. Bot. 2017 (Plötze), Salm 2017 (Sesam)

Autonomous applications:

UK, AT, ES, HU, PL

Free support by FCL team

Interested?

Please contact [foodrisklabs@bfr.bund.de](mailto:foodrisklabs@bfr.bund.de)

## Impact:

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

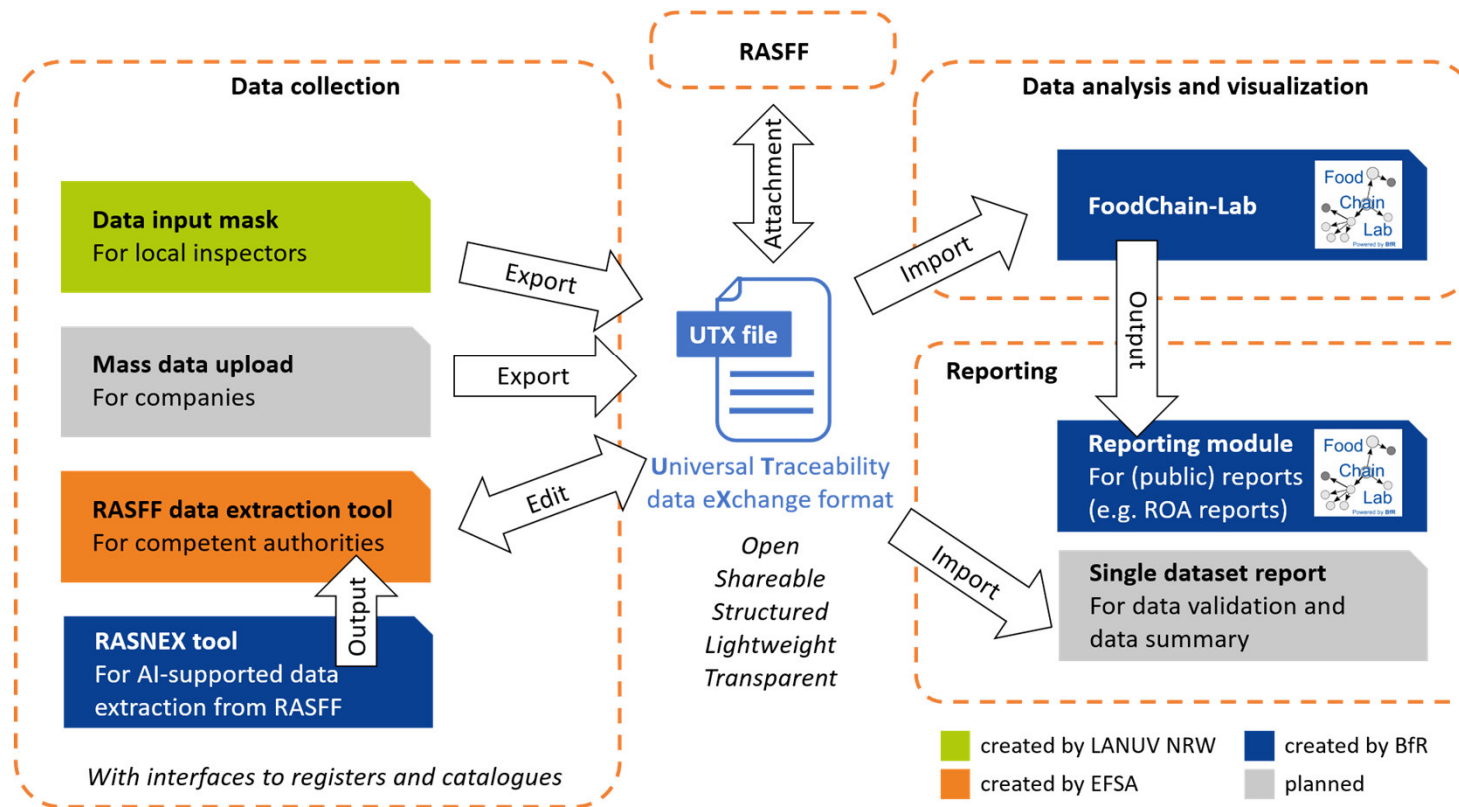
U.S. FDA implemented FCL and FCL Web in data analysis workflow

# FCL Web – Where does the road take us?

EFSA-BfR cooperation on multiactor tracing software workflow + universal traceability data exchange format



## Tracing software ecosystem for Europe



**Benefits:**  
Facilitate data exchange  
Avoid double work  
Easy visualisation + analysis

Your tool?  
Feedback on UTX?

Please contact  
[foodrisklabs@bfr.bund.de](mailto:foodrisklabs@bfr.bund.de)

## Universal Traceability data exchange format (UTX)

Harmonisation of data models is key for interoperability → UTX standard



Universal Traceability  
data eXchange format

*Open*  
*Shareable*  
*Structured*  
*Lightweight*  
*Transparent*

### Structured:

- Core information (investigation, product, station, activities) is interoperable (standardised part of UTX)
- additional unstructured part → offers flexibility to include data which are characteristic for specific tools

### Open + Shareable:

- All tools respecting the UTX standard can be used
- Can be uploaded to RASFF system


### Transparent:

- Information source is noted

### Lightweight:

- JSON or XML file

## Benefits of using FoodChain-Lab for MS/EU authorities

- Free and open-source software
- Unifies stepwise tracing information in visualization
- All steps 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 
- Harmonisation with/integration of other tools and initiatives

 Fast and reliable investigation of foodborne incidents



## Thank you for your attention

### Marion Gottschald

#### German Federal Institute for Risk Assessment

Max-Dohrn-Str. 8-10, 10589 Berlin

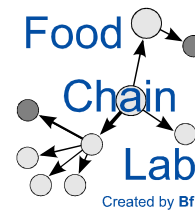
Tel. +49 30 - 184 12 - 0

Fax +49 30 - 184 12 - 99099

[bfr@bfr.bund.de](mailto:bfr@bfr.bund.de)

[www.bfr.bund.de](http://www.bfr.bund.de)

### (Extended) FoodChain-Lab Team



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*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.*