GERMAN FEDERAL INSTITUTE FOR RISK ASSESSMENT

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Bundesinstitut für Risikobewertung

Application of whole genome sequencing for foodborne outbreak investigations and epidemiological studies in Germany

Burkhard Malorny

European salmonellosis outbreak

Update:

- 60 cases in six European countries
- Last cases august 22/23
- No source identified yet

Rare Salmonella strain sickens 50 in five EU countries

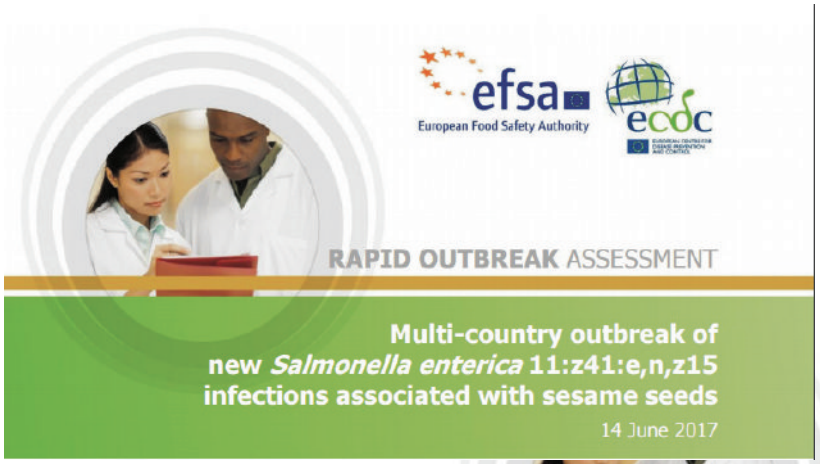
By **Joe Whitworth** on September 1, 2018

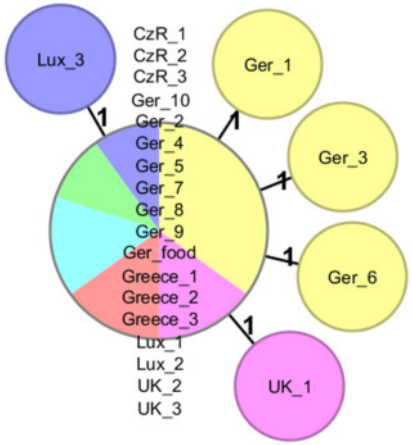
Around 50 people in five European countries have been struck down with a rare strain of Salmonella.

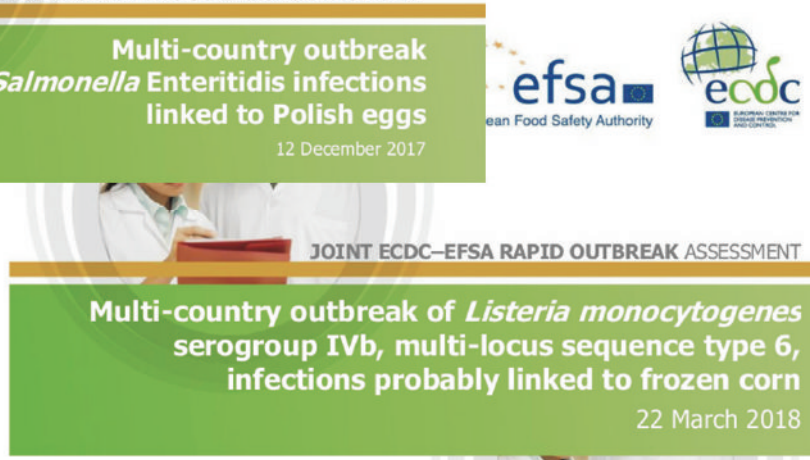
Salmonella Mikawasima has infected 15 people in Germany, 13 in Sweden, eight in both Denmark and the Czech Republic and six in Austria.

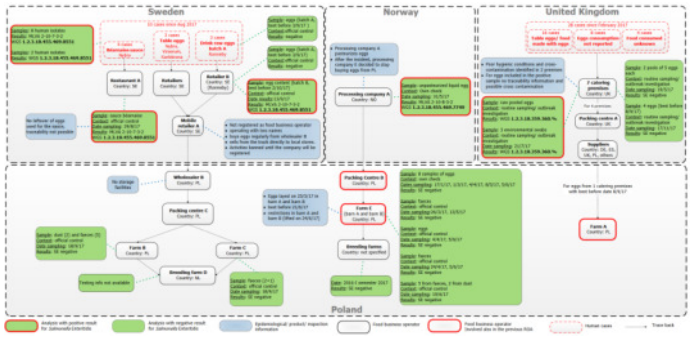
Source: Food Safety News. https://www.foodsafetynews.com/2018/09/rare-salmonella-strain-sickens-50-in-five-eu-countries/

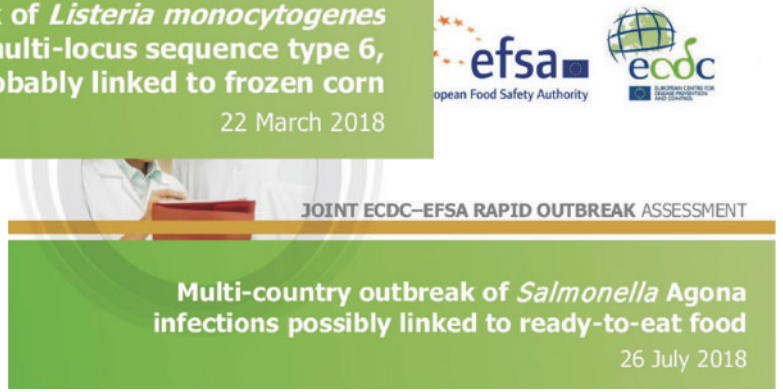
EFSA-ECDC Rapid outbreak assessments, Scientific opinions











Outbreaks in Germany

Campylobacter and raw milk was the most frequent food and pathogen combination

Campylobacter and Salmonella behind most outbreaks in Germany

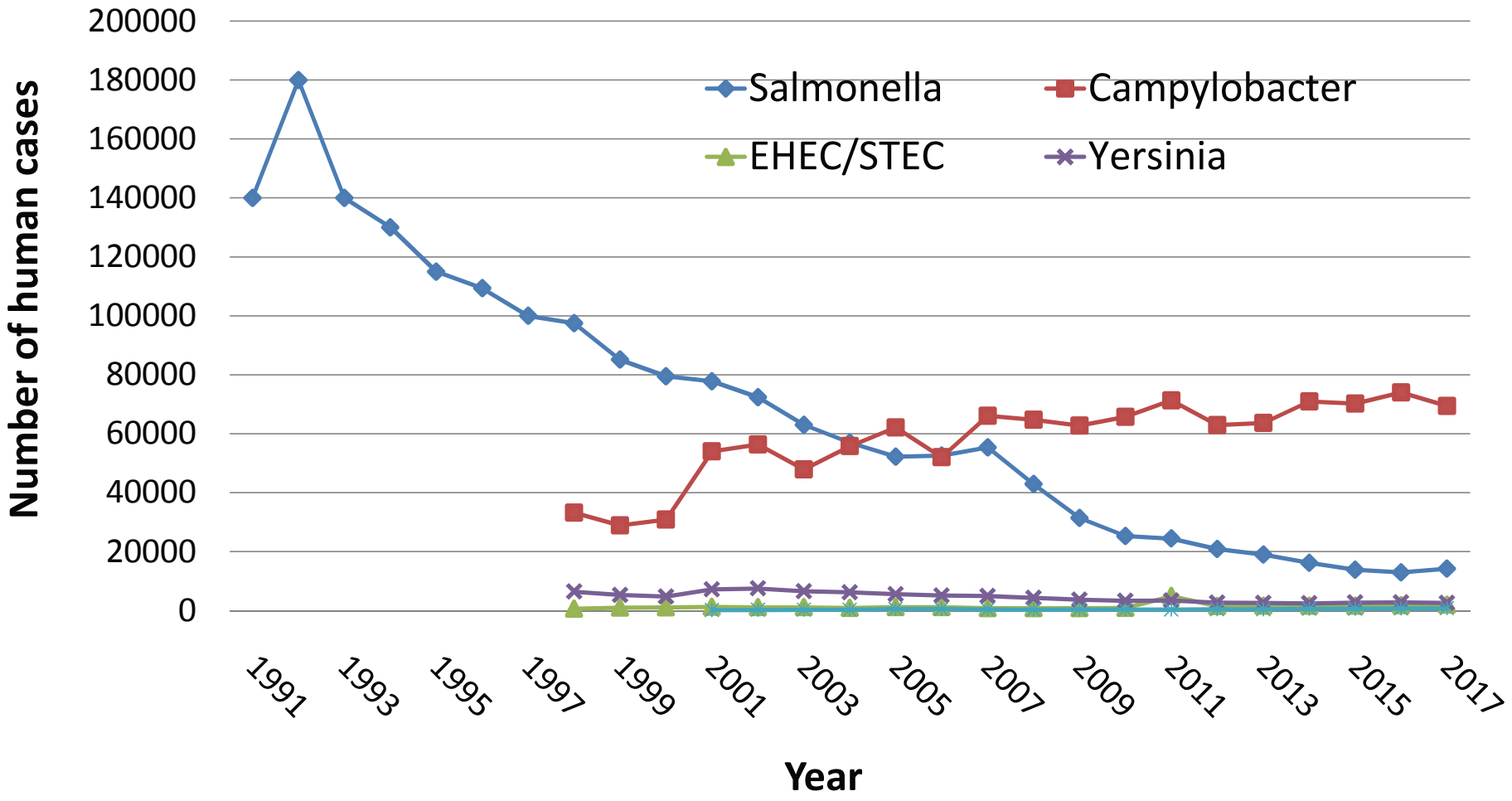
By **Joe Whitworth** on October 3, 2018

Almost 400 foodborne outbreaks occurred in Germany last year, according to a report. Most outbreaks with high evidence were caused by raw milk.

A total of 389 outbreaks involved at least 2,277 illnesses, 412 hospitalizations and four deaths. Salmonella was implicated in two deaths and Verotoxin-producing E. coli (VTEC) and Hepatitis A virus in one each.

Source: Food Safety News. https://www.foodsafetynews.com/2018/10/campylobacter-and-salmonella-behind-most-outbreaks-in-germany/

Reported human cases in Germany



Source: RKI SuvStat, http://www3.rki.de/SurvStat/

Reported foodborne outbreaks in Germany 2016/2017 with low evidence

	Number of outbreaks		Number of cases		Number of hospitalisation		Number of fatal cases	
	2016	2017	2016	2017	2016	2017	2016	2017
Campylobacter spp.	198	131	552	331	71	61	0	0
Salmonella Enteritidis	53	72	169	265	35	62	0	0
Salmonella Typhimurium	11	22	36	96	10	23	0	0
Other Salmonella spp.	18	25	65	122	18	51	2	0
VTEC (EHEC)	5	10	20	22	7	1	0	0
Shigella spp.	3	1	8	2	1	0	0	0
Listeria monocytogenes	2	1	4	2	4	2	1	0
Francisella tularensis	1	-	6	-	2	-	0	-
Clostridium botulinum	1	-	2	-	2	-	0	-
Bacillus cereus	1	3	3	53	0	0	0	0
Norovirus	29	17	627	134	21	10	0	0
Hepatitis Virus (A or E)	10	12	25	31	14	12	0	0
Giardia	6	7	13	15	0	1	0	0
Cryptosporidium spp.	2	3	4	8	0	0	0	0
Unknown pathogen	16	28	190	161	n.k.	7	0	0
Total	**356**	**332**	**1724**	**1242**	**185**	**230**	**3**	**0**

Source: Bundesamt für Verbraucherschutz und Lebensmittelsicherheit (BVL). 2017. Gemeinsamer nationaler Bericht des BVL und RKI zu lebensmittelbedingten Krankheitsausbrüchen in Deutschland 2017. https://www.bvl.bund.de/DE/01_Lebensmittel/01_Aufgaben/9_BELA/BELA_node.html

Reported foodborne outbreaks in Germany 2016/2017 with high evidence

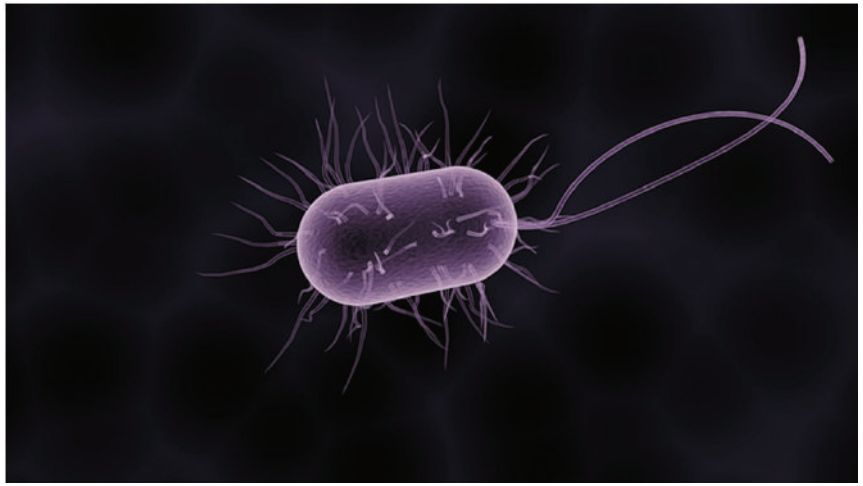
	Number of outbreaks		Number of cases		Number of hospitalisation		Number of fatal cases	
	2016	2017	2016	2017	2016	2017	2016	2017
Campylobacter spp.	11	16	113	221	29	26	0	0
Salmonella spp.	9	14	81	334	13	106	0	2
Norovirus	6	3	462	173	14	2	0	0
Bacillus cereus	5	2	73	33	3	n.k.	0	0
Histamin	3	2	9	9	0	n.k.	0	0
VTEC (EHEC)	1	2	3	27	3	17	0	1
Staphylococcus aureus	1	3	21	43	n.k.	11	0	0
Listeria monocytogenes	1	-	12	-	10	-	1	0
Clostridium botulinum	1	-	4	-	4	-	0	0
Clostridium perfringens	1	4	3	114	0	n.k.	0	0
Cryptosporidium spp.	1	-	2	-	0	-	0	-
Hepatitis A	-	1	-	5	-	4	-	1
Flavivirus	1	1	2	13	2	1	0	0
Total	**41**	**48**	**785**	**972**	**78**	**167**	**1**	**4**

Source: Bundesamt für Verbraucherschutz und Lebensmittelsicherheit (BVL). 2017. Gemeinsamer nationaler Bericht des BVL und RKI zu lebensmittelbedingten Krankheitsausbrüchen in Deutschland 2017. https://www.bvl.bund.de/DE/01_Lebensmittel/01_Aufgaben/9_BELA/BELA_node.html

Listeriose outbreak in Germany 2012 – 2016

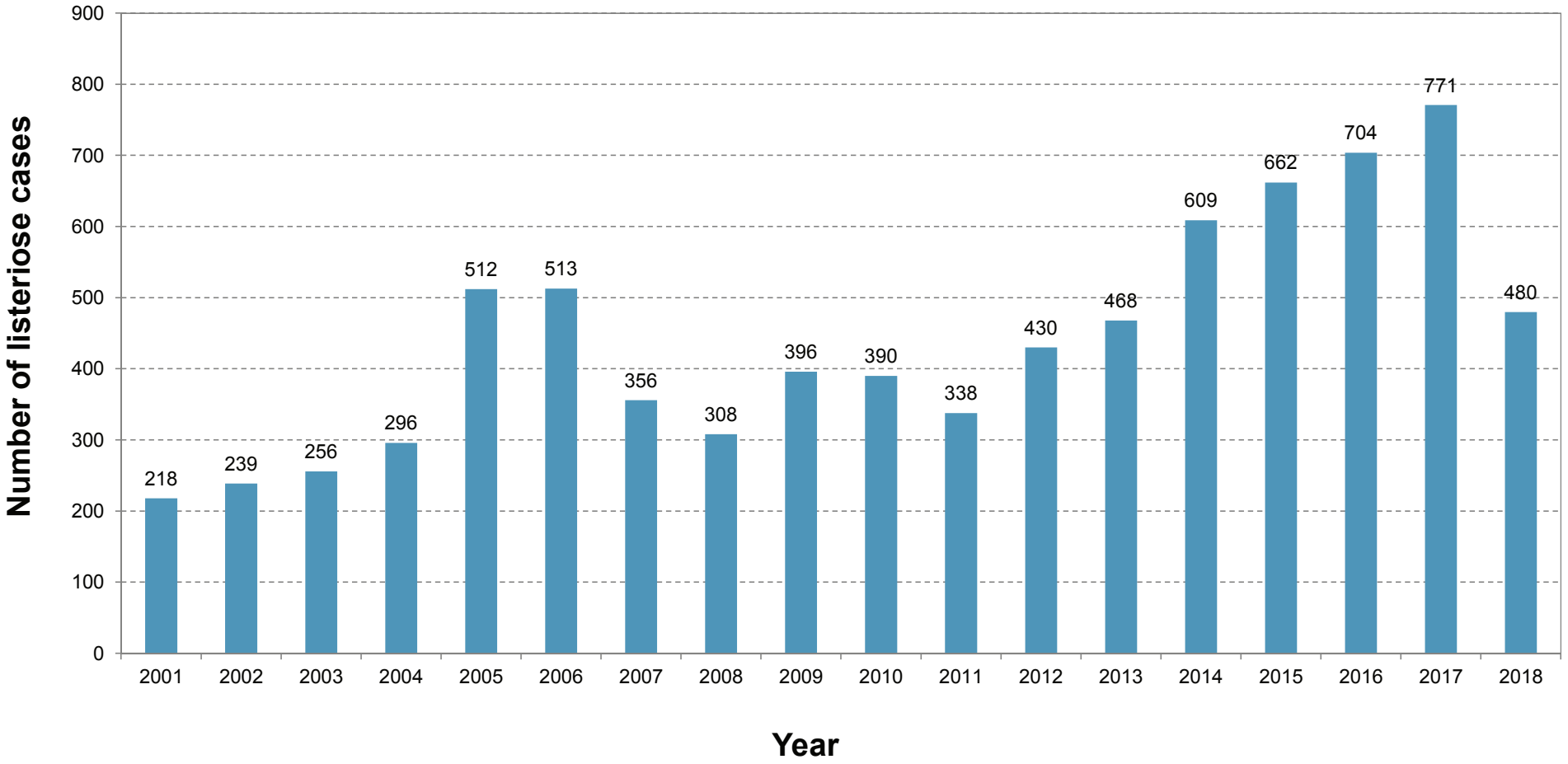
caused by pork products

Publication: Kleta et al. (2017). Molecular tracing to find source of protacted invasive listeriosis outbreak, southern Germany, 2012-2016. Emerging Infect. Dis. 23: 1680-1683



Listeriose cases in Germany

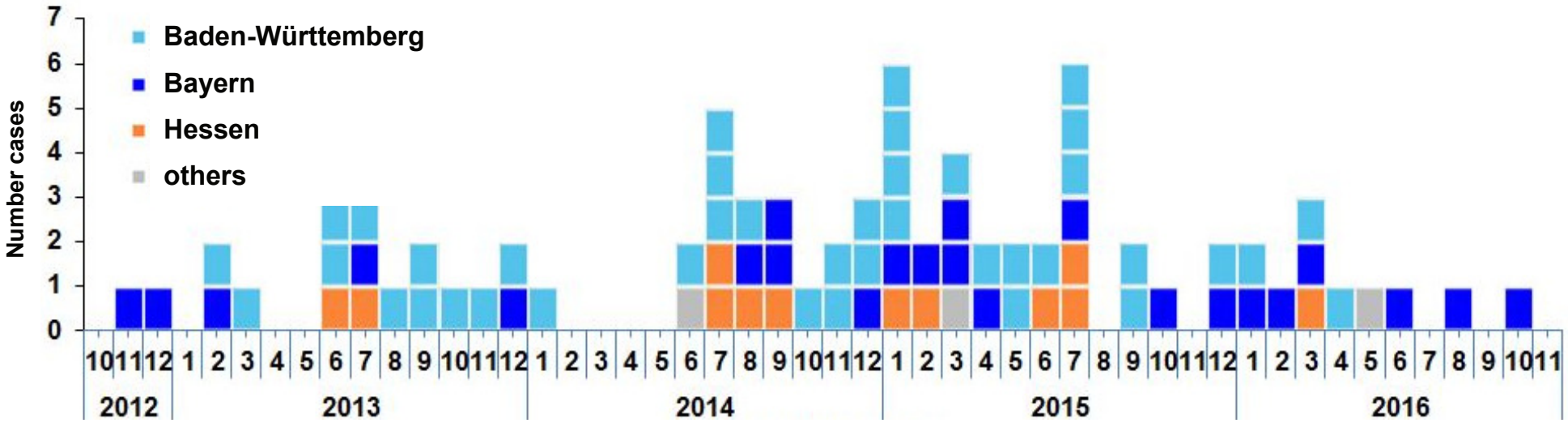
Source: SURVSTAT@RKI 2.0, data up to 04.10.2018



Listeriosis outbreak, Germany, 2012-2016

- 78 cases Nov 2012 – Oct 2016 in Germany
- 8 fatal cases, 4 confirmed by listeriosis
- explorative interviews without clear reference to causative food
- Several PFGE profile matches with NRL and EURL-Listeria database
  but no match of isolates with outbreak strain using whole genome sequencing

Epicurve [Source: Robert Koch-Institut]

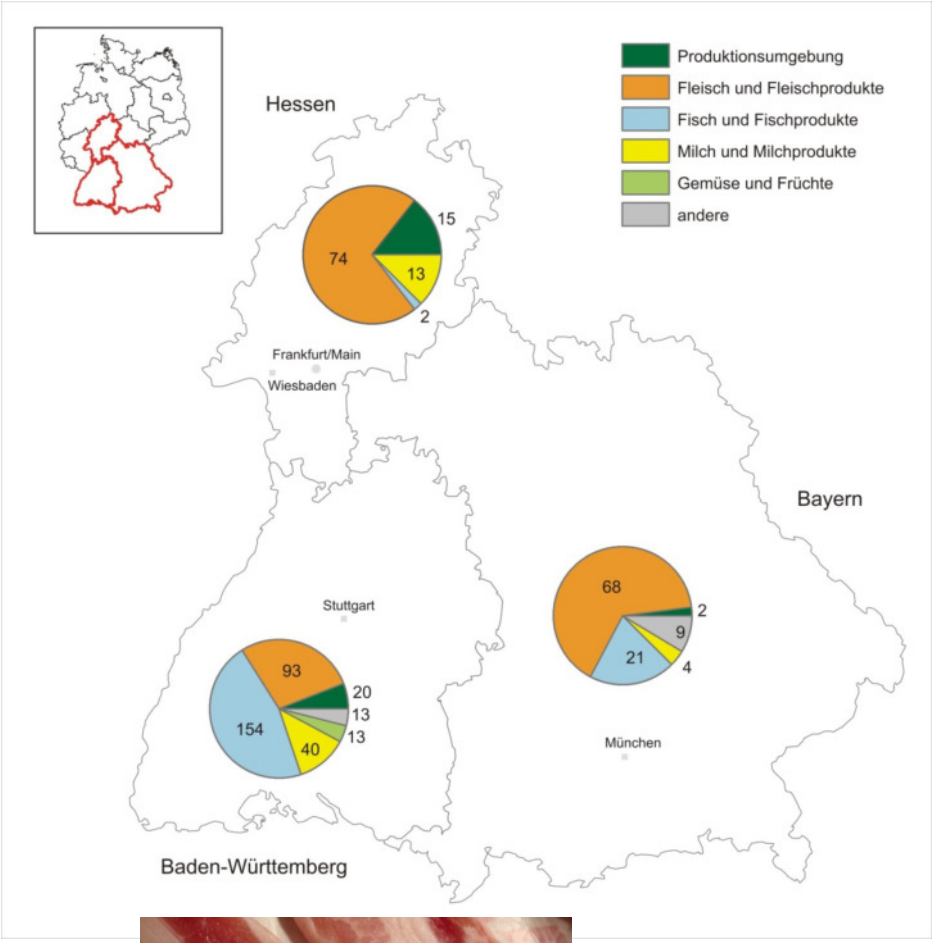


Molecular typing of *L. monocytogenes* isolated from food

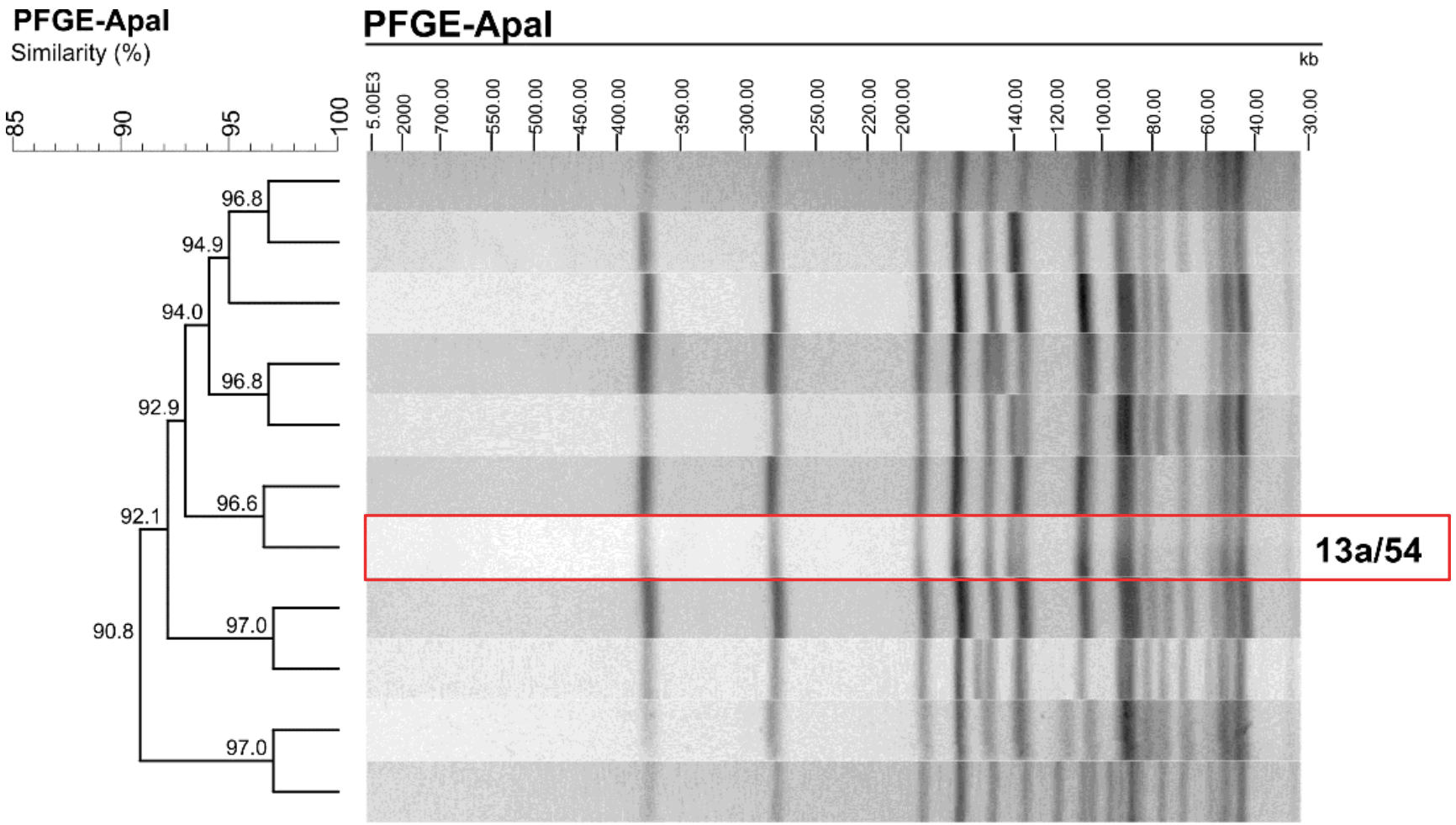
- Further epidemiological surveys point to pork products from supermarkets in southern Germany
- Intensified official sampling of food and production environments in BY, BW and HE
- Altogether 543 isolates were typed
- Smoked pork belly positive sampled by food inspectors positive (May 2016), 1.9 x 10^5 CFU/g

  ⇒ Match with human outbreak strain:
  PFGE 13a/54, CT1248

- 4 other products of company positive related to the outbreak strain

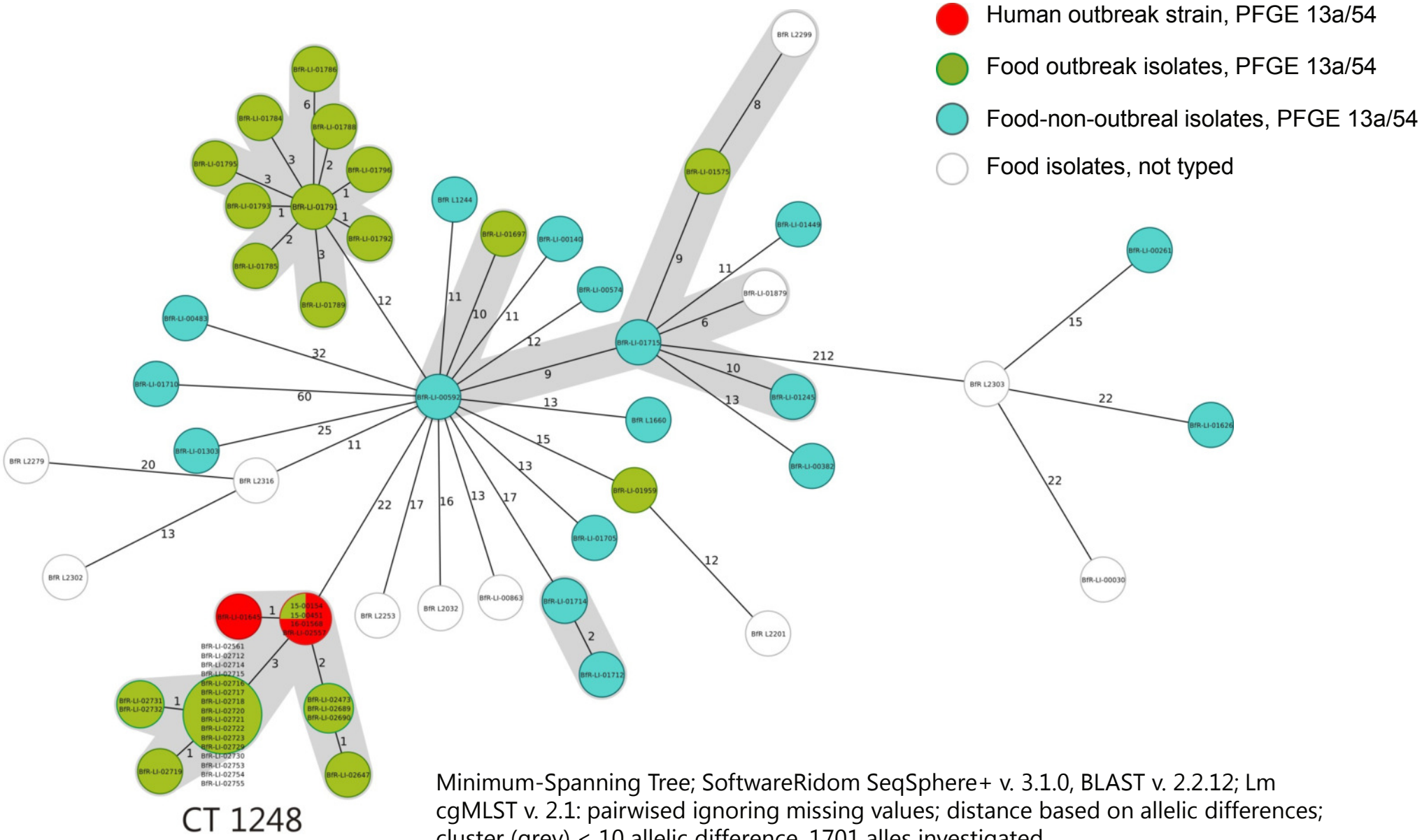


PFGE-cluster-analysis (ApaI)
human outbreak strain + 90% cluster similarity in food



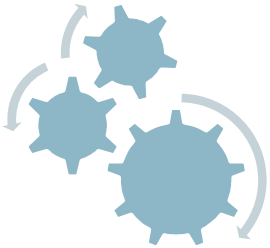
Bionumerics software v. 7.5 , similarity matrix using band based Dice coefficient with optimization 1% and band matching tolerance 1%, UPGMA method

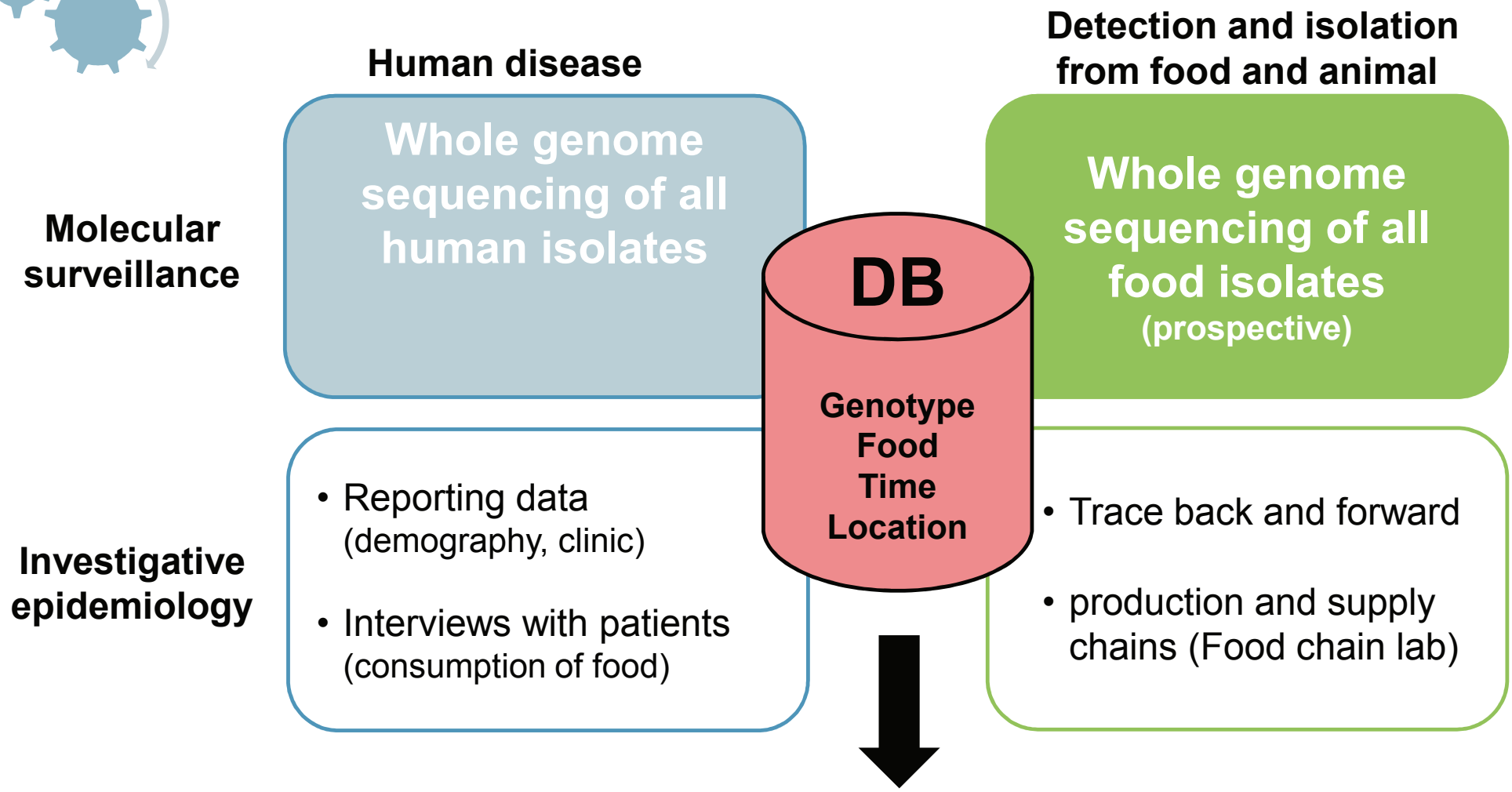
Whole-genome sequencing, cgMLST-analysis



Minimum-Spanning Tree; SoftwareRidom SeqSphere+ v. 3.1.0, BLAST v. 2.2.12; Lm cgMLST v. 2.1: pairwised ignoring missing values; distance based on allelic differences; cluster (grey) < 10 allelic difference, 1701 alles investigated

Efficient surveillance of foodborne pathogens





- Identification of suspected sources
- Identification and eradication of contamination sources in processing plants
- Implementation of improved control measurements in the plant

Conclusions

- There is a transition in Europe to investigate outbreaks using WGS technologies
- Efforts are under way to establish a common database system for improved investigation of European outbreaks (EFSA and ECDC)
- Nomenclature of WGS data needs to be harmonized to easier comparison of data (worldwide problem!)
- Global Microbial Identifier initiative should be supported to harmonize WGS analyses and to create WGS repositories on global level

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Thank you for your attention

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