



UK Health
Security
Agency

Salmonella reservoirs and pathways; The investigation of pub /carvery restaurant settings

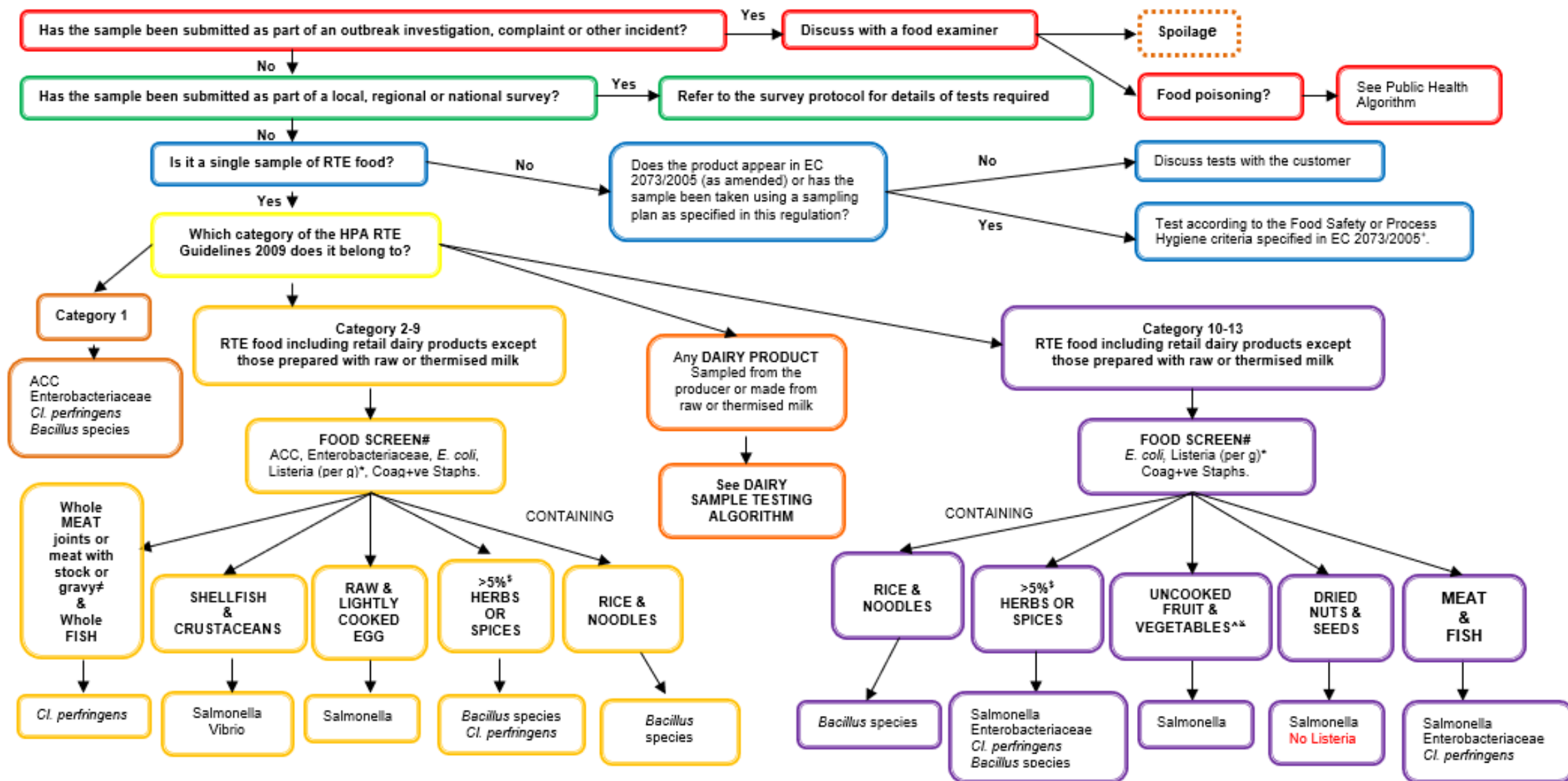
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Salmonella Cases in England

- Non-typhoidal Salmonella infections lead to approximately 8000 lab diagnosed cases per annum
- It is estimated that there are approximately 5 times more cases that go undiagnosed
- Laboratory methods enable isolation of low levels of Salmonella from food, water and environmental samples
- Reference lab testing allows establishment of a link to human cases of disease
- Traditional methods have proven valuable when more than one salmonella type is present in a sample.
- Legislative standard can help to control the amount of Salmonella in the food chain but there is some tolerance in slaughtered animals
- UKHSA Food, Water and Environmental Microbiology Laboratories use testing algorithms to maximise resource and target food stuff with the highest risk
- [Non-Typhoidal Salmonella data 2010 to 2019 \(publishing.service.gov.uk\)](https://publishing.service.gov.uk)



APPENDIX 1: UKHSA FOOD WATER AND ENVIRONMENTAL LABORATORIES FOOD SAMPLE TESTING ALGORITHM



British Medical Journal 1970 Salmonella Outbreak

- Wedding reception
- 39/59 people at reception became ill with vomiting diarrhoea and abdominal pain within a day of the reception
- Salmonella was isolated from 25 who were ill, and also those who didn't have symptoms
- Fifteen chickens were served as part of the wedding food
- The chickens had been pre-cooked and placed within the refrigerator (along with other raw chickens and raw fish)
- Cross contamination was thought to be significant in the incident
- Personal hygiene was a potential key factor

Such cross contamination and personal hygiene issues were, and remain key pathways in incidents of Salmonellosis

Salmonella Foods and biofilm formation

- ***Salmonella* can form biofilms under numerous conditions**
- Impact of challenging conditions, such as drying or low water activity, can have an impact on protection mechanisms
- Attachment mechanisms (that are involved in cell adherence and pathogenicity) also serve to protect the organism in long term protection in environmental niches
- The production of glycocalyx layers (made up of exopolysaccharides and proteins), forming an extracellular matrix, may also ensure protection of the organism in challenging environments
- In some settings, surface type may be also be an important factor in the persistence of the organism – eg the material made up of conveyors
- **The variations in wet cleaning regimes and dry cleaning, seen in production, could promote survival of the *Salmonella***

East Mids Pub / Carvery Restaurant - *Salmonella* Typhimurium 2015

- 82 cases (confirmed by microbiology) 12 February 2015 to 8 March 2016.
(Note- figures suggest 5 times more cases go undiagnosed and confirmed)
- Seventy-two cases matching the nationally unique WGS profile (SNP address: 1.1.1.124.395.395).
- Epidemiology; association with eating carvery buffet food



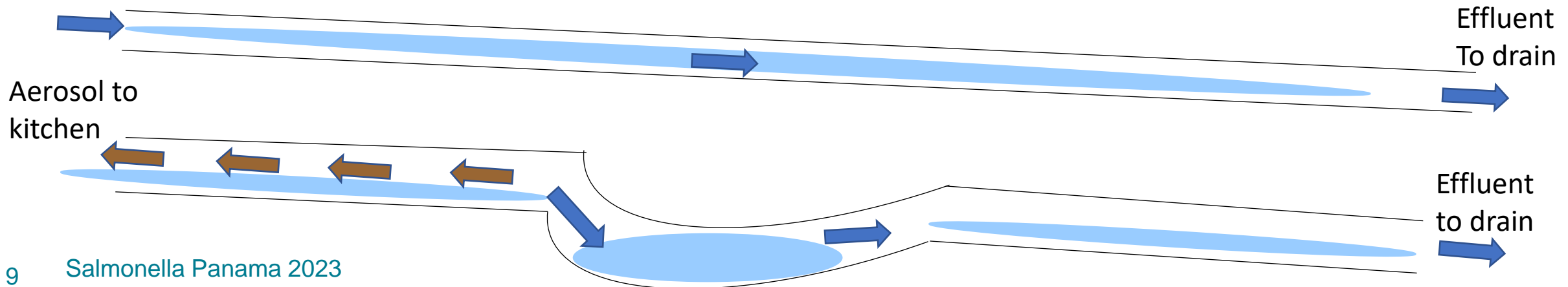
Pub Restaurant - Salmonella Typhimurium 2015



- Premises not particularly remarkable
- Good standards of maintenance and repair
- Systems in place to manage food safety risks

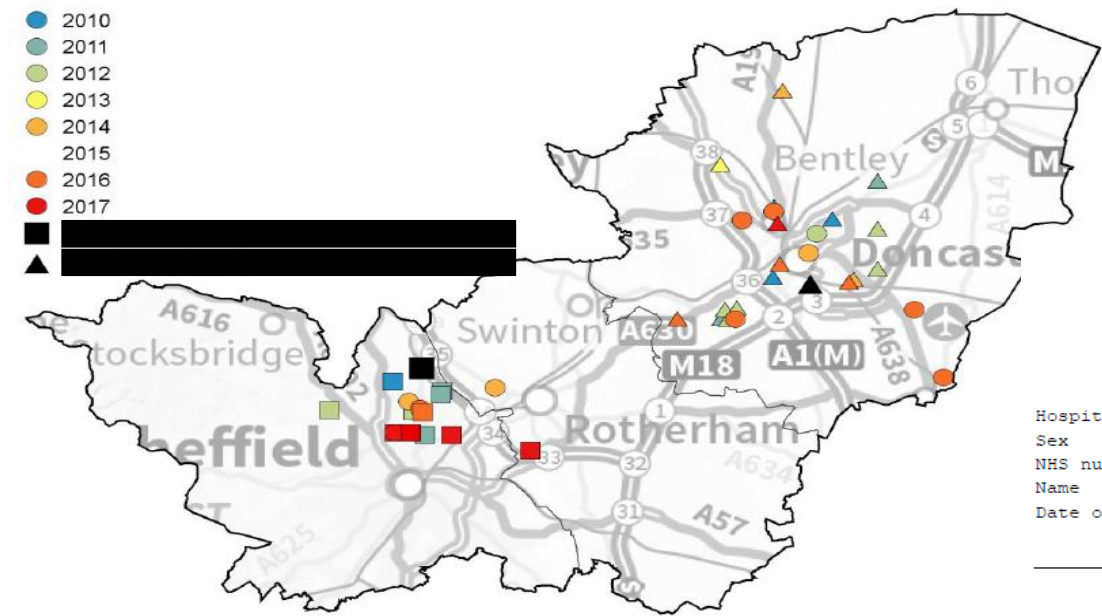
Pub Restaurant- *Salmonella* Typhimurium 2015

Suspended drains below building 'timber' floor



Salmonella Agona South Yorkshire 2010-2017

Figure 2: Geographical distribution of *Salmonella* Agona t13 cases in Sheffield, Rotherham and Doncaster local authorities by reported exposure to the [redacted] from 2010 to 2017



Oven drip tray – positive *Salmonella* Agona

SAND HUTTON
YORK

YO41 1LZ

Billing reference PHE
Outbreak/Investig. No
Ilog number
Project code

Hospital No.
Sex
NHS number
Name OVEN DAY TRIP
Date of collection 07.03.2018 10:30

Date of birth
Age
Patient postcode
Y.

Laboratory report

Final report from the Gastrointestinal Bacteria Reference Unit

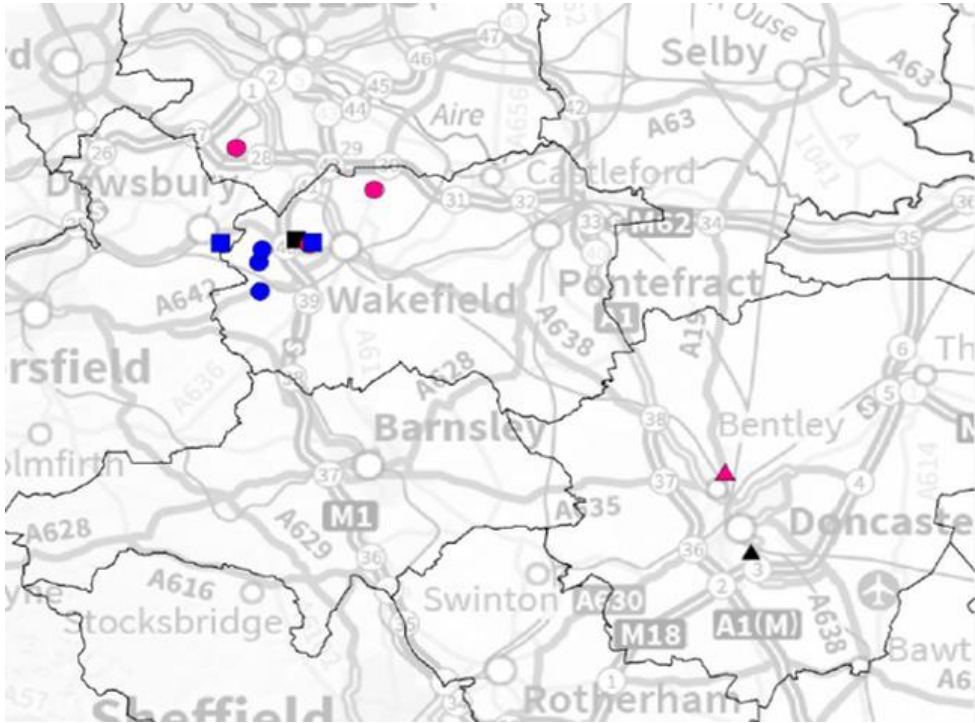
Salmonella Reference Service

1. Identification: *Salmonella* Agona

Subspecies: I
ST 13
EBG: 54
SNP address: 1.1.1.11.12.13.703

These results have been derived by whole genome sequencing.

Salmonella Bovis-morbificans S & W Yorkshire 2017-18



Oven drip tray – positive *Salmonella* Bovismorbificans

Hospital No.				
Sex	Date of birth	Age		Y.
NHS number		Patient postcode		
Name	DRIP TRAY			
Date of collection	24.04.2018 12:25			

Laboratory report

Final report from the Gastrointestinal Bacteria Reference Unit

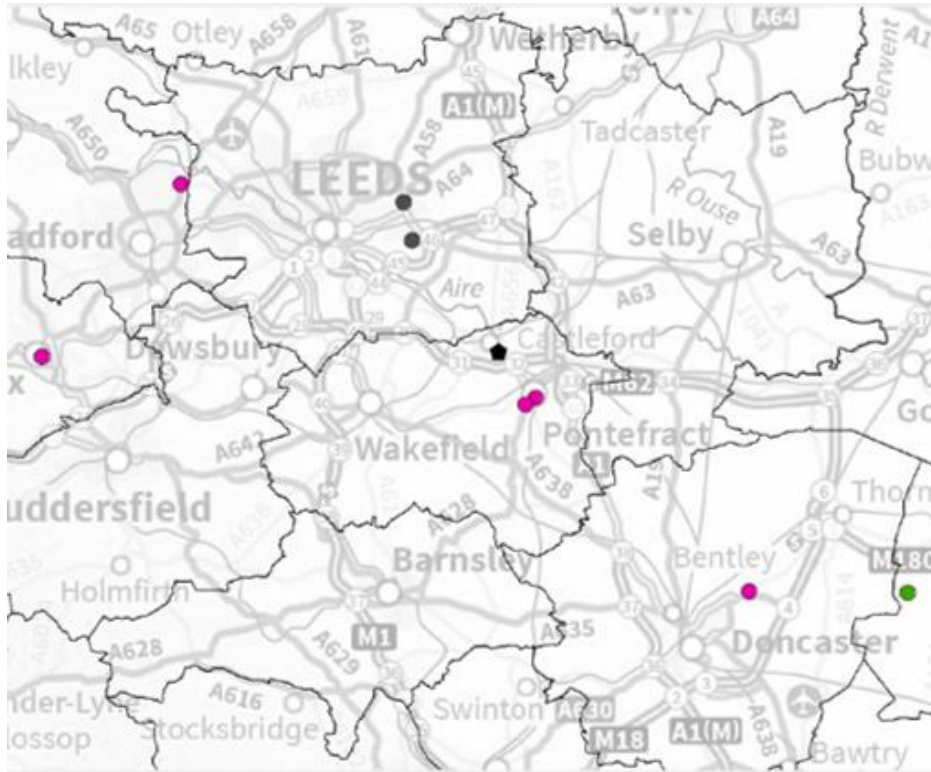
Salmonella Reference Service

1. Identification: *Salmonella* Bovismorbificans

Subspecies: I
ST 142
EBG: 34
SNP address: 4.6.7.71.90.175.257

These results have been derived by whole genome sequencing.

Salmonella London - West Yorkshire 2014-2017



Drain on oven – positive *Salmonella* London

Hospital No.
Sex Date of birth Age Y.
NHS number Patient postcode
Name DRAIN ON OVEN 4
Date of collection 07.06.2018 10:15

Laboratory report

Final report from the Gastrointestinal Bacteria Reference Unit

Salmonella Reference Service

1. Identification: *Salmonella* London

Subspecies: I
ST 2124
EBG: 237
SNP address: 3.8.8.8.8.9.65

These results have been derived by whole genome sequencing.

Salmonella Panama; clinical cases 2020/2021

- *Salmonella* Panama cases in adults
- Limited food history – but one questionnaire mentions a specific pub/restaurant
- Different Local Authority areas

- | | | |
|----------------------------|--------------------------|------------|
| • <i>Salmonella</i> Panama | 42 48 3.3.3.3.51.220.268 | 2021-11-26 |
| • <i>Salmonella</i> Panama | 42 48 3.3.3.3.51.220.268 | 2021-11-02 |
| • <i>Salmonella</i> Panama | 42 48 3.3.3.3.51.220.241 | 2020-09-08 |

Investigation of Carvery Ovens in Notts Pub/Carvery Restaurant 2021



- Ovens with calibrated probes
- Long slow cooking ($>65^{\circ}\text{C}$ then $\sim 60^{\circ}\text{C}$ for several / many hours)
- Cleaning at end of 'session' - including cleaning of oven interior and drains to the ovens
- NB; Don't neglect floor cleaning and wash waster – potential pathways to sinks and WHBs

Food and Environmental Sampling

Notts Pub/Carvery Restaurant 2021

Sample Date	Sample Description	Analyte	Result
15/12/2021 11:08	HW BASIN NEXT TO OVEN	Salmonella species detection	Not Detected in Swab
15/12/2021 11:11	FLOOR UNDER OVEN (R)	Salmonella species detection	DETECTED in Swab
15/12/2021 11:13	FLOOR UNDER OVEN (L)	Salmonella species detection	DETECTED in Swab
15/12/2021 11:15	BOTTOM OF OVEN TRAY	Salmonella species detection	Not Detected in Swab
15/12/2021 11:17	DRIP TRAY OF OVEN (L)	Salmonella species detection	DETECTED in Swab
15/12/2021 11:20	OVEN DRAIN INTERNAL	Salmonella species detection	DETECTED in Swab
15/12/2021 11:21	TEMP PROBE OVEN	Salmonella species detection	Not Detected in Swab
15/12/2021 11:26	WET VACUUM SQUEEGEE	Salmonella species detection	DETECTED in Swab
15/12/2021 11:29	WH BASIN BEHIND COOKING MODULE	Salmonella species detection	Not Detected in Swab
15/12/2021 11:30	OVEN DRAIN (UPPER RIGHT)	Salmonella species detection	DETECTED in Swab
15/12/2021 11:32	OVEN DRAIN (L)	Salmonella species detection	Not Detected in Swab
12/01/2022 10:50	VEG PREP AREA	Salmonella species detection	Not Detected in Swab
12/01/2022 10:52	OVEN DRIP TRAY	Salmonella species detection	Not Detected in Swab
12/01/2022 10:56	INTERNAL OVEN FLOOR	Salmonella species detection	Not Detected in Swab
12/01/2022 10:57	FLOOR UNDER OVEN	Salmonella species detection	Not Detected in Swab
12/01/2022 11:00	OVEN DRAIN EXTERNAL RIGHT	Salmonella species detection	Not Detected in Swab
12/01/2022 11:02	EXTERNAL OVEN DRAIN	Salmonella species detection	Not Detected in Swab
12/01/2022 11:03	OVEN TEMP PROBE RIGHT	Salmonella species detection	Not Detected in Swab
12/01/2022 11:31	BEEF END PIECE	Salmonella species detection	Not Detected in 25g
12/01/2022 11:33	GAMMON END PIECE	Salmonella species detection	Not Detected in 25g
12/01/2022 11:35	TURKEY CENTRAL PIECE	Salmonella species detection	Not Detected in 25g

Salmonella PCR followed by culture method

Salmonella standard culture method (ISO)



sample + BPW broth; enrich overnight at 37°C



Boil 1 ml of enriched sample, extract DNA and perform PCR

IF *salmonella pos* sub into RVS/MKttn

Streak onto media (ie XLD, BGA)

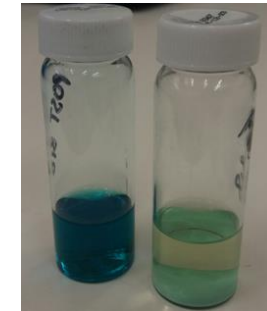
Pick 5 (suspect or less suspect) colonies

Point inoculate onto agar and confirm by further PCR and/or biochemical/serological confirmation



sample + BPW broth; enrich overnight at 37 °C

Sub into RVS/MKttn



Selective enrichment 24-28 hours

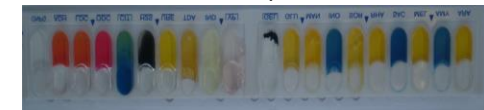
Streak onto XLD and BGA

Incubate overnight at 37°C



Pick up to 5 colonies if typical of salmonella

Biochemical and serological confirmation (and PCR if accredited)



Salmonella - Environmental Sampling



Food and Environmental Sampling at the Pub/Carvery Restaurant ; Reference Laboratory Results

Hospital No.
Sex Date of birth Age y.
NHS number Patient postcode
Name **SWAB-OVEN DRAIN (UPPER RIGHT)**
Date of collection **15.12.2021 11:30**

Culture isolated from: swab

Laboratory report

Final report from the Gastrointestinal Bacteria Reference Unit

Salmonella Reference Service

1. Identification: *Salmonella* Derby

Subspecies: I


ST 682

EBG: 264

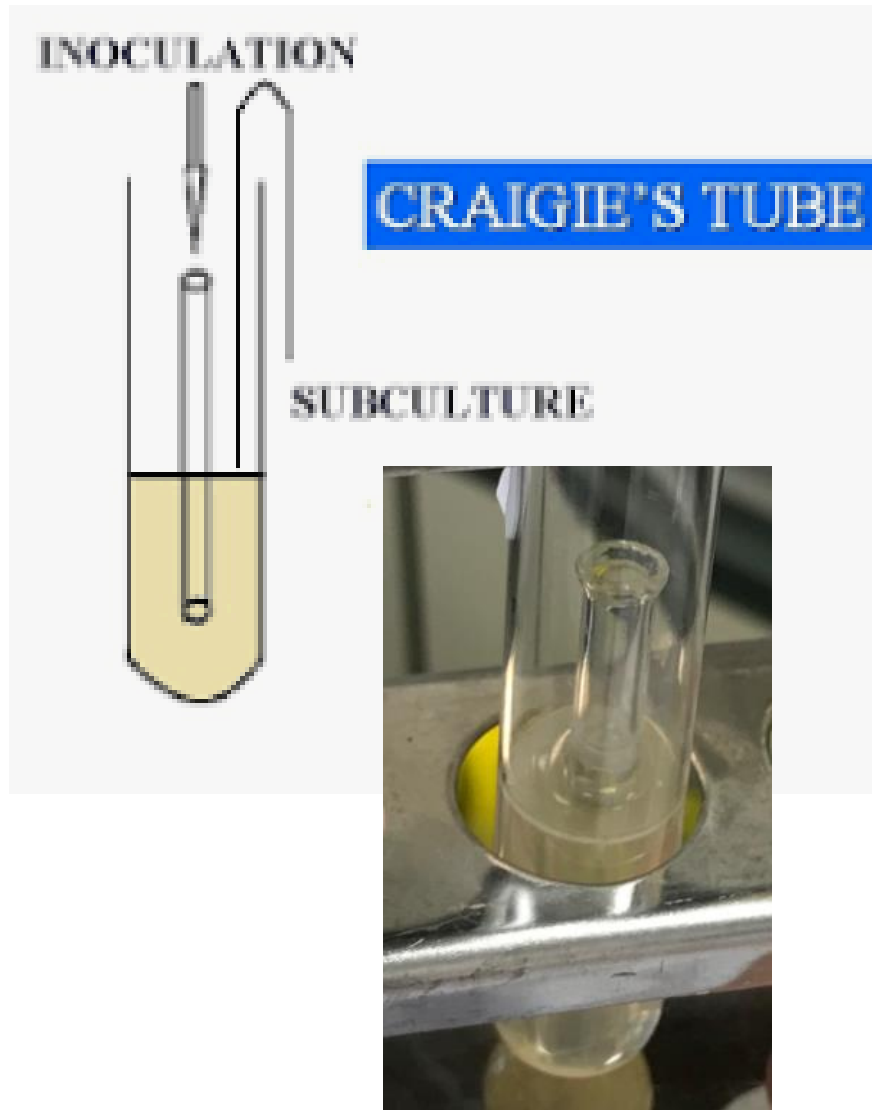
SNP address: 1.1.2.2.59.65.107

These results have been derived by whole genome sequencing.

**Oven Drain – positive
Salmonella Derby**



Mixed populations of Salmonella in the same sample



Pub / Carvery Restaurant

Outbreak of S Panama but S Derby was found by culture from oven drain sample.

	<i>O</i> -antigen	<i>H</i> -antigen	
		Phase 1	Phase 2
<i>Salmonella</i> Derby	1,4,5,12	<i>f</i> , <i>g</i>	-
<i>Salmonella</i> Panama	1, 9, 12	<i>l</i> , <i>v</i>	1, 5

Food and Environmental Sampling at the Pub/Carvery Restaurant ; Reference Laboratory Results – after Craigie tube technique employed on isolates in FW&E Microbiology Laboratory

Hospital No.
Sex Date of birth Age y.
NHS number Patient postcode
Name **SWAB-OVEN DRAIN (UPPER RIGHT)**
Date of collection 15.12.2021 11:30

Culture isolated from: swab-oven drain (upper right)

Laboratory report

Final report from the Gastrointestinal Bacteria Reference Unit

Salmonella Reference Service

1. Identification: *Salmonella* Panama

Subspecies: I
ST 48
EBG: 42
SNP address: 3.3.3.3.51.220.268

These results have been derived by whole genome sequencing.

**Oven Drain – positive
Salmonella Panama**

Salmonella; further clinical cases with associations

Site Inspection and Sampling

- Salmonella Panama 42 48 3.3.3.3.51.220.316 2023-03-13
- Salmonella Panama 42 48 3.3.3.3.51.220.300 2022-11-23



Salmonella; further clinical cases with associations

Site Inspection and Sampling Results

Sample Date	Sample Description	Analyte	Result
23/02/2023 10:35	OVEN ONE DRIP TRAY	Salmonella species detection	Not Detected in Swab
23/02/2023 10:40	OVEN TWO DRIP TRAY	Salmonella species detection	DETECTED in Swab
23/02/2023 10:45	OVEN THREE DRIP TRAY	Salmonella species detection	Not Detected in Swab
23/02/2023 10:50	OVEN FOUR DRIP TRAY	Salmonella species detection	Not Detected in Swab
23/02/2023 10:55	OVEN THREE DRAIN	Salmonella species detection	Not Detected in Swab
23/02/2023 11:00	OVEN TWO RED TRAY	Salmonella species detection	Not Detected in Swab
23/02/2023 11:05	OVEN THREE RED TRAY	Salmonella species detection	DETECTED in Swab
23/02/2023 11:10	FLOOR UNDER OVEN THREE	Salmonella species detection	DETECTED in Swab
23/02/2023 11:15	FLOOR UNDER OVEN TWO	Salmonella species detection	DETECTED in Swab
23/02/2023 11:20	DOOR SEALS OVEN THREE	Salmonella species detection	DETECTED in Swab
23/02/2023 11:25	GREEN STEAM NOZZLE	Salmonella species detection	Not Detected in Swab
23/02/2023 11:30	PROBE OVEN THREE	Salmonella species detection	Not Detected in Swab
23/02/2023 11:35	RAW MEAT WHB	Salmonella species detection	Not Detected in Swab
23/02/2023 11:40	POSTWASH SINK	Salmonella species detection	DETECTED in Swab
23/02/2023 11:45	VIPER WET VAC	Salmonella species detection	DETECTED in Swab
23/02/2023 11:50	FLY CATCHER BACK DOOR	Salmonella species detection	Not Detected in Swab

Food and Environmental Sampling at the Notts Pub/ Carvery Restaurant - 2023



Food and Environmental Sampling at the Notts Pub/Carvery Restaurant – May 2023 Re-sampling and Further Review of Management

Sample Date	Sample Description	Analyte	Result
11/05/2023 09:30	OVEN 2 BOTTOM DRIP TRAY	Salmonella species detection	Not Detected in Swab
11/05/2023 09:35	002 OVEN BOTTOM	Salmonella species detection	Not Detected in Swab
11/05/2023 09:40	FLOOR UNDER OVEN 002 BOTTOM	Salmonella species detection	Not Detected in Swab
11/05/2023 09:45	TOP OVEN 002 BOTTOM	Salmonella species detection	Not Detected in Swab
11/05/2023 09:50	SINK	Salmonella species detection	Not Detected in Swab
11/05/2023 09:55	OVEN 002 TOP INTERNAL SURFACE	Salmonella species detection	Not Detected in Swab
11/05/2023 10:00	SQUEEZY END OF WET	Salmonella species detection	Not Detected in Swab
11/05/2023 10:55	OVEN 002 BOTTOM HANDLE	Salmonella species detection	Not Detected in Swab

Positive Interventions and Ongoing Surveillance

- Re-sampling after review of cleaning processes and procedures. (Note – cleaning chemical was changed as part of the review)
- Re-training of staff on hygiene measures, including floor cleaning and disposal of water from wet dry cleaning paraphernalia
- Re-training staff on personal hygiene measures
- Replacement of ovens – of the design present, believed to exacerbate colonisation issues
- Ongoing review of cases of Salmonellosis by Health Protection Team and Local Authority Environmental Health Services
- Active cluster reviews by UKHSA

☺ Two cases of Salmonella Derby identified in 2019 and 2022 were within 5 SNPs of the environmental samples, However, it could not be ascertained whether these cases were epidemiologically linked to the premises, though they both lived within 8 kilometres of the pub.

Acknowledgements:

Many Thanks:

Local Authority Environmental Health Teams

UKHSA Food, Water and Environmental Microbiology Laboratories

Clinical Microbiology Services

UKHSA Gastrointestinal and Bacterial Reference Unit

UKHSA Field Services and Health Protection Teams

Other Agencies