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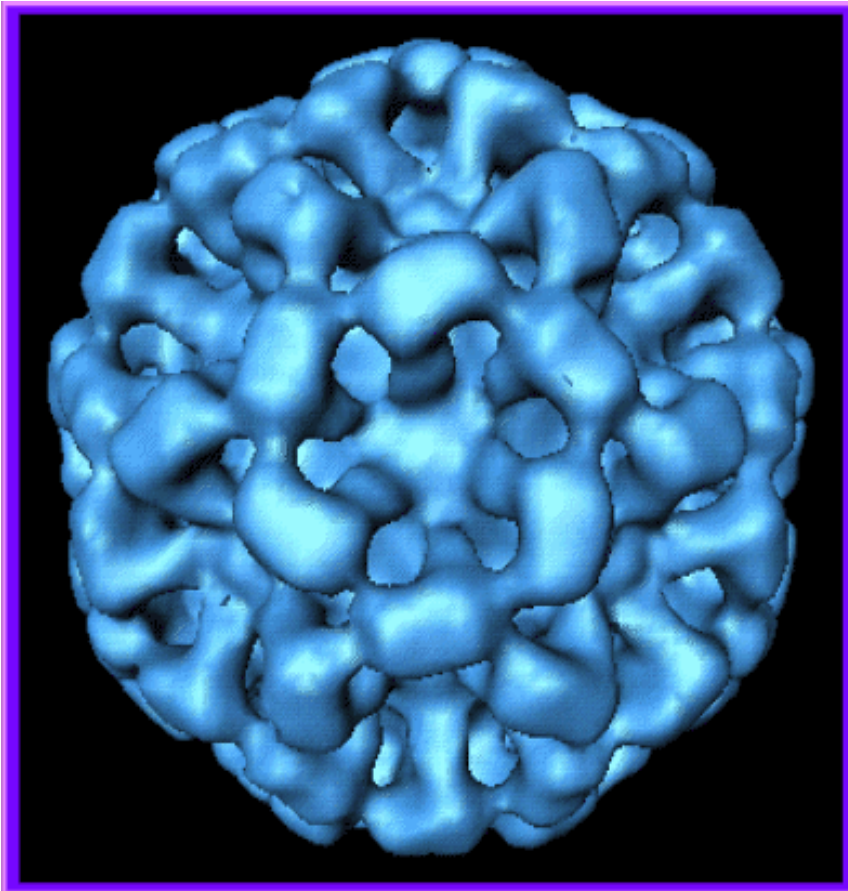
Norovirus, epidemiology, shellfish and the public health 'hazard'

John Harris



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Norovirus



Family : *Caliciviridae*

Non-enveloped small round structured virus (27-32 nm diameter)

Genome: positive sense ssRNA ~ 7.5kb

Reservoir: Human beings



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Routes of transmission

Person to person



Contaminated
surfaces



Contaminated
food or water





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Norovirus characteristics

Incubation period: 10-72h

Duration of symptoms: 24-48h

Low infectious dose.

10 - 100 virus particles



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Norovirus characteristics

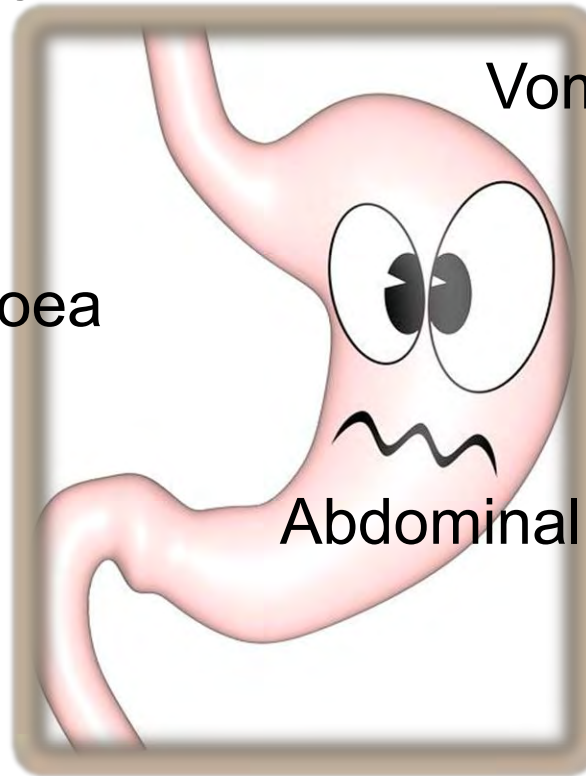
Nausea

Vomiting

Diarrhoea

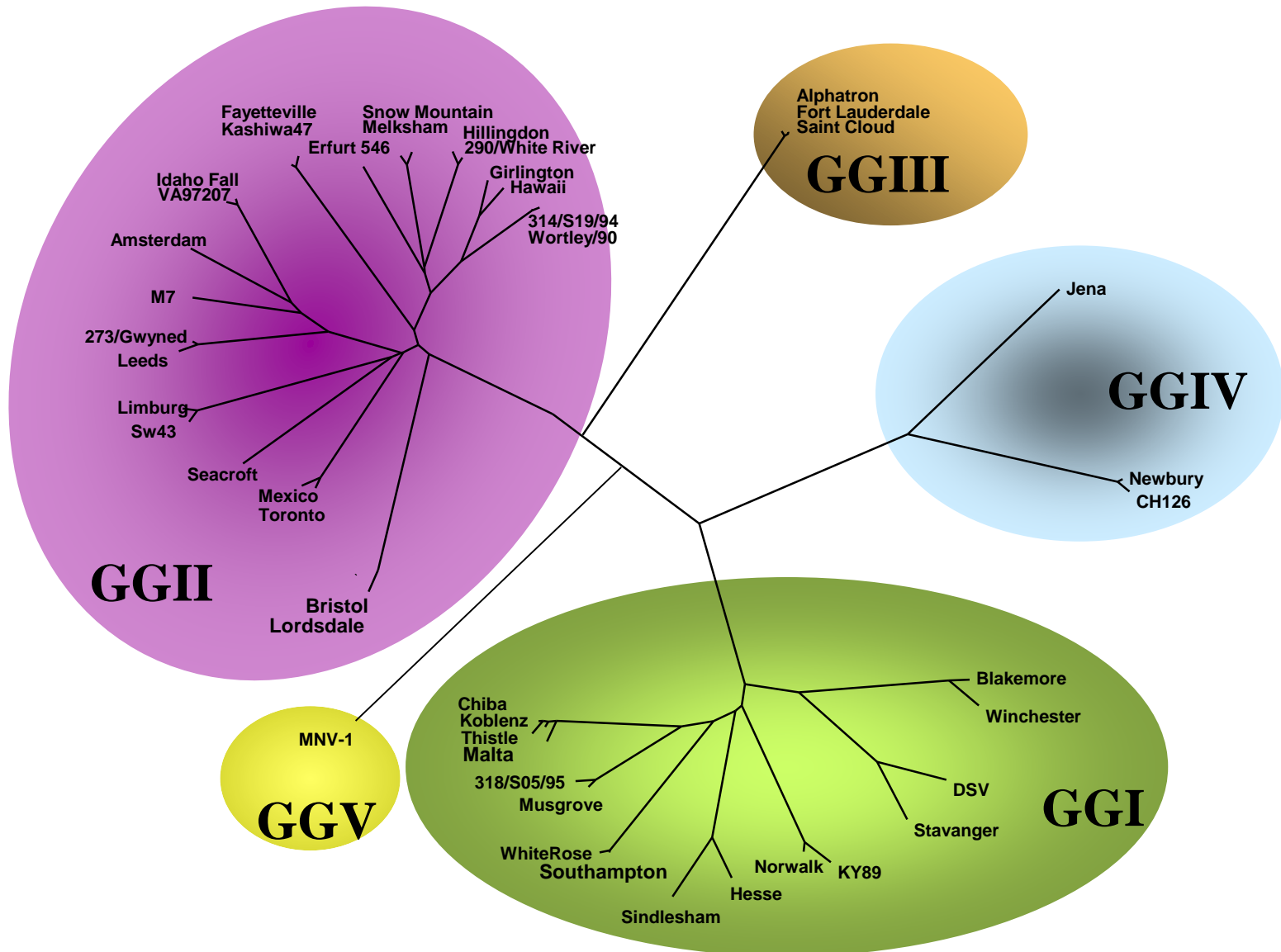
Abdominal pain

Fever



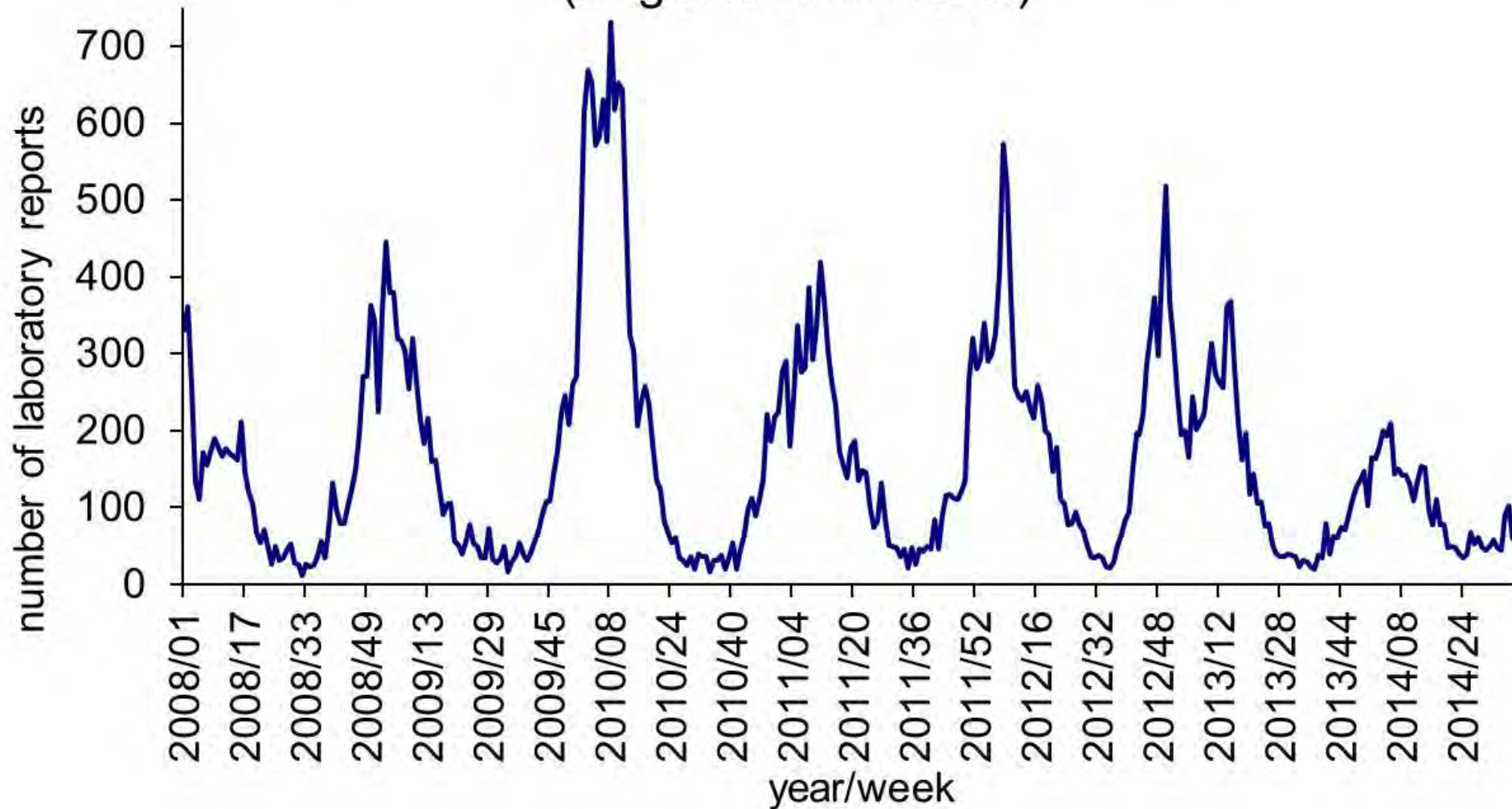


Norovirus: genetic diversity





Laboratory reports of norovirus 2008-2014 (England and Wales)





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Norovirus – epidemiology

IID2 study results Community cohort:

1,201 cases of IID

65% submitted stool samples

40% positive for one or more pathogens

16.5% were positive for norovirus



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Norovirus – epidemiology

IID2 study results: GP Presentation study:

1,254 cases with IID recruited

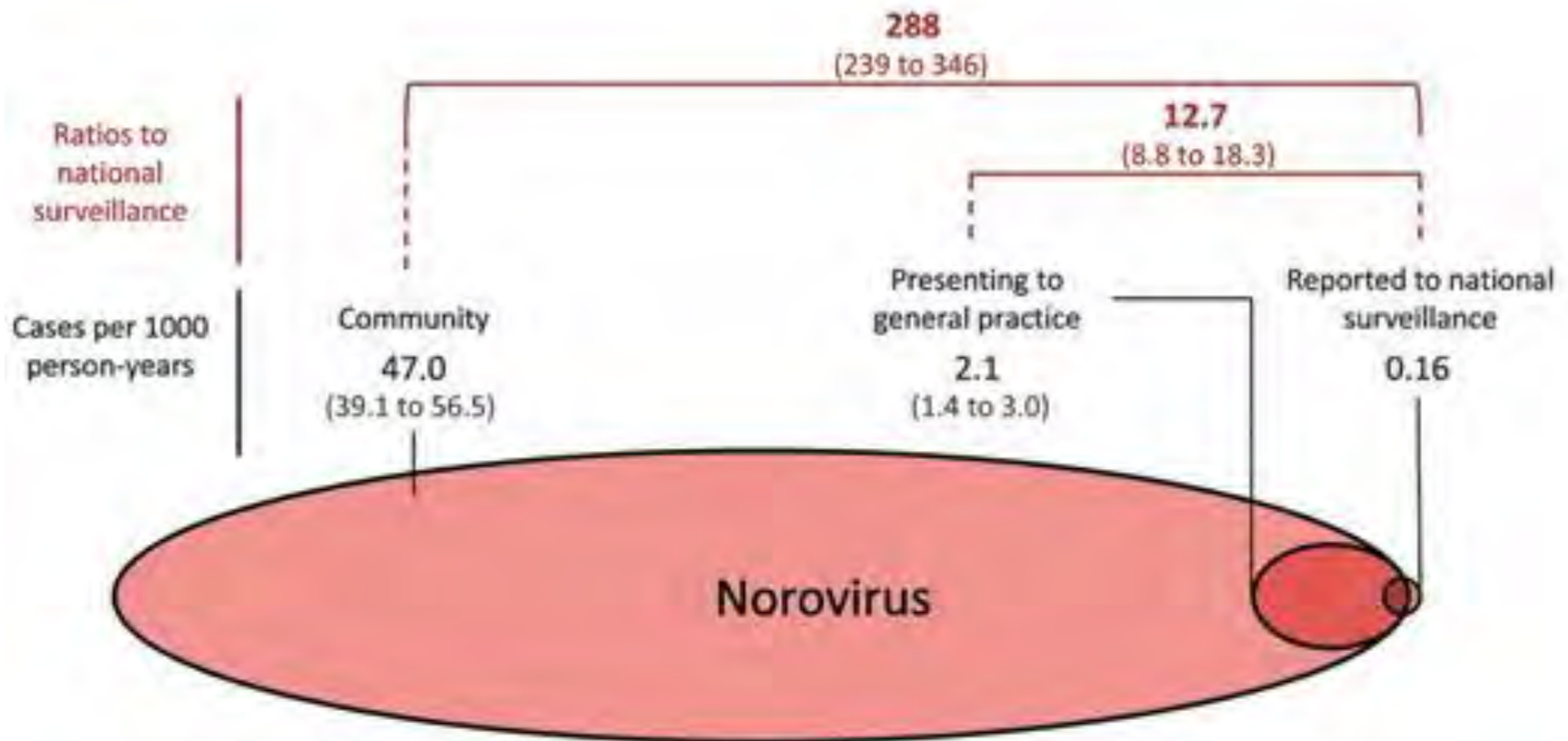
88% submitted stool samples

51% positive for one or more pathogens

12.4% were positive for norovirus



Norovirus – epidemiology





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Norovirus – epidemiology

IID2 study results:

47/1000 person years in the community

~3 million cases each year UK (2.4 -3.5 million)

130,000 GP consultations annually

Tam CC, Rodrigues LC, Viviani L, et al. Gut (2011)



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Norovirus – epidemiology

~12 % population asymptomatic

G. PHILLIPS, C. C. TAM, L. C. RODRIGUES, B. LOPMAN Epidemiol.
Infect. 2010



Why norovirus?

The header of the Food Standards Agency website features a green background. On the left is the FSA logo, which consists of a stylized fork and knife. To the right of the logo is the text 'Food Standards Agency'. Further right are links for 'FSA in UK', 'FSA in Scotland', 'FSA in Wales', and 'FSA in Northern Ireland'. A search bar is located on the far right. Below the header is a navigation menu with buttons for 'Home', 'News & updates', 'Policy & advice', 'Business & industry', 'Enforcement & regulation', 'Science & research', and 'About Us'. The 'News & updates' button is highlighted in a darker green.

Homepage ▶ News and updates ▶ Media Centre ▶ 2011 ▶ New research identifies norovirus levels in oysters



News and updates

▼ News centre

▶ 2013

▶ 2012

▶ **2011**

▶ 2010

▶ Food alerts news

▶ Allergy alerts news

▶ Consultations

▶ Campaigns

Last updated on 29 November 2011



New research identifies norovirus levels in oysters

Research published today by the Food Standards Agency shows that a significant proportion (76%) of oysters tested from UK oyster growing beds contained norovirus. The virus was detected at low levels in more than half of the positive samples (52%).



It is difficult to assess the potential health impact of these findings, as the available



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Shellfish outbreaks

1992-2013 (22 years)

280 outbreaks reported attributed to seafood

176 crustacean/shellfish 4153 people affected

OYSTERS:

120 outbreaks 2064 affected



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year	seafood shellfish/crustacea	no. affected(crust shellfish)	oysters	No. affected	
1992	17	14	324	10	183
1993	14	10	203	5	74
1994	20	11	125	7	104
1995	26	15	869	7	76
1996	21	8	254	5	81
1997	30	14	182	8	83
1998	11	6	156	3	42
1999	14	4	53	2	27
2000	11	7	164	5	32
2001	9	5	46	3	21
2002	2	1	7	1	7
2003	2	2	7	1	3
2004	7	5	108	3	37
2005	15	9	126	8	92
2006	12	11	186	9	44
2007	5	2	12	2	12
2008	6	5	26	4	24
2009	16	11	732	11	732
2010	15	13	132	11	101
2011	9	7	59	4	32
2012	5	3	24	3	24
2013	13	13	358	8	233
Total	280	176	4153	120	2064



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Shellfish outbreaks - Causes

Bacteria 23

Viral 116

- norovirus 58

- suspect viral 56

Diuretic shellfish poisoning (DSP) 5

- suspected toxin 2

Not known 30



Shellfish outbreaks - Causes

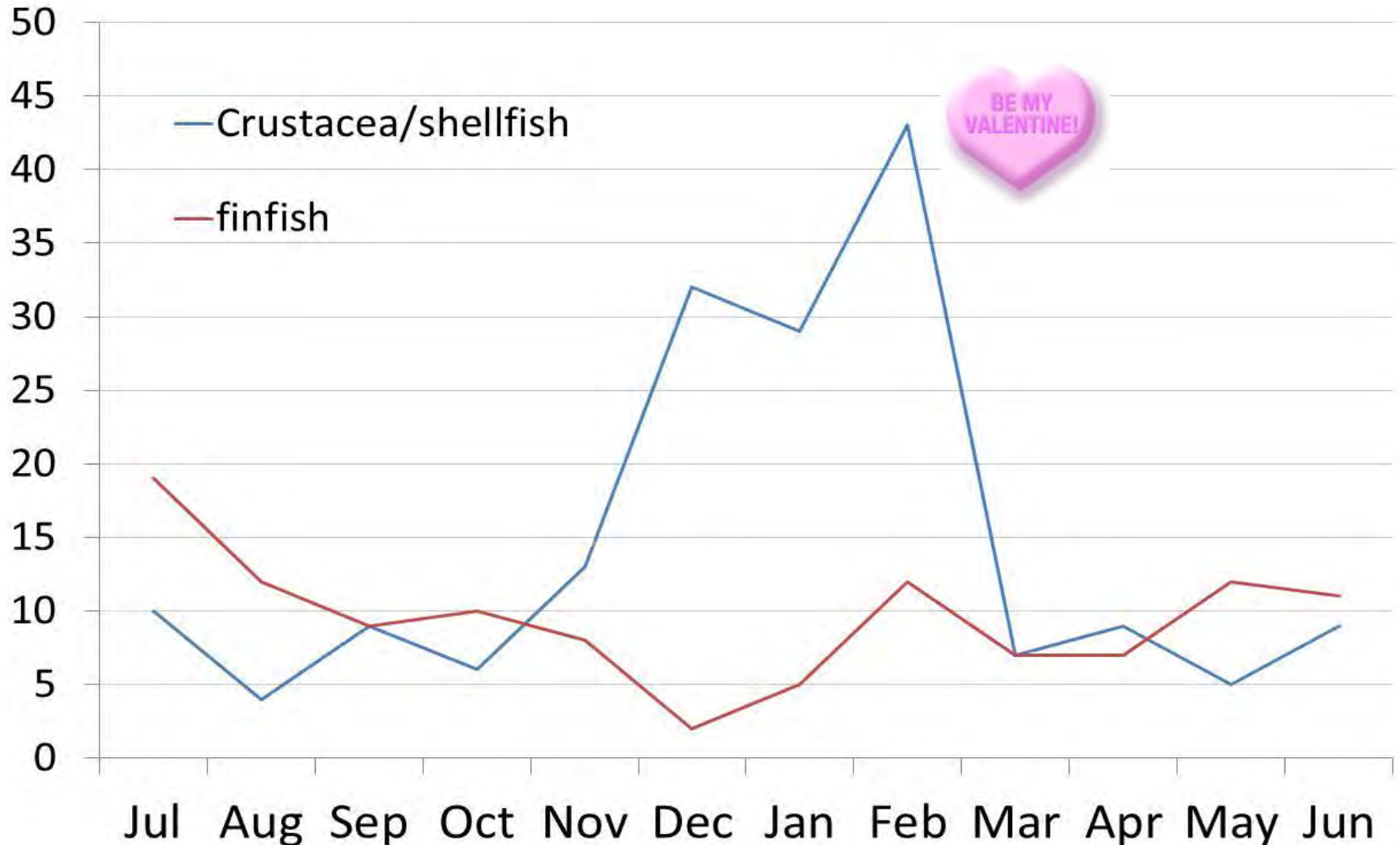
Bacteria 23

Prawns/prawn dishes	12
seafood platter	3
Crab meat	3
Cockles/whelks	2
Lobster	1
Oysters	1
seafood salmon	1



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Fish & shellfish outbreaks by month of occurrence





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Difficulties for surveillance

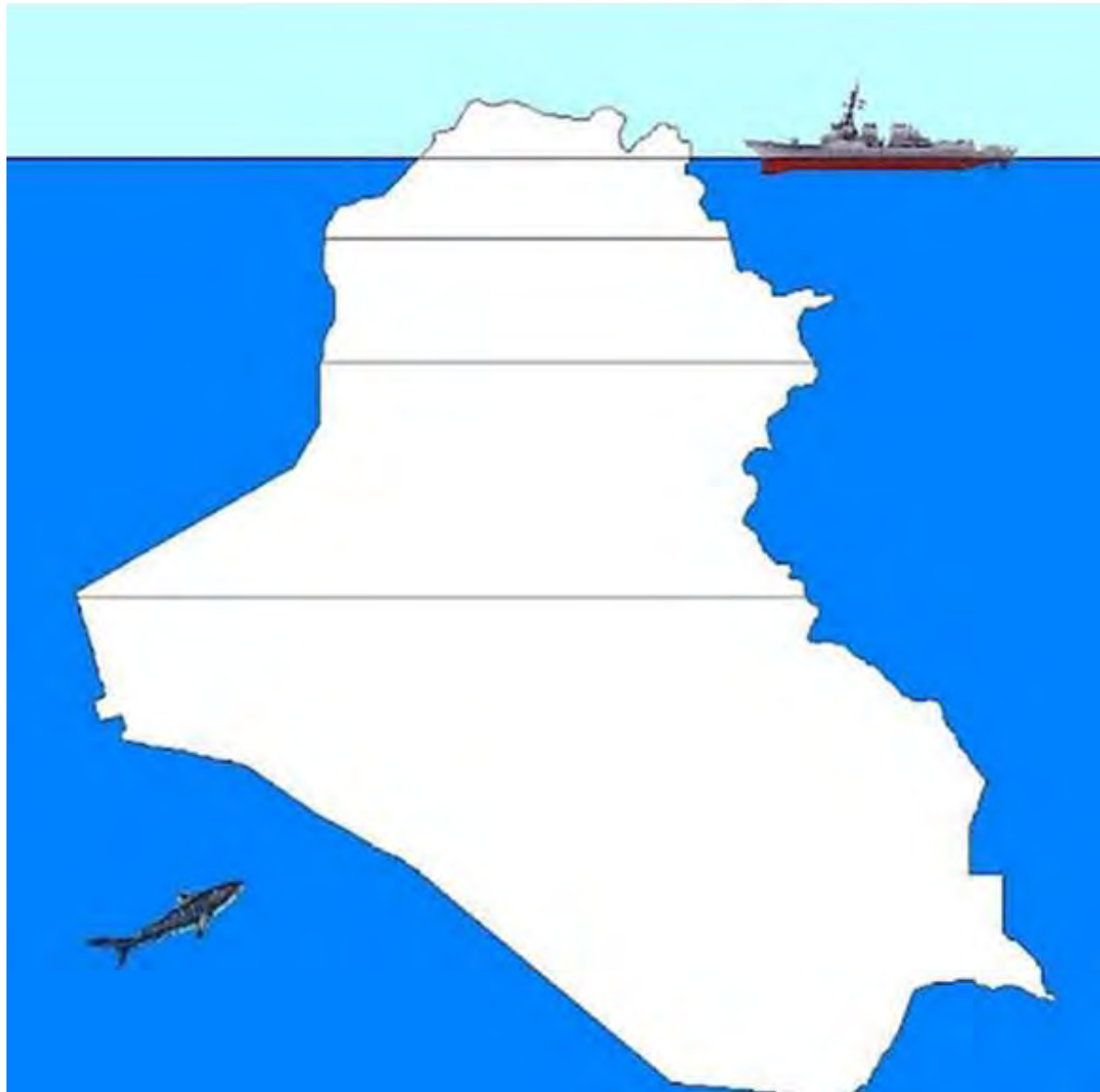
Vast majority of cases no contact with medical services

Norovirus not a notifiable disease

No mandatory reporting system for outbreaks



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The Fat Duck outbreak


Symptom	Number reporting
Diarrhoea (three or more in 24 hours)	197
Nausea	188
Vomiting	175
Loose stools (one or two in 24 hours)	68
Headache	103
Fever	102
Abdominal pain	155
Muscle ache/flu-like symptoms	114
Weight loss	75
Blood in stool	5

The Fat Duck outbreak

18 symptomatic diners submitted stool samples for analysis
norovirus was identified in samples from 10 diners

1/17 of the staff who reported recent illness submitted a stool
sample for analysis
norovirus was identified in this sample

The Fat Duck outbreak

Food items	Conditional odds ratio	95% CI	P-value
Oyster, Passion Fruit Jelly, Lavender	18	4.8-68	<0.001
Sound of the Sea*	8.4	2.6-26.6	<0.001
		2.4-21.5	<0.001
		1.3-25.5	0.019
		1.7-17	0.004
		0.9-11.9	0.055
		0.9-11.7	0.052
		1.3-9.1	0.012

*Sound of the Sea includes: raw oysters and cooked razor clams.

The Fat Duck outbreak

80 environmental samples taken

26 from high risk areas

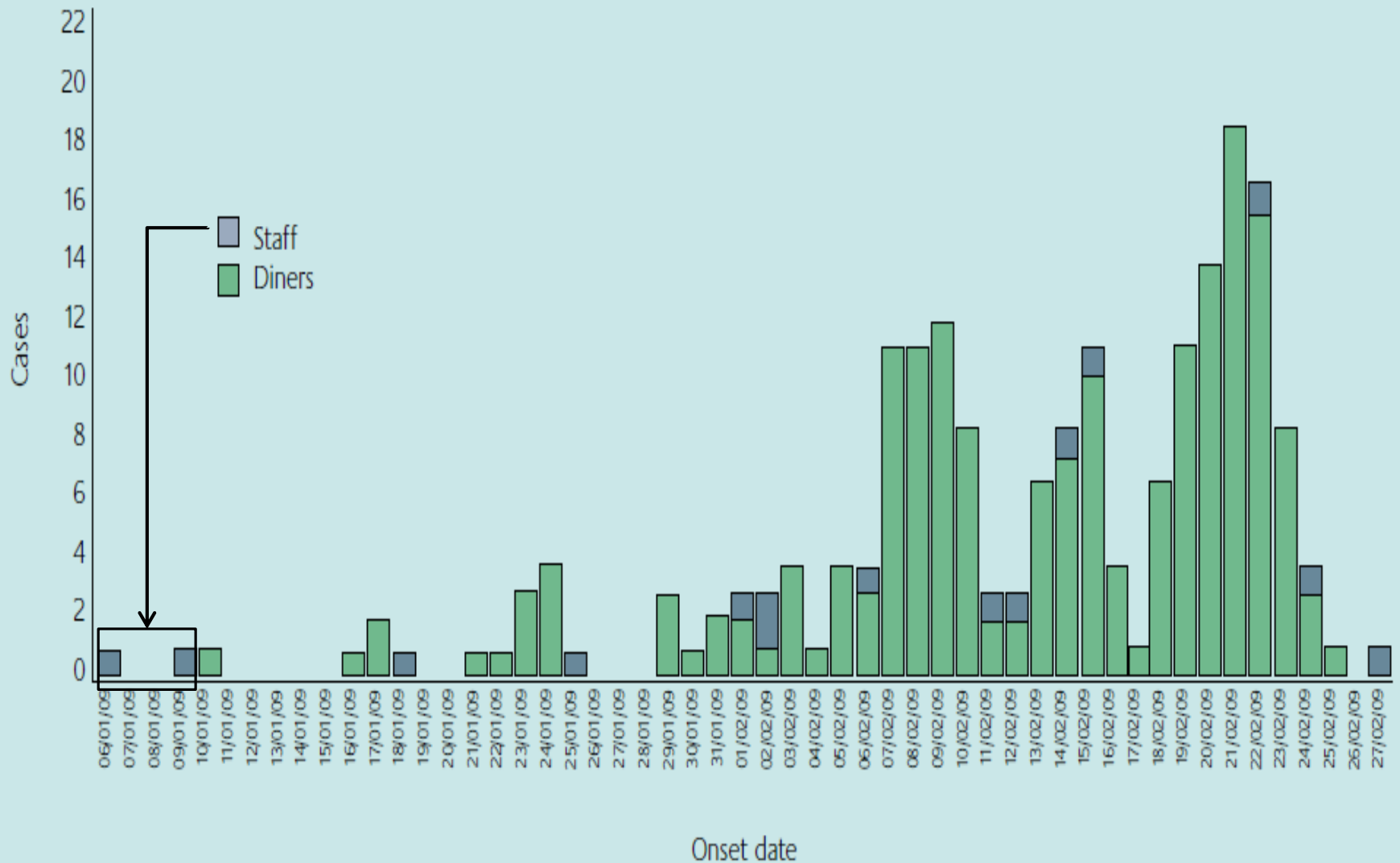
All were negative for norovirus

Restaurant had undergone a deep clean before the outbreak
notified to the LA

No oysters were available for analysis

Langoustine cream and cooked razor clam samples were found
to have unsatisfactory levels of *E. coli*.

The Fat Duck outbreak





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Norovirus

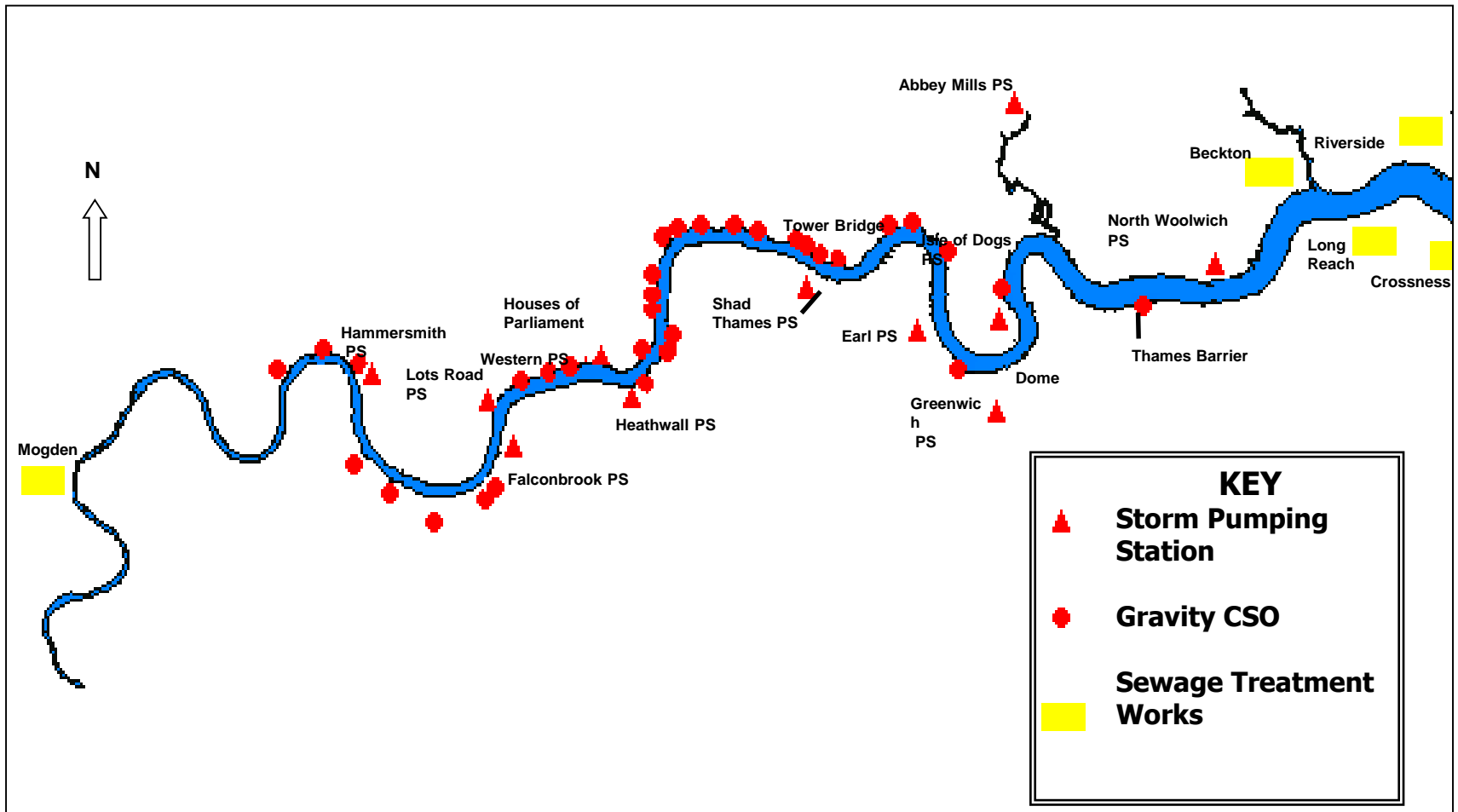
Contamination of seawater

Combined Sewage Overflows (CSO)

Contamination of oyster beds



CSO locations on the Thames tideway.





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Shellfish and public health hazards – conclusions

Contamination by norovirus common

Depuration not efficient at removing viral contamination

Consumption of raw shellfish (oysters) risks illness

Outbreaks are difficult to detect



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Shellfish and public health hazards – conclusions

Virus constantly evolving

Lack of long term immunity

Low infectious dose

High numbers of virus shed in stools/vomit

Exceptional persistence in environment



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Shellfish and public health hazards – conclusions

Food handlers can contaminate food

Foodborne? Human reservoir