Prevalence of NoV in the catering environment in outbreak and non-outbreak premises

November 2014 - M. Iturriza-Gómara

1. Background

Recently it has been suggested that NoV genetic diversity and genotype profiles can be used to discriminate between foodborne outbreaks linked with transmission via food-handlers from those associated with food contaminated at source.

Foodborne outbreaks associated with the consumption of shellfish or other foods contaminated with sewage are often associated with multiple strains of NoV, including genotype GII-4, among the individuals implicated in the outbreaks (Gallimore *et al*, 2005a; Gallimore *et al*, 2005b), whereas in outbreaks associated with transmission via a food-handler, the same strain is often found in all involved, including the food-handler (Daniels *et al*, 2000; Sala *et al*, 2005; Vivancos *et al*, 2009). Currently there are no UK data on contamination of the catering environment with NoV to provide evidence of the role of the infected food handler in transmission.

In collaboration with Environmental Health Officers, we will undertake a prevalence survey of NoV in the catering environment in outbreak and non-outbreak premises. This will allow us to assess the contribution of food handlers to contamination of the catering environment.

This study aims to investigate the following hypotheses:

a) Contamination of the kitchen environment with NoV will be higher in premises that have recently reported a foodborne NoV outbreak than those that have not;

b) The levels of environmental contamination are likely to be seasonal, with greater levels of contamination being detected in the winter months (November to March);

c) In food-handler associated outbreaks the viruses in the environment will exhibit the same sequence types as viruses found in faecal samples from food workers and affected consumers.

2. Methods

2.1 Study design and definitions

We will perform a prevalence survey in catering premises across north west and south east England. **Catering premises will be defined as a commercial or voluntary organisation that prepares and serves food to the final consumer**. This includes restaurants, public houses, cafes, takeaways, hotels, guesthouses, and caterers. It does not include passenger carrying ships that travel outside the UK, private houses, mobile retailers, manufacturers and suppliers.

2.2 Pilot Study

In order to assess the feasibility and validate sampling protocols and schedules, referral and communications paths and suitability of the information and data collection forms, a pilot study was conducted in August 2014. Sampling was performed in ten premises in each of the two regions (20 in total) between July and August 2014. The feedback obtained from EHOs and data collected during this pilot have been fed into the design of the standardised form for data collection (Appendix i). The target of sampling 10 premises per region was achieved in the expected time, and including sampling of one premises linked to a suspected food borne outbreak (see summary in Appendix ii). All environmental samples taken during the pilot study, including those from linked to an outbreak, were negative for the presence of norovirus RNA (note that sampling was carried out in the summer, during a period of very low norovirus activity in the community).

2.3 Surveillance sampling

We have estimated that sampling 250 premises will allow us to detect environmental contamination in the kitchen at a level of 20%, with 95% confidence and an error in the final prevalence estimate of +/- 5%.

The sampling will be carried out at monthly intervals, include a similar number of premises each month (20-22 premises /month ; 10-11 in each of the regions included in the survey) and cover one calendar year to account for the known high risk period for NoV contamination. Premises will be selected at random to represent all food hygiene rating scores (see Appendix iii for example sampling plan). Each Local Authority will sample across the six scores and across premises types that are represented in their area. National chains will be allowed, however sampling Officers will aim to include a variety of premises and national chains to not exceed 20% of premises sampled.

In London we will work with Local Authority (LA) Environmental Health Officers (EHOs) undertaking routine inspections of catering premises across the London Boroughs and in the in North West England, Greater Manchester LAs will respond to support the

sampling required for the study. Sampling will be divided between the LAs to ensure the requirements of the study are met. For London, of a total of 23 LAs, agreement to participate in the study has been confirmed for the following LAs: London Borough of Southwark, Royal Borough of Greenwich, London Borough of City of London, London Borough of Tower Hamlets and London Borough of Ealing (see Appendix iv) for breakdown of establishments available for sampling in these LAs). There is interest from additional LAs in the study, and if required, the inclusion of additional LAs can be readily arranged through the Association of London Environmental Health Managers.

For the North West of England local authorities representative from each of the four Food Liason groups in the North West have agreed to participate specifically Sefton for Cheshire and Merseyside, Allerdale for Cumbria, Fylde for Lancashire and Salford for Greater Manchester. In addition there are a number of other authorities who are also interested.

Inspections will be recorded using the current UK Food Surveillance System (UKFSS), as done routinely by Local Authorities. The Local Authority will select the sample type as swab and clearly mark in the notes field that this is for the NoVAS study. The UKFSS code will be used to link the bacteriology and virology swabs. The PHE Food, Water and Environmental Microbiology Service Laboratory Information Management System, STARLIMS, does allow norovirus to be selected as a test, so viral swabs will be logged onto this system alongside the swabs collected for bacteriological testing and once results are returned by the viral testing labs, results will be uploaded. This will mean that Local Authorities will get a report for both the viral and bacteriological testing, although the viral testing report will not be available in real-time.

Pre-moistened Polystyrene Shaft Viscose Tip Swab in Deionised Water (TS/6-62, Technical Service Consultants Ltd.) and SpongeSicle™ swabs with 10 ml neutralising buffer (SSL-10NB, Sterilab Services) will be supplied by the PHE Food, Water and Environmental Microbiology Service for Local Authorities to collect bacteriological swabs alongside viral swabs for this study. Sampling Officers can collect samples from a defined template area or from a random area at the sampling point.

During inspections the following environmental surfaces will be swabbed using the virology swabs:

In the kitchen or food preparation area:

- The refrigerator door handle
- A food preparation surface (e.g. chopping board)
- Kitchen sink tap

In the toilets used by members of staff:

- The inside door handle of the toilet
- The toilet flush

Similar areas of the kitchen will be sampled with the bacteriology swabs, but not the same the exact areas; for the kitchen taps, one tap will be used for bacteriological sampling the other for virology sampling; for the food preparation surfaces, adjacent areas will be sampled using the standard 10cmx10cm square template.

In addition, the hands of up to 5 kitchen staff (the right hand if the individual is right-handed or the left hand if the individual is left-handed) will be swabbed for virology testing only. Individual level data about staff will not be collected in order to increase compliance with sampling.

After sampling, all swabs will be sent back to the corresponding region's FWE laboratory; swabs for NoV testing will be then referred to the virology labs (Liverpool or VRD), and those for microbiological indicators will be tested at the FWE labs.

EHOs will complete the short questionnaire provided including details such as the type of premises (cafe, restaurant, pub, gastropub, takeaway, hotel etc), number of covers (if applicable), number of staff, number of sinks and wash basins for hand-washing in the kitchen, number of toilets designated for staff, type of hand drier. In addition details on food hygiene rating score, confidence in management systems or business food safety culture scores will be recorded (see Appendix i).

2.4 Sampling during outbreaks

We will supplement the prevalence survey by including premises that are being investigated because of a foodborne NoV outbreak (estimated to be up to 10 a year per region). **An outbreak will be defined as either (a) two or more people from more than one household who are thought to have a common exposure to proven NoV infection or (b) clinically on the basis of Kaplan's criteria. Foodborne NoV outbreaks will be defined according to the following criteria:**

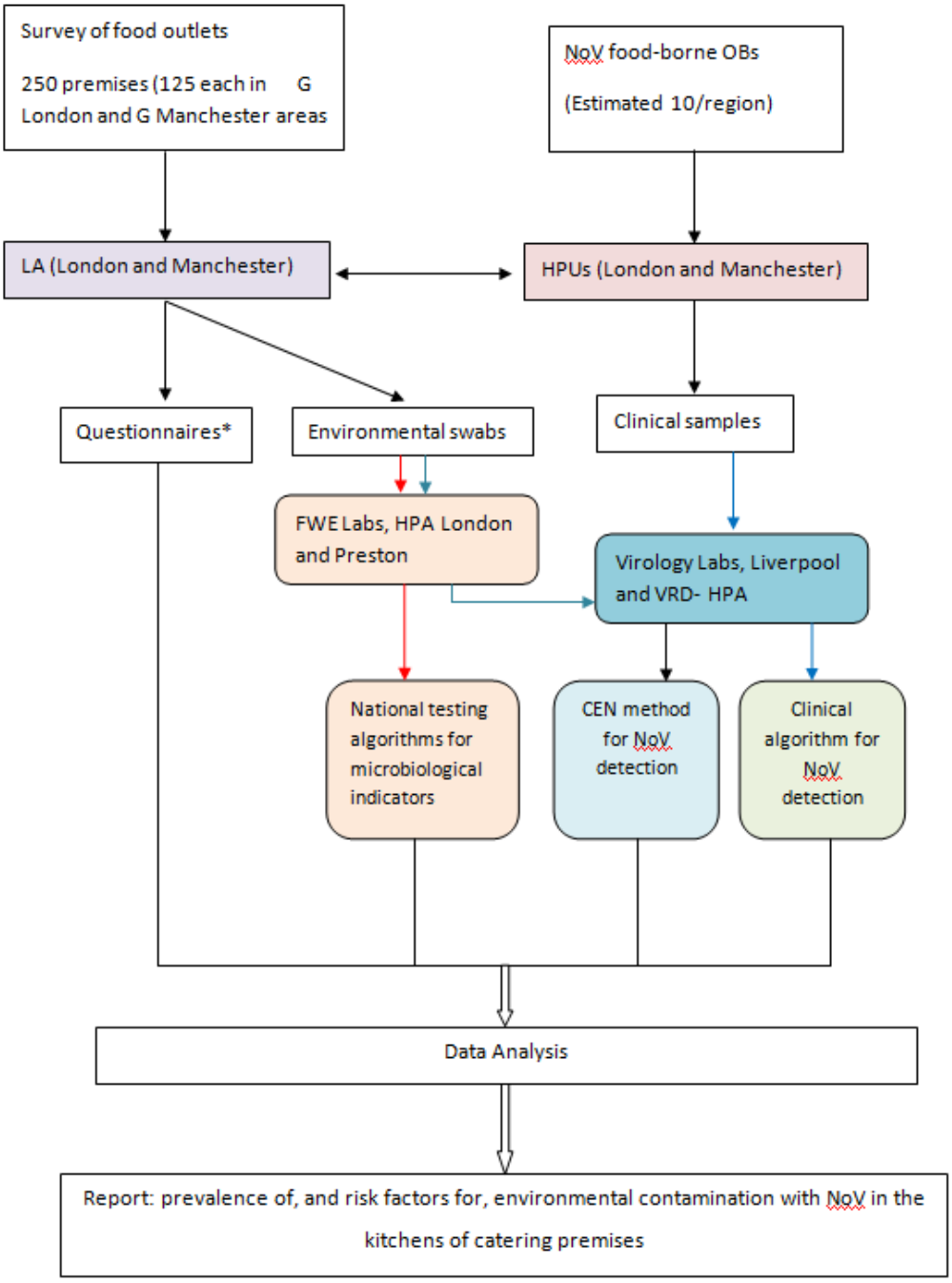
- The outbreak is a point source outbreak.
- There is a common food exposure – meal/buffet lunch/wedding breakfast.
- Foodborne transmission is the only or predominant transmission pathway identified by investigators.
- The cases do not have any other common exposure that could explain the outbreak apart from the consumption of food.
- The outbreak is not known to be the result of a guest or member of staff vomiting in a public area.

In outbreak premises, in addition to environmental swabs, a stool sample from members of staff will be collected via the appropriate Environmental Health Department. Where possible clinical specimens associated with outbreaks of NoV in catering establishments in the North West England and London will be submitted to the respective lead Public Health Laboratory for NoV detection. NoV positive outbreak case specimens associated with catering establishments will be referred for genotyping and strain characterization as described below. Outbreak case genotypes will be

compared with NoV genotypes from environmental or food handler positive samples for source attribution.

Outbreak premises will be revisited after cleaning has taken place and samples as in the first visit. Cleaning products and procedures used will be recorded in order to assess their effectiveness in reducing or removing norovirus RNA detection rates. For each outbreak premises, two matched control premises will be selected to be included in the monthly surveillance inspection visits. Matching will be done on food hygiene rating, size (number of covers) and type of premises.

Figure 1: Sampling and testing algorithm



2.5 Laboratory methods

2.5.1 Virological testing

Detection of norovirus RNA in environmental and hand swabs will be performed by Reverse Transcription Polymerase Chain Reaction (RT-PCR) following a standardised method (CEN ISO/TS 15216-2:2013).

Detection of norovirus in clinical samples linked to outbreaks of gastroenteritis will be done in NHS laboratories using validated RT-PCR methods.

The method is described in detail in Appendix v, and briefly consists of the following steps; Upon arrival to the virology laboratory (EVU, PHE, London or Clinical Virology, RLBUHT, Liverpool), swabs will be immersed in lysis buffer with an external control (EC) added; samples can then be stored refrigerated (+4 to +8 ^{o}C) until processing (up to one week). Total nucleic acid will be extracted from the entire sample using magnetic silica beads in a semi automated extractor system. Positive and negative controls will also be included in each run.

A fraction of the extracted nucleic acid will be used for the RT-PCR tests and the remainder will be stored immediately at -80^{o}C.

Each sample will be tested in three separate RT-PCR reactions for detecting RNA derived from norovirus genogroup I, norovirus genogroup II or the EC (Mengovirus). The results will be interpreted qualitatively only.

- Samples with cycle threshold (CT) values below the cut-off in either of the norovirus-specific assays will be considered positive.
- Samples with cycle threshold (CT) values above the cut-off in both of the norovirus-specific assays will be reported negative **only if** the EC RT-PCR results are within the expected CT range.
- Samples with cycle threshold (CT) values above the cut-off in either of the norovirus-specific assays in which EC RT-PCR results are not within the expected CT range (suggesting inhibitory samples) will be retested in a 1 in 10 dilution from the RNA extract (note that as all sample is extracted at once, it is not possible to re-extract the nucleic acid) and reported accordingly. In the event that the sample remains inhibitory in the dilution the results will be reported as invalid test.

Positive samples derived from the environmental or hand swabs or form clinincal samples will be genotyped using the current reference genotyping standard methods (see Appendix vi). In brief, cDNA will be synthesised by performing a reverse transcription reaction using random hexamers. Subsequently, genotyping will be done by amplification and sequencing of a fragments of the norovirus capsid S domain, which this is sufficiently discriminatory for genotype assignment. Sequences will be analysed by alignment against a database containing representative sequences of all known genotypes and assigned to a genotype based on >80% amino acid homology to a given reference sequence genotype. For outbreak tracking, when two or more samples are of the same genotype, amplification and sequencing of the norovirus hyper-variable region (P2 domain) will be carried out, and 100% homology between sequences from different samples indicates a common source and <100% identity indicates more than one potential source. Note that environmental samples are usually associated with low viral loads and that genotyping PCRs are inherently less sensitive than the detection RT-PCR. If amplicons are not obtained in the genotyping PCR, both cDNA and original PCR will be retested in the detection PCR to confirm positivity. When results are

concordant, the results will be reported as “NoV RNA detected: untypable”, if upon retesting the results are discordant with the original result, the sample will be result will be reported as equivocal.

2.5.2 Bacteriological testing

Sampling Officers can collect samples from a defined template area or from a random area at the sampling point and this must be clearly recorded on the sample request form submitted with the samples to allow testing to be directed to the right sample type.

For random or non-template swabs, results will be presented as colony forming units (cfu) per swab. Samples will be enumerated for:

- Coagulase positive Staphylococci, including *Sataphylococcus aureus*
- *Escherichia coli*
- Enterobacteriaceae

For template area swabs (10 x 10 cm), results will be rpesented as cfu per cm^2. Samples will be enumerated for:

- Aerobic colony count
- Coagulase positive Staphylococci, including *Sataphylococcus aureus*
- *Escherichia coli*
- Enterobacteriaceae

Results for swabs will be interpreted on the report as shown in Table 1.

Table 1. Interpretation for swabs collected for bacteriological testing as part of the NoVAS Study

Sample Type	**Test**	**Interpretation**		
		Considered **Satisfactory**	Considered **Borderline**	Considered **Unsatisfactory**
Measured Area **(CFU per cm2)**	Aerobic colony count	<100	≥10^2 - <10^3	≥10^3
	Escherichia coli	<2	-	≥2
	Enterobacteriaceae	<2	-	≥2
	Coagulase positive Staphylococci	<2	-	≥2
Random Area **(CFU per swab)**	Escherichia coli	<200	**-**	≥200
	Enterobacteriaceae	<200	**-**	≥200
	Coagulase positive Staphylococci	<200	**-**	≥200

2.6 Communication

The PHE Food, Water and Environmental Microbiology Laboratories at London and Preston will meet with the Local Authorities in December, before the launch of the main study. This will constitute a training session to help standardise sample collection and also to allow any questions and issues to be resolved prior to the project start.

During sampling, Local Authorities will be able to contact the laboratory on a daily basis to ask questions, as they would do for their routine sampling. A report will be issued with the results of bacteriological samples (see interpretation of results in Table 1) in real-time and a report for norovirus testing will be reported once the testing laboratory has provided results from batch testing. Norovirus results will be reported as Norovirus RNA found (NoV PCR positive), or Norovirus RNA not found (NoV PCR negative).

Meetings will be held every four months with the Local Authorities through the main project to allow opportunities for issues to be raised and to feedback on progress to date.

A final meeting will be held with Local Authorities in each of the regions to share the final Work Package results and to allow them to feedback for the final project report.

2.7 Reimbursement of sampling costs

Local Authorities will be reimbursed £30 towards the cost of collecting samples for the NoVAS pilot and main project for Work Package 5 via Public Health England costs.

To allow PHE to pay this, Local Authorities will need to complete the PHE Payment Request Form (see appendix vii) and return it to their local laboratory. The yellow highlighted sections of the form will need to be completed with Local Authority details. PHE will confirm the total sum each Local Authority will receive. This money will be reimbursed every three months.

Appendix 1: Environmental sampling for norovirus in food premises

This protocol is for environmental sampling of surfaces and equipment for detecting the presence of noroviruses in food premises.

Swabs will be used to sample surfaces of the kitchen environment and the toilets used by staff and should include:

- the refrigerator door handle
- a food preparation surface (e.g. chopping board)
- another frequently touched surfaces such as sink taps
- the inside door handle of the toilet used by staff members
- the toilet flush of the toilet used by staff members
- in addition to the above any surfaces known or suspected to have been contaminated, such as the floor, areas or objects in frequently used and touched (e.g. sink, taps, door handles, telephone, etc.) will also be swabbed in premises involved in a confirmed or suspected outbreaks of norovirus.

In addition swabs will also be taken from the hands of up to five members of the staff that handle food at the premises: the right hand if the individual is right-handed or the left hand if the individual is left-handed.

Swabbing technique:

1. Use a sterile cotton swab (provided by the PHE Food, Water and Environmental Microbiology Laboratory for use in this study) per surface to be samples, moisten with the sterile saline or phosphate buffered saline provided.
2. Swab the area, object or palm of the hand including the fingers and finger tips, applying a small amount of pressure. For surfaces and objects record the approximate size and shape of the area swabbed, and for flat surfaces choose a maximum area of 10 x 10 cm (100 cm^2).
3. Place the swab back into its original sheath (**without** adding any additional transport medium or buffer)
4. Label each swab with a unique reference and use the enclosed form to record the number of swabs taken, details of the areas swabbed Hand swabs should be anonymised and should not include any details that would allow identification of the staff sampled.
5. Pack swabs and completed form together and transfer to the Food Water and Environmental laboratory for testing using the dedicated courier system.

Samples should be sent to:

In London:

Public Health England
Food, Water and Environmental Microbiology Laboratory, London
PHE Colindale, 61 Colindale Avenue
London
NW9 5EQ

Email: FWEM@phe.gov.uk
Telephone: 0208 327 6548/6550/6551
Local Project Coordinator: Nicola Elviss

In the North West of England:

Public Health England
Food, water and Environmental Microbiology Laboratory Preston
Royal Preston Hospital
Sharoe Green Lane
North Preston
PR2 9HT

Email: LabFwePreston@phe.gov.uk
Telephone: 01772522759
Local Project Coordinator: Andrew Fox

Environmental sampling for norovirus in food premises: Record sheet

Name of establishment		Post code	
Local Authority			
EHO responsible for sampling			
Pre-visit Food Hygiene Rating Score	Confidence in management systems	Practices	Structures
0☐ 1☐ 2☐ 3☐ 4☐ 5☐			
New Food Hygiene Rating Score	Confidence in management systems	Practices	Structures
0☐ 1☐ 2☐ 3☐ 4☐ 5☐			

Premises type	Hotel ☐	Pub ☐	Cafe ☐	Take away ☐	Other ☐ *Please state*
Number of Kitchen Staff		Number of covers			
Number of sinks in the kitchen:		Number of toilets Dedicated to staff:		Type of hand drying: Paper towels ☐ Air (above) ☐ Air (blade) ☐	
Number of washbasins in the kitchen:					
Surface cleaning product in use					
Does cleaning product comply to British Standard?	Yes ☐ No ☐				
Date of Sampling		Surveillance ☐ Outbreak investigation ☐			
Total number of Swabs taken[1]					

FOR LABORATORY USE ONLY:			
Date received		Time Received	
Received By		Received From	
Cool box reference		Datalogger reference	
Temperature on receipt		Sample receipt:	Satisfactory ☐ Unsatisfactory ☐

[1] For routine surveillance maximum number of swabs to be taken is 10. During outbreak investigation up to 15 swabs in total can be taken ad referred for investigation.

Environmental Samples: Viral (Cotton-tipped, pre-moistened Swab ONLY) – up to five for routine sampling visit or up to 10 in an incident investigation

UKFSS code / Sample reference	**Swab number**	**Surface sampled**	**Laboratory Number**
	EV1		
	EV2		
	EV3		
	EV4		
	EV5		
	EV6		
	EV7		
	EV8		
	EV9		
	EV10		

Hand Swabs: Viral Only (Cotton-tipped, pre-moistened Swab ONLY) – up to five

UKFSS code / Sample reference	Swab number	Hand swab identifier	Attended Food Hygiene Training?	Laboratory Number
	HV1		☐	
	HV2		☐	
	HV3		☐	
	HV4		☐	
	HV5		☐	

Environmental Samples: Bacteriological (SpongeSicle™ Swab ONLY) – up to five for routine sampling visit or up to 10 in an incident investigation

UKFSS code / Sample reference	Swab number	Surface sampled	Laboratory Number
	EB1		
	EB2		
	EB3		
	EB4		
	EB5		
	EB6		
	EB7		
	EB8		
	EB9		
	EB10		

Additional Notes:

Appendix 2: Number of premises and swabs taken by LA, premise and food hygiene rating for the North West region during the pilot study

Local Authority	Number Premises Sampled	Type – Café	Type – Hotel	Type – Other (not stated)	Type – Pub	Type – Restaurant	Type – Take away	Environmental swabs	Number of hand swabs
Allerdale	3				3			16	9
Salford City Council	4				1	2	1	20	8
Sefton Council	3		2	1				15	6
Wyre Borough Council	3	1	1				1	16	5
Grand Total	13	1	3	1	4	2	2	67	28

Number of premises by Food Hygiene Rating

Local Authority	0	1	2	3	4	5
Allerdale			1	1		1
Salford City Council	1			1	2	
Sefton Council				1	1	1
Wyre Borough Council		1			1	5
Grand total	1	1	1	3	4	7

Number of premises and swabs taken by LA, premise and food hygiene rating for the London region during the pilot study

Local Authority	Number of Premises Sampled	Premises Type						Environmental swabs	Hand swabs
		Cafe	Hotel	Other (not stated)	Pub	Restaurant	Take Away		
Royal Borough of Greenwich	4	1			1	1	1	16	3
London Borough of Southwark	4				1	2	1	39	9
London Borough of City of London	3			1		2		38	5
London Borough of Ealing	1					1		5	5
London Borough of Tower Hamlets	1			1					
Grand Total									

Number of premises by Food Hygiene Rating Scheme score

Local Authority	0	1	2	3	4	5
Royal Borough of Greenwich			1	1	1	1
London Borough of Southwark	1			1	1	1
London Borough of City of London		1			1	1
London Borough of Ealing	1					
London Borough of Tower Hamlets						
Grand Total						

Appendix 3: Example of sampling plan by month and LA

Month	Local Authority 1	Local Authority 2	Local Authority 3	Local Authority 4	Local Authority 5
1	Two Premises: 1 x FHRS 0, 1 x FHRS 3	Two Premises: 1 x FHRS 1, 1 x FHRS 4	Two Premises: 1 x FHRS 2, 1 x FHRS 5	Two Premises: 1 x FHRS 0, 1 x FHRS 3	Two Premises: 1 x FHRS 1, 1 x FHRS 4
2	Two Premises: 1 x FHRS 2, 1 x FHRS 5	Two Premises: 1 x FHRS 0, 1 x FHRS 3	Two Premises: 1 x FHRS 1, 1 x FHRS 4	Two Premises: 1 x FHRS 2, 1 x FHRS 5	Two Premises: 1 x FHRS 0, 1 x FHRS 3
3	Two Premises: 1 x FHRS 1, 1 x FHRS 4	Two Premises: 1 x FHRS 2, 1 x FHRS 5	Two Premises: 1 x FHRS 0, 1 x FHRS 3	Two Premises: 1 x FHRS 1, 1 x FHRS 4	Two Premises: 1 x FHRS 2, 1 x FHRS 5
4	Two Premises: 1 x FHRS 0, 1 x FHRS 3	Two Premises: 1 x FHRS 1, 1 x FHRS 4	Two Premises: 1 x FHRS 2, 1 x FHRS 5	Two Premises: 1 x FHRS 0, 1 x FHRS 3	Two Premises: 1 x FHRS 1, 1 x FHRS 4
5	Two Premises: 1 x FHRS 2, 1 x FHRS 5	Two Premises: 1 x FHRS 0, 1 x FHRS 3	Two Premises: 1 x FHRS 1, 1 x FHRS 4	Two Premises: 1 x FHRS 2, 1 x FHRS 5	Two Premises: 1 x FHRS 0, 1 x FHRS 3
6	Two Premises: 1 x FHRS 1, 1 x FHRS 4	Two Premises: 1 x FHRS 2, 1 x FHRS 5	Two Premises: 1 x FHRS 0, 1 x FHRS 3	Two Premises: 1 x FHRS 1, 1 x FHRS 4	Two Premises: 1 x FHRS 2, 1 x FHRS 5
7	Two Premises: 1 x FHRS 0, 1 x FHRS 3	Two Premises: 1 x FHRS 1, 1 x FHRS 4	Two Premises: 1 x FHRS 2, 1 x FHRS 5	Two Premises: 1 x FHRS 0, 1 x FHRS 3	Two Premises: 1 x FHRS 1, 1 x FHRS 4
8	Two Premises: 1 x FHRS 2, 1 x FHRS 5	Two Premises: 1 x FHRS 0, 1 x FHRS 3	Two Premises: 1 x FHRS 1, 1 x FHRS 4	Two Premises: 1 x FHRS 2, 1 x FHRS 5	Two Premises: 1 x FHRS 0, 1 x FHRS 3
9	Two Premises: 1 x FHRS 1, 1 x FHRS 4	Two Premises: 1 x FHRS 2, 1 x FHRS 5	Two Premises: 1 x FHRS 0, 1 x FHRS 3	Two Premises: 1 x FHRS 1, 1 x FHRS 4	Two Premises: 1 x FHRS 2, 1 x FHRS 5
10	Two Premises: 1 x FHRS 0, 1 x FHRS 3	Two Premises: 1 x FHRS 1, 1 x FHRS 4	Two Premises: 1 x FHRS 2, 1 x FHRS 5	Two Premises: 1 x FHRS 0, 1 x FHRS 3	Two Premises: 1 x FHRS 1, 1 x FHRS 4
11	Two Premises: 1 x FHRS 2, 1 x FHRS 5	Two Premises: 1 x FHRS 0, 1 x FHRS 3	Two Premises: 1 x FHRS 1, 1 x FHRS 4	Two Premises: 1 x FHRS 2, 1 x FHRS 5	Two Premises: 1 x FHRS 0, 1 x FHRS 3
12	Two Premises: 1 x FHRS 1, 1 x	Two Premises: 1 x FHRS 2, 1 x	Two Premises: 1 x FHRS 0, 1 x	Two Premises: 1 x FHRS 1, 1 x	Two Premises: 1 x FHRS 2, 1 x

Month	Local Authority 1	Local Authority 2	Local Authority 3	Local Authority 4	Local Authority 5
	FHRS 4	FHRS 5	FHRS 3	FHRS 4	FHRS 5

Appendix 4: Premises type and FHRS by local authority

		Rating Value								
LA Name	Business Type	0	1	2	3	4	5	Awaiting Inspection	Exempt	Grand Total
Southwark	Distributors/Transporters				3	5	7		1	16
	Farmers/growers					1	2			3
	Hospitals/Childcare/Caring Premises			3	7	37	98		4	149
	Hotel/bed & breakfast/guest house				2	4	16		2	24
	Importers/Exporters					2	1			3
	Manufacturers/packers		1		7	9	9		2	28
	Mobile caterer			3	9	5	20			37
	Other catering premises	1	9	6	29	61	70		4	180
	Pub/bar/nightclub		9	26	40	78	77	1	4	235
	Restaurant/Cafe/Canteen	6	59	56	137	164	277	2	4	705
	Retailers - other	3	74	33	136	229	202	1	103	781
	Retailers - supermarkets/hypermarkets		3	1	6	13	37			60
	School/college/university		1	1	6	20	85			113
	Takeaway/sandwich shop		32	31	65	53	53			234
Southwark Total		10	188	160	447	681	954	4	124	2568

		Rating Value								
LA Name	Business Type	0	1	2	3	4	5	Awaiting Inspection	Exempt	Grand Total
Greenwich	Distributors/Transporters	1			3	1	1	1	2	9
	Hospitals/Childcare/Caring Premises			2	10	14	68	30	7	131
	Hotel/bed & breakfast/guest house				1	3	6	8		18
	Manufacturers/packers		1		5	8	4	4	1	23
	Mobile caterer		4	1	11	20	15	12		63
	Other catering premises		3	1	20	30	48	44	10	156
	Pub/bar/nightclub		9	2	21	20	31	45		128
	Restaurant/Cafe/Canteen	3	24	11	80	80	124	51		373
	Retailers - other	3	33	9	52	35	39	121	90	382
	Retailers - supermarkets/hypermarkets		2		4	7	9	21		43
	School/college/university		3		15	33	52	27	3	133
	Takeaway/sandwich shop	7	29	10	54	44	40	13	3	200

Greenwich Total		14	108	36	276	295	437	377	116	1659
		Rating Value								
LA Name	Business Type	0	1	2	3	4	5	Awaiting Inspection	Exempt	Grand Total
Ealing	Distributors/Transporters		1		1		1		4	7
	Farmers/growers						1			1
	Hospitals/Childcare/Caring Premises		5	2	24	44	107	5	7	194
	Hotel/bed & breakfast/guest house			1	7	2	6			16
	Importers/Exporters		1			1				2
	Manufacturers/packers	2	7	1	17	17	37	13	6	100
	Mobile caterer		3	1	10	8	13	11		46
	Other catering premises	2	3	14	35	30	60	27	49	220
	Pub/bar/nightclub		16	10	45	32	58	9		170
	Restaurant/Cafe/Canteen	18	71	44	151	109	161	24	1	579
	Retailers - other	11	113	53	164	82	100	17	159	699
	Retailers - supermarkets/hypermarkets		4	4	6	8	32	1		55
	School/college/university		1	6	8	15	72	3		105
	Takeaway/sandwich shop	10	25	26	39	36	47	9		192
Ealing Total		43	250	162	507	384	695	119	226	2386

		Rating Value								
LA Name	Business Type	0	1	2	3	4	5	Awaiting Inspection	Exempt	Grand Total
Tower Hamlets	Distributors/Transporters		6	1	16	25	22	2		72
	Hospitals/Childcare/Caring Premises		1			8	28			37
	Hotel/bed & breakfast/guest house						2			2
	Manufacturers/packers		6		8	14	33	28		89
	Mobile caterer				2	2	6	3		13
	Other catering premises		3	2	6	8	24	6		49
	Pub/bar/nightclub		7	3	47	53	67	8		185
	Restaurant/Cafe/Canteen	10	87	22	147	218	429	68		981
	Retailers - other	3	61	8	98	168	125	33	1	497
	Retailers - supermarkets/hypermarkets			2	1	7	33	2		45
	School/college/university		1	1	3	18	77			100
	Takeaway/sandwich shop	5	52	7	50	72	98	20		304
Tower Hamlets Total		18	224	46	378	593	944	170	1	2374

		Rating Value								
LA Name	Business Type	0	1	2	3	4	5	Awaiting Inspection	Exempt	Grand Total
City of London Corporation	Distributors/Transporters						4			4
	Hospitals/Childcare/Caring Premises					1	5			6
	Hotel/bed & breakfast/guest house		1		1	2	5			9
	Importers/Exporters					2				2
	Mobile caterer		1		1		5	1		8
	Other catering premises		1	3	5	32	118	2	19	180
	Pub/bar/nightclub	3	11	25	30	89	91	2		251
	Restaurant/Cafe/Canteen	6	37	42	79	148	397	18	8	735
	Retailers - other		4	2	8	22	81	1	45	163
	Retailers - supermarkets/hypermarkets			1		4	23			28
	School/college/university		1			5	2			8
	Takeaway/sandwich shop	10	15	21	45	78	171	5		345
City of London Corporation Total		19	71	94	169	383	902	29	72	1739

		Rating Value								
LA Name	Business Type	0	1	2	3	4	5	Awaiting Inspection	Exempt	Grand Total
Allerdale, Cumbria	Distributors/Transporters					2			2	4
	Farmers/growers								2	2
	Hospitals/Childcare/Caring Premises			1	5	9	23	1	7	46
	Hotel/bed & breakfast/guest house			3	14	65	157		1	240
	Manufacturers/packers			2	3	5	9		6	25
	Mobile caterer			3	2	8	10			23
	Other catering premises	1		2		7	25	1	26	62
	Pub/bar/nightclub	1	1	4	19	28	33	1	31	118
	Restaurant/Cafe/Canteen		5	6	19	65	113	1	9	218
	Retailers - other			9	12	37	64	1	39	162
	Retailers - supermarkets/hypermarkets				1	10	10		1	22
	School/college/university				1	9	64		7	81
	Takeaway/sandwich shop	1		10	14	24	31			80
Allerdale Total		3	6	40	90	269	539	5	131	1083

		Rating Value								
LA Name	Business Type	0	1	2	3	4	5	Awaiting Inspection	Exempt	Grand Total
Fylde, Lancashire	Distributors/Transporters						1		1	2
	Farmers/growers								1	1
	Hospitals/Childcare/Caring Premises		2	1	6	23	41		27	100
	Hotel/bed & breakfast/guest house		2	1	3	11	18	1		36
	Manufacturers/packers				2	3	2		1	8
	Mobile caterer		1	3	3	10	13	1	1	32
	Other catering premises			2	4	3	19	4	20	52
	Pub/bar/nightclub		4	6	11	20	33	3	1	78
	Restaurant/Cafe/Canteen	1	10	11	18	36	59	3	8	146
	Retailers - other		2	2	7	22	45	1	58	137
	Retailers - supermarkets/hypermarkets			2		9	11			22
	School/college/university			1	1	2	32		1	37
	Takeaway/sandwich shop	1	4	11	14	21	31	3		85
Fylde Total		2	25	40	69	160	305	16	119	736

		Rating Value							
LA Name	Business Type	0	1	2	3	4	5	Exempt	Grand Total
Salford, G Manchester	Hospitals/Childcare/Caring Premises		3	4	12	27	81	19	146
	Hotel/bed & breakfast/guest house		4		2	3	13		22
	Mobile caterer		3	2	5	26	44	1	81
	Other catering premises		3	1	8	13	95	12	132
	Pub/bar/nightclub		12	4	16	44	120	1	197
	Restaurant/Cafe/Canteen	2	23	15	65	65	168	25	363
	Retailers - other	5	89	11	52	82	195	32	466
	Retailers - supermarkets/hypermarkets		1	1	3	2	30		37
	School/college/university			1	3	16	75	1	96
	Takeaway/sandwich shop	5	58	23	57	63	75		281
Salford Total		12	196	62	223	341	896	91	1821

		Rating Value							
LA Name	Business Type	0	1	2	3	4	5	Awaiting Inspection	Grand Total
Sefton,	Farmers/growers				1	1			2
Cheshire and Merseyside	Hospitals/Childcare/Caring Premises		2		9	31	191		233
	Hotel/bed & breakfast/guest house		3		1	18	42		64
	Mobile caterer				4	6	34		44
	Other catering premises		2		3	27	123		155
	Pub/bar/nightclub		7	2	25	60	153	2	249
	Restaurant/Cafe/Canteen		21	7	43	63	268		402
	Retailers - other	2	24	6	37	72	165	3	309
	Retailers - supermarkets/hypermarkets		4	1	2	5	47		59
	School/college/university				3	10	106		119
	Takeaway/sandwich shop	6	19	10	50	45	101	2	233

Appendix 5: Further information

Bench protocols

European Committee for Standardization Technical Committee. *Bench Protocol for Carrying out the Cen Horizontal Method for Detection of Norovirus and Hepatitis a Virus in Food by RT-PCR.* Version 9. CEN: Geneva, Switzerland; 2011

Standard methods for norovirus genotyping

Health Protection Agency. *Genotyping and Characterisation of Norovirus Strains*. David J Allen 2011