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# Field and laboratory scenario for gastro-enteritis outbreaks: norovirus

Scientific Service of Food Pathogens

Juliette Wytsmansstraat 14  
1050 Brussels | Belgium

[www.wiv-isp.be](http://www.wiv-isp.be)



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**Nadine Botteldoorn, Sarah Denayer, Katelijne Dierick, Maria Naranjo**





## **FIELD AND LABORATORY SCENARIO FOR GASTRO-ENTERITIS OUTBREAKS: NOROVIRUS**

### 1. Introduction:

At European level a food-borne outbreak (FBO) is defined as an incidence, observed under given circumstances, of two or more human cases of the same disease and/or infection; or a situation in which the observed number of human cases exceeds the expected number and where the cases are linked, or are probably linked, to the same food source (Directive 2003/99/EC, Article 2(d)). Reporting is mandatory for every Member State. In Belgium, different authorities are dealing with FBO and the information is dispersed and difficult to collect for reporting purposes. The Federal Agency for the Safety of the Food chain (FASFC) is responsible for the sampling of suspected food; the Communities (Flemish, French and German speaking Community and Brussels) are responsible for data collection at human side. The Scientific Institute of Public Health (IPH) harbors the National Reference Laboratory for food-borne outbreaks (NRL-FBO) and it is responsible for collecting, centralizing the information, reporting and following up of FBO in Belgium. Furthermore, the NRL-FBO analyses all suspected food samples. After isolation, the pathogens are identified by biochemical and molecular techniques. The molecular patterns of food and human isolates are compared to determine the causative agent of the FBO with certainty.

To bring together the different competent authorities on food safety and public health, a national platform was created in 2004. This platform was approved by the National Conference of Ministers of Public Health. Since 2005, the Microbiology Laboratory at the IPH was chosen as National Reference Laboratory for foodborne outbreaks. A protected web application was created in order to share communication in "real time" between the different authorities dealing with FBO. In this web-application, a common file is created for each individual outbreak, and the data and laboratory results are shared between food and human health inspectors.

Actually this web application is available and contains the required data for the annual rapport to the European Commission via EFSA. In 2006 the laboratory started with the detection of Norovirus (NoV) in food and human samples. In 2008 the Flemish Community decided to assign a budget for the systematic analyzing of NoV during FBOs in which the agent was suspected as being the causal one.

### 2. Key words:

Norovirus, outbreaks, scenario, surveillance

### 3. Epidemiology:

With the advent of efficient methods for their detection NoV has emerged as major, worldwide cause of gastroenteritis in diverse populations and in all age groups. Considering the high attack rates and the fact that NoV can cause disease in all age groups, the socio-economical burden of NoV infection is very important.

Some studies suggest that NoV is the second most common cause of severe childhood gastroenteritis, following rotavirus. With the advent of a vaccine against Rotavirus we might thus expect an increasing finding of NoV as causal agent of gastroenteritis in children younger than 5 years.

Data from population-based studies suggest that NoVs are the most common cause of infectious gastroenteritis at the community level in developed countries. The Centre for Disease Control and Prevention (CDC) estimates that NoV causes >90% of nonbacterial and  $\approx$ 50% of all-cause epidemic gastroenteritis worldwide. Data from Europe show an increase of reported NoV outbreaks in the last years. Foodborne outbreaks of noroviruses occur year-round but epidemic gastroenteritis has a higher incidence in the winter months in temperate climates, therefore, NoV outbreaks are often referred to as 'the winter vomiting disease'.

#### 4. Surveillance system for food-borne outbreaks in Belgium

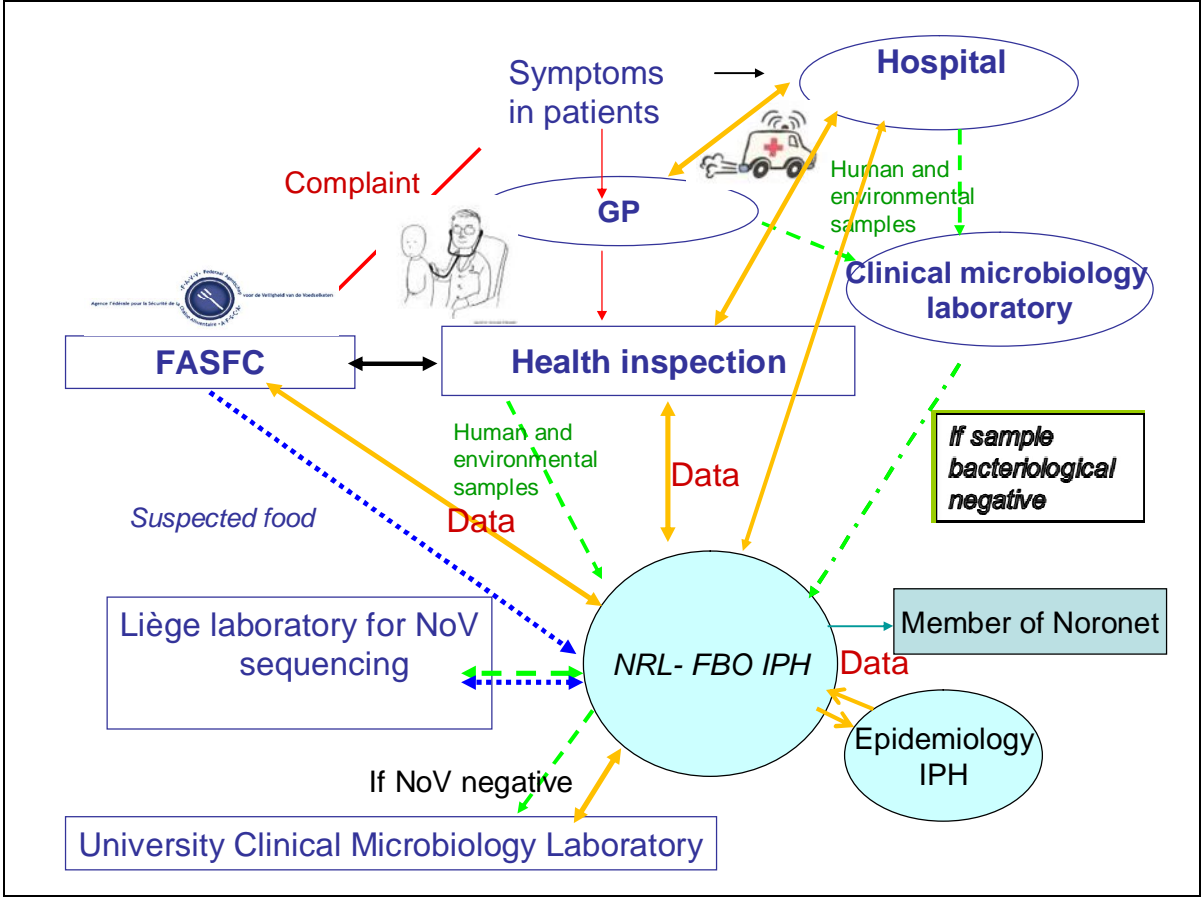
The NRL-FBO at IPH collects and centralizes the information from all actors dealing with food-borne outbreaks.

The FASFC, responsible for the safety of the food chain, collects data by using a standardized questionnaire covering suspected food, the setting where food was prepared and consumed, processing and storage of the food and contributing factors in causing the outbreak. If present, leftovers of the suspected food and in some cases food of the same production date are sampled and sent to the NRL-FBO to be analyzed. In consultation with the NRL-FBO the parameters to be analyzed are selected on the basis of the quantity of the leftovers, the symptoms of the patient, the epidemiological information and the nature of the suspected food product.

The Communities, responsible for the ill persons, collect data and epidemiological information on symptoms, number of persons involved, deaths and hospitalizations, incubation period, and transmission route. Stool samples can be taken and are sent to a clinical laboratory or to the NRL-FBO which dispatches the samples to the clinical microbiology laboratory of the University of Brussels. The NRL-FBO analyzes those parameters on human samples that are not routinely analyzed in clinical laboratories, like Norovirus, *Staphylococcus* and *Bacillus cereus*. If the stool samples are bacteriologically positive the isolates are immediately forwarded to the human National Reference Centers of the IPH (*Salmonella*, *Shigella* and *Listeria*).

The NRL-FBO also collects information on food-borne outbreaks from the Sentinel Laboratory Network coordinated by the Epidemiology Section of the IPH and from the human National Reference Centers.

Figure 1: Surveillance system for foodborne outbreaks in Belgium



After isolation, the pathogens are further identified by biochemical, phagetyping and molecular techniques. Wherever possible the molecular patterns of food and human isolates are compared to determine the causative agent of the FBO with certainty. Therefore there is a close collaboration with the National Reference Center for *Salmonella* and *Shigella* and the National Reference Center for *Listeria* situated in the same institute (2, 5). For *Bacillus cereus* and Coagulase positive *Staphylococcus* relevant bacterial toxins are detected and underlying toxin and virulence genes are determined by PCR (4). Furthermore a laboratory network is being created with experienced university laboratories specialized in different species of food-borne pathogens to further characterize the isolated agents(3). The data and sample flows are presented in figure 1.

To advance data exchange between the different authorities competent for food-borne outbreaks, a National Platform Food-Borne Outbreaks and Zoonoses transmitted by food, was created in 2004, including members of all competent authorities, university veterinary public health laboratories, human reference laboratories and the anti-poison centre. Furthermore in 2007, for a better communication, a protected web application was made available to exchange outbreak data and laboratory results in “real time” between the different authorities dealing with FBO. In this web-application a common file is created for

each individual outbreak, and the data and laboratory results are shared between food inspectors and human health inspectors.

## 5. Scenario for food-borne Norovirus gastro-enteritis

### 5.1 Reporting of a gastro-enteritis outbreak

Sick people with gastrointestinal symptoms will firstly contact their general practitioner. When a common food source is suspected they might also complain directly to the Federal Agency for the Safety of the Food Chain (FASFC). FASFC contacts then the health inspection (Toezicht Volksgezondheid Infectieziekten or Direction Générale de la Santé) to inform about the complaint. The GP also informs the health inspection when he suspects a foodborne outbreak(FBO).

If  $\geq 2$  persons became ill, probably upon consuming the same food, the FASFC will start a questionnaire to receive more information on the circumstances of the outbreak (number of ill, symptoms, food involved (if applicable),...). Similarly, according to the obligatory reporting of collective gastro-enteritis outbreaks, the same is done by the Health Inspection.

The FASFC inspectors and Health Inspectors inform the National Reference Laboratory for food borne outbreaks at the Institute of Public Health (NRL-FBO IPH), about the outbreak and the samples which will be send for analysis.

#### Contacts:

Institute/organization	website	telephone
Institute of Public Health NRL FBO J. Wytsmansstraat 14 1050 Brussels	<a href="http://www.wiv-isp.be">www.wiv-isp.be</a>	0032-(0)2-6425183
Toezicht Volksgezondheid Infectieziekten Ellipsgebouw Koning AlbertII laan 35 bus 33 1030 Brussels	<a href="http://www.zorg-en-gezondheid.be/infectieziekten.aspx">http://www.zorg-en-gezondheid.be/infectieziekten.aspx</a>	0032-(0)2-5129389
Direction Générale de la Santé Boulevard Léopold II 44 1080 Brussels	<a href="http://www.sante.cfwb.be">www.sante.cfwb.be</a>	0032-(0)2-4133311
FASFC Food Safety Center Kruidtuinlaan 55 1000 Brussels	<a href="http://www.favv.be/meldpuntconsument/">http://www.favv.be/meldpuntconsument/</a> <a href="http://www.favv.be/pointcontactconsommateurs/">http://www.favv.be/pointcontactconsommateurs/</a> <a href="http://www.favv.be/kontaktstellekonsumenten/">http://www.favv.be/kontaktstellekonsumenten/</a> <a href="http://www.favv.be/callcenterconsumers/">http://www.favv.be/callcenterconsumers/</a>	0032-(0)800-13550

### 5.2 Symptoms

The Kaplan criteria for the diagnosis of NoV may be useful in empirical diagnosis of NoV outbreaks. These include a short incubation period of 24-48 hours, and a short duration of 12 to 60 hours. Illness is characterized by acute onset of nausea, vomiting, abdominal cramps, and diarrhoea. Vomiting should be the prominent symptom in more than 50% of affected individuals and lack of identifiable pathogens on routine examinations of stool samples. In reality the reported attack rate of 50% affected individuals is seldom reported in foodborne Norovirus infections (often between 20-50%) and bacteriological results are often not yet known at the onset of an outbreak. Constitutional symptoms (e.g., headache, fever, chills) are frequently reported. Although rare, severe dehydration caused by NoV gastroenteritis can be fatal, with this outcome

occurring among susceptible persons (e.g., older persons with debilitating health conditions).

### 5.3 Epidemiology

#### 5.3.1. A point-source epidemic

A **point-source epidemic curve** shows a fast increasing number of ill, with a peak which is followed by a decrease or eventually new cases as a result of secondary infection. The incubation time is often equal to the time between exposure to a common food and the first peak of the epidemic curve. In this case, two modes of transmission can be distinguished:

a. food related transmission: Upon consuming a common foodstuff. Most often, a bacterial germ is at the origin of the infection, but Norovirus cannot be excluded. In case of a common kitchen or consuming a common meal, consumers become ill approximately at the same time. Personnel and people who did not consume the food are not ill. In most cases, a food handler is at the origin of the food contamination, but primary infected foodstuff exist (shellfish, raw vegetables, raspberries).

b. Not food related transmission: Although the epidemic curve is a point-source one, no relation with food is demonstrated. Norovirus presence in aerosols (vomit) is often at the origin of this type of transmission. This is often observed at events with many people being closely together.

#### 5.3.2 A person-to-person epidemic

A person-to-person epidemic is often observed in close living communities (eg hospitals, elderly homes, youth camps, ...). The **person-to-person epidemic curve** starts with one or few sporadic cases and is followed by an increase in the number of cases, especially within the sections where the first cases were reported. It is often obvious that transmission is not related to food consumption. In most cases ill people are observed both within the group of consumers of a common foodstuff and/or users of the same kitchen, and within people who did not share these common features. Different generations of infections will be observed as several peaks in the epidemiological curve.

#### 5.3.3 A common-source epidemic or mixed epidemics

In a **common-source epidemic**, several cases are reported over a longer period of time and no peak of illness is observed. A bacterial germ or toxin as causative agent is more probable, but Norovirus can not be excluded. A common food source or water supply can be at the origin of transmission. More investigations are required to identify a foodstuff or water supply which is at the origin of sporadic cases. This can include Norovirus carriers among the kitchen personnel or fecal contamination of tap water.

In **mixed epidemics**, a peak of illness can be observed and is followed by Gaussian curves, which result from transmission from person-to person or a contaminated environment.

### 5.4 Sampling, storage and transport of samples

#### **Sampling:**

Suspected food samples are taken by FASFC, human and environmental samples by the Health Inspectors. General Practitioners or clinical laboratories at hospitals can send the samples to the Health Inspectors or directly to the IPH. The highest number of samples possible should be taken, if possible of all involved people of an outbreak.

**Storage:**

Before and upon transport, samples should be stored refrigerated at a temperature of 2-8°C

**Transport of samples:**

Samples are sent to the NRL FBO (IPH) either directly by the inspectors who performed the sampling, the clinical laboratories from hospitals, a courier service or a driver from the IPH. Samples are transported refrigerated (2-8°C) if possible.

5.5 Result interpretation

**Food samples:**

Negative: According to the results, Norovirus is not present in the analysed food and based on this result, Norovirus can not be defined as the causative agent responsible for the outbreak. However, the sample might not be representative for ingested food. Further investigation of the foodstuff for the presence of bacteria or other viruses (eg sapoviruses) is required.

Positive: According to the result, the foodstuff is probably involved in the Norovirus infection. In case of primary infected foodstuff (shellfish, raw vegetables, raspberries, ready-to-eat foods ...), these should be withdrawn from the market. On the other hand, in case of secondary contamination from a food handler, samples from the food handlers should be analysed.

**Human samples:**

Negative: According to the results, Norovirus is not present in the ill people and based on this result, Norovirus can not be defined as the causative agent responsible for the outbreak. Further investigation of the sample for the presence of bacteria or other viruses (eg sapoviruses) is required.

Positive: According to the result, Norovirus is probably the causative agent for the reported outbreak. Control measures should be taken to avoid secondary transmission of Norovirus.

**Environmental samples:**

Negative: According to the results, Norovirus is not present in the environment and based on this result, Norovirus can not be defined as the causative agent responsible for the outbreak. Further investigation of the environment for the presence of bacteria or other viruses (eg sapoviruses) is required.



Positive: According to the result, Norovirus is present in the environment and possibly at the origin of the reported outbreak. Control measures should be taken to avoid secondary transmission.

All human NoVs detected are sequenced and reported to Noronet, a European database. Based on these results a map of circulating NoV in Belgium is being build. Due to low extraction efficiencies, NoV from food or environmental origin cannot be sequenced.

## 6. Management and control measures of NoV

There is no specific treatment or vaccine against NoV. As in all gastroenteritis, supportive measures for preventing dehydration are the cornerstone of the treatment. Some specific characteristics of NoV made of it an easily transmissible pathogen and a very difficult one to prevent and control. These are: A very low infective dose (less than 10-100 viral particles), asymptomatic excretion before and after the symptoms, presence of asymptomatic carriers, and a very high viral stability, high genetically diversity, not protecting immunity and the fact that the only known reservoirs are humans.

### 6.1 Control Measures during FBO:

#### 1/ Cleaning and disinfection.

Table : Overview of the use of chlorine for disinfection of Norovirus \*

Chlorine (ppm**)	Application
200 ppm	Stainless steel Food/mouth contact items Toys
1000 ppm	non-porous surfaces tile floors counter-tops Sinks Toilets
5000 ppm	Porous surfaces Wooden floors

\*from Centre for Disease Control – World Health Organization

\*\* : parts per million

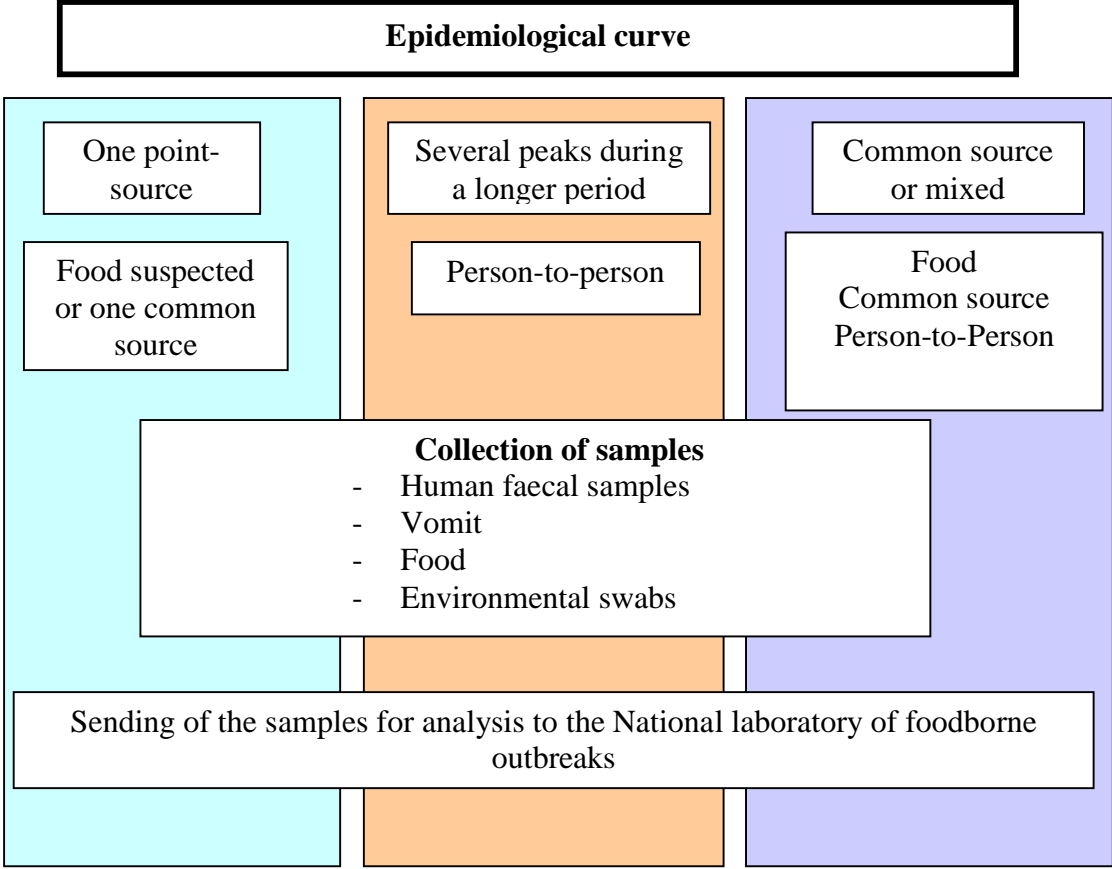
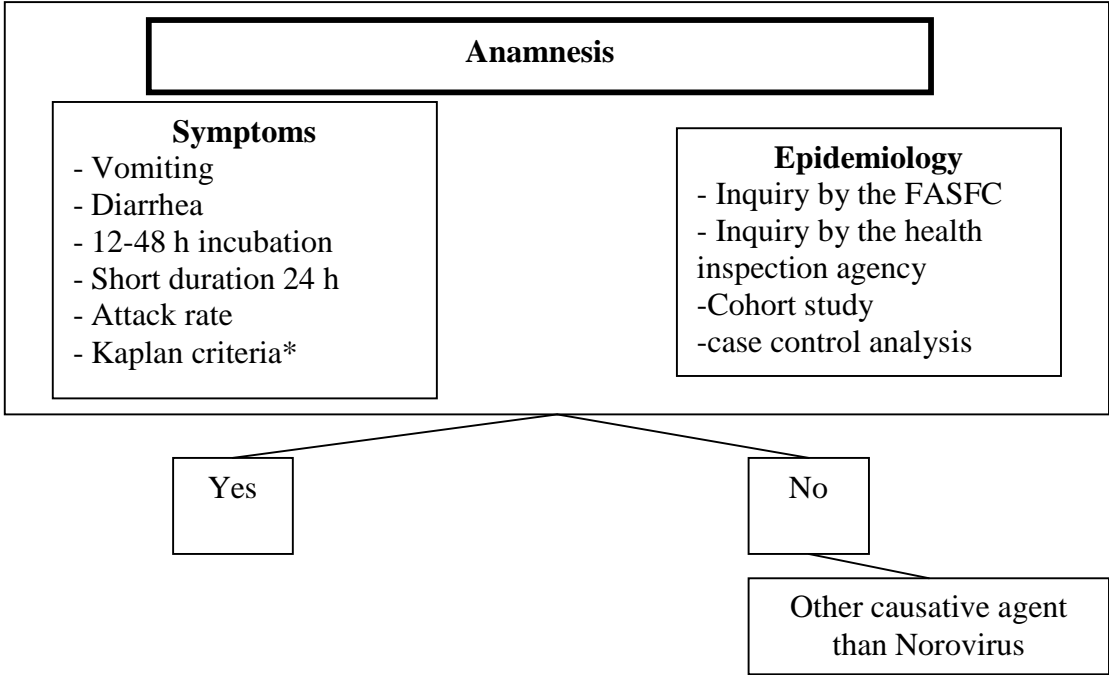
- **Surfaces**: Clean using warm water and soap before disinfection. Only disinfection using 1000 ppm free chlorine can avoid transmission from contaminated surfaces. For the preparation of a 1000 ppm solution, 1 chlorine tablet (1.5g free chlorine) should be resolved in 1.5 liters of water, or 16 ml bleach (NaOCl, 20°) per liter water should be used. Because of stability reasons, the use of tablets is recommended. Depending on the type of surface to be disinfected, different concentrations of chlorine are used (see table). If a low concentration of chlorine must be used for reasons of the type of material, a repetition of disinfection with a lower concentration is recommended. Alternatively, the surface can be treated with steam for materials which do not support any chlorine treatment.

- **Tissues** (clothes, sheets) contaminated with Norovirus should be washed once at 90°C or twice at 70°C. For sensitive tissues (eg. towels): Washing at 60°C or higher or two times at 40°C

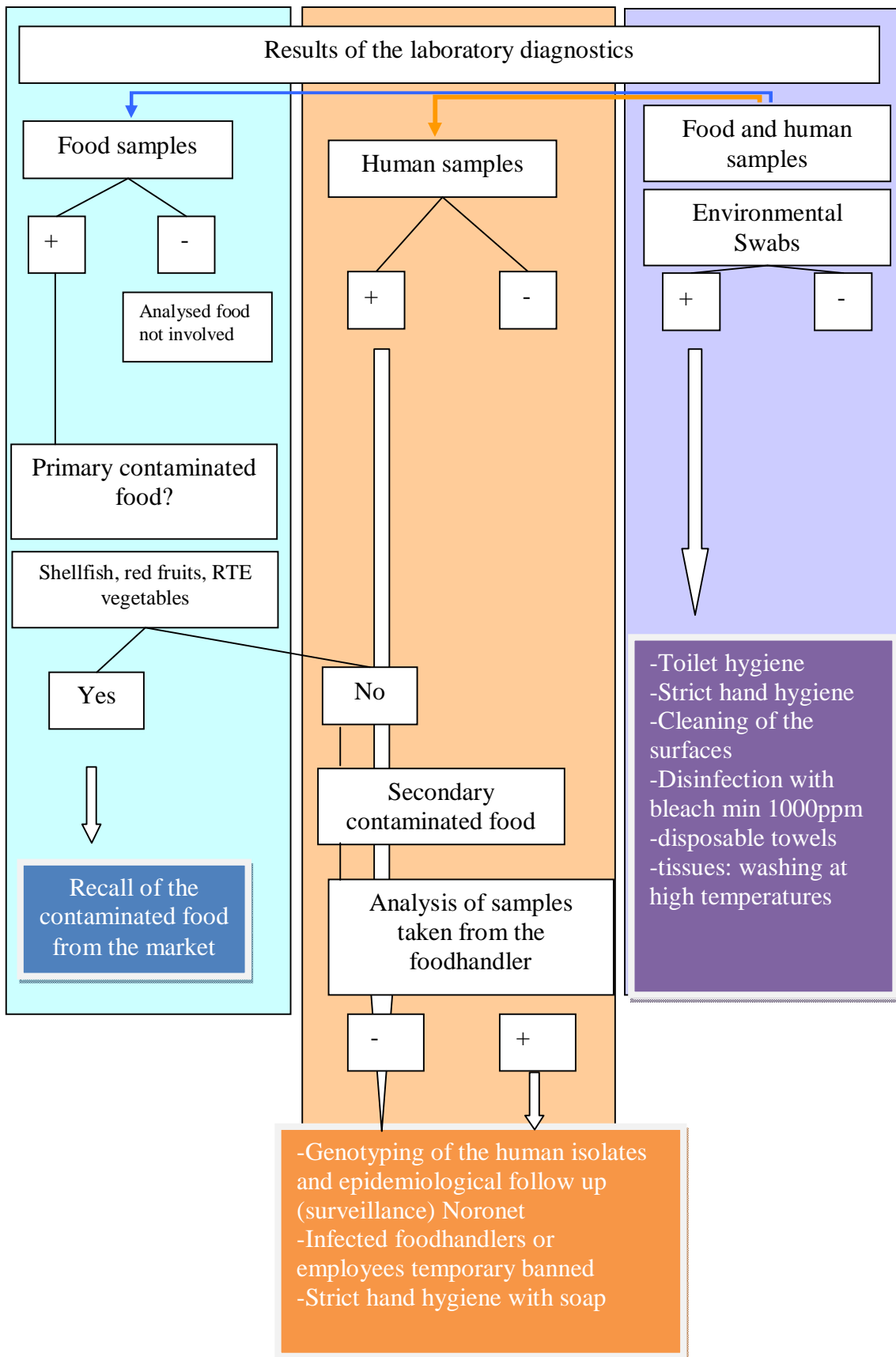
#### 2/ others

- Food handlers or other persons with clinical symptoms of a (viral) gastro-enteritis must be prohibited from the work floor or the group event for at least 3 days to avoid spread of the infection. Alternatively, these can exert temporarily other activities (no contact with patients or food).
- Visitors of elderly homes or hospitals having gastro-enteritis symptoms should not be allowed.
- Strict hand hygiene: regular washing using liquid hand soap. The efficiency of alcohol-based disinfectants is too low to inactivate Norovirus.
- Use of disposable towels

# Gastro-enteritis



\* Kaplan criteria for NoV : Infection in more than 50% of exposed, vomit as predominant symptom, incubation time less than 48 hours, duration of disease between 24-48 hours and coproculture negative for common bacterial causes



## 7. Abbreviations:

- NoV: Norovirus
- NoVAD Norovirus associated disease
- EFSA: European Food Safety Authority
- GP: General Practitioners
- IPH: Institute of Public Health
- FASFC: Federal Agency for the Safety of the Food Chain
- HI: Health Inspector
- UZ: Brussels University Hospital
- GI: Gastrointestinal
- FBD: Food borne disease
- NRL-FBO IPH: National Reference Laboratory for Foodborne outbreaks at the Institute of Public Health.
- GLEM:
- CDC: Centre for Disease Control and Prevention
- Noronet: European Network of scientists sharing virological, epidemiological and molecular data on norovirus.

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