Recommendation on Anticipating Noroviral Contamination through the Use of Antidiarrhoeals

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1 Background and explanatory memorandum

Among the pressures facing shellfish production areas, the attention of producers, consumers, and regulators in recent years has focused on contamination by norovirus, a major agent of acute gastroenteritis in humans.

This contamination, the origin of which is associated with the discharge of viral strains from the catchment area into the environment, has an impact on production and in some cases may lead to the closure of production areas, impacting on both the business sector and the employment area.

In order to face the risks caused by this norovirus contamination, the AAC considers it relevant to analyse the possibility of having tools to predict the areas affected by norovirus by integrating the use of antidiarrhoeals in a coastal catchment area.

A prediction tool could subsequently become one of the components of an action plan enabling the prioritisation of action programmes and/or the triggering of a series of preventive actions in the event of a proven risk, defined in consultation with the stakeholders and the management authorities concerned.

The AAC also considers it relevant that, depending on the quality of the available data on contaminant fluxes, this tool could also be used to define alert thresholds.

Moreover, the need for a tool to prevent the risk of norovirus contamination is all the more clear, as the existing indicators are not sufficient to characterise the vulnerability of shellfish production areas. Bacteriological contamination, for example, is the subject of a regular monitoring network based on the evaluation of E. Coli and Enterococci indicators. These monitoring networks are based on measurement points located on waterways, direct discharge outlets, and on certain sites at sea to characterise water quality in the receiving environment. While these types of contamination are now relatively well known and the potential sources of pollution are clearly identified thanks to regulatory files, including the vulnerability profiles of bathing areas and recently the vulnerability profiles of shellfish production areas, the case of norovirus is insufficiently well known and, in particular, the bacteriological indicators cannot be used to treat viral contamination.

The AAC has sent the Commission and the Member States a recommendation concerning noroviral contamination, on the methods for detecting this pathogen and on the further work considered necessary to describe infectious noroviruses and their degree of infectivity with a view to amending the regulatory criteria in force.

This work is in progress and it promises, particularly in the case of a project entitled OXYVIR2, to provide relevant answers from a scientific viewpoint.

In addition, the AAC believes that a risk prevention tool is needed to help producers reduce the impact of pollution from the catchment area on their activities.

2 Methodological framework for a preventive alert tool

The transfer mechanisms of these viral strains from the catchment area to the shellfish production areas are complex. They depend on:

- flows at discharge levels into the receiving environment
- their dilution in the receiving environment, under the effect of weather and sea conditions
- their survival in the receiving environment

- and their filtering by shellfish.

The AAC proposes the use of a methodology based on a deterministic approach to the dilution of contaminant plumes at sea. This methodology should be based, for a given geographical area, on the following information:

- the inventory of potential sources of pollution, enabling the geolocation of discharges;
- watercourse flow data;
- the data available from the services of the Member State in charge of public health, to characterise the level of viral load in norovirus estimated or measured during the year, with the aim of defining a record on the year of contamination.

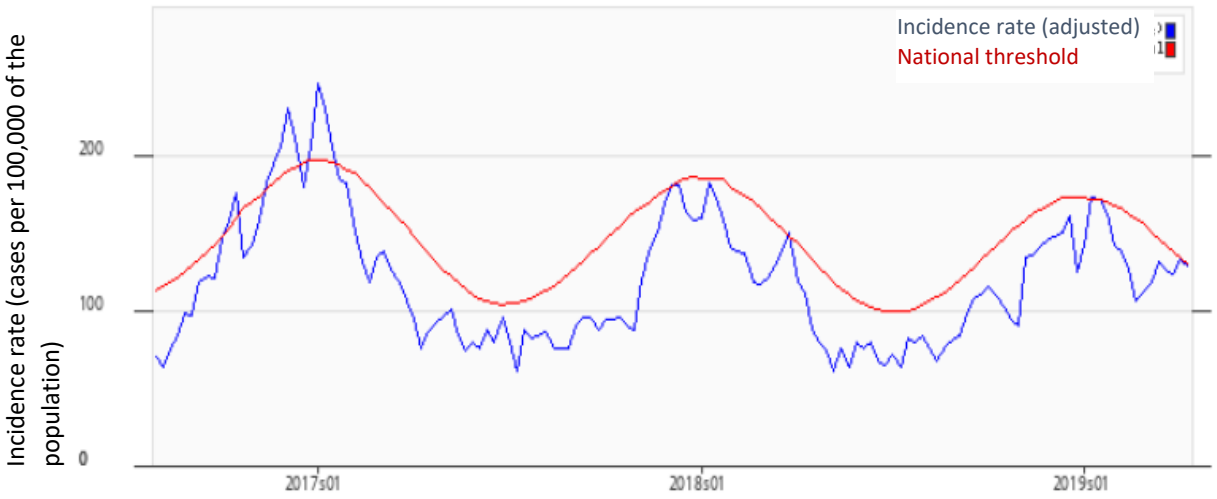
2.1 Implementation: Case study "France"

2.1.1. Collection of available data

The data available at Santé Publique France (the French Public Health Agency) provides a database of three types of information on norovirus activity in catchment areas:

- the SENTINEL network of medical practitioners who report the number of cases and make it possible to characterise the evolution of the epidemic throughout the year;
- the SOS MEDECIN network, which records the number of emergency telephone calls for acute gastroenteritis;
- the hospital emergency network, which records the number of admissions for acute gastroenteritis.
- These data are available for the years 2011 to 2020. They make it possible to characterise the most unfavourable months (winter period).
- months (winter period).

Sentinelles Network, Acute diarrhoea, Mainland France



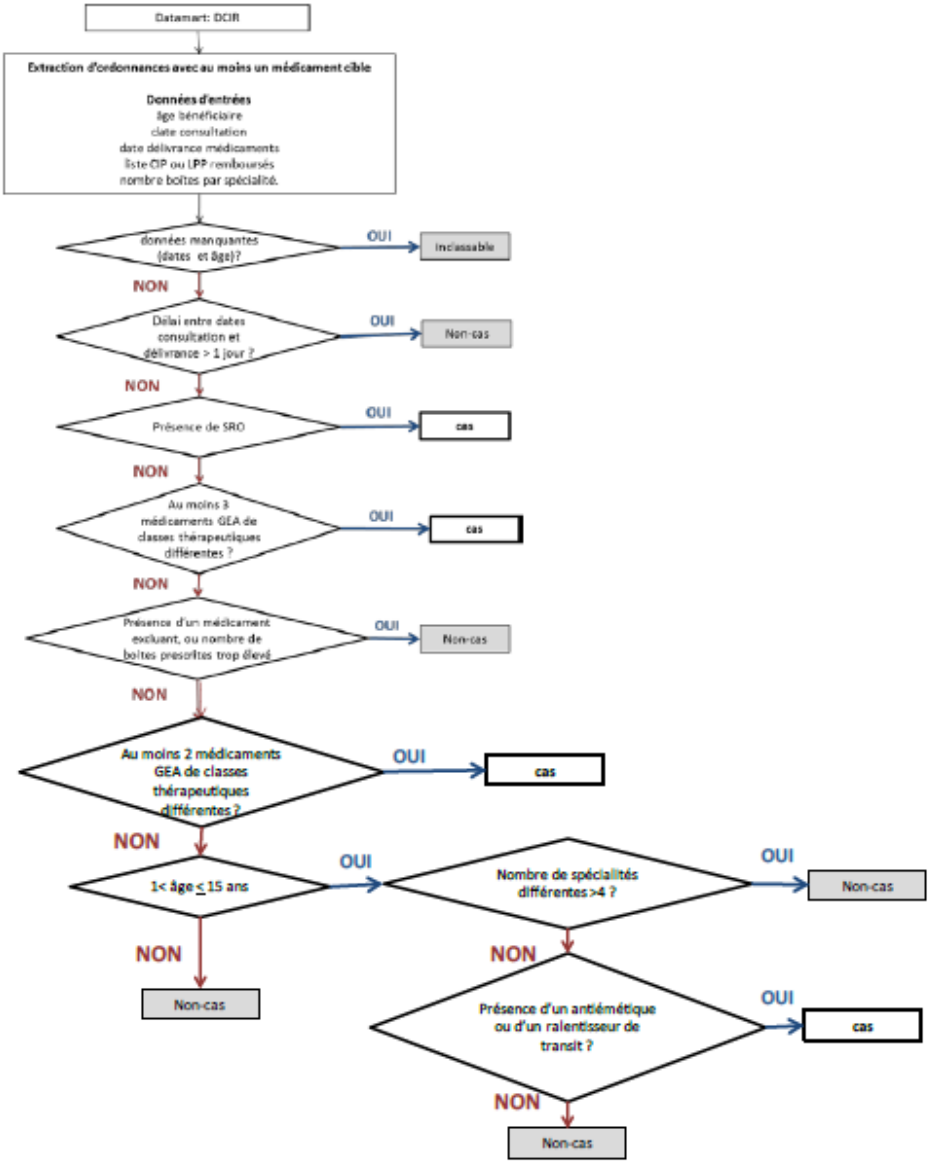
The availability of a national database, allowing extraction by catchment area of sales of anti-diarrhoeal drugs, is also an extremely useful source of information: the documentary store of cases of medicalised gastroenteritis is the subject of a methodological guide permitting the use of these data.

After a reminder of the procedures for differentiating cases of medicalised gastroenteritis from medical prescriptions, it describes the contents of the store, the procedures for updating the store,

the quality of the original data and of the resulting gastroenteritis incidence indicators, as well as their limitations of use.

I FIGURE 1 I

Algorithme simplifié utilisé pour la discrimination des cas de GEAm



SANTÉ PUBLIQUE FRANCE / *Les données de l'entrepôt de cas de gastro-entérite médicalisés issues du SNIIRAM : description, qualité et utilisation* / p. 11

This guide completes a procedure for the operators of the monitoring system. This procedure describes in detail the processes for building the data store, and for controlling the quality of the data implemented at each update of the store.

Data extraction is possible at commune (i.e. local) level, so it is easy to collate data for all the communes in a catchment area. The data make it possible to differentiate a resident of the area from a tourist passing through.

TABLE 9.

Data accounts available for case location in case account files for users. Sample table

Geolocation: count of available valid codes		**Beneficiary (B)**			
		Commune (C)	**Département (D)**	**None**	**TOTAL**
Practitioner (P)	**Commune (C)**				
	Département				
	None			(1)	
	TOTAL				

(1) Account available for France, estimate possible on a per capita basis for the data set

TABLE 10.

User configurable categorical variables

Variable	**Comments**	**Format of the settings**	**Examples of methods**
Date	Date of instruction for the order	Start and end dates	
Commune	Commune of residence of the beneficiary (resident case), or the commune of the practitioner (tourist case)	Insee Code lists	
Age_cl	Age group of the beneficiary	Class boundaries	[0-11 months] [1-5 years] [6-15 years] [16-65 years] [66-75 years] [76+ years]
Sex	Gender of the beneficiary	Global/separate	Man Woman
StatusResid	Resident or tourist status If distance ≥ boundary then StatusResid = "tourist"		By default, two classes with boundary = 50km
Distance	Distance "beneficiary commune-practitioner commune". Allows StatusResid to be modified	Boundaries (km)	Number and values of free boundaries

2.1.2. Identification of potential sources of pollution

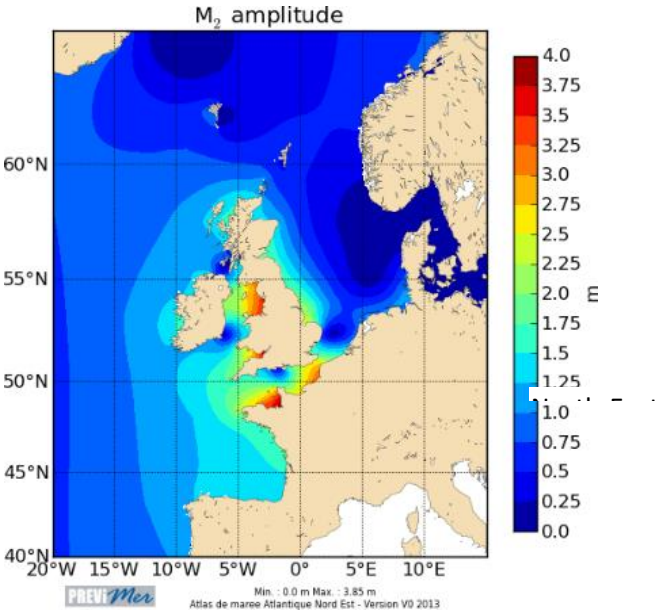
As this contamination is mainly of human origin, we will try to identify in the catchment area the outlets of wastewater treatment plants and the discharges of overflows from the sewerage system. For each of these sources, an annual series of flows will be estimated on the basis of available data in the vulnerability profiles of shellfish areas if they exist or in the vulnerability profiles of bathing areas.

2.1.3. Numerical modelling

The hydrodynamic code MARS (Model for Applications at Regional Scales) is a community model developed and disseminated by the DYNECO/DHYSED team of Ifremer and UMR LOPS (Joint research unit - Laboratory for Ocean Physics and Remote Sensing). This code is dedicated to coastal

oceanographic modelling from regional to littoral scales (a few hundred or even tens of metres) and includes a strong environmental component (sedimentology and biogeochemistry). The theoretical elements and description of the numerical formalism are presented in Lazure and Dumas (2008).

MARS seems relevant to regional modelling of mainland coastlines and to coastal configurations dedicated to the study of environments and ecosystems of economic or heritage interest. This model is also used by research organisations for their own research activities, such as hydrodynamics and littoral morphodynamics, lagoon hydrodynamics, estuarine hydrodynamics and the application to fine sediment transport (GIP Seine Aval (Seine Aval Public Interest Group); UMR EPOC (Joint research unit - Oceanic and Continental Environments and Paleoenvironments) of the University of Bordeaux; University of Buenos Aires; University of Montevideo). Finally, the MARS code is used by various consultants to carry out impact studies for local communities and by the operational coastal oceanography system PREVIMER (PREvision de la MER, or 'Sea forecast') which provided daily hydrodynamic and environmental forecasts until 2016. They are now available on the new IFREMER website.



Amplitude of the harmonic component M_2 in the North-East Atlantic

MARS is adapted to coastal applications, manages low tide elevations (foreshore area) and, thanks to a semi-implicit scheme, enables long simulations to be performed (over several years) with a significant time interval (10-100 w) despite a high spatial resolution (hundreds of metres and less).

The model used is the MARS model in its V11.0 version. It has been adapted to the needs of the area, in particular by a more precise bathymetric correction based on existing data. In addition, the model has the capacity to take into account the low tide elevations (foreshore), a phenomenon that is amplified, as in the Channel.

On the Atlantic coast, the different spatial scales are resolved by successive interlocking of nested models, the resolution of which increases near the coast. The calculation grid used was derived from a larger-scale model developed by the Ifremer Laboratory in Normandy.

This model is used for many applications, including larval monitoring, and has been validated with tidal current data from SHOM (the French Naval Hydrographic and Oceanographic Service).

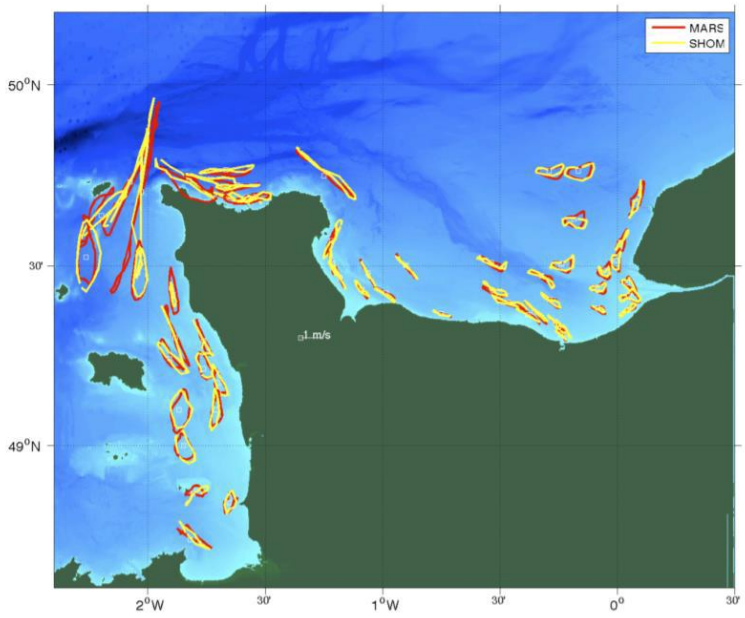


Figure 25: Comparison of barotropic current ellipses by 95 coefficient.

Validation of current roses (Ifremer report, Dilemes, 2014[1])

2.2 Exploitation of the model

In the preventive approach to noroviral contamination alert, this numerical model should be used to estimate the dispersion at sea of contamination flows from potential pollution sources.

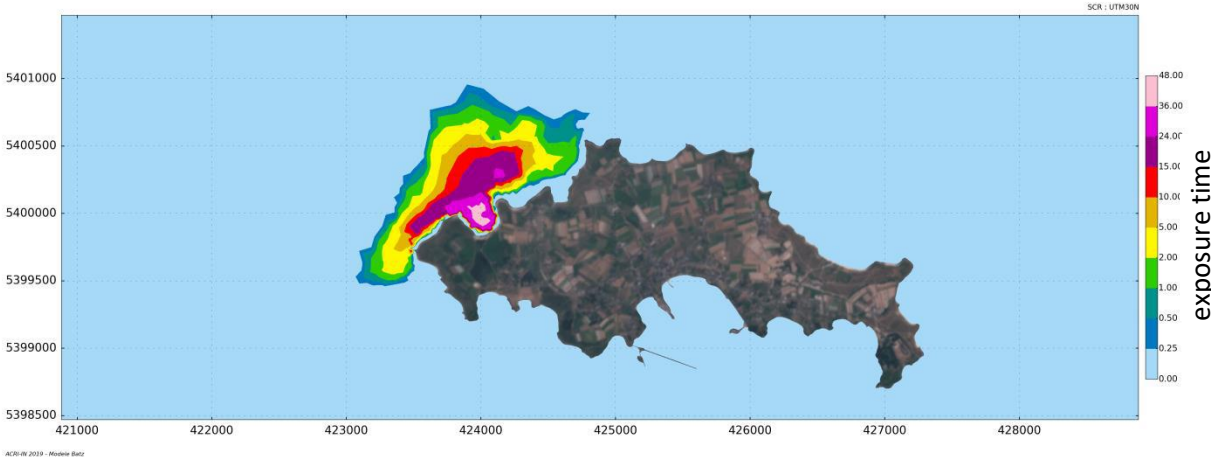
It would be implemented over a representative year and for each discharge a nominal passive tracer concentration would be imposed. Relatively little is known about norovirus mortality at sea and the hypothesis of a conservative tracer should be made.

Such a hypothesis could have an increasing effect on the risk of contamination, but from a risk management point of view it should be considered a safer approach.

A sequence of discharges should be considered to take into account the duration of contamination and its phasing in relation to weather and ocean conditions. Therefore, for each discharge, a continuous weekly report should be considered. The dilution of this discharge will be taken into account over a period representative of the dispersion, i.e. approximately 15 days following the start of the discharge, i.e. the duration of a dead water/live water cycle.

This type of simulation should make it possible to estimate, for each discharge, a spatial representation of the maximum concentration in the environment and a rate of exceeding a given threshold, i.e. the duration during which a given concentration is exceeded.

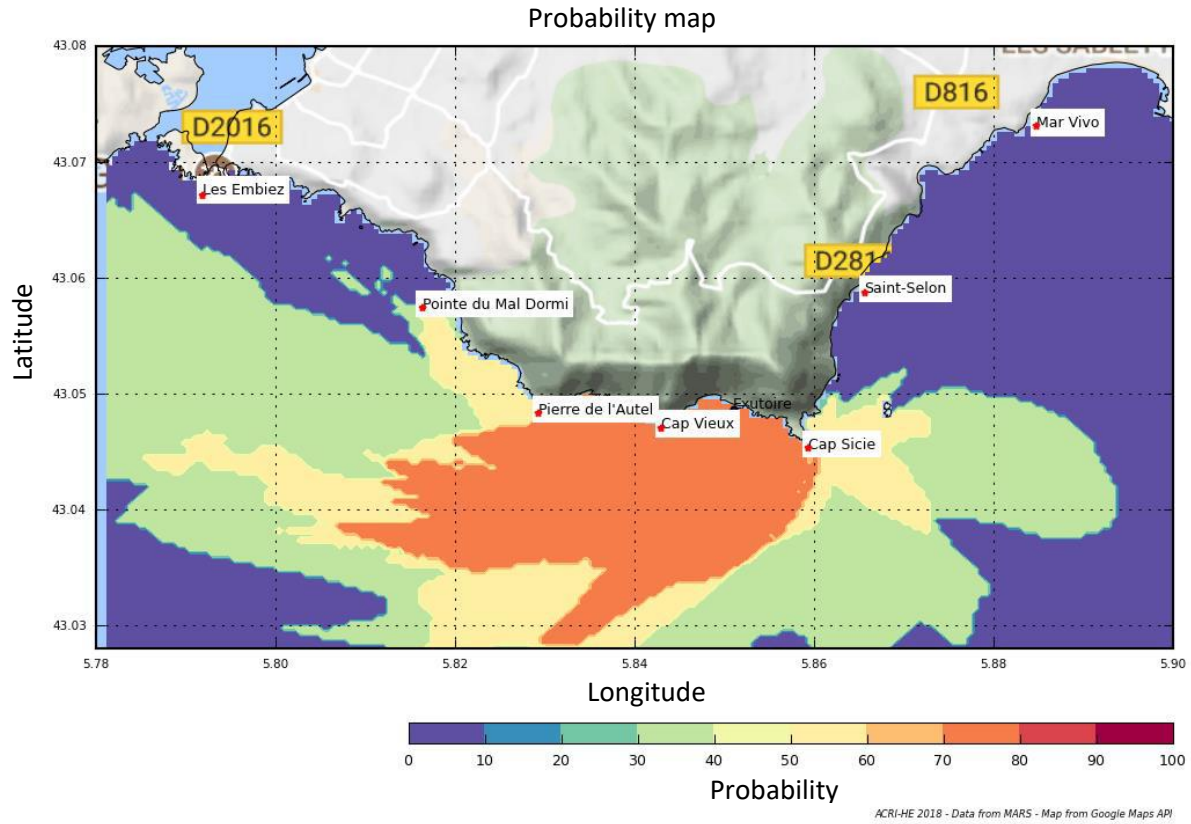
[1] DILEMES (Larval dispersal of *Mytilus Edulis* in the Seine Bay, February 2014)



Example of return for the exposure time to a concentration higher than 30npp/100ml for a 0.3m/s discharge and a concentration of 10,000npp/100ml

2.3. Production of contamination risk indicator maps

Combining the data from the simulation over a representative year should allow for the determination of iso-probability maps exceeding a given concentration threshold. It should therefore be possible to know at each point in the study area how often a given threshold is exceeded over the course of a year.



Example of a probability of exceedance map for a given concentration threshold.

Three concentration thresholds should be considered, 10% of the nominal concentration, 50% of the nominal concentration, and 90% of the nominal concentration.

Given the seasonal nature of the norovirus pollution risk, seasonal and monthly maps of exceedance probability could also be constructed. This temporal zoom will provide decision-making support for the active management of the parks.

3 Recommendations

The AAC recommends that one of the HORIZON EUROPE calls for proposals should be an opportunity for a consortium to study the hypothesis described in this recommendation.

The AAC recommends that the terms of reference of this call for proposals should include the validation of such a system in at least four Member States and in each case in at least two different catchment areas and production areas:

- An open production area
- A more closed production area (lagoon, ria, etc.)

The AAC recommends that all relevant stakeholders in each Member State (producers, consumers, public health individuals, data and spatial modelling specialists) be involved.

Finally, the AAC recommends that it should be kept informed of the progress of this project and that it should sit on the steering and monitoring committees for such a project with DG MARE, DG SANTE and DG RDI.

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