Eurosurveillance
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Eurosurveillance, Volume 8, Issue 1, 01 January 2003

Outbreak report

An outbreak of Norwalk-like viral gastroenteritis in holidaymakers travelling to Andorra, January–February 2002

Citation style for this article: Pedalino B, Feely E, McKeown P, Foley B, Smyth B, Moren A. An outbreak of Norwalk-like viral gastroenteritis in holidaymakers travelling to Andorra, January–February 2002. Euro Surveill. 2003;8(1):pii=393. Available online: http://www.eurosurveillance.org/ViewArticle.aspx?ArticleId=393

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A retrospective cohort study was conducted to investigate an outbreak of Norwalk-like viral gastroenteritidis that occurred in Irish holidaymakers visiting Andorra, in January–February 2002. Preliminary results showed the risk exposure was higher for tourists who stayed in Soldeu and consumed ice cubes in their drinks (OR = 2.5, 95% CI [1.3–4.6)], after logistic regression and adjusting for sex and water consumption).

In this issue

An outbreak of Norwalk-like viral gastroenteritis in holidaymakers travelling to Andorra, January–February 2002
Patterns of Puumala virus infection in Finland
Creutzfeldt-Jakob disease and related diseases in France from 1998 to 2000
Tuberculosis in Austria 1995–99: geographical distribution and trends

Related articles

Outbreaks of gastroenteritis linked to lettuce, Denmark, January 2010
Outbreak of norovirus infection in a nursing home for the elderly in Malta, November-December 2008
Cohort study of an outbreak of viral gastroenteritis in a nursing home for elderly, Majorca, Spain, February 2008
Import of norovirus infections in the Netherlands and Ireland following pilgrimages to Lourdes, 2008 – preliminary report
Outbreak of norovirus gastroenteritis among staff at a hospital in Barcelona, Spain, September 2007

Introduction

Norwalk-like virus (NLV or Small Round Structured Virus, renamed Norovirus in 2002 (1)) is increasingly recognised as a cause of sporadic and epidemic viral gastroenteritis. The clinical syndrome caused by NLV was first described in 1929 (2). The causative agent, a small RNA virus, classified as a human enteric calicivirus, was identified by electron microscopy in 1972, from clinical samples taken in 1968 during a school outbreak of gastroenteric illness in Norwalk, Ohio, United-States of America (3). The Norwalk-like virus is distributed widely in nature; its only known reservoir is human (4). The virus causes a relatively typical illness characterised by sudden-onset, forceful vomiting and nausea with variable amounts of mild diarrhoea (5). These gastrointestinal symptoms may be associated with fever, myalgia and headache. The incubation period varies from 15 to 50 hours and the mean duration is between 12 and 60 hours. Transmission has been demonstrated through food (in particular raw shellfish), through water, ice, by person-to-person transmission, and through aerosolisation of viral particles (6,7).

Background

On the morning of Sunday 27 January 2002 (11.30 am), an airplane carrying ill holidaymakers returning from Andorra landed in Dublin, Ireland. Many of the passengers had gastrointestinal symptoms. Emergency services were alerted, and were in place to meet the plane on arrival. The flight, coming from Toulouse, France, carried holidaymakers who had spent the week from 20 to 27 January on a skiing holiday in Andorra. A second flight from Toulouse, also carrying holidaymakers returning from Andorra with the same tour operator, landed in Belfast, Northern Ireland, two hours after the Dublin flight. Many of the passengers on board of this flight were also ill. The principal symptoms described were vomiting and diarrhoea. Initial interviews suggested that the illness was sudden in onset and short in duration. At that stage no information about cases of illness in Andorra was available. The National Disease Surveillance Centre (NDSC) in Ireland and the Communicable Disease Surveillance Centre-Northern Ireland (CDSC - NI) initiated a joint investigation in order to identify the possible source and the vehicle of the infection.

Materials and Methods

Case definition

A case was defined as a passenger travelling on one of the two flights from Andorra, who holidayed in Andorra from 20 to 27 January 2002, and developed nausea, vomiting or diarrhoea (at least three loose stools per day for 24 hours) at least 48 hours after arrival in Andorra, or within 48 hours of return.

Case finding methods

The lists of passengers travelling on the two flights were obtained from the tour operator. A questionnaire was mailed to passengers four days after their arrival home in Ireland, in order to collect information on the following: demographic details, holiday accommodation details in

Andorra (town and type of accommodation), symptoms of gastrointestinal illness while on holiday, time of onset and duration of symptoms, contact with other ill persons during the three days prior to the onset of illness, food items consumed during the last three days of holidays or during the three days preceding the onset of illness and place of consumption, consumption habits and use of water during the holiday, whether the family doctor was contacted because of the illness, whether hospitalisation was required and length of hospital stay if admitted, and laboratory results if a sample was taken.

The Andorran health authorities were informed about the outbreak and it was suggested an active case finding be carried out in Andorra.

Analytical study design

A retrospective cohort study among passengers of the two charter flights was conducted in order to identify any potential vehicle and the mode of transmission of the infection in this outbreak.

Definition of exposure

As the outbreak occurred among holidaymakers travelling to Andorra, the exposure was investigated in terms of water use and water consumption. Travellers were also asked about food items consumed within 72 hours before becoming ill and about the place of food consumption. No detail about the amount of water or food consumed was collected.

Secondary transmission

To investigate secondary transmission of the disease we focused on cases which occurred before and after the landing both in Belfast and in Dublin.

Laboratory investigation

Microbiological investigation was performed on two samples from Andorran holidaymakers living in the Eastern Region of the Republic of Ireland. Stool specimens were tested for NLV using two different reverse transcriptase polymerase chain reaction (RT−PCR) methods (8,9).

Statistical analysis

Attack rates, relative risks (RR), and 95% confidence intervals (CI) were computed using EpiInfo software (version 6.04d) (10). Confounding factors were assessed through logistic regression using SPSS package (version 10.1.0 for Windows) (11).

Results

Epidemiological data

Over a total of 350 questionnaires sent, 234 (67%) were returned (table 1). The respondents were mainly young males (61%) with a mean age of 30.5 years [range 1 to 72 years]. An illness was reported in the questionnaire by 95 travellers (41%) among whom 71 (75%) met the case definition (overall attack rate: 30% (71/234)).

Table 1. Outbreak of gastroenteritis among travellers to Andorra, study characteristics. January-February 2002

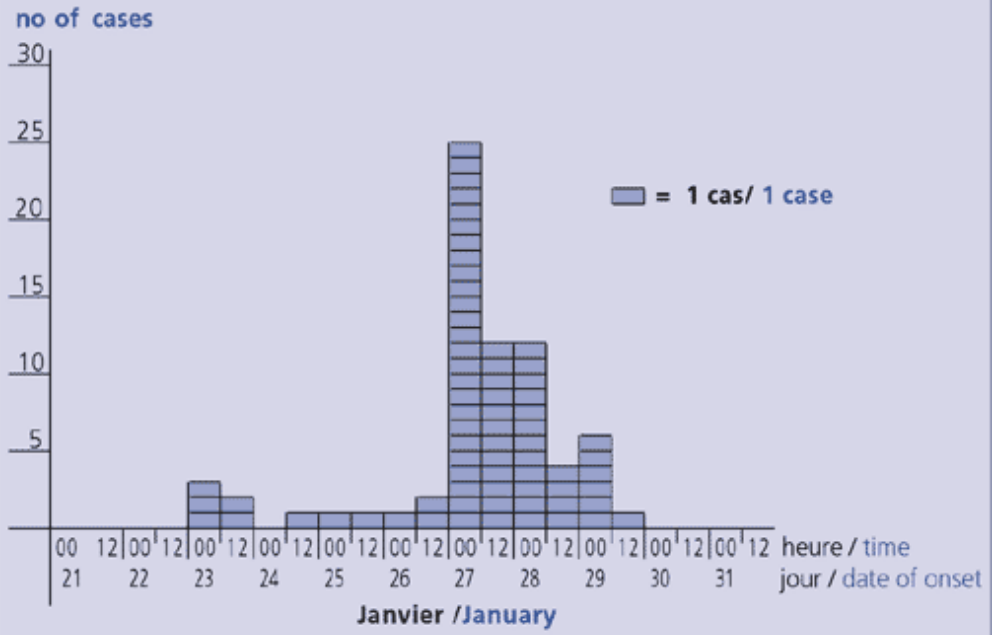
	Nombre / Number	Pourcentage / Percent
Cohorte des voyageurs / Traveller's cohort	350	100
Vol de Dublin / Dublin flight	173 / 350	49
Vol de Belfast / Belfast flight	177 / 350	51
Personnes interviewées (taux de réponse) / Interviewed (response rate)	234 / 350	67
Personnes malades / Ill people	95 / 234	41
Définition de cas remplie (population de l'étude) / Met Case Definition (study population)	71 / 95	75
Taux d'attaque global / Overall attack rate	71 / 234	30

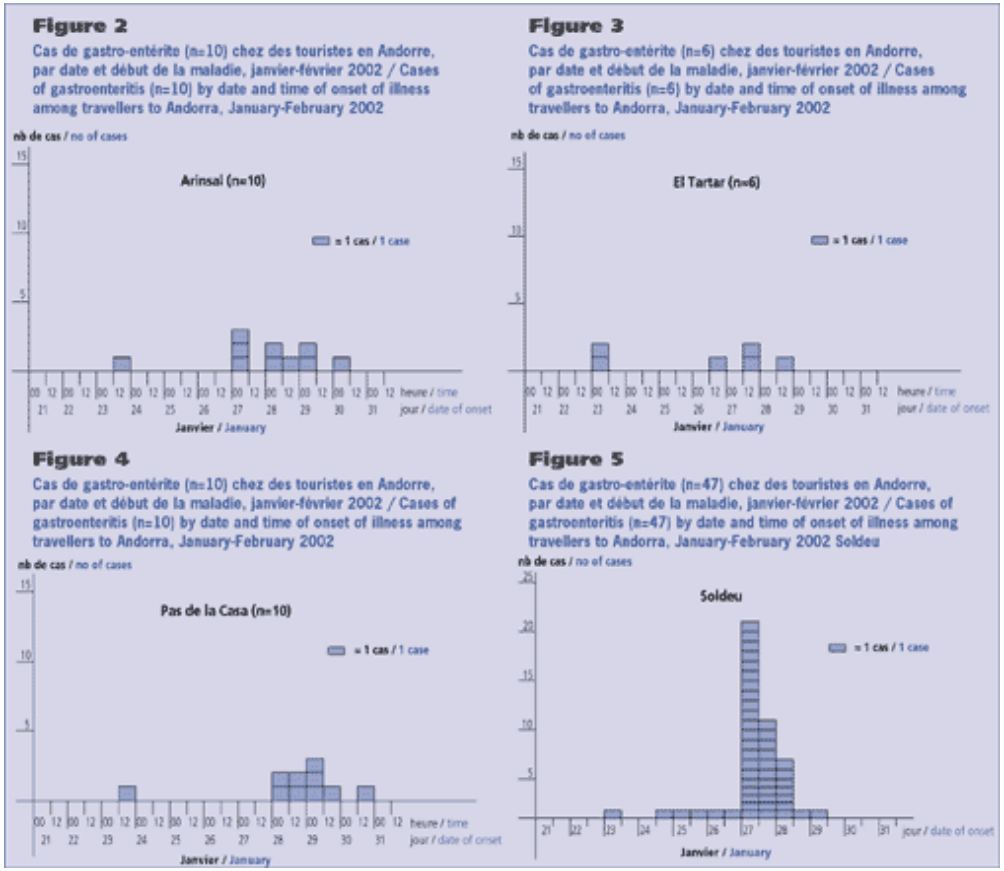
Date and time of onset of illness for the 71 cases were collected. The results showed a small number of cases occurred during the first five days of the stay in Andorra, but most of the cases (37/71) occurred on 27 January (figure 1). The number of cases subsequently decreased dramatically. A small cluster seemed to have occurred on 23 January. Data on date and time of onset were stratified by town of accommodation. Most of cases occurring on 27 January (32/37) developed the disease in Soldeu (figures 2 to 5).

Figure 1

Cas de gastro-entérite (n=71) chez des touristes en Andorre, par date et début de la maladie, janvier 2002

Cases of gastroenteritis (n=71) by date and time of onset of illness among travellers to Andorra, January 2002





Two travellers developed symptoms on 21 January, two on 22 and thirteen after the 29 January. These travellers were not included in the analysis as they did not meet the case definition.

Women (n=92) were 1.8 times (95% CI [1.23–2.62]) more likely to be a case than men. The attack rate was lower in the age group 0-19, and similar among other age groups (table 2).

Table 2. Age and sex specific attack rates of gastroenteritis (n= 71) among travellers to Andorra. January – February 2002

	Répondants Respondents	Cas / Cases	Taux d'attaque (%) Attack Rate ° (%)	RR (IC 95%) RR (95% CI)
Tous les cas / All cases	234	71	30	
Sexe / Sex				

Femmes / Female	92	39	42	1.8 (1.2 – 2.6)
Hommes / Male	142	32	22	reference
Groupe d'âge (années) / Age class (years)				
0 – 19	28	6	21	reference
20 – 29	84	28	33	1.4 (0.7 – 3.1)
30 – 39	74	26	35	1.5 (0.7 – 3.3)
>= 40	32	11	34	1.5 (0.6 – 3.5)

The main symptoms of cases were nausea (85%), vomiting (78%), diarrhoea (74%), and abdominal pain (52%). Other symptoms included shivering (47%), pyrexia (44%), headache (31%) and bloody diarrhoea (4%).

The duration of illness ranged from 10 hours to 11 days with a median of 48 hours.

Geographical results

Among the respondents who gave details on the type of accommodation (221/234 = 94%), 157 (71%) had stayed in hotels on their holiday, and 64 (29%) had chosen self-catering apartments. Respondents who gave information on the town of accommodation (n=227) had stayed mainly in four Andorran towns: Arinsal (19%, 42/227), El Tartar (12%, 27/227), Pas de la Casa (38%, 86/227), and Soldeu (31%, 70/227).

Travellers who chose to stay in self-catering apartments were 1.5 times more likely to be cases than those who stayed in hotels (95% CI [1.04–2.22]). Travellers who stayed in Soldeu were 6.5 times more likely to be cases than travellers in other towns (95% CI [3.44 – 12.25]) (table 3).

Table 3. Attack rates of gastroenteritis among travellers to Andorra, by type and town of accommodation (n=71). January – February 2002

Type d'hébergement Type of accommodation*	**Répondants Respondents**	**Cas Cases**	**Taux d'attaque (%) Attack Rate (%)**	**RR (IC 95%) RR (95% CI)**

Hôtel / Hotel	144	42	29	reference
Appartements en location Self − catering apartments	61	27	44	1.5 (1 − 2.2)
Ville d'hébergement / Town of accommodation				
Arinsal	37	9	24	2.2 (1 − 5.1)
El Tartar	25	6	24	2.2 (1 − 5.5)
Pas de la Casa	82	9	11	reference
Soldeu	66	47	71	6.5 (3.4 − 12.3)

* Données disponibles pour 69/71 cas / Data available for 69/71 cases.

Potential vehicle of the outbreak

Trawling questionnaires on food specific exposures or other common exposure did not reveal any information on common exposures. Ninety-seven per cent of cases (n=69) drank bottled water, 21% (n=15) drank tap water, 13% (n=9) consumed water in jugs during their meals, and 76% of cases (n=54) had ice in their drinks. The percentage of people who attended a swimming pool was 26%. Ninety five percent of cases used tap water for personal hygiene purposes (table 4).

Table 4.
Water use and water consumption specific attack rates of gastroenteritis among travellers to Andorra. January − February 2002

	Consommé / Utilisé Consumed-Used	**Non consommé / Non utilisé** **Not consumed / Not used**	**RR (IC95%)** **RR (95% CI)**	**% cas exposés / % cases exposed**

Consommation d'eau **Water consumption**	**Cas Cases**	**Total**	**TA (%) AR (%)**	**Cas Cases**	**Total**	**TA (%) AR (%)**		
Eau minérale Bottled water	69	203	34	2	12	16	2 (0.6 – 7.3)	97
Eau du robinet Tap water	15	60	25	56	155	36	0.7 (0.4 – 1.1)	21
Glaçons dans les boissons Ice cubes in drinks	54	136	39	17	79	21	1.9 (1.2 – 3)	76
Eau en carafe sur les tables Water in jugs on table	9	24	37	62	191	32	1.2 (1 – 2)	13
Utilisation de l'eau / Water use								
Douche / Shower	67	202	33	4	13	31	1.1 (0.5 – 2.5)	94
Dents / Teeth	68	202	34	3	13	23	1.5 (0.5 – 4)	96
Piscine / Swimming pool	19	41	46	52	174	30	1.5 (1 – 2.3)	26

Travellers who had ice in their drinks were approximately 2 times more likely to be a case than people who did not consume any ice (95% CI [1.2–3]).

Travellers who used tap water for personal hygiene purposes (showering and brushing teeth) were 1.1 times and 1.5 times respectively more likely to become ill than those who did not

(95% CI [0.5−2.5]; 95% CI [0.5−4]). Travellers who consumed bottled water were 2 times more likely to be cases (95% CI [0.6−7.3]). Travellers who used a swimming-pool were 1.5 times more likely to be cases than travellers who did not (95% [CI 1−2.3]).

Data were stratified by place of residence. Most cases (79%, 19/24) occurring in other towns than Soldeu developed the disease after flights arrived home in Ireland. Among residents in Soldeu, the attack rate was higher among those who had ice in drinks than among those who did not (RR = 2.3, 95% CI [1.3−4.2]). Travellers who consumed bottle water were less likely to be a case than those who did not (RR = 0.7 [95% CI 0.6−0.8]) (table 5).

Table 5. Risk factor specific attack rates for gastroenteritis (n=47) among travellers staying in Soldeu. January – February 2002

	Consommé-Utilisé Consumed-Used			**Non consommé-Non utilisé Not consumed-Not used**			**RR (IC95%) RR (95% CI)**	**% de cas exposés % cases exposed**
Consommation d'eau Water consumption	**Cas Cases**	**Total**	**TA (%) AR (%)**	**Cas Cases**	**Total**	**TA (%) AR (%)**		
Eau minéale / Bottled water	46	65	71	1	1	100	0.7 (0.6-0.8)	98
Eau du robinet / Tap water	8	10	80	39	56	69	1.15 (0.8 – 1.6)	17
Glaçons dans les boissons / Ice cubes in drinks	40	47	85	7	19	37	2.3 (1.3 – 4.2)	85

Eau plate sur la table / Water in jugs on table	7	9	77	40	57	70	1.1 (0.7 - 1.6)	15
Utilisation de l'eau / Water use								
Douche / Shower	46	65	71	1	1	100	0.7 (0.6 - 0.8)	98
Dents / Teeth	46	64	72	1	2	50	1.4 (0.4 – 5.8)	98
Piscine / Swimming pool	16	22	73	31	44	70	1.1 (0.7 – 1.4)	34

Results from a logistic regression analysis showed that after adjusting for sex, water consumption and use, ice consumption among those staying in Soldeu was still strongly associated with the likelihood of being ill (OR = 2.5, 95% CI [1.3–4.6)]) (table 6).

Table 6. Results from a logistic regression adjusting for sex, water consumption and use among travellers staying in Soldeu, January-February 2002

	Odds ratio	Intervalle de confiance à 95% 95% Confidence Interval
Glaçons dans les boissons Ice cubes in drinks	2.5	1.3 - 4.6

Secondary transmission

To investigate secondary transmission of the disease we focused on ice consumption among cases that occurred in Soldeu before and after the landing, both in Belfast and in Dublin. Ice consumption during the stay in Soldeu was significantly associated with the likelihood of falling ill (RR = 2.5, 95% CI [1.3–5]) (table 7).

Table 7. Ice consumption relative risk of gastroenteritis among travellers to Soldeu, by date of onset, January 2002

Vol (27 janvier 2002) Flight (January, 27th 2002)	Nr de cas No of cases	RR	IC 95% 95% CI
Avant / Prior to	48	2.5	1.3-5
Après / After	23	0.9	0.8-1.1

Microbiological investigation

Norwalk-like virus (NLV) was identified in a clinical sample from one holidaymaker. The other result was negative but the specimen was of questionable quality.

Environmental investigation

The outcome of the environmental investigations, performed by the Andorran authorities is not known at this stage.

Discussion

The primary objectives of our investigation were to identify the mode of transmission, the vehicle of the outbreak and to provide appropriate recommendations to prevent future similar outbreaks.

The epidemic curve suggests that, apart from a stable number of gastroenteritis cases that occured during the holiday in Andorra, possibly due to the change of diet, the possible common source of infection was on 25 January. Unfortunately, no information was available about whether a particular event was held on that day in Soldeu.

The small cluster that occurred on 23 January included five cases that stayed in three different towns. However the investigation did not highlight any link among them.

Cases whose date of onset was after 27 January (date of arrival of the two flights) may have occurred due to person-to-person transmission during the return flights both to Dublin and Belfast.

One difficulty encountered was the limited number of stool samples taken which led to difficulties in the microbiological confirmation of the cause of the outbreak. The environmental component of the investigation was also difficult, because the environmental sampling was conducted in another country with different protocols and procedures. The epidemiological component however demonstrated a clear statistically significant relationship between ice consumption and illness, particularly in Soldeu. This result was consistently found using both stratified and logistic regression analysis.

Ice being traditionally made with tap water, a similar association between risk exposure and tap water was expected. However no significant association related to the use of tap water was

found. This was probably because only a small percentage of cases consumed tap water (17%), making the association not strong enough to reach statistical significance.

As we did not enquire about the amount of water consumed, we were unable to calculate the dose response. It was felt that this information would not have been available or reliable. Trawling questionnaires on food specific exposure did not reveal any information on common exposures.

Two potential biases have to be considered in the study: selection and information bias. They are related to the way information was collected. Both may have led to an over-estimation of the risk associated with ice consumption. However, according to the response rate obtained, the accuracy of the results should have been guaranteed.

Our data suggest, according to the symptomatology, laboratory findings and duration of the disease, that the possible vehicle of transmission was ice consumed with drinks. This is particularly evident in Soldeu, and the data also suggest that the Norwalk-like Virus (Small Round Structured Virus − SRSV) may be the pathogen responsible for this outbreak.

Norwalk-like viruses (NLVs) are now established as the most important causative agents of epidemic gastroenteritis. They cause outbreaks of gastroenteritis worldwide and are spread frequently through contaminated food or water (12−15). In the United States, NLV are estimated to be responsible for 23 million cases of gastroenteritis, 50 000 hospitalisations, and 300 deaths annually (16). In the United Kingdom, it is estimated that the incidence of illness due to NLVs is as much as 1% of the population per year (17).

Gastroenteritis due to NLVs tend to occur in outbreaks, although sporadic cases may occur. These viruses are highly contagious and different modes of transmission have been recognised, such as fecal-oral and airborne transmission from fomites, which has been suggested to explain the rapid spread in hospital settings (18).

Recommendations

This investigation highlights the importance of international collaboration in outbreaks involving holiday destinations where people of many different nationalities may be affected. Tourism is a primary industry in Andorra and prompt action in response to gastroenteric outbreaks such as these is required.

Every travel guide emphasises the importance of water use and water consumption, but very often ice may be a vehicle of gastroenteric infections (19). Where water might be contaminated, travellers should be specifically advised that ice cubes should also be considered contaminated, and should not be used in beverages. Ice cubes may be made from unsafe water and therefore should be avoided. If ice has been in contact with containers used for drinking water, travellers should be advised to thoroughly clean the containers, preferably with soap and hot water, after the ice has been discarded (20,21).

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Back to Table of Contents

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Next

To top | Recommend this page

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