Epidemiol. Infect. (2016), **144**, 215–224. © Cambridge University Press 2015
doi:10.1017/S095026881500093X

The national web-based outbreak rapid alert system in Norway: eight years of experience, 2006–2013

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Received 7 October 2014; Final revision 13 April 2015; Accepted 15 April 2015; first published online 1 June 2015

SUMMARY

In 2005, the Norwegian Institute of Public Health established a web-based outbreak rapid alert system called Vesuv. The system is used for mandatory outbreak alerts from municipal medical officers, healthcare institutions, and food safety authorities. As of 2013, 1426 outbreaks have been reported, involving 32913 cases. More than half of the outbreaks occurred in healthcare institutions (759 outbreaks, 53·2%). A total of 474 (33·2%) outbreaks were associated with food or drinking water. The web-based rapid alert system has proved to be a helpful tool by enhancing reporting and enabling rapid and efficient information sharing between different authorities at both the local and national levels. It is also an important tool for event-based reporting, as required by the International Health Regulations (IHR) 2005. Collecting information from all the outbreak alerts and reports in a national database is also useful for analysing trends, such as occurrence of certain microorganisms, places or sources of infection, or route of transmission. This can facilitate the identification of specific areas where more general preventive measures are needed.

Key words: Outbreaks, surveillance systems.

INTRODUCTION

Surveillance of infectious disease outbreaks is a crucial part of public health prevention and control. Rapid and complete outbreak reporting provides an effective tool for assessing the extent of a given outbreak and for providing assistance in investigation and control as needed. This may also constitute a part of event-based reporting as required under the International Health Regulations (IHR) (2005) [1]. A database with all reported outbreaks is useful for assessing disease burden, contributing factors behind the outbreaks and effective control measures. This can help in setting priorities and facilitate implementation of preventive measures including regulatory actions and development of guidelines and recommendations [2]. Such a database may also facilitate annual outbreak reporting to national authorities, the European Centre for Disease Prevention and Control (ECDC), and the World Health Organization (WHO).

In this paper we describe outbreak surveillance in Norway and present how this is facilitated by the national web-based outbreak rapid alert system (Vesuv). In

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addition, we present a general overview of the outbreaks that have been reported during the 8 years the system has been in place, with some of the information included in Vesuv, so that the reader can get an insight of the type of knowledge that the system can generate.

METHODS

Regulation

Outbreak reporting in Norway is regulated by the Communicable Disease Act [3] and the Norwegian Surveillance System for Communicable Diseases (MSIS) and Tuberculosis Register Regulations (MSIS regulation) [4]. An outbreak is defined as (1) a number of cases of an infectious disease which clearly exceeds the expected level within a given time and area, or (2) $\geqslant 2$ cases of the same infectious diseases where a common source is suspected [5].

According to the MSIS regulation, the following suspected or confirmed outbreaks should be notified: (1) outbreaks caused by infectious diseases that are notifiable to MSIS, (2) outbreaks suspected to be associated with food or water, (3) outbreaks of particularly severe illnesses (i.e. diseases with high mortality, high complication rate, or otherwise severe manifestations not otherwise notifiable to MSIS), (4) particularly extensive outbreaks, and (5) outbreaks in healthcare institutions.

An outbreak alert should be sent immediately upon suspicion. If the outbreak is severe, the Norwegian Institute of Public Health (NIPH) should be contacted immediately by telephone. Early notification to the national level gives NIPH and the national office of the Norwegian Food Safety Authority (H-NFSA) the opportunity to assess a local outbreak in a national and international context.

Reporting flow

Clinicians who suspect an outbreak are obliged to alert the Municipal Medical Officer (MMO) of the relevant municipality. The MMO is required to notify the County Governor and the NIPH (Fig. 1*a*). If the outbreak is suspected to be foodborne or waterborne or zoonotic (FWBO), the MMO is also required to alert the Local Food Safety Authority (LFSA) while if the outbreak is detected by the LFSA, they are obliged to alert the MMO. The LFSA is required to notify H-NFSA, which will notify the Ministry of Health and Care Services, Ministry of Agriculture and Food and Ministry of Trade, Industry and Fisheries, in case of serious outbreaks.

Outbreaks occurring in long-term care facilities should be notified by the MMO to the County Governor and NIPH. Outbreaks in hospitals should be notified by the hospital to the Regional Centre for Infection Control, the County Governor and NIPH (Fig. 1*b*).

When the outbreaks are serious, the NIPH will further alert the Norwegian Directorate of Health and the Ministry of Health and Care Services. In addition, NIPH and H-NFSA will notify each other following an existing agreement.

Outbreak management – roles and responsibilities

An outbreak is defined as local if the source of infection is present in a single municipality (e.g. an outbreak in a hotel), and the responsibility for investigation and control of the outbreak lies with the local authorities. An outbreak is defined as national if the source of infection is most likely present in more than one municipality (e.g. outbreaks caused by a product with wide distribution). In such cases, investigation and control of the outbreak is coordinated by national authorities.

Reporting format

Until 2005, outbreaks were notified to the NIPH by fax on a standard form or by telephone, and the information was stored in an Excel database. In 2005 Norway established a web-based outbreak alert system called Vesuv ('vevbasert system for utbruddsvarsling', www.vesuv.no), which is used by the MMOs, hospitals and other healthcare institutions, and LFSA for mandatory outbreak notification. The system is administered by NIPH. If an outbreak is directly identified at the national level (e.g. by the National Reference Laboratory at the NIPH, or through epidemic intelligence routines) it will be notified in Vesuv by epidemiologists at NIPH, who will also contact the parties that should be involved from the relevant municipalities. Vesuv was implemented to simplify reporting procedures, provide a standardized reporting format, compile all information about reported outbreaks in one national database, improve data quality by sending automatic reminders, and facilitate rapid flow of information among the relevant stakeholders during the course of the outbreak investigation and updating information as new information becomes available.

Any professional can log on to the Vesuv home page with a user name and a password, and report an outbreak in an electronic template form. The NIPH has access to all notified outbreaks, while the

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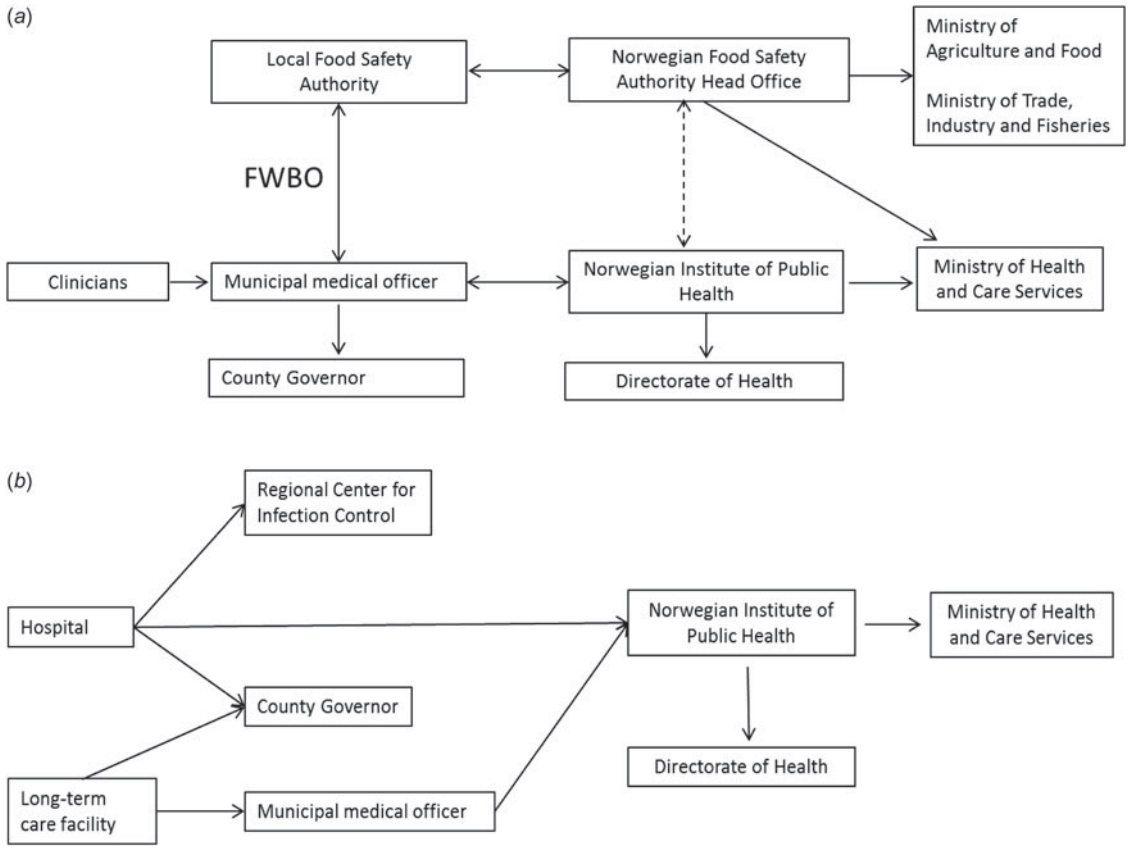

Fig. 1. Outbreak notification process, Norway, 2013. (*a*) Outbreaks outside healthcare institutions, (*b*) outbreaks in healthcare institutions.

Food Safety Authorities have access to all food- and waterborne outbreaks reported. At the local level, the MMO and reporting healthcare institutions have access to all the outbreaks they have notified. They will at any time be able to update outbreak information and obtain a list of all outbreaks they have notified. Whenever a local outbreak is reported, the local authorities involved in the investigation or management can exchange a link to the outbreak concerned, enabling all partners involved to see the information and continuously add or update the information as the outbreak investigation proceeds.

Reporting form

The outbreak report form is divided into different sections, all of which include questions with pre-categorized answers as well as free text entries:

General information on the outbreak: County, municipality, place of infection, date of onset of symptoms (first and last case), number of cases, number of persons exposed, number of cases admitted to hospital, number of deaths, whether the outbreak is over, main symptoms, transmission route, laboratory testing (both human and food/water/environmental samples), suspected causative agent. The reporting form does not contain sensitive personal information since notifications are performed in an aggregative way, with outbreak as units, and do not contain names, personal IDs or other information that could allow the identification of single cases.

Information on the outbreak investigation and management: How was the outbreak identified, who is responsible for the investigation, what studies are planned or conducted, what control measures are implemented.

For certain types of outbreaks, specific information is collected:

- *Foodborne outbreaks*: Information on the suspected food items, country of production, inspection of food production or handling premises, and trace-back and trace-forward investigation, contributing factors to contamination.
- *Waterborne outbreaks*: Information on the water source, water supply and water treatment methods, and suspected contributing factors.

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- *Outbreaks in healthcare institutions*: Department involved, number of cases divided by patients *vs.* healthcare personnel and by carriers *vs.* symptomatic individuals.
- In addition, the registration date is automatically recorded. In order to provide rapid feedback and advice if needed, the investigators are also requested to state if they wish assistance from the NIPH or H-NFSA.

When the web-based form is completed and saved, it is added to a general overview list in the Vesuv database. At the same time, an automatically generated e-mail report comprised of the most relevant information is sent as a confirmation to the person that notified the outbreak, to the NIPH, and to other relevant institutions according to the type of the outbreak and legal requirement (H-NFSA, County Governor, Regional Centre of Infection Control).

Updating information

After the first rapid alert, which normally contains only preliminary data, the person notifying the outbreak or other persons involved in the investigation can log on to the system and update information about the outbreak as new and more information is generated. To ensure that the outbreak information is complete, an automatic reminder is sent to the person that notified the outbreak after 3 weeks, requesting supplementary information, if available.

Output and reports from the system

Regular analyses and reports from the system are sent to stakeholders at the national level. Annual reports are published on the NIPH website [6, 7]. In addition, outbreak information from Vesuv is used to fulfil international reporting requirements.

In the present study, we performed a descriptive analysis of key variables from all outbreaks notified to Vesuv from 2006 to 2013. Two groups of outbreaks are described in detail, outbreaks notified from healthcare institutions and food- and waterborne outbreaks (outside healthcare institutions).

RESULTS

Overview of outbreaks notified to Vesuv in 2006–2013

During the 8-year period from January 2006 to December 2013, a total of 1426 outbreaks were notified to Vesuv, involving 32913 reported cases. The number of persons involved per outbreak ranged from 2 to 2500 (median = 11). More than half of the outbreaks occurred in healthcare institutions (759 outbreaks, 53·2%) with 15 746 cases reported. A total of 474 (33·2%) outbreaks, with 9485 persons involved, were associated with food or drinking water. Twenty of the outbreaks that occurred in healthcare institutions were associated with food and water (Table 1). The number of outbreaks notified per year does not show clear time trends (Fig. 2). About 42% ($n = 601$) of the outbreaks were notified within 7 days after the onset of symptoms of the first case. Only 6% ($n = 83$) of the outbreaks were notified within 24 h (Fig. 3).

A total of 1234 (86·5%) outbreaks had a known aetiology. Of these, the majority ($n = 870$) were caused by viruses, 339 had a bacterial origin, 16 were caused by parasites, and nine were caused by microbial toxins or chemical agents.

Outbreaks in healthcare institutions

Of the 759 outbreaks in healthcare institutions, 495 (65%) outbreaks with 9366 cases reported occurred in long-term care facilities, 217 (29%) outbreaks with 5678 cases, occurred in hospitals, and 47 outbreaks, with 702 cases were notified from other types of healthcare institutions, such as private clinics (Table 1). The number of cases in each outbreak ranged between 2 and 320 (median = 11) patients. The total number of outbreaks reported in these settings varied from year to year without a clear trend, ranging from 72 to 140 (median = 94) outbreaks per year.

The most frequent agent involved was norovirus (607 outbreaks, 80% of all outbreaks in healthcare institutions), followed by methicillin-resistant *Staphylococcus aureus* (MRSA) (76 outbreaks, 10%), and influenza virus (24 outbreaks, 3·2%) (Table 2). Not many specific trends could be identified during this period. It should be noted that outbreaks caused by influenza virus or vancomycin-resistant *Enterococcus* (VRE) have been observed to increase during the recent years (Table 2). Moreover, number of norovirus outbreaks and cases involved have fluctuated widely from season to season (122 norovirus outbreaks with 2690 cases were reported in 2010, while only 49 outbreaks with 875 cases were reported in 2012).

Food- and waterborne outbreaks

An important proportion of outbreaks associated with food or drinking water occurred in restaurants,

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Table 1. *Types of outbreaks by setting, number of outbreaks (number of cases), Vesuv 2006–2013*

Place of transmission	2006	2007	2008	2009	2010	2011	2012	2013	2006–2013
Outbreaks in healthcare institutions									
Long-term care facilities	33 (966)	46 (1203)	64 (1171)	63 (1095)	96 (1908)	52 (771)	66 (944)	75 (1308)	495 (9366)
Hospital	31 (854)	40 (1080)	37 (691)	25 (616)	36 (1053)	15 (565)	12 (237)	21 (582)	217 (5678)
Other	8 (70)	3 (41)	3 (58)	10 (173)	8 (175)	7 (93)	2 (41)	6 (51)	47 (702)
Total*	72 (1890)	89 (2324)	104 (1920)	98 (1884)	140 (3136)	74 (1429)	80 (1222)	102 (1941)	759 (15 746)
Foodborne and waterborne outbreaks									
Restaurant, cafe, pub, bar	19 (80)	31 (244)	33 (275)	18 (192)	17 (127)	22 (313)	14 (169)	21 (284)	175 (1684)
Private household	20 (225)	22 (2132)	10 (45)	4 (17)	8 (239)	9 (128)	2 (28)	4 (20)	79 (2834)
Hotel, other overnight accommodation	7 (283)	7 (161)	11 (489)	9 (234)	5 (119)	4 (121)	9 (530)	12 (211)	64 (2148)
Canteen	3 (73)	6 (177)	3 (36)	3 (31)	3 (59)	2 (62)	3 (42)	5 (188)	28 (668)
Event or meeting location	4 (63)	3 (141)	4 (78)	2 (34)	3 (60)	6 (159)	3 (58)	1 (30)	26 (623)
Airplane, bus, boat, train	1 (45)	2 (37)	3 (16)	1 (45)	—	—	1 (11)	2 (46)	10 (200)
Catering company	—	2 (40)	—	—	2 (36)	2 (9)	2 (22)	2 (25)	10 (132)
Kindergarten, daycare	4 (47)	1 (10)	—	—	2 (46)	—	—	2 (19)	9 (122)
Other	3 (83)	2 (27)	2 (36)	4 (101)	3 (22)	1 (16)	5 (155)	7 (208)	28 (648)
Unknown	3 (51)	5 (52)	5 (81)	12 (95)	7 (38)	3 (10)	5 (27)	6 (72)	45 (418)
Total	64 (950)	81 (3021)	71 (1056)	53 (749)	50 (746)	49 (818)	44 (1042)	62 (1103)	474 (9485)

* Twenty of the outbreaks that occurred in healthcare institutions were associated with food and water

cafes, bars or pubs (175 outbreaks, 36·9% of all food- and waterborne outbreaks), private households (79 outbreaks, 16·7%), and hotels or overnight accommodation (64 outbreaks, 13·5%). Outbreak reporting from each of these venues remained relatively stable during these years, with the exception of outbreaks reported from single households, which have decreased considerably (Table 1). The number of cases per outbreak ranged from 2 to 2000 (median = 11) patients.

The most frequent causative agent was norovirus (138 outbreaks, 29·1% of all food- and waterborne outbreaks), followed by *Salmonella* (33 outbreaks, 7%) and *Campylobacter* spp. (28 outbreaks, 5·9%) (Table 3). Number of outbreaks reported per year ranged from 44 to 81 (median = 58), without clear trends in time.

In 295 (62%) of the outbreaks there was a suspected or verified food item involved. The most frequent items were meat produce ($n = 28$), seafood ($n = 25$), chicken produce ($n = 21$) and vegetables ($n = 20$). In 40 outbreaks food had been served in a buffet.

In 22 outbreaks drinking water was the suspected source of infection. The most frequent type of water source involved was surface water ($n = 10$). Both waterborne outbreaks linked to municipal or private waterworks ($n = 13$) and single household water supply ($n = 9$) were reported in this period. The most common contributing factor was contamination at the source ($n = 11$), followed by failures in the distribution system ($n = 3$). There have not been any outbreaks linked to recreational water reported in this period.

Other outbreaks

Table 4 shows an overview of all the outbreaks notified to Vesuv between 2006 and 2013 that were not associated with food or drinking water, and did not occur in a healthcare institution. The most common pathogens involved were norovirus, influenza and MRSA and most were linked to person-to-person transmission in closed settings such as kindergartens or overnight accommodation.

DISCUSSION

During the 8 years in which Vesuv has been in place, it has proved to be a helpful tool. First, the system has enhanced rapid alerts between relevant stakeholders and exchange of information between different levels

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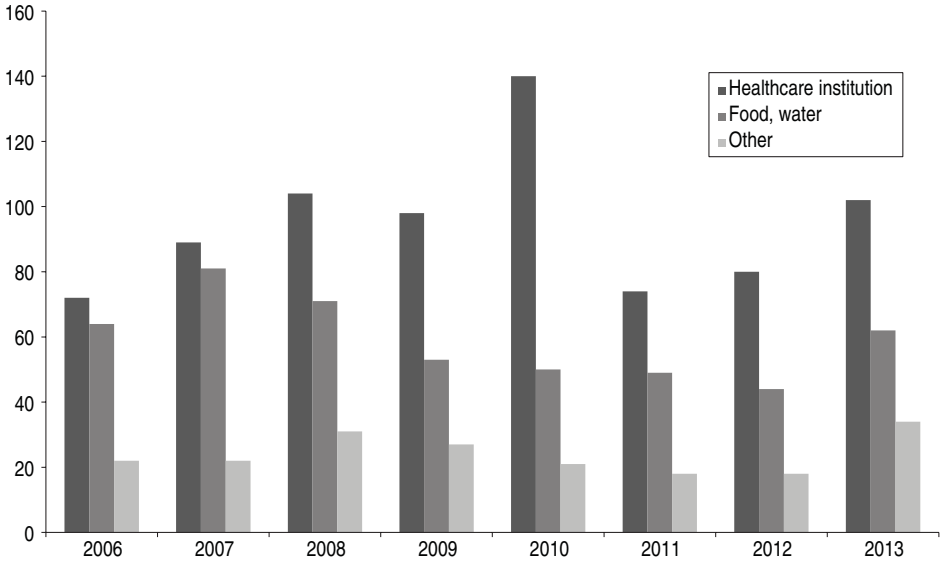

Fig. 2. Number of outbreaks notified to Vesuv, Norway, 2006–2013.

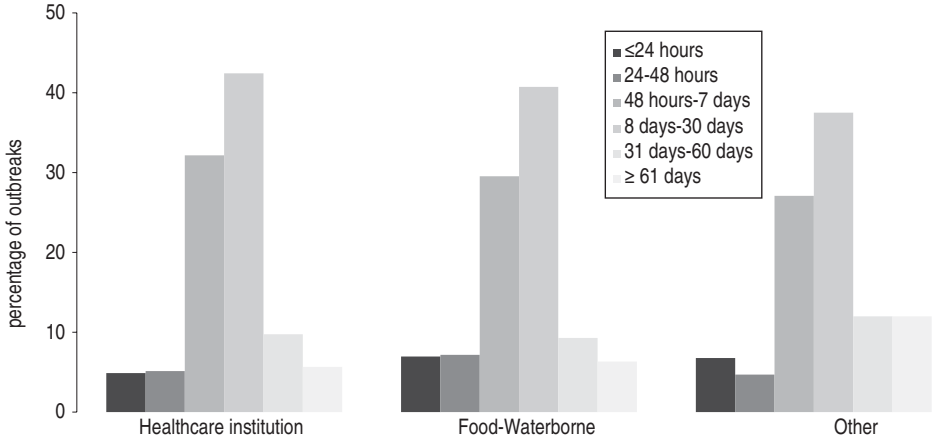

Fig. 3. Time between onset of symptoms of the first case and reporting date, Vesuv, 2006–2013.

of authority. The fact that the information included in each notification can be modified and updated as the investigation is ongoing, enables Vesuv to be a practical, standardized and easy-to-use log for those conducting the outbreak investigation. This is one of the most important attributes of the system, since it is not only a 'one direction' notification system from local to national levels, but also a system that allows the collaboration and information flow among all parties involved. It has also enabled rapid and efficient information-sharing between different authorities both at the local and national levels, and has facilitated prompt responses when needed. Currently, we cannot quantitatively assess the timeliness of the system. Although the date of onset of the first case is reported, and this can be compared to the date of registration we are lacking the date of identification of the outbreak. This is a key variable that needs to be added in the notification form to be able to measure the amount of time between the outbreak identification and its notification.

Collecting information from all the outbreak alerts and reports in a national database is also useful for analysing trends and contributing factors in order to identify specific areas where more general preventive measures are needed. The regular analysis of the information contained in such a system makes feasible the identification of potential time-trends and changes in epidemiological parameters, such as causative agents, settings where the outbreaks occurred, food items or

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Table 2. *Outbreaks in healthcare institutions by microbial agent, number of outbreaks (number of cases), Vesuv, 2006–2013 (only agents that caused ⩾5 outbreaks are displayed)*

Microbial agent	2006	2007	2008	2009	2010	2011	2012	2013	2006–2013
Virus									
Norovirus	56 (1771)	73 (2199)	89 (1794)	81 (1746)	122 (2690)	66 (1371)	49 (875)	71 (1674)	607 (14 120)
Influenza virus	—	—	—	2 (25)	—	1 (15)	14 (166)	7 (90)	24 (296)
Rotavirus	—	1 (20)	—	—	4 (54)	—	1 (7)	—	6 (81)
Other viruses	—	—	4 (30)	—	—	—	1 (50)	—	5 (80)
Bacteria									
MRSA	12 (97)	12 (69)	9 (32)	10 (41)	9 (41)	4 (17)	12 (44)	8 (93)	76 (434)
Enterococcus (VRE)	—	—	—	—	1 (320)	1 (13)	1 (67)	2 (6)	5 (406)
Other bacteria	3 (10)	2 (29)	1 (3)	—	3 (14)	2 (13)	2 (13)	7 (28)	20 (110)
Parasites									
Scabies	1 (12)	—	—	2 (43)	1 (17)	—	—	1 (3)	5 (75)
Unknown	—	1 (7)	1 (61)	3 (29)	—	—	—	6 (47)	11 (144)
Total	72 (1890)	89 (2324)	104 (1920)	98 (1884)	140 (3136)	74 (1429)	80 (1222)	102 (1941)	759 (15 746)

MRSA, Methicillin-resistant *Staphylococcus aureus*; VRE, vancomycin-resistant *Enterococcus*.

other sources of infection, and contributing factors, depending on the type of outbreak. As an example, the increase of notifications of seasonal influenza outbreaks in several long-term care facilities prompted an investigation of compliance with the recommendations for management of seasonal influenza outbreaks in this type of facility [8]. Further, the notification of several gastroenteritis outbreaks in children visiting holiday farms led into more emphasis on recommendations for hand hygiene practices and routines related to animal contact in these settings [9]. The information in Vesuv is analysed regularly and included in descriptive reports that are shared with Norwegian authorities, published on the web, and distributed internationally in a periodic way. This enables the comparison of Norwegian trends to those from other countries where similar surveillance systems are in place, such as Germany [10], England and Wales [11], or the United States [12]. The use of data from Vesuv for research purposes has so far been limited. To date, Vesuv data have only been used in one international project called 'Waterborne Outbreaks and Climate Change', commissioned by ECDC, in which data on waterborne outbreaks from four Nordic countries have been analysed [13].

The number of outbreaks notified to Vesuv most likely represent a small proportion of all outbreaks occurring in Norway. Underreporting is an inherent problem of surveillance systems and several small outbreaks might have gone undetected [14]. Moreover, despite the fact that notification is mandatory by law, some outbreaks might not be notified to the system. An important factor linked to underreporting is that there might be users at the local level that are unfamiliar with the system or are unaware of its existence. NIPH routinely promotes Vesuv through lectures, courses, workshops and conferences on both regional and national levels, aiming to encourage the use of Vesuv by local health authorities and health personnel in hospitals and long-term care facilities. Likewise, the H-NFSA arranges national and regional exercises among the LFSA where notification to Vesuv is included as part of the outbreak response training.

In addition to underreporting, failure to update information is a challenge. For example, an outbreak may remain recorded with 'unknown' aetiology if laboratory results were pending when the first notification was made, and updates were not made. Although an automatic reminder is sent 3 weeks after the first notification, it has not been assessed

Table 3. *Outbreaks associated with food or drinking water by agent, number of outbreaks (number of cases), Vesuv, 2006–2013 (only agents that caused ⩾5 outbreaks are displayed)*

Microbial agent	2006	2007	2008	2009	2010	2011	2012	2013	2006–2013
Virus									
Norovirus	18 (424)	20 (414)	19 (650)	21 (405)	21 (544)	13 (371)	13 (404)	13 (517)	138 (3729)
Hepatitis A virus	—	—	1 (3)	—	1 (5)	1 (2)	—	2 (14)	5 (24)
Bacteria									
Salmonella	8 (163)	5 (100)	9 (149)	1 (5)	3 (26)	1 (3)	4 (25)	2 (60)	33 (531)
Campylobacter spp.	3 (10)	4 (2025)	3 (18)	4 (26)	5 (18)	5 (60)	2 (5)	2 (32)	28 (2194)
Bacillus cereus	5 (65)	5 (85)	7 (52)	3 (11)	2 (5)	1 (22)	1 (6)	—	24 (246)
Staphylococcus aureus	1 (5)	6 (39)	8 (20)	—	1 (3)	2 (12)	—	—	18 (79)
Escherichia coli	1 (17)	1 (4)	—	6 (34)	1 (3)	—	1 (300)	2 (18)	12 (376)
Clostridium perfringens	—	5 (100)	1 (4)	1 (33)	—	3 (90)	2 (81)	—	12 (308)
Shigella spp.	2 (57)	1 (6)	—	2 (35)	—	3 (35)	—	2 (33)	10 (166)
Francisella tularensis	—	3 (10)	1 (15)	—	1 (3)	2 (19)	—		7 (47)
Yersinia enterocolitica	2 (14)	2 (7)	—	—	—	1 (21)	—	1 (6)	6 (48)
Other bacteria	—	—	2 (4)	1 (2)	—	1 (5)	3 (56)	1 (3)	8 (70)
Parasites*	1 (5)	1 (33)	—	1 (74)	—	—	—	1 (11)	4 (123)
Toxin/chemical agent									
Histamine	1 (12)	—	1 (5)	1 (4)	—	1 (2)	1 (2)	—	5 (25)
Other toxins/chemical agents	1 (2)	—	—	—	—	1 (9)	2 (9)	—	4 (20)
Unknown	21 (176)	28 (198)	19 (136)	12 (120)	15 (139)	14 (167)	15 (154)	36 (409)	160 (1499)
Total	64 (950)	81 (3021)	71 (1056)	53 (749)	50 (746)	49 (818)	44 (1042)	62 (1103)	474 (9485)

* *Giardia* ($n = 2$), *Cryptosporidium* ($n = 2$).

Table 4. *Other outbreaks by microbial agent, number of outbreaks (number of cases), Vesuv 2006–2013 (only agents that caused ⩾5 outbreaks are displayed)*

Microbial agent	2006	2007	2008	2009	2010	2011	2012	2013	2006–2013
Virus									
Norovirus	6 (447)	12 (279)	7 (98)	2 (25)	8 (833)	9 (347)	2 (48)	8 (288)	54 (2365)
Influenza virus	2 (44)			13 (766)		1 (187)	1 (21)	1 (9)	18 (1027)
Morbillivirus (measles)			2 (22)			1 (5)		2 (7)	5 (34)
Other viruses	1 (7)	1 (15)	2 (11)	1 (2)	2 (12)		1 (3)		8 (50)
Bacteria									
MRSA	1 (4)	1 (3)	6 (26)	—	2 (6)	1 (3)	3 (14)	3 (34)	17 (90)
Legionella	6 (46)	—	2 (9)	3 (17)	—	—	—	—	11 (72)
Salmonella	—	3 (49)	2 (4)	—	—	1 (4)	3 (21)	2 (4)	11 (82)
Escherichia coli	—	—	1 (2)	2 (15)	1 (3)	—	3 (27)	1 (6)	8 (53)
Bordetella pertussis	1 (4)	1 (3)	—	1 (28)	2 (44)	1 (8)	—	3 (108)	9 (195)
Campylobacter spp.	—	1 (6)	1 (4)	1 (8)	1 (500)	—	—	4 (106)	8 (624)
Other bacteria	2 (9)	1 (5)	5 (34)	1 (2)	2 (6)	2 (17)	—	3 (35)	16 (108)
Parasites*	2 (10)	—	—	—	1 (8)	—	2 (30)	2 (94)	7 (142)
Unknown	1 (20)	1 (6)	3 (64)	3 (2567)	2 (18)	2 (54)	4 (23)	5 (88)	21 (2840)
Total	22 (591)	21 (366)	31 (274)	27 (3430)	21 (1420)	18 (625)	19 (187)	34 (779)	193 (7682)

MRSA, Methicillin-resistant *Staphylococcus aureus.*

* *Giardia* ($n = 3$), scabies ($n = 1$) and *Cryptosporidium* ($n = 3$).

https://doi.org/10.1017/S095026881500093X Published online by Cambridge University Press

whether the users actually log in and update the information in response to the prompt. Since 2013, the 'last date of update' is recorded each time a user opens the outbreak notification form. This allows Vesuv administrators to assess the need to request an update of specific information. In addition, starting in 2014 an email was sent at the beginning of the year to all users that notified outbreaks in the previous year, asking them to update their notifications if needed. This will likely contribute to increased quality of the information published in future annual outbreak reports and in our records.

Being aware of the strengths and weaknesses of Vesuv, NIPH undertakes continuous efforts to further develop the system. As of 2015 there are three main areas for improvement that are ongoing or under discussion. The first is to improve the feedback given to the users, by improving the design of the monthly reports, and by making them publicly available. This can promote the use of Vesuv nationwide. However, the type of information included in a public report and the way it is presented has to be carefully considered as some organizations might be more reluctant to notify if reports are publicly accessible and the outbreak setting is easily identifiable. A second working area is to improve access for MMOs to data in Vesuv on all outbreaks reported in their municipality and neighbouring areas, not only those they have reported themselves. This will be a useful source of information to provide MMOs with an overview of the epidemiological situation in their municipality.

A third area for improvement is to develop a toolbox under the Vesuv domain, allowing outbreak investigators at the local level to make descriptive and statistical analyses of epidemiological investigations conducted at the local level. This toolbox may include spreadsheets with dummy linelists, epicurves, and routines for univariable analyses. A set of tools has already been generated in Germany [15]. Such type of tools could help to increase the use of analytical epidemiological studies in local investigations.

CONCLUSION

National web-based outbreak reporting systems, such as the one implemented in Norway, have proved to be an important tool for event-based reporting as required under the IHR 2005. The system enables rapid reporting and information-sharing between the different authorities involved in outbreak investigations. A national database with information on all reported outbreaks is also useful for analysing trends such as occurrence of certain microorganisms, places or sources of infection or routes of transmission. This can facilitate the identification of specific areas where general preventive and control measures need to be reinforced.

ACKNOWLEDGEMENTS

The authors thank Emily MacDonald from the Norwegian Institute of Public Health for her input to the manuscript.

DECLARATION OF INTEREST

None.

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