

SURVEILLANCE REPORT



Annual Threat Report

2009

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Glossary

ARI	Acute respiratory infection
E.	<i>Escherichia</i>
ECDC	European Centre for Disease Prevention and Control
EEA	European Economic Area
EFTA	European Free Trade Association
EMA	European Medicines Agency
EMCDDA	European Monitoring Centre for Drugs and Drug Addiction
EPIET	European Programme on Intervention Epidemiology Training
EU	European Union
EUROPOL	European Police Office
EWGLI	European Working Group on <i>Legionella</i> Infections
EWGLINET	European surveillance scheme for travel-associated legionnaires' disease
EWRS	Early Warning and Response System
FWD	Food- and waterborne diseases
GPHIN	Global Public Health Intelligence Network
HPAI	Highly pathogenic avian influenza
IDU	Injecting drug users
ILI	Influenza-like illness
MedISys	Medical information system
MMR	Measles-mumps-rubella vaccine
PEP	Post-exposure prophylaxis
PHE	Public health emergency
ProMED	Program for Monitoring Emerging Diseases
PT	Phage type
S.	<i>Salmonella</i>
SANCO C3	Directorate General for Health and Consumers, public health and risk assessment, health threats
SANCO C7	Directorate General for Health and Consumers, public health and risk assessment, risk assessment
Sh.	<i>Shigella</i>
sp.	species
STEC	Shigatoxin-producing <i>Escherichia coli</i>
TESSy	The European Surveillance System
TTT	Threat Tracking Tool
UIN	Urgent Inquiry Network
VTEC	Verocytotoxin-producing <i>Escherichia coli</i>
WHO	World Health Organization
WNND	West Nile neuroinvasive disease
WNV	West Nile virus



Preface

ECDC exists to help the EU and its Member States protect Europeans from infectious diseases. In order to do this, ECDC and its partners need to be constantly vigilant against the emergence of new epidemics and other such health threats. Epidemic intelligence officers in ECDC, together with our national and international counterparts, are therefore exchanging information and monitoring for unusual patterns of illness, seven days a week, 52 weeks a year.

Most years, this work is largely invisible. Small-scale multi-country disease outbreaks happen pretty much every week in Europe: *Legionella* bacteria are found in the water pipes in a large holiday hotel, and tourists from two or three different countries are identified as having been exposed to them. A food processing plant in one country seems to be the source of salmonella infections in a neighbouring country. EU-level information sharing enables us to quickly identify and assess these sorts of threats. National health authorities then work together with ECDC, the European Commission and each other to resolve the situation and protect the people at risk. These sorts of outbreaks rarely make headlines or command the attention of policy makers. However, they can have a profound impact on the people affected. Both the pathogens I mentioned earlier, and many others that we deal with, can cause severe illness and even death. The value of ECDC's work on rapid detection and assessment of health threats, then, is that it can help national authorities to save lives. This is happening day after day, week after week in Europe.

2009 was unusual in that a multi-country disease outbreak occurred that did, in fact, grab the attention of policy makers and the media in Europe, and indeed around the world. I am talking, of course, of the 2009 influenza A(H1N1) pandemic. The pandemic virus emerged in Mexico and the US in late April 2009, and within a matter of days, cases were being seen in EU countries. One of the key findings of this report is that the infrastructure and systems in place in the EU for dealing with health threats were heavily used by Member States during the 2009 pandemic, and proved to be very useful. National authorities shared a lot of information with each other on the situation in their countries and benefited from authoritative epidemiological analyses, risk assessments and scientific guidance from ECDC.

The 2009 influenza A(H1N1) pandemic, thankfully, proved to be less deadly than had first been feared. Nonetheless, as of 3 May 2010 nearly three thousand people in the EU were confirmed as having died from this virus, with the total death toll (i.e. including people who died from the virus, but were never tested for it) likely to be much higher. Even a relatively benign multi-country outbreak has some fatal consequences. This is something the health professionals in ECDC, the European Commission and their national counterparts are well aware of. It is why we strive each year to be vigilant against health threats and work together effectively to protect EU citizens from them.

I hope you will find this report interesting and useful.

Marc Sprenger
Director

Introduction

When ECDC became operational in 2005, it started to 'gather and analyse data and information on emerging public health threats' (Article 9 of the Founding Regulations of the Centre¹). According to Article 2(e), health threat 'shall mean a condition, agent or incident which may cause, directly or indirectly, ill health'. Article 3(1) of the Founding Regulations further states that ECDC's mission is to 'identify, assess and communicate current and emerging threats to human health from communicable diseases', while Article 8 adds that ECDC shall 'assist the Commission by operating the early warning and response system' and 'analyse the content of messages received by it'. ECDC has been hosting the Early Warning and Response System (EWRS) application since November 2007 and assists the European Commission by operating the system²⁻⁹.

This is the first Annual Threat Report published as a separate document. Previously, it was included in the ECDC Annual Epidemiological Report, where event- and indicator-based surveillance results were presented together.

This document describes emerging threats that were either directly reported to ECDC through Member State notifications on EWRS according to defined criteria^{2,3}, or found through active screening of various sources, including national epidemiological bulletins, international networks (Program for Monitoring Emerging Diseases (ProMED), Global Public Health Intelligence Network (GPHIN)), media, and various additional sources, both formal and informal.

The EWRS was implemented in 1998, based on Decision 2119/98/EC of the European Parliament and of the Council to set up a network for epidemiological surveillance and control of communicable diseases in the Community. The first message distributed in the EWRS was related to legionellosis and posted on 30 October 1998¹⁰. A new EWRS application was introduced on 17 May 2004 and has been hosted by ECDC since 17 November 2007. EWRS messages are labelled according to their activation level, where level 1 refers to 'information exchange', level 2 indicates a 'potential health threat' and level 3 a 'definite public health threat'². In the EWRS application, events can be posted as original messages (message threads) or as comments to original messages. In addition, messages can be posted as a selective exchange of information between Member States, e.g. if not all Member States are concerned or if confidential information is exchanged (e.g. contact tracing). It should be noted that the number of message threads, comments and selective exchange messages reported through the EWRS does not correspond to the threats monitored by ECDC in the course of its routine epidemic intelligence activities.

All health threats identified through epidemic intelligence activities are documented and monitored by using a dedicated database, called the Threat Tracking Tool (TTT). All data analysed in this report are extracted from this tool.

The analysis covers the period from June 2005, when the TTT was activated, until the end of 2009, with special emphasis on threats emerging in 2009.

The expression 'opening a threat' refers to the way ECDC assesses threats during its daily threat review meetings, internally known as 'roundtable meetings'. The roundtable consists of ECDC experts that evaluate potential threats and validate events which require further attention or action from ECDC due to their relevance for public health or the safety of EU citizens. The following criteria to open a threat and further monitor an event are used:

- More than one Member State is affected.
- A disease is new or unknown, even if there are no cases in the EU.
- There is a request from a Member State or from a third party for ECDC to deploy a response team.
- There is a request for ECDC to prepare a threat assessment of the situation.
- There is a documented failure in an effective control measure (vaccination, treatment or diagnosis).
- There is a documented change in the clinical/epidemiological pattern of the disease, including changes in disease severity, the way of transmission, etc.
- The event matches any of the criteria under the IHR or EWRS.

Following Decision No. 2000/57/EC of the European Parliament and of the Council, events are considered relevant to be reported to the EWRS if one or more of the criteria mentioned below are met². After the revised International Health Regulations (IHR) entered into force on 15 June 2007, the decision was amended, and criteria now include both IHR notifications and the possible exchange of details following contact tracing³.

EWRS criteria

1. Outbreaks of communicable diseases extending to more than one Member State of the Community.
2. Spatial or temporal clustering of cases of a disease of a similar type if pathogenic agents are a possible cause and there is a risk of propagation between Member States within the Community.
3. Spatial or temporal clustering of cases of disease of a similar type outside the Community if pathogenic agents are a possible cause and there is a risk of propagation to the Community.
4. The appearance or resurgence of a communicable disease or an infectious agent which may require timely coordinated Community action to contain it.

5. Any IHR notification has to be reported also through EWRS.
6. Any event related to communicable diseases with a potential EU dimension necessitating contact tracing to identify infected persons or persons potentially in danger may involve the exchange of sensitive personal data of confirmed or suspected cases between concerned Member States.

Analysis is performed both quantitatively (e.g. comparing the number of threats) and qualitatively (describing the content of threats).

1 Descriptive analysis of emerging threats

1.1 Temporal analysis

Threats monitored in TTT

Since June 2005, 806 threats have been monitored, with a median of 13 threats per month and a range of 5 to 39. The seasonal distribution of threats shows a tendency to peak around summer and autumn. These peaks are mainly related to food- and waterborne diseases and legionellosis-related threats (Figures 1 and 2).

In 2009, ECDC monitored 192 threats, of which 174 (91%) were new threats opened in 2009, 10 (5%) were carried over from 2009, and 8 (4%) represented recurrent threats, opened prior to 2009 and monitored continuously. Recurrent threats were related to human cases of avian influenza (worldwide since 2005, in the European region in 2005), chikungunya fever (2005), poliomyelitis (2005), dengue fever (2006), cholera (2006), as well as two threats related to the new variant of Creutzfeldt-Jakob disease (2006, 2007).

The 192 emerging threats monitored in 2009 represent a 24% decrease compared with 2008. This decrease is largely related to the emergence of the 2009 pandemic influenza A(H1N1) at the end of April 2009, which prompted an unprecedented worldwide response and resulted in fewer threats being reported (and therefore monitored) in epidemic intelligence sources, including EWRS¹¹.

Messages circulated in EWRS

From January 2005 until the end of 2009, 934 new message threads were posted in the EWRS. In 2009, the number of message threads (509) increased fivefold compared with the previous two years (Table 1). In addition, the proportion of level 3 messages (definite public health threat) increased from less than 2% for the period 2006 to 2008 to 44% (226) in 2009 (Figure 3). The influenza pandemic is mainly responsible for this increase in the number of TTT threats: 88% (449) of all message threads and 99% (223) of level 3 message threads in 2009 were related to influenza.

Figure 1: Distribution of threats monitored through TTT by month, June 2005 to December 2009, EU and EFTA Member States

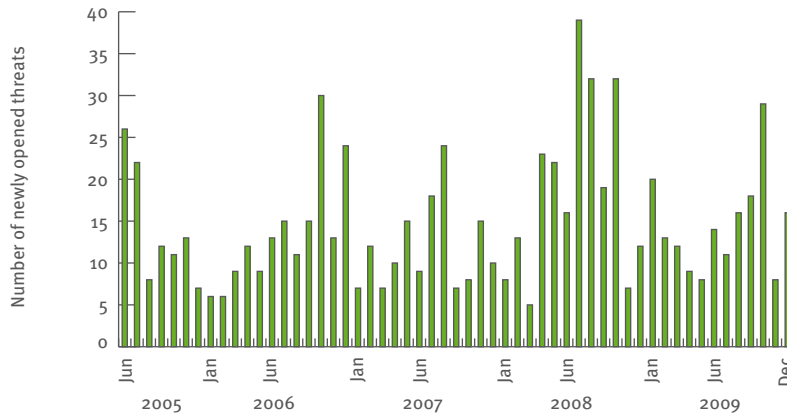
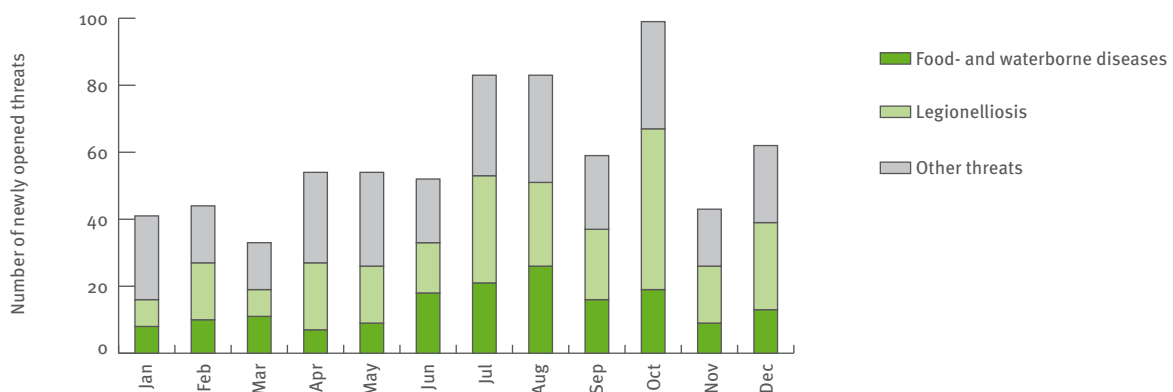


Figure 2: Distribution of threats by month, 2006 to 2009, EU and EFTA Member States



The number of message comments (820) posted in response to new notifications increased almost fourfold compared with 2008, as did the number of selective exchanges (721) (Table 1).

EWRs system usage (user access) increased significantly in April 2009, after the start of the 2009 influenza A(H1N1) pandemic (Figure 4).

1.2 Analysis by disease group

The distribution of threats monitored per disease group in 2009 is comparable to those monitored in previous years (Table 2), except for threats related to diseases of environmental or zoonotic origin, which increased from 20 (20%) monitored threats in 2005 to 114 (59%) in 2009.

The majority of all threats (81%) were related to clusters of legionellosis (Figure 5).

The proportion of threats related to food- and waterborne outbreaks decreased from 42% (42) in the second half of 2005 to 15% in 2009 (29), while the number of monitored threats on a yearly basis was similar for the entire monitoring period, ranging between 29 and 68 threats (Table 2). The proportion of threats related to vaccine-preventable diseases varied between 6% and 13% (11–28 threats) over the monitoring period; in 2009, 18 threats (9%) were monitored. Eight threats monitored in 2009 were related to tuberculosis (4%) and four to hepatitis, HIV and blood-borne infections. No threats regarding hospital-acquired infections and antimicrobial resistance were monitored in 2009.

Figure 3: Distribution of EWRs message threads by year of posting and level, 2005 to 2009, EU and EFTA Member States

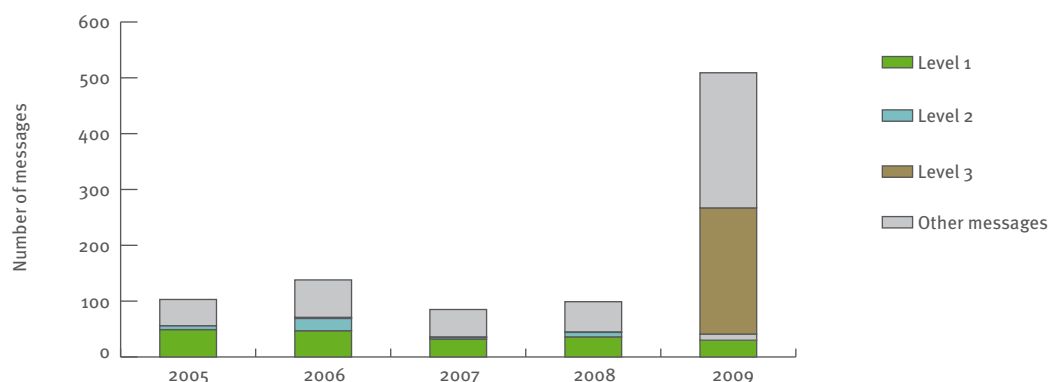
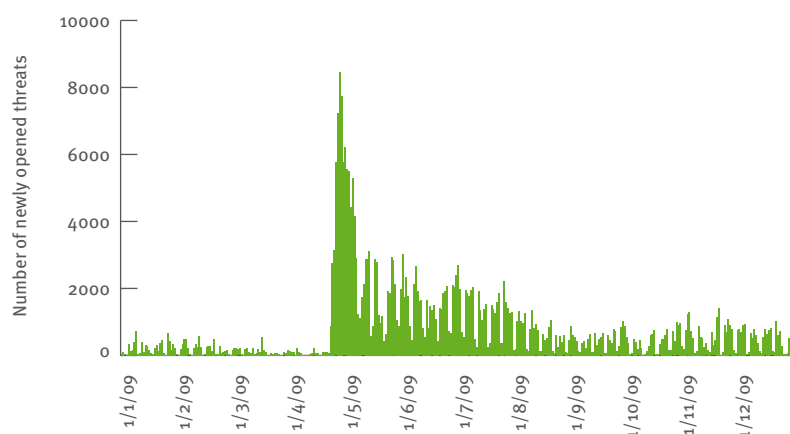


Table 1: Distribution of EWRs message threads, comments and selective exchange by year of posting, EU and EFTA Member States

Year of posting	Message threads	Message comments	Selective messages
2005	103	131	2
2006	138	223	50
2007	85	300	208
2008	99	210	169
2009	509	820	721
Overall total	934	1,684	1,150

Figure 4: Frequency of EWRs usage by day, 2009, EU and EFTA Member States



Six of the monitored threats in 2009 were not related to specific diseases but to events, i.e. mass gatherings (the 6th Francophone Games in Beirut, the Universiade in Belgrade, the EXIT and Guca festivals in Serbia, and the 12th IAAF World Championships in Athletics in Berlin), an earthquake in Italy's Abruzzo region, a request for information from the European Commission on the unexplained death of a laboratory worker in Taiwan, and a request from the US CDC on animal die-offs in Spain and the risk to human health.

In 2009, thirteen of the monitored threats (7%) were related to influenza, including the 2009 influenza A(H1N1) pandemic. Other monitored threats related to influenza were the recurrent threat of avian influenza (worldwide and in the European region), seasonal influenza, the contamination of an experimental influenza A(H3N2) vaccine with a live A(H5N1) strain, an outbreak of highly pathogenic influenza A(H7) virus in poultry in Spain, a human case of influenza A(H9N2) in Hong Kong, and influenza A(H3N2) in mink in Denmark. Nevertheless, the most common events monitored in 2009 were clusters of travel-associated legionellosis, which accounted for 48% of the monitored threats.

1.3 Analysis by source of initial notification

In 2009, the European Working Group on *Legionella* Infections (EWGLI) was the main source of new threats that were reported in relation to clusters of travel-associated legionellosis.

The majority of monitored threats (n=140, 80%) in 2009 originated from confidential sources (sources with restricted access). EWRS accounted for 30% of monitored threats from confidential sources (42 threats). The number of threats originating from public sources decreased by 36% compared to 2008 (Table 3). Information from confidential sources including the EWRS is treated as confidential and only distributed to the EWRS Focal Points in the Member States until it becomes publicly available, either through media sources or through publication in scientific journals, e.g. Eurosurveillance.

1.4 Analysis by region of origin and affected countries

Seventy percent of the monitored threats in 2009 affected the EU and EEA/EFTA countries. This proportion has been steadily increasing from 35% in the second half of 2005 (Figure 6).

The 2009 influenza A(H1N1) pandemic was monitored from a global perspective, as were the threats related to A(H5N1) avian influenza, chikungunya fever, dengue fever, cholera and poliomyelitis. During 2009, the monitored threats affected 112 countries worldwide, excluding the 2009 influenza A(H1N1) pandemic.

Of 30 EU/EEA countries, 26 (87%) were affected by monitored threats, excluding the 2009 influenza A(H1N1) pandemic. Italy was the country most affected by monitored

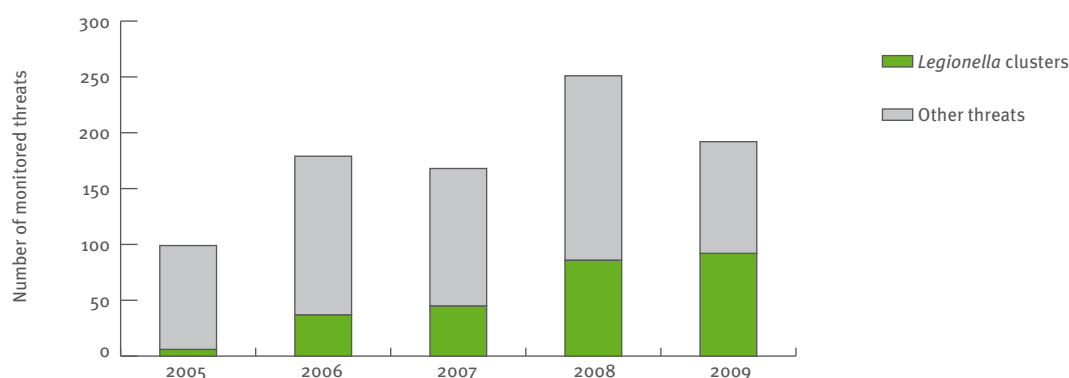
Table 2: Number of threats monitored by year and group of disease, EU and EFTA Member States

Disease groups	Year and number of threats monitored					Total**
	2005*	2006	2007	2008	2009	
Food- and waterborne diseases	42	68	42	55	29	236
Vaccine-preventable diseases and diseases due to invasive bacteria	13	11	16	28	18	86
Influenza	6	6	4	9	13	38
Tuberculosis	2	3	17	13	8	43
Hepatitis, HIV, sexually transmitted infections, blood-borne infections	1	2	1	3	4	11
Antimicrobial resistance and healthcare-associated infections	3	4	2	1	0	10
Diseases of environmental or zoonotic origin	20	53	64	119	114	370
Other	12	32	22	23	6	95
Overall total**	99	179	168	251	192	886

* Includes only the second half of 2005.

** The number of new threats monitored does not correspond to the number of threats monitored by year as several threats were carried over from previous year(s).

Figure 5: Number of threats monitored by year, June 2005 to December 2009, EU and EFTA Member States



threats (41 threats), which accounted for 21% of the 192 threats that affected EU/EEA countries in 2009. The majority of the monitored threats from Italy were due to clusters of legionellosis (n=32, 78%). ECDC monitored 24 threats from the UK, 18 threats each from France and Spain, and 15 from Germany. All other EU/EEA countries accounted for fewer than 10 monitored threats in 2009.

No threats in relation with Iceland, Liechtenstein, Lithuania or Luxembourg were monitored in 2009, with the single exception of pandemic influenza A(H1N1).

Among the three candidate countries (the former Yugoslav Republic of Macedonia, Turkey, Croatia) and the five potential candidate countries (Serbia, Bosnia and Herzegovina, Montenegro, Albania and the United Nations-administered province of Kosovo), three were affected by a total of 14 monitored threats: Turkey (11), Croatia (2) and Serbia (1). Again, these numbers exclude the monitoring of the 2009 pandemic influenza A(H1N1).

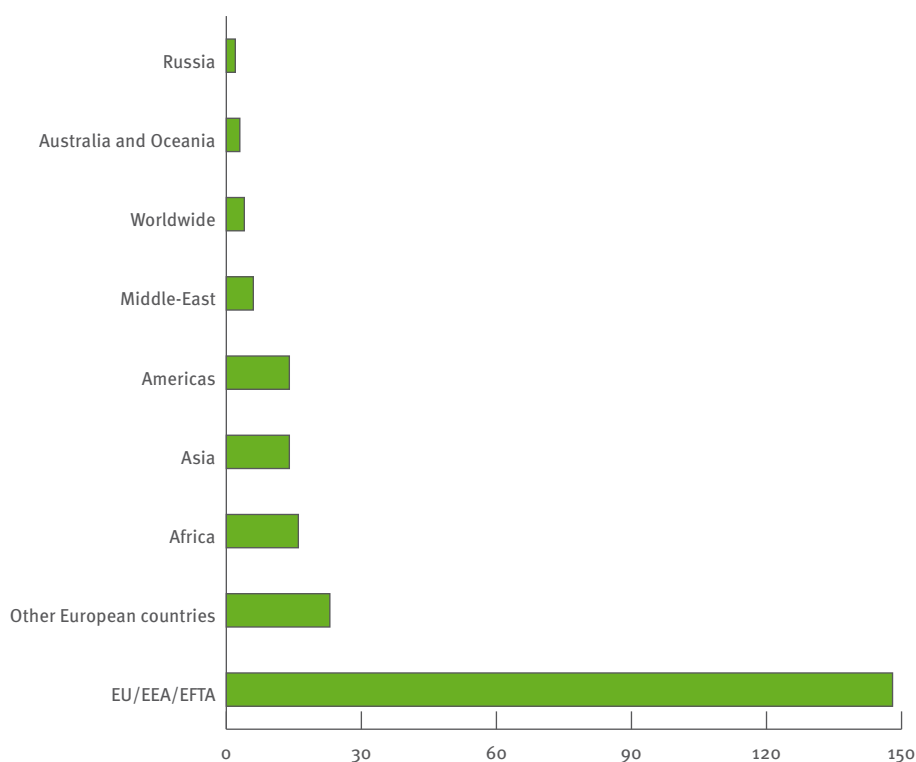
Table 3: Initial sources of information for newly opened threats, by year, EU and EFTA Member States

Number of new threats monitored	2005*	2006	2007	2008	2009	Total**
Confidential sources						
EWGLI	2	30	40	78	85	235
EWRS	23	52	42	74	42	233
WHO	17	14	5	3	4	43
Information from Member States	1	5	2	6	1	15
European surveillance networks	9	11	8	4	5	37
Other confidential sources	0	2	4	10	3	19
Total	52	114	101	175	140	582
Public sources						
PROMED	36	15	20	9	5	85
Medlsys	2	5	0	1	7	15
GPHIN	4	19	4	1	4	32
Eurosurveillance	0	1	2	0	0	3
Public reports available on the internet	5	9	12	17	8	51
Other public sources	0	0	3	25	10	38
Total	47	49	41	53	34	224
Overall total**	99	163	142	228	174	806

* Includes only the second half of 2005.

** The number of new threats monitored does not correspond to the number of threats monitored by year as several threats were carried over from previous year(s).

Figure 6: Distribution of monitored threats in 2009 by affected region(s), EU and EFTA Member States



2 Response to threats

In 2009, ECDC's response activities were characterised by supporting and coordinating the response to the 2009 influenza A(H1N1) pandemic. The pandemic situation required enhanced epidemic intelligence up to the first months of 2010, particularly during the early weeks of the outbreak when there were still many unknowns about the nature of the disease. From the end of April 2009 to January 2010, ECDC produced daily updates which summarised epidemiological information on the pandemic derived from global sources.

2.1 Published threat assessments (TA)

During 2009, 25 threat assessments were conducted by ECDC, for which an additional six updates were provided. Twelve were initiated by EWRS messages, eight by requests from the European Commission, and five by following a threat detected through other sources. Nineteen threat assessments were related to threats affecting EU Member States, two threats concerned North America (US and Canada), and two Asia (Philippines and China). One threat affected northern Africa and one a non-EU country within the European WHO region (Ukraine).

Influenza accounted for ten threat assessments in 2009, five of which were related to the 2009 influenza A(H1N1) pandemic and the remaining ones to other influenza strains. West Nile virus accounted for two assessments, while cowpox, chikungunya, measles, Lassa

fever and Ebola-Reston each prompted one assessment. Contamination of drugs spawned two further assessments (anthrax and botulism). Threat assessments were also prepared for legionellosis, malaria, Q fever, *Salmonella* contamination of pistachios, and plague in Algeria (Table 4).

The UK was the EU country for which the highest number of threat assessments was published (4), followed by Germany (3), France (2), and Spain (2). Other countries for which a threat assessment was produced were Austria, the Czech Republic, Cyprus, Greece, Ireland, Italy, the Netherlands, Norway, Romania, and Slovenia. Some threat assessments targeted more than one country. The distribution of threat assessments by country is shown in Table 4.

2.2 Targeted expert consultations

In 2009, ECDC organised two expert consultations on emerging threats.

An expert consultation on rabies post-exposure prophylaxis (PEP) with 18 participants from several relevant institutions and vaccine producers was held in January 2009. The consultation concluded that there is a need for strengthening the links between clinicians and public health authorities, particularly in the areas of reporting potential exposures and conducting individual risk assessments. It was also noted that there was no shortage of vaccines or immunoglobulin for routine prophylaxis. However, in situations that put a large number of people at risk, a substantial

Table 4: Distribution of threat assessments by requesting party, topic, country involved, and month, 2009

Request	Month	Country involved	Subject
SANCO C3	January	Cyprus	Legionellosis cluster in hospital
SANCO C3	January	Algeria	Suspected plague affecting terrorists
EWRS	January	Spain	H1 influenza of swine origin
SANCO C3	January	Philippines	Ebola Reston in pigs
SANCO C3	January	China	Avian influenza human cases
EWRS	January	Germany	Cowpox in Germany
EWRS	January	United Kingdom	Lassa fever in patient on flight from Nigeria to UK
EWRS	February	Austria, Czech Republic, Slovenia, Germany	Contamination of influenza vaccine with H5N1
SANCO C3	March	United Kingdom	Wound botulism among injecting drug users
SANCO C3	April	US and EU	Salmonella contamination of pistachios: US and Germany (via Iran)
Other	April	US	Swine influenza with new genomic segment in US
Other	July	Canada	Re-assortment of swine influenza virus in Canada
SANCO C3	August	France	Chikungunya fever in La Réunion, France
EWRS	August	Romania	West Nile virus infection in Romania
Other	September	Italy	West Nile virus infections in Italy: Veneto and Emilia Romagna
EWRS	September	France	West Nile virus infection in Var district, France; update on the situation in Italy and cases in Hungary
Other	October	Spain	Highly pathogenic avian influenza H7 in poultry: Castilla-La Mancha, Spain
EWRS	October	Denmark	H3N2 in farm minks
Other		Ukraine	Viral pneumonia: Ukraine
EWRS	November	United Kingdom	Cluster of oseltamivir-resistant H1N1 virus strain, UK
EWRS	November	Norway	Mutation in H1N1 HA gene: Norway
EWRS	November	Ireland	Measles outbreak among travellers
EWRS	December	Greece	Malaria (<i>P. vivax</i>) autochthonous cases
SANCO C3	December	The Netherlands	Q fever outbreak
EWRS	December	UK	Outbreak of anthrax among injecting drug users in Glasgow

amount of vaccine and immunoglobulin may be needed for PEP, which could then lead to a vaccine shortage. Therefore a virtual stockpile needs to be considered¹².

An expert consultation on West Nile virus (WNV) infection was held in April 2009, attended by 57 participants from Member States, the European Commission, the European Food Safety Agency (EFSA), WHO and ECDC. The meeting participants recommended an improved communication flow for planned and implemented measures, e.g. for the rapid alert system for blood, tissue and organ safety as well as EWRS outbreak reporting. Efforts to strengthen the preparedness for WNV infections through better collaboration and a multidisciplinary approach should be continued. ECDC was asked to assist Member States in the development of a decision-making tool for WNV infection preparedness and control, including guidance on a risk assessment for blood supplies and the development of thresholds of acceptable risk¹³.

2.3 Mobilisation of expertise

Several threats made it necessary to dispatch ECDC experts to outbreak areas. A senior ECDC expert joined a mission to Ukraine during the 2009 influenza A(H1N1) pandemic; in May 2009, ECDC sent an expert from its Emergency Operations Centre (EOC) to act as liaison with the US Centres for Disease Control (CDC) in Atlanta.

During four weeks in the summer of 2009, a liaison officer from the China CDC supported the ECDC Emergency Operations Centre in Stockholm. In addition, two experts in epidemic intelligence and mass gatherings acted as ECDC liaison officers during mass gathering events in Serbia. ECDC also provided support to a risk assessment project on vector-borne diseases in Malta.

3 Threats of particular interest

The selection of threats in this section covers threats of particular interest. These threats are characterised by:

- continuous close monitoring (e.g. food- and waterborne diseases, travel-related legionellosis clusters, influenza);
- unexpectedness (e.g. outbreak of anthrax in injecting drug users);
- increased media attention (e.g. vaccine safety issues);
- the possibility of intentional release (e.g. plague, water contamination in Italy); or
- unusual transmission modes (e.g. VTEC in the UK, anthrax in injecting drug users).

3.1 Urgent inquiries concerning food- and waterborne diseases

The FWD UIN (Food- and Waterborne Diseases – Urgent Inquiries Network) consists of epidemiologists and microbiologists from all EU Member States, EEA/EFTA countries and Australia, Canada, Japan, New Zealand, South Africa, Switzerland and the United States of America.

In 2009, 28 urgent inquiries were issued through FWD UIN (compared with 33 in 2008). Three quarters of the urgent inquiries (21) were initiated by EU and EEA/EFTA Member States, three by the USA, one by Australia, and one was issued jointly by the USA and Canada. Two urgent inquiries were launched by ECDC, following epidemic intelligence information.

Seventeen (61%) inquiries affected only a single country, compared with 38% in 2008. Sixty-eight percent (19) of inquiries were limited to countries in the EU and EFTA region, and 11% were in both EU/EFTA and non-EU/EFTA countries (Table 5).

As in 2008, the majority (61%) of inquiries were related to *Salmonella* sp. infection, followed by Shiga toxin-producing *Escherichia coli* (STEC)/Verocytotoxin-producing *E. coli* (VTEC) infection (21%) and *Shigella* sp. infection (11%). Among the 17 *Salmonella*-related inquiries, five were related to serotype Typhimurium and four to serotype Enteritidis. Two inquiries were related to *Cyclospora* and hepatitis A infection. A detailed breakdown of pathogens associated with the urgent inquiries is shown in Table 6.

Table 5: Distribution of urgent inquiries by number of affected countries and region

Number of countries involved	EU only		Non-EU only		EU and non-EU		Total	
	No.	%	No.	%	No.	%	No.	%
Single country	12		5		0		17	61%
Two countries	2		1		0		3	11%
Three countries	2		0		2		4	14%
Four countries	2		0		1		3	11%
Six countries	1		0		0		1	3%
Total	19	68%	6	21%	3	11%	28	100%

Table 6: Pathogens associated with urgent inquiries in 2009

Pathogen	Number	(%)
<i>Cyclospora</i>	1	3.6
Hepatitis A	1	3.6
<i>Salmonella</i> sp.	17	60.7
<i>S. Newport</i> , <i>S. Montevideo</i> , <i>S. Senftenberg</i> , <i>S. Larochelle</i>	1	
<i>S. Bovismorbificans</i>	1	
<i>S. Carrau</i>	1	
<i>S. Enteritidis</i>	4	
<i>S. Goldcoast</i>	1	
<i>S. Hadar</i>	1	
<i>S. Ohio</i>	1	
<i>S. Oranienburg</i>	1	
<i>S. Saintpaul</i>	1	
<i>S. Typhimurium</i>	5	
<i>Shigella</i> sp.	3	10.7
<i>Sh. dysenteriae</i>	1	
<i>Sh. sonnei</i>	2	
STEC/VTEC infection	6	21.4
VTEC O145 and O121	1	
VTEC O157	4	
VTEC sorbitol-fermenting	1	
Total	28	(100)

For 68% of the inquiries, a suspected source of infection could be identified (which does not imply that the source of infection was actually confirmed). In 2009, there was an increase in inquiries related to less commonly recognised sources of exposure, including exposure to pet reptiles, domestic animals, imported vegetables and dried fruit (Table 7).

'Travel-related urgent inquiries' refers to inquiries that were issued by countries detecting instances of salmonella infection in travellers who returned from abroad (*Salmonella* Enteritidis phage type (PT) 6a, *Salmonella* Enteritidis PT8 and PT11, *Shigella sonnei* and *E. coli* O157). Three urgent inquiries were related to travel to a country in the European region, and three epidemiologically linked human cases were identified in other EU or EEA/EFTA countries. Despite intense efforts, it was impossible to identify the source of infection for any of the salmonella infections that prompted these travel-related urgent inquiries. This not only illustrates the difficulties of conducting outbreak investigations for travel-related enteropathogenic outbreaks, but also shows how important it is for the FWD network to provide such information.

3.2 *Salmonella* Goldcoast in Hungary

In October 2009, Hungary issued an urgent inquiry to the FWD network, following an unusual increase in cases of *Salmonella* Goldcoast with mutually indistinguishable pulse field gel electrophoresis (PFGE) profiles. The onset of symptoms of cases was recorded between July and September 2009. During the following weeks, five additional EU Member States (Spain, Norway, Denmark, United Kingdom and Italy) reported cases possibly linked, either epidemiologically or microbiologically, to the cases in Hungary.

In order to find a possible common source of contamination, ECDC coordinated an epidemiological investigation at the European level. The investigation was divided into two branches. The first branch included cases reported

in the UK, Norway and Denmark, and dealt mostly with cases that had a travel history outside their country in the week prior to the disease onset. ECDC developed a hypothesis-generating questionnaire, which was given to those cases that were laboratory-confirmed *S. Goldcoast* since October 2009 (December 2009 to January 2010). A specific hypothesis of source of exposure could not be verified but the interviews supported the working hypothesis that pork meat was the potential source of infection.

The second branch of the investigation focused on Italy and Hungary where *S. Goldcoast* cases appeared to cluster in space and time. The Italian and Hungarian public health authorities initiated case-control studies with questionnaires similar to those used in the UK, Norway and Denmark. These investigations were supported by the EPIET programme. At the time of writing, the investigation is still ongoing, with the active hypothesis for both national case-control studies firmly focused on the consumption of pork-containing products.

3.3 VTEC in UK related to petting farms

On 15 September 2009, the Health Protection Agency of the United Kingdom posted a report on their website about an outbreak of *Escherichia coli* O157 among visitors to a petting farm in Surrey. The initial report described 36 laboratory-confirmed cases that had been identified with onsets since mid-August 2009, including 12 hospitalised children. An investigation was initiated and local health authorities implemented control measures that included closure of the farm and contact tracing of potentially exposed people.

ECDC's concern was based on the severity of the disease and on the potentially large number of exposed persons, as the farm reported receiving up to 2 000 visitors a day during school holidays.

On 16 September, the UK public health authorities informed EU Member States through EWRS and provided more details on the clinical condition of the hospitalised cases and the VTEC O157 phage type. It was also confirmed that a number

Table 7: Distribution of urgent inquiries by suspected source of exposure

Suspected source of exposure	Number	(%)
Meat products	5	(18)
Minced meat, steak tartare or dried sausage	1	
Pork meat	2	
Raw minced beef	1	
Exposure associated with hamburger or hot dog consumption	1	
Vegetable products	4	(14)
Alfalfa sprouts	2	
Sugar peas	2	
Dried food products	3	(11)
Roasted pistachios	1	
Sun-dried tomatoes	1	
Peanut butter crackers	1	
Domestic animals/pets	3	(11)
Aquatic frogs	1	
Pet reptiles	1	
Petting farms	1	
Travel-related inquiries	4	(14)
No source identified	9	(32)
Total	28	

of specimens from animal species in the same farm had been confirmed positive for the same VTEC O157 phage type.

As the main concern was the rapid identification of cases in other EU countries, an urgent inquiry was sent through FWD UIN on 18 September. No Member State reported linked cases. During the following days, other farms in the area were investigated and one was closed on a precautionary basis. On 15 October 2009, the outbreak was considered over and the threat was closed. The overall total of cases detected was 93 (91 proven microbiologically) with the last case (secondary transmission) reported on 10 October. There were no deaths.

The majority of cases were reported in children below five years of age, whose risk of developing haemolytic uremic syndrome (HUS) is approximately five times higher than for other age groups. HUS has a case fatality rate of up to 2.5%. The implications at the EU level and for other Member States are to consider enhanced surveillance of VTEC infections with special emphasis on the risk of previous animal contact. Regulations on petting farms might be necessary in the future.

3.4 Suspicion of intentional release

The possibility that a threat is caused by the intentional release of pathogens calls for a systematic review of each incident. In 2009, two threats were considered.

Water contamination in a resort, Italy

On 29 July 2009, European news media reported that hundreds of tourists at a resort in Calabria, a region in southern Italy, presented with headache and gastrointestinal symptoms including stomach pain, diarrhoea and vomiting. The first cases were hospitalised on 24 July, after which the local health authorities initiated an investigation. No further cases were reported from outside the resort. Media also reported that environmental testing confirmed faecal coliform contamination of the resort's drinking water storage tanks and swimming pool. Intentional contamination was suspected by local authorities.

ECDC assessed the potential EU health impact of this event as the event occurred during the height of the tourist season and the area receives visitors from all over Europe. ECDC contacted the health authorities in Italy the same day it received the news reports in order to validate the events. Additionally, the information was shared with the WHO Office for the European Region (WHO EURO) and with the European Police Office (EUROPOL) because of the possibility of a deliberate act.

The outcome of the investigations determined that only a limited number of people were affected (less than 40) and that the contamination was not caused by an intentional release of contaminating agents. Nonetheless, charges were pressed against the managers of the resort for neglecting their responsibilities. No further symptomatic cases were reported during the following week, and ECDC closed the threat on 5 August.

Plague in Algeria

On 6 January 2009, an Algerian newspaper reported that more than 40 alleged terrorists died after being infected with plague in a forest training camp located between the cities of Tizi Ouzou and Bejaya. According to the news report, the remaining extremist group members then buried the corpses before leaving the camp for an unspecified area. One dead body was reported to have been recovered by security forces. The information was published in the Arabic edition of Echorouk Online on 6 January 2009 and received by ECDC epidemic intelligence as a GPHIN alert on the same day. The information could not be validated.

The Oran area in Algeria has a history of plague outbreaks. The last outbreak with 11 confirmed and seven suspected cases was reported in 2003, all of them bubonic plague, and two patients later developed septicaemia and coma¹⁴. In 2005, *Yersinia pestis* circulation in fleas was confirmed in the vicinity of Oran¹⁵. In neighbouring Libya, five cases of plague (including one death) were reported in 2008 in a semi-nomadic setting¹⁶.

The ECDC threat assessment concluded that a cluster of deaths due to plague in this area was plausible although probably very rare and a natural event. The event was later assessed as a hoax.

3.5 Biosafety

In 2009, one event relevant to biosafety was monitored.

Needle-stick injury of laboratory technician working with Ebola

On 12 March 2009, a 45-year-old female scientist at the Bernhard Nocht Institute for Tropical Medicine in Hamburg, Germany, possibly contaminated herself with Ebola virus after a needle-stick injury through three layers of safety gloves while conducting animal experiments in a high-security laboratory (BSL4). She was given a new experimental live-attenuated vaccine produced at the National Microbiology Laboratory of the Public Health Agency of Canada in Winnipeg, Manitoba, within 48 hours after exposure. The vaccine was used for the first time in humans but had been shown to be effective in monkeys. Within 12 hours after administration of the vaccine, the patient developed fever, headache and other clinical signs typical of vaccine reactions. She was then admitted to an isolation ward. The vaccine virus was confirmed in the blood soon after vaccination but vanished within two days, suggesting elimination by the patient's immune system. She remained asymptomatic until the end of the incubation period of 21 days and neither the virus nor antibodies were confirmed in her blood¹⁷.

3.6 Vaccine safety

Contamination of an experimental laboratory product (Austria, Czech Republic, Germany, Slovenia)

A laboratory product contaminated with a live A(H5N1) virus strain was blamed for the unexpected deaths of ferrets in a

laboratory study in the Czech Republic. The contaminated product was manufactured for research purposes in a research facility in Austria. The personnel in the involved facilities were offered antiviral prophylaxis and further monitored. None of them developed disease or showed signs of infection. The research facility in Austria which produced the laboratory product acknowledged a cross-contamination. Cross-contaminated products were also distributed to research facilities in Slovenia and Germany. The manufacturer of the product categorically ruled out any cross-contamination of commercial products, clinical material and experimental material. After an investigation, the Austrian and German health authorities concluded that the corrective and preventive measures in both facilities had been appropriate; other materials produced and distributed by the research facility in Austria were confirmed to be free of contamination. All contaminated materials were destroyed at high temperatures. Biosafety measures in the Austrian and German facilities prevented the infection of staff and the contamination of the environment. In order to avoid similar incidents in the future, safety measures (including work safety, biosecurity and biosafety) in the facilities were improved.

3.7 Mumps outbreaks

Ireland and the UK reported large mumps outbreaks in 2009, mainly among university students. In the UK, 8 211 cases were reported between January and November 2009. Patients aged 20 to 24 years accounted for 38% of cases, followed by the 15-to-19 age group (30%) and those over 25¹⁸. Many of these cases were reported among unvaccinated individuals or persons who had received only one dose of the vaccine as they were not part of the routine two-dose measles-mumps-rubella vaccine (MMR) schedule due to their age. Ireland reported 1 734 cases during the first three months of 2009, with a high proportion of cases in the 15-to-24 age group^{19,20}. Among 146 cases with known vaccination status in young adults from the mid-west of Ireland, 17% were unvaccinated, 47% were vaccinated with one dose of MMR, and 36% had received two doses of MMR. More males were affected, with a male-to-female ratio of 1.4 to 1.

3.8 Measles outbreaks

In 2002, the WHO Regional Office for Europe developed a strategic plan for the elimination of measles and the prevention of congenital rubella, which was expanded in 2004 to cover the elimination of both diseases by 2010. For measles, 'elimination' is defined as less than one case per one million inhabitants per year; for congenital rubella, 'elimination' means less than one case per 100 000 live births. One of the key targets is to reach a vaccination coverage of at least 95% at the national level and at least 90% in all districts, with two doses of the measles-mumps-rubella vaccine.

Although considerable progress has been made since 2002, and vaccine coverage with MMR has increased dramatically, huge outbreaks of both diseases were reported in recent

years and outbreaks are still ongoing in some western European countries.

Since the implementation of the TTT in the second half of 2005, 28 threats involving 29 countries were related to measles, of which only one was not initially related to an EU/EEA, candidate or potential candidate country. Monitored measles threats were also affecting countries outside EU/EEA, candidate and potential candidate countries, namely Belarus, the Russian Federation, Ukraine, the United States of America, Congo (one threat each) and Israel (three threats).

Among the five measles threats monitored during 2009, three were initially reported through EWRS. One was related to air travel during the infectious period of the case, and four were related to hard-to-reach populations (two related to Irish Travellers and two to the Roma ethnic group in Bulgaria).

Measles outbreak in Bulgaria

While between 2002 and 2008 Bulgaria reported only six imported cases of measles, a large outbreak occurred in 2009. The likely index case was an infected 24-year-old male returning from Germany. The case was reported by Bulgaria through EWRS in March 2009. Subsequent cases occurred among close contacts²¹, then the disease rapidly spread country-wide, reaching a crude incidence of 29.5 per 100 000 inhabitants, with a total of 2 249 cases registered in 2009. Of these, 31% were laboratory-confirmed and 60% had an epidemiological link to confirmed cases. The identified genotype of the outbreak was D4.

At least 90% of cases occurred in the Roma ethnic community²². Sixteen percent of all cases were under one year of age and therefore not eligible for routine immunisation; 56% were younger than 15 years of age. The proportion of complications was reported to be 42%, probably due to late presentation in health facilities. Pneumonia was the most frequently reported complication (42%), three cases were reported to have developed encephalitis by 31 December 2009. Five fatal cases were reported.

The main reason for the widespread outbreak is believed to be the low vaccination coverage among the hard-to-reach Roma population in Bulgaria, estimated at 350 000 to 1.5 million. Vaccination campaigns were started as early as April 2009, targeting persons aged 13 months to 30 years. Real-time surveillance was implemented in June 2009.

Further in-country transmission is likely, as is a spread to countries with a low two-dose coverage, or countries with a significant Roma population²³. With respect to measles control, strong political commitment is needed, combined with a coordinated approach regarding surveillance and control activities. In addition, re-enforcement of vaccination efforts is needed to reduce further spread of the disease.

Measles outbreak in Ireland

In November 2009, Ireland reported 78 measles cases through EWRS since August 2009. The outbreak was associated with the Irish Traveller community, a highly mobile

and transient population. In 2009, 195 cases were notified. Nearly half of them were laboratory-confirmed (48%) and 15% were epidemiologically linked. The majority of cases occurred among unvaccinated persons under 20 years of age. In the early stages of the outbreak, a substantial number of cases were related to the Irish Traveller community. Some cases also occurred among the Roma community and citizens from Eastern Europe. The outbreak subsequently spread to the general population. Parents who object to vaccination either for perceived safety concerns or philosophical reasons, contributed to the spread of the outbreak²⁴. National measles-mumps-rubella vaccine coverage currently stands at 90%, however, no information about the uptake in the Irish Traveller community or Roma is available. MMR mop-up activities among those groups and areas most affected were started by the Irish authorities, and alerts to healthcare workers and the general public were launched. ECDC published a threat assessment which conceded that there is an actual risk, domestically and internationally, as language barriers and social factors may prevent prompt identification of cases and thus make it difficult to control disease transmission²⁴.

A previous outbreak of measles associated with the Irish Traveller community was reported by England in 2007, with 173 outbreak-associated cases from six of England's nine regions. The outbreak was linked to a funeral in south-east London^{25, 26}. In addition, 19 cases among Irish Travellers were reported by Norway, with exposure of several individuals to the same gathering in the UK. The isolated genotype was D4 and similar to the outbreak strain in the UK^{27, 28}.

3.9 Contaminated drugs

Two separate outbreaks of potentially life-threatening infectious diseases among injecting drug users (IDUs) were reported in 2009. Similar outbreaks have been described previously, with contaminated heroin or cutting agents the most likely vehicles, even though an actual proof of contamination is rarely possible²⁹.

Outbreaks of botulism in injecting drug users

In January 2009, two cases of severe wound infection among injecting drug users were identified by the UK health authorities, including a case of wound botulism due to *C. botulinum* Type A and an infection due to *C. novyi*. By mid-March, a total of eight cases of wound botulism in IDUs were reported by the UK authorities, from different regions in the country. Four of these were confirmed to be due to *C. botulinum* Type B.

A link to six cases reported at the end of 2008 in Ireland (also *C. botulinum* Type B) could not be established, nor were further cases reported from other EU countries. However, the clustering in time and place confined to these two neighbouring countries could be an indication that possible common distribution channels of heroin played a role in the outbreaks³⁰.

Together with the European Monitoring Centre for Drugs and Drug Addiction (EMCDDA), ECDC published a joint threat assessment suggesting that behavioural factors

may contribute to the development of wound botulism, e.g. 'skin popping' (the injection of drugs into the skin and subcutaneous tissues), heating the drugs before use (which kills non-spore-forming bacteria and provides advantages to spore-forming bacteria) and 'speed balling' (co-injection of heroin and cocaine, which may cause soft-tissue ischemia).

The occurrence of skin and soft-tissue infections in IDU is a well-known phenomenon. In 2005, ECDC monitored an outbreak of wound botulism involving 16 cases in Germany. All patients were IDUs and *C. botulinum* was cultivated from six clinical samples which were clonally identical. Two samples of heroin provided by one of the patients were examined but *C. botulinum* could not be isolated³¹.

Outbreaks of anthrax in injecting drug users

In December 2009, another outbreak among IDUs was reported from Scotland. The infectious agent was identified as *B. anthracis*, a very rare pathogen. Only one case has ever been reported previously: in the year 2000 in Norway³². The initial cluster of five cases in IDU (two confirmed) reported from Glasgow by Health Protection Scotland later increased to six confirmed cases, including three deaths as of 31 December 2009³³. Contaminated heroin or cutting agents are the suspected vehicle here as well.

ECDC, together with the EMCDDA and EUROPOL, coordinated the assessment at European level and produced a joint threat assessment. Awareness was increased through alerting Member States through the EWRS, and protocols for handling patients, corpses and samples were shared to ensure bio-safety. At the time of writing, no contaminated heroin had been identified, and more cases were expected^{34, 35}.

3.10 Threats related to legionellosis

In 2009, 92 clusters of legionellosis were recorded in the ECDC Threat Tracking Tool. For the majority of clusters (86 = 93%) ECDC received notification through the European surveillance scheme for travel-associated legionnaires' disease (EWGLINET), four (4%) were reported through the Early Warning and Response System (EWRS). The two remaining clusters were identified through ProMed and an unspecified public source of information, respectively. The number of monthly clusters peaked in October (n=21), and 49% of the annual total were concentrated in the last quarter of 2009. The 91 clusters with information on geographic location were found on a cruise ship and in a total of 23 countries. All continents were affected, except for Oceania. Sixty-five (71%) of the 91 clusters occurred in an EU country. Italy alone accounted for 31 (34%) of the clusters. The 71 (77%) threats related to legionellosis in 2009 were at a low alert level and no follow-ups were required. Compared with previous years, incidence numbers as well as seasonal and geographic distribution of legionnaires' disease clusters were in the expected range.

3.11 West Nile virus in Europe

West Nile virus (WNV) is transmitted by mosquitoes (chiefly of the genus *Culex*) with wild birds as its natural hosts. Birds also play a role in the geographic dispersion of WNV. Human infections have been reported since 1996 in sporadic outbreaks in several countries in eastern and southern Europe. The presence of the virus in amplifying hosts (birds) suggests ongoing transmission and endemicity of WNV in Europe.

In 2009, three EU countries reported human cases of WNV infection:

- Between May and September 2009, seven cases of WNV were diagnosed in four counties in Hungary (Békés: 4, Csongrád: 1, Pest county: 1, Budapest: 1). The case from Pest county was classified as an imported case. Four cases presented with neurological symptoms, the remaining three with fever (two of them also with rash, which lead to an initial diagnose of rubella). All seven cases were laboratory-confirmed. During 2008, 19 cases of WNV infection were reported.
- Romania reported two cases, one in August and one in September.
- Between August and September 2009, Italy reported 16 human cases of West Nile neuro-invasive disease in three regions: Veneto, Emilia-Romagna and Lombardia, as compared with nine cases in the previous year³⁶. During an investigation, two cases of Usutu virus infection (a virus related to WNV) were detected in immunocompromised patients, which were the first human cases reported in Europe.

The presence of West Nile virus is well-documented in all three affected countries. Climatic conditions, temperature and humidity favour the presence and the multiplication of *Culex spp.* from May to October in the affected zones. At the same time, there has been an increase in the number of cases in the EU over the past decade. It is uncertain whether this is only due to increased surveillance or reflects a changing epidemiology^{37,38}.

In areas of Europe where West Nile virus transmission has been documented and the risk for further transmission of the virus exists, continued close monitoring of the situation (in terms of human, veterinary and entomological surveillance) is warranted. Increasing the awareness among clinicians to rapidly identify new human cases of WNV would ensure an appropriate public health response. The risk of transmission of WNV by blood products has also to be taken into consideration. This applies to all EU countries with identified risk for WNV transmission.

3.12 Q fever in the Netherlands

Over the last decades, the Netherlands reported an average of 20 human cases of Q fever per year. However, in 2007 the case numbers in the southern part of the country rose to 168 notified human cases. In 2008, numbers jumped to 1 007 registered human cases (one fatal). Since April 2009 a sharp increase in Q fever has been observed³⁹,

resulting in a total of 2 355 cases of Q fever reported by the national authorities, including six deaths. Most fatal cases had severe underlying disease⁴⁰.

Although increased awareness for Q fever has certainly led to more clinically diagnosed and laboratory-confirmed cases, this is by far the largest community outbreak of Q fever ever reported in the literature. The epidemic is most likely related to intensive goat and sheep farming in the proximity of densely populated areas. The concurrence of these two factors seems to be unique to the Netherlands. The possibility of a spread to neighbouring countries exists, and careful preparedness is needed, as stated in an ECDC threat assessment in December 2009. Further preparedness activities and monitoring of the situation are ongoing.

ECDC has been constantly monitoring Q fever outbreaks since 2007. The Netherlands has informed the international community through several channels since August 2007⁴¹. As of December 2009, the outbreak is still ongoing, but no spread to neighbouring Member States has been reported.

3.13 Autochthonous malaria in Greece

In summer 2009, two immigrants from Pakistan and Afghanistan with a past history of malaria due to *Plasmodium vivax* arrived in Greece. In August 2009, while both were working on a farm in a small village, they developed symptoms and were confirmed positive for *P. vivax*. Between September and October 2009, six other persons residing in the same area of Greece were diagnosed with *P. vivax*. None of them had a past history of malaria or had travelled to a malaria-affected area. It is possible that the two initial cases (both coming from endemic countries) introduced the parasite to the concerned area, where at least one competent vector for malaria was present. Secondary cases occurred within two months. The necessary epidemiological surveillance and control measures were immediately implemented. Greece has been free from malaria for many years, thanks to scientifically applied insect control activities carried out by the Greek authorities throughout the country. The vast majority of the cases reported in the EU/EEA are travel-associated. In the WHO European Region, autochthonous *P. vivax* infections are regularly reported from eastern Turkey⁴²⁻⁴⁴.

3.14 Selected influenza threats in 2009 in EU/EFTA countries

Influenza season 2008/2009

ECDC covered the 'official' start of the influenza season with a press release on 9 October 2008 (week 40)⁴⁵. The 2008/09 influenza season started earlier than the previous two seasons: around week 49, a steep rise in influenza-like illness (ILI)/acute respiratory infection (ARI) consultation rates was reported by those countries that were affected first. The majority of seasonal influenza virus detections occurred between week 48/2008 and week 15/2009. The season was dominated by influenza A(H3N2), peaking in week 5, followed by a smaller peak of influenza B in week

11. All influenza A(H₃N₂) viruses tested were sensitive to oseltamivir and zanamivir, but resistant to M2 inhibitors. The small numbers of influenza B viruses tested were sensitive to oseltamivir and zanamivir. Nevertheless, 98% of influenza A(H₁N₁) viruses analysed were resistant to oseltamivir, while all those tested against zanamivir were sensitive. On 8 January 2009 (week 2), ECDC published a press release⁴⁶, in addition to a Technical Statement, concluding that vaccination of risk groups and healthcare workers should be further strengthened and the level of protection for high-risk groups be raised. The Member States were also reminded that seasonal influenza usually spreads across Europe starting in the southwest and then moving in a north-easterly direction⁴⁷.

Pandemic influenza A(H₁N₁)

After the confirmation of swine influenza in two children in California and an increased number of influenza fatalities in Mexico due to the same strain, WHO declared a public health event of international concern on 25 April 2009, now recognised, in retrospect, as the beginning of the influenza A(H₁N₁) pandemic. An initial ECDC threat assessment on the situation was published on 23 April 2009⁴⁸. Usually the regular influenza season ends in week 22, but in 2009 a 99% increase in recorded cases of pandemic influenza A(H₁N₁) virus infections in the WHO European Region could be observed between week 21 and 22. On 4 June 2009 the total count stood at 937 cases. On 11 June 2009, the WHO headquarters in Geneva declared the epidemic 'the first pandemic of the 21st century', solely on grounds of an alert classification system based on binomial distribution and geographic transmission.

Building on its initial threat assessment document, ECDC produced a risk assessment document on the pandemic which was regularly updated as more scientific evidence on the different areas of risk emerged from the literature⁴⁹. In addition, ECDC produced numerous guidance documents and technical outputs. At the time of writing, the 2009/10 influenza pandemic is declining in intensity of transmission and number of deaths. In spite of this, continued vigilance is needed, as previous experience has shown that influenza, and particularly pandemics, are quintessentially unpredictable. Nevertheless, it is likely that the pandemic strain becomes seasonal and transmission of the pandemic strain will also continue outside the influenza season.

Human influenzas of animal origin: the worldwide situation of human cases of influenza A(H₅N₁) during 2009

During 2009, 73 human cases of influenza A(H₅N₁) were acknowledged by WHO, 32 of which had a fatal outcome, with a case-fatality ratio of confirmed cases remaining high at 43.8%⁵⁰. The confirmed cases during 2009 originated in Indonesia (21 cases, 19 fatal), Egypt (39, 4 fatal), Vietnam (5, all fatal), China (7, 4 fatal) and Cambodia (1). The decreasing trend observed in 2008 was confirmed again in 2009 but human cases are expected to continue to occur in countries where the A(H₅N₁) virus is entrenched in poultry.

A WHO study published in 2010⁵¹ reported that during the period 2003 to 2009, 480 confirmed or probable human cases of H₅N₁ virus infection were identified and communicated to WHO, 138 of which were associated to 54 clusters of infection. The remaining 342 cases were sporadic. Between 2003 and 2006 the percentage of all cases identified as cluster-associated was 39%, whereas during the period 2007 to 2009 this percentage declined to 12%. The mean age of cluster-associated cases was 19 years, compared with 22 years for sporadic cases. With regard to seasonality, temporal trends, cluster duration and reporting, the WHO report notes that clusters peaked during 2005 and 2006. China, Indonesia and Vietnam were the only countries to have clusters identified for more than two consecutive years. Indonesia and Vietnam had the most clusters, but no seasonality was identified. Additionally, it is interesting to observe that, up to now, these two countries have recorded the highest case-fatality ratios.

4 Discussion

The key sources of the epidemic intelligence information remain networks like EWGLINET, EWRS, and information sources with restricted access. These sources report more than 80% of all monitored threats – a clear indication of the value of these networks for threat detection.

The number of threats monitored over the last five years show an increasing trend peaking in 2008. 2009 was dominated by the influenza A(H1N1) pandemic, and a notable surge in messages communicated through EWRS was recorded. A ten-fold increase in messages was recorded during the pandemic period (April to September 2009), while the reporting of other threats during the same period dropped significantly. This suggests a strong correlation between major public health events and the reporting process: events such as a pandemic require the extensive mobilisation of public health resources, which seems to significantly reduce vigilance for other threats – e.g. a potential second influenza wave – which could emerge concomitantly or in temporal proximity¹¹.

The EWRS system was quickly adapted to the new situation and was used as the reporting system of choice for the 2009 influenza A(H1N1) pandemic: case numbers and deaths as well as individual and aggregated cases were reported daily through EWRS and then added to The European Surveillance System database (TESSy). ECDC is currently preparing a special report on the pandemic which should be available by the time this report has been released.

Just as disease reporting from the Member States focused primarily on the pandemic, media reporting was also dominated by the pandemic influenza, particularly during the early phases of the pandemic when the media mainly reported on the influenza A(H1N1) pandemic and largely ignored other potential threats. Therefore, ECDC's efforts to monitor media from global sources for non-pandemic events only revealed a limited number of threats that were not influenza-related.

Food- and waterborne disease threats were at an all-time low in 2009. This might be due to the fact that Member States health services were busy responding to the pandemic. Another explanation might be that the public awareness messages on hand-washing were effective and helped not only to prevent influenza transmission but also curbed the emergence of food- and waterborne threats, thanks to better hand hygiene.

As in previous years, travel-related legionellosis clusters reported through the EWGLI network represented the largest proportion of threats monitored by ECDC. However, very little additional action is required in this area on the part of ECDC, as standardised procedures for investigation are in place, coupled with the application of a series of public health measures. Also, community clusters limited to autochthonous cases in individual Member States are

not monitored by ECDC. For this reason, these travel-associated threats do not represent the actual occurrence of community clusters.

Vector-borne diseases and diseases of environmental origin are becoming increasingly important, partially due to the emergence of vectors related to global warming (e.g. ticks and tick-borne encephalitis), increased travel and trade activities (e.g. influenza), and the identification of new pathogens.

Despite the WHO's efforts to eliminate measles in the WHO European Region by 2010, measles outbreaks are not a thing of the past: in 2009, a large measles outbreak in Bulgaria led to a high proportion of fatal cases. In 2007, a measles outbreak among unvaccinated individuals in Switzerland also affected several neighbouring countries and lasted for more than two years. In the light of such outbreaks, the ambitious goal of eliminating measles (and congenital rubella) in Europe seems to be rather difficult to reach.

Many of the outbreaks of measles or mumps emerged in hard-to-reach populations like the Roma community in Bulgaria or the Irish Traveller community and spread rapidly to the general population, as described in the literature. Frequently, itinerant or 'nomadic' groups only become risk groups because of the lack of attention and political commitment. Without additional immunisation and control activities including awareness-raising campaigns for healthcare workers and the public, such outbreaks are prone to spread to the general population, and nosocomial clusters may ease the spread. A high prevalence of the viruses in the population will make control significantly more difficult, no matter how aggressive any future efforts might be. As many of these risk groups are highly mobile, spread to other countries is likely. This will be of particular concern as mobility increases in spring, with major mass gathering events held in spring and summer. Mass gathering events in Roma populations have been previously described to be the source for international spread of measles from affected areas²⁶. Consequently, the rapid identification of measles and the immediate implementation of control measures are of utmost importance.

Primary and secondary vaccine failures are suspected to contribute to mumps outbreaks among highly vaccinated populations⁵²⁻⁵⁴. The mumps component of the MMR vaccine has the lowest reported effectiveness, which varies between 73% and 91% for one dose, and between 79% and 95% for two doses. Waning immunity has been described: the geometric mean titres of neutralising antibodies among individuals who received two doses of mumps-containing vaccines were significantly lower in persons who were vaccinated more than 15 years ago when compared with individuals who were vaccinated one to five years ago⁵⁵. The Jeryl Lynn mumps vaccine strain used in the MMR vaccine derived from genotype A, but most of the

currently circulating strains identified in recent outbreaks are due to genotype G^{56, 57}. The geometric mean titres of neutralising antibodies against genotype G were reported to be approximately one-half the titres measured against the vaccine strain ten years post vaccination, suggesting limited cross-protection. Nevertheless, vaccine coverage with two doses of MMR vaccine is of utmost importance, and suboptimal vaccine coverage is still one of the key factors responsible for outbreaks of mumps in the EU.

Another area of concern are religious or philosophical groups that object to vaccination, for example anthroposophic communities. Many anthroposophic communities maintain intensive international contacts, and an outbreak in a local group may easily spread to other countries. Populations with low-vaccine coverage are also vulnerable to outbreaks of more severe vaccine-preventable diseases, such as polio or diphtheria. Measles, mumps and rubella cases are repeatedly reported to be exported from EU/EEA, EU candidate and potential EU candidate countries to other regions, frequently to the Americas, where measles is considered to be eradicated.

Biosafety and vaccine safety issues are of particular concern and need close monitoring. Adverse events following immunisation need thorough investigation to establish a possible causal relationship. As an example, there were reports of severe events following immunisation with HPV vaccine, but no causal relationship could be established. It can be expected that the number of such events will rise as vaccine uptake increases.

The contamination of the experimental laboratory product (see 3.6) was a serious biosafety accident, but has resulted in improved biosafety regulations to prevent similar occurrences in the future.

The identification of petting zoos as risk factor for the transmission of VTEC infections in the UK is an important finding, and the implementation of preventive measures should be considered by countries faced with similar threats.

An unusual threat was the large Q fever outbreak in the Netherlands, particularly when considering the unprecedented increase in case numbers. Many questions on how to control the disease remain unanswered. Intense livestock breeding practices are likely to have significantly contributed to the unusual extent of the Q fever outbreak in the Netherlands, as the disease has not spread to neighbouring countries where different breeding methods are employed. The need for rigorous implementation of control measures results in huge financial losses. The current epidemiological situation carries the risk of further spread through other routes of transmission, e.g. via contaminated blood and blood products. The high proportion of asymptomatic cases and the lack of reliable screening methods for potentially contaminated products contribute to the increased risk. Similar precautionary measures have to be considered for areas with WNV transmission: reaching a balance between sufficient supplies of blood products and acceptable risk is both difficult and crucial.

Another rather unusual threat was the outbreak of anthrax among injecting drug users, another hard-to-reach group that receives little attention and political commitment. In 2009, injecting drug users were affected twice by potentially life-threatening contaminated drugs. Whereas contamination with *C. botulinum* has been previously reported, *B. anthracis* contamination has to be considered as an emerging pathogen when transmitted through this route. Control options are severely limited by the lack of knowledge about drug distribution routes, the low compliance of patients with authorities, and the high case fatality of this threat.

Several threats in 2009 were opened in relation to situations which presented an increased risk for communicable disease spread, such as large mass gatherings organised in the Member States or in third countries. These threats are different in nature and reflect the flexibility of ECDC's approach to threat detection, which allows for the enhanced monitoring of situations that could lead to serious outbreaks, with devastating consequences to public health.

5 Conclusions

Event-based surveillance, as a component of epidemic intelligence⁶, is a relatively new discipline. Over the course of the last few years, ECDC has perfected its arsenal of tools and methods for epidemic intelligence, which is not to say that they would not benefit from some additional fine-tuning and tweaking. The Threat Tracking Tool has proven to be extremely useful for keeping track of monitored threats, and a more sophisticated version, scheduled for 2011, is currently in development.

2009 saw the development and implementation of the new EPIS platform for food- and waterborne diseases⁶. EPIS will also be used for other disease-specific programmes at ECDC. The new tool will help to improve the timeliness of information exchange and ease the verification and validation of potential threats. It will also ensure the rapid exchange of information, mainly among technical experts in the Member States.

Procedures for the timely delivery of threat assessments were updated in 2009, but as some content was considered confidential, these threat assessments were not systematically and publicly communicated.

In the course of 2009, ECDC has become increasingly more involved in mass gathering activities, particularly in the areas of preparedness and support to response activities. ECDC provided support related to preparedness, epidemic intelligence and response activities to EU/EEA Member States, EU candidate countries, potential EU candidate countries, and countries outside the WHO European Region.

None of the large mass gathering events in 2009 have been associated with increased transmission of communicable diseases, which is not to say that a connection between mass gatherings and disease transmission can be ruled out: the possibility of disease outbreaks during mass gathering events always has to be taken into account. It is, however, difficult to assess the exact impact of mass gathering events in regard to the spread of specific diseases, for example 2009 pandemic influenza A(H1N1).

The EU added value of ECDC's coordination of epidemic intelligence and response in Europe has been clearly proven, e.g. during the 2009 influenza A(H1N1) pandemic, when the relevance of ECDC-conducted threat assessments became obvious. Equally helpful was ECDC's support for response activities, e.g. the organisation of expert consultations and support during outbreak investigations. All these activities have clearly added value to the control of communicable diseases in Europe. In 2010, ECDC will continue on this path, providing even more advanced and sophisticated tools for the rapid detection and control of communicable diseases in the European Union.

References

- [1] Regulation (EC) No 853/2004 of the European Parliament and of the Council of 21 April 2004 establishing a European centre for disease prevention and control. Official Journal of the European Union. 2004;L 142:1–11 (30 April 2004).
- [2] Decision No 2119/98/EC of the European Parliament and of the Council of 24 September 1998 setting up a network for the epidemiological surveillance and control of communicable diseases in the Community. Official Journal of the European Union. 1998;L 268 (3 October 1998).
- [3] Commission decision of 10 July 2009 amending Decision No 2000/57/EC on the early warning and response system for the prevention and control of communicable diseases under Decision No 2119/98/EC of the European Parliament and of the Council. Official Journal of the European Union. 2009;L 181/57–59 (14 July 2009).
- [4] Coulombier D. Epidemic intelligence in the European Union: strengthening the ties. *Euro Surveill.* 2008 Feb 7;13(6).
- [5] Coulombier D, Ciotti M, Freitas G, Frota A, Varela C, Vasconcelos P, et al. Strengthening Europe's epidemic intelligence capacity: the first collaboration between a European Union Member State and the European Centre for Disease Prevention and Control. *Euro Surveill.* 2008 Feb 7;13(6).
- [6] Paquet C, Coulombier D, Kaiser R, Ciotti M. Epidemic intelligence: a new framework for strengthening disease surveillance in Europe. *Euro Surveill.* 2006;11(12):212–4.
- [7] Kaiser R, Coulombier D. Epidemic intelligence during mass gatherings. *Euro Surveill.* 2006;11(12):E061221 3.
- [8] Kaiser R, Coulombier D. Different approaches to gathering epidemic intelligence in Europe. *Euro Surveill.* 2006;11(4):E060427 1.
- [9] Kaiser R, Coulombier D, Baldari M, Morgan D, Paquet C. What is epidemic intelligence, and how is it being improved in Europe? *Euro Surveill.* 2006;11(2):E060202 4.
- [10] Guglielmetti P, Coulombier D, Thinus G, Van Loock F, Schreck S. The early warning and response system for communicable diseases in the EU: an overview from 1999 to 2005. *Euro Surveill.* 2006;11(12):215–20.
- [11] Cox A, Guglielmetti P, Coulombier D. Assessing the impact of the 2009 H1N1 influenza pandemic on reporting of other threats through the Early Warning and Response System. *Euro Surveill.* 2009;14(45).
- [12] ECDC. Expert consultation on rabies post-exposure prophylaxis; 2009 30/09/2009.
- [13] ECDC. Expert consultation on West Nile virus infection; 2009 08/09/2009.
- [14] Bertherat E, Bekhoucha S, Chougrani S, Razik F, Duchemin JB, Houti L, et al. Plague re-epidemiology in Algeria after 50 years, 2003. *Emerg Infect Dis.* 2007 Oct;13(10):1459–62.
- [15] Bitam I, Baziz B, Rolain JM, Belkaid M, Raoult D. Zoonotic focus of plague, Algeria. *Emerg Infect Dis.* 2006 Dec;12(12):1975–7.
- [16] Tarantola A, Mollet T, Gueguen J, Barboza P, Bertherat E. Plague outbreak in the Libyan Arab Jamahiriya. *Euro Surveill.* 2009 Jul 2;14(26).
- [17] Tuffs A. Experimental vaccine may have saved Hamburg scientist from Ebola fever. *BMJ.* 2009 Mar 23;338:b1223.
- [18] Health Protection Agency. Laboratory confirmed number of mumps cases in England and Wales: update to end-November 2009 [cited 03/03/2010]. Available from: <http://www.hpa.org.uk/hpr/archives/2010/newso210.htm#mmps>
- [19] Whyte D, O'Dea F, McDonnell C, O'Connell NH, Callinan S, Brosnan E, et al. Mumps epidemiology in the mid-west of Ireland 2004–2008: increasing disease burden in the university/college setting. *Euro Surveill.* 2009;14(16).
- [20] Gee S, O'Flanagan D, Fitzgerald M, Cotter S. Mumps in Ireland, 2004–2008. *Euro Surveill.* 2008 Apr 30;13(18).
- [21] Marinova L, Kojouharova M, Mihneva Z. An ongoing measles outbreak in Bulgaria, 2009. *Euro Surveill.* 2009 Jul 2;14(26).
- [22] Marinova L, Muscat M, Mihneva Z, Kojouharova M. An update on an ongoing measles outbreak in Bulgaria, April–November 2009. *Euro Surveill.* 2009;14(50).
- [23] Andrews N, Tischer A, Siedler A, Pebody RG, Barbara C, Cotter S, et al. Towards elimination: measles susceptibility in Australia and 17 European countries. *Bull World Health Organ.* 2008 Mar;86(3):197–204.
- [24] Gee S, Cotter S, D OF. Spotlight on measles 2010: Measles outbreak in Ireland 2009–2010. *Euro Surveill.* 2010;15(9).
- [25] Cohuet S, Bukasa A, Heathcock R, White J, Brown K, Ramsay M, et al. A measles outbreak in the Irish traveller ethnic group after attending a funeral in England, March–June 2007. *Epidemiol Infect.* 2009 Dec;137(12):1759–65.
- [26] Cohuet S, Morgan O, Bukasa A, Heathcock R, White J, Brown K, et al. Outbreak of measles among Irish Travellers in England, March to May 2007. *Euro Surveill.* 2007 Jun;12(6):E070614 1.
- [27] Lovoll O, Vonen L, Nordbo SA, Vevatne T, Sagvik E, Vainio K, et al. Outbreak of measles among Irish Travellers in Norway: an update. *Euro Surveill.* 2007 Jun;12(6):E070614 2.
- [28] Folkehelseintittuet. Norwegian Surveillance System for Communicable Diseases (MSIS). 2010 [cited 2010 12/03/2009]. Available from: <http://www.msis.no/>
- [29] Kalka-Moll WM, Aurbach U, Schaumann R, Schwarz R, Seifert H. Wound botulism in injection drug users. *Emerg Infect Dis.* 2007 Jun;13(6):942–3.
- [30] Barry J, Ward M, Cotter S, Macdiarmada J, Hannan M, Sweeney B, et al. Botulism in injecting drug users, Dublin, Ireland, November–December 2008. *Euro Surveill.* 2009 Jan 8;14(1).
- [31] Schroeter M, Alpers K, Van Treeck U, Frank C, Rosenkoetter N, Schaumann R. Outbreak of wound botulism in injecting drug users. *Epidemiol Infect.* 2009 Nov;137(11):1602–8.
- [32] Ringertz SH, Hoiby EA, Jensenius M, Maehlen J, Caugant DA, Myklebust A, et al. Injected anthrax in a heroin skin-popper. *Lancet.* 2000 Nov 4;356(9241):1574–5.
- [33] ScottishDrugsForum. 3rd anthrax case confirmed in Dumfries and Galloway. 2010 [cited 15/03/2010]. Available from: <http://www.sdf.org.uk/sdf/3588.html>
- [34] Agency HP. Anthrax: information on 2010 outbreak. 2010 [cited 03/03/2010]. Available from: http://www.hpa.org.uk/web/HPAweb&HPAwebStandard/HPAweb_C/1265637164517
- [35] Scotland STHP. Anthrax Outbreak Information. 2010 [cited 03/03/2010]. Available from: <http://www.hps.scot.nhs.uk/anthrax/index.aspx>
- [36] Rizzo C, Vescio F, Declich S, Finarelli AC, Macini P, Mattivi A, et al. West Nile virus transmission with human cases in Italy, August–September 2009. *Euro Surveill.* 2009;14(40).
- [37] Reiter P. West Nile virus in Europe: understanding the present to gauge the future. *Euro Surveill.* 2010;15(10):19508.
- [38] Lelli R. West Nile virus in Europe: understanding the present to gauge the future. *Euro Surveill.* 2010 15 April 2010;15(15).
- [39] Schimmer B, Dijkstra F, Vellema P, Schneeberger PM, Hackert V, ter Schegget R, et al. Sustained intensive transmission of Q fever in the south of the Netherlands, 2009. *Euro Surveill.* 2009 May 14;14(19).
- [40] RIVM. Q-koorts. 2006 [cited 04/03/2010]. Available from: <http://www.rivm.nl/cib/themas/Q-koorts/q-koorts-professionals.jsp>
- [41] Schimmer B, Morroy G, Dijkstra F, Schneeberger PM, Weers-Pothoff G, Timen A, et al. Large ongoing Q fever outbreak in the south of The Netherlands, 2008. *Euro Surveill.* 2008 Jul 31;13(31).
- [42] Dilmeç F, Kurcer MA, Akkafa F, Simsek Z. Monitoring of failure of chloroquine treatment for Plasmodium vivax using polymerase chain reaction in Sanliurfa province, Turkey. *Parasitol Res. Mar;*106(4):783–8.
- [43] Akiner MM, Caglar SS. [Identification of Anopheles maculipennis Group Species using Polymerase Chain Reaction (PCR) in the Regions of Birecik, Beysehir and Cankiri.]. *Turkiye Parazitolo Derg.*34(1):50–4.
- [44] Karahocagil MK, Baran AI, Yaman G, Cicek M, Bilici A, Binici I, et al. [Case report: two Plasmodium vivax malaria cases in the Van Province]. *Turkiye Parazitolo Derg.* 2009;33(2):172–3.
- [45] ECDC. Press release: Start of 'influenza season': severity of this winter's epidemic not yet clear but ECDC supports vaccination of risk groups. 2008 [cited 12/03/2010]. Available from: http://ecdc.europa.eu/en/press/Press%20Releases/081009_PR_Start_of_influenza_season.pdf
- [46] ECDC. Press release: ECDC concludes that vaccination of risk groups and healthcare workers should be further strengthened as seasonal influenza spreads across Europe. 2009 [cited 12/03/2010]. Available from: http://ecdc.europa.eu/en/press/Press%20Releases/090108_PR_Flue.pdf
- [47] ECDC. Guidance – Priority risk groups for influenza vaccination. 2008 [cited 12/03/2010]. Available from: http://ecdc.europa.eu/en/publications/Publications/0808_GUI_Priority_Risk_Groups_for_Influenza_Vaccination.pdf
- [48] ECDC. Human cases of swine influenza without apparent exposure to pigs, United States and Mexico. 2009 [cited 15/03/2010]. Available from: http://ecdc.europa.eu/en/healthtopics/Documents/090424_Influenza_AH1N1_TA_Swine_influenza_US-Mexico.pdf
- [49] ECDC. ECDC Risk assessment: Implication for Europe of the novel influenza A(H1N1) virus. 2009 [cited 15/03/2010]. Available from: http://ecdc.europa.eu/en/healthtopics/H1N1/Documents/1001_RA_090508.pdf

- [50] WHO. Cumulative number of confirmed human cases of avian influenza A/(H5N1) reported to WHO. 2010 [cited 2010 15/03/2010]. Available from: http://www.who.int/csr/disease/avian_influenza/country/cases_table_2010_03_12/en/index.html
- [51] WHO. Summary of human infection with highly pathogenic avian influenza A (H5N1) virus reported to WHO, January 2003–March 2009: cluster-associated cases. *Weekly Epidemiological Report*. 2010;3(85): 13–20.
- [52] Barskey AE, Glasser JW, LeBaron CW. Mumps resurgences in the United States: A historical perspective on unexpected elements. *Vaccine*. 2009 Oct 19;27(44):6186-95.
- [53] Shanley JD. The resurgence of mumps in young adults and adolescents. *Cleve Clin J Med*. 2007 Jan;74(1):42-4, 7-8.
- [54] Update: mumps outbreak – New York and New Jersey, June 2009–January 2010. *MMWR Morb Mortal Wkly Rep*. Feb 12;59(5):125-9.
- [55] LeBaron CW, Forghani B, Beck C, Brown C, Bi D, Cossen C, et al. Persistence of mumps antibodies after 2 doses of measles-mumps-rubella vaccine. *J Infect Dis*. 2009 Feb 15;199(4):552-60.
- [56] Cui A, Myers R, Xu W, Jin L. Analysis of the genetic variability of the mumps SH gene in viruses circulating in the UK between 1996 and 2005. *Infect Genet Evol*. 2009 Jan;9(1):71-80.
- [57] Kaaijk P, van der Zeijst B, Boog M, Hoitink C. Increased mumps incidence in the Netherlands: review on the possible role of vaccine strain and genotype. *Euro Surveill*. 2008 Jun 26;13(26).

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