

SURVEILLANCE REPORT

Annual Epidemiological Report for 2016

Communicable disease threats to public health in the European Union

Introduction

This report covers the events, threats and actions taken in 2016 related to the findings of routine activities carried out by the ECDC epidemic intelligence team. The objective of epidemic intelligence at ECDC is to rapidly detect and assess public health events of any origin to ensure EU health security as defined in ECDC's mandate.

Methods

This report is based on data for 2016 retrieved from ECDC's Epidemic Intelligence Information System (EPIS), Early Warning Response System (EWRS) and Threat Tracking Tool (TTT) on 12 January 2017. The different applications are described in the report.

For a detailed description of methods used to produce this report, please refer to the *Methods* chapter [1].

An overview of the national surveillance systems is available online [2].

A subset of the data used for this report is available through ECDC's online *Surveillance atlas of infectious diseases* [3].

1 Epidemic intelligence

1.1 Description of the epidemic intelligence framework

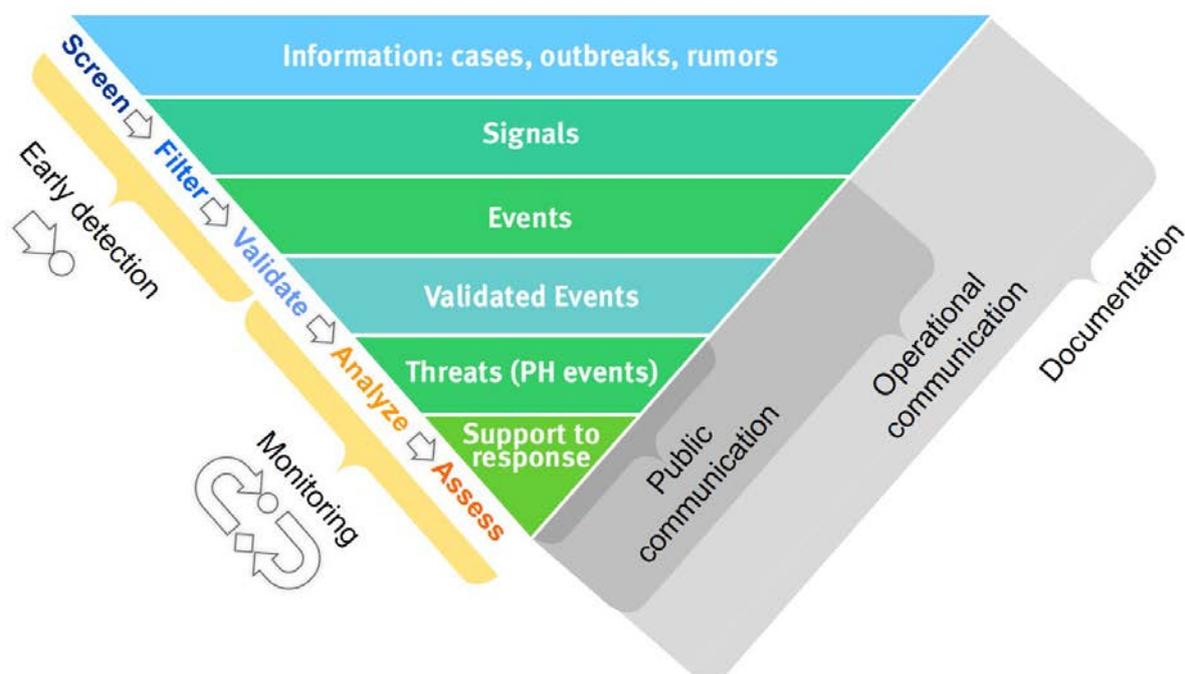
Epidemic intelligence (EI) is the process of detecting, verifying, analysing, assessing and investigating events that may represent a threat to public health. It encompasses activities related to early warning functions, integrating event and indicator-based surveillance as well as signal assessments and outbreak investigations. Providing early warning signals is the main objective of public health surveillance systems. EI is the systematic collection and collation of information from a variety of sources either by screening information or via notification from Member States through EPIS platforms and the EWRS.

When communicable disease outbreak signals are detected, they are assessed and verified to ensure they correspond to actual public health events. The identified events are discussed at the daily ECDC round table (RT) meeting and an initial assessment on appropriate ECDC actions is carried out. The assessment is based on analysis made by the first-line duty officer using International Health Regulations (IHR) and EWRS criteria and expert opinions during the meeting. Possible actions include continued monitoring of the event, sharing information through the EPIS platform, launching an urgent inquiry (UI), preparing an epidemiological update ('epi update'), preparing or updating a rapid risk assessment (RRA), posting a news item on the ECDC website and offering technical assistance to affected Member States.

Early detection comprises six steps (Figure 1):

- Screening news, official reports and rumours through websites and social media relevant from a European perspective in order to distinguish the meaningful information signals by applying specified criteria
- Filtering signals to identify potential public health events of European interest
- Validating events that originate from unofficial sources by cross-checking with official and/or reliable media sources to ensure that the event detected is real
- A validated event is then analysed to capture the full information available about the event, including epidemiological data, facts related to exposure and contextual information.
- Based on analysis, an assessment is made to estimate the risk associated with the event.
- Finally, communication and documentation of the identified threats are an integral part of EI throughout the five steps above. Documentation consists of logging events and threats in a dedicated repository called Threat Tracking Tool (TTT).

Figure 1. The process of epidemic intelligence



Threats, also called public health events, are escalated and validated events that have an impact on public health. Monitoring previously identified threats refers to actively following up on all relevant information directly related to the concerned threat. This iterative process continues until the threat is considered to have subsided or all appropriate public health measures have been implemented.

1.2 Sources for epidemic intelligence

EI uses both indicator-based surveillance (IBS) and event-based surveillance (EBS) for the early detection of health threats.

- IBS data, which comes from structured and well identified formal sources, can be found on health agency websites or distributed through newsletters to ECDC. ECDC hosts TESSy, where EU/EEA countries report on over 50 communicable diseases based on agreed case definitions and set time intervals for reporting. For example, during West Nile fever monitoring season, EU Member States are asked to submit data each week by a set deadline so ECDC can produce an up-to-date West Nile fever map.
- Event-based surveillance refers mainly to media monitoring. There are moderated and unmoderated media aggregators to perform this activity. A good example of an unmoderated media aggregator is MediSys,

which uses selected sources and keywords to capture outbreaks in over 50 languages. An example of a moderated system is ProMed.

For additional details, please consult the ECDC Epidemic Intelligence tutorial [4].

EU-specific sources for epidemic intelligence

To complement IBS and EBS as described above, two tools are operated by ECDC: EPIS and the EWRS.

EPIS

The system aims to ensure the transparent and timely sharing of information among participating public health authorities in order to detect public health threats at an early stage, coordinate response activities and facilitate reporting under Decision No 1082/2013/EU. There are five platforms in EPIS:

- **FWD** (food and waterborne diseases): EPIS-FWD facilitates the early detection and assessment of multi-country/multinational molecular typing clusters and outbreaks of FWDs. In 2016, the platform connected epidemiologists and microbiologists from 52 countries: 28 EU Member States, three European Economic Area (EEA) countries – Iceland, Norway and Liechtenstein – and 21 non-EU countries¹. UIs are events launched by participating countries or ECDC to assess the multi-country dimension of events occurring at the national level.
- **STI** (sexually transmitted infections): EPIS-STI supports the rapid reporting and dissemination of unusual events related to STI transmission across the EU and assesses their EU relevance. The appointed contact points for STI surveillance in EU/EEA countries submit reports. All 31 EU/EEA Member States have access to EPIS-STI. Posting in EPIS-STI is voluntary and structured by infection and type of event. It is also possible to post 'null reports' (i.e. nothing of EU significance in a selected month).
- **ELDSNet** (European Legionnaires' Disease Surveillance Network): EPIS-ELDSNet is a communication tool where notifications of travel-associated Legionnaires' disease (TALD) cases are disseminated to ELDSNet and contact points outside the EU/EEA region. The focus is on detecting and following up on travel-associated clusters and investigating community outbreaks in an *ad hoc* forum with restricted access. This allows for risk assessment and timely communication to public health authorities in charge of risk management. In addition to EU/EEA Member States, 33 non-EU countries currently have access to EPIS-ELDSNet.
- **VPD** (vaccine-preventable diseases): EPIS-VPD facilitates the early detection and sharing of information on VPD outbreaks and adverse events following immunisation and allows for exchanging information on technical topics related to vaccination and vaccine-preventable disease control. The platform connects vaccination programme managers, vaccine experts, epidemiologists and microbiologists from EU/EEA Member States and the WHO Regional Office for Europe. Events of public health relevance are discussed through the UI or disease discussion functionalities of EPIS-VPD. Posts in EPIS-VPD are initiated by participating countries or ECDC to discuss and assess cross-border dimensions of events occurring at regional or national levels. EPIS-VPD is also used to share a weekly list of vaccine-related publications.
- **AMR** (antimicrobial resistance) and **HAI** (healthcare-associated infections): EPIS-AMR-HAI supports the rapid reporting and dissemination of information related to bacterial pathogens with previously unseen or emerging antimicrobial resistance and healthcare-associated infections which are or may become relevant for public health in the EU/EEA. All EU/EEA Member States have access to EPIS-AMR-HAI.

EWRS

The EWRS is used in the context of serious cross-border threats to health. It is a web-based system linking the European Commission, ECDC and public health authorities in EU/EEA countries responsible for measures to control serious cross-border threats to health, including communicable diseases. Under Decision No 2119/98/EC of the European Parliament and of the Council and Decision No 2000/57/EC, Member States should inform about events likely to affect public health at the EU level. In 2013, Decision No 1082/2013/EU extended the scope of the EWRS to all hazards. These decisions also regulate the procedure for reporting and the functioning of the system. The EWRS is frequently used for notifications on outbreaks, exchanging information and decisions about the coordination of measures among Member States. The EWRS has been successfully deployed during a number of events such as severe acute respiratory syndrome (SARS), Ebola virus disease, avian influenza in humans and other communicable diseases. ECDC is in charge of providing RRAs concerning messages received through the

¹ Albania, Armenia, Australia, Bosnia and Herzegovina, Canada, Georgia, Israel, Japan, Kosovo (this designation is without prejudice to positions on status, and is in line with UNSCR 1244/1999 and the ICJ Opinion on the Kosovo declaration of independence), Moldova, Morocco, New Zealand, South Africa, Serbia, Switzerland, the former Yugoslav Republic of Macedonia, Montenegro, the United States, Tunisia, Turkey and Ukraine.

EWRS. Since November 2007, the Centre also supports the European Commission by operating the informatics of the EWRS and providing technical input to the system.

Global sources of epidemic intelligence

On 15 June 2007, WHO implemented the International Health Regulations (IHR) (2005) in order to help the international community prevent, control and respond to public health threats. The scope of the IHR (2005) is to provide a framework for the control of international outbreaks, strengthening international public health security and avoiding unnecessary traffic and trade limitations. In addition, the IHR (2005) includes operational concepts and procedures related to public health event notifications, risk assessment collaboration and international response coordination.

In order to manage epidemiological data, WHO developed an Event Management System (EMS) that allows for the timely exchange of information among countries and partners. The EMS includes information such as EI data, risk assessment, critical decisions and actions taken by WHO, skills and availability of international experts for response teams and standardised information products for public health officials and the public.

1.3 ECDC response

All threats and relevant signals detected through EI screening are discussed at the daily RT meeting involving experts in several fields available at ECDC. The aim of this meeting is to properly assess threats or potential threats and decide on relevant actions.

To support the decision-making process during RT meetings, ECDC implements systematic analysis based on likely scenarios that include critical events, risk, immediate actions and preparedness planning.

Once a threat is verified as a potential public health concern, an RRA is undertaken (usually within 72 hours) to evaluate the risks to human health as per ECDC operational guidance.

Typical events that can trigger the production of an RRA include:

- Outbreaks or events related to communicable diseases extending to more than one Member State of the EU/EEA
- Outbreaks or events related to communicable diseases where there is a risk of introduction to or propagation between Member States within the EU/EEA
- Outbreaks or events related to communicable diseases that may require timely and coordinated EU action to contain
- Outbreaks or events that may potentially have a high impact on public health or where EU assistance may be requested
- Events where contact tracing across EU internal borders necessitates information exchange
- A communicable disease event with high public, media or political interest in the EU
- Follow-up requests by EU Member State, European Commission (EC) or ECDC senior management teams (SMT)
- Serious, unusual or unexpected public health events or outbreaks of unknown origin
- Public health events that pose significant travel risks and trade restrictions
- Public health incidents of non-natural origin and at least one of the previous criteria.

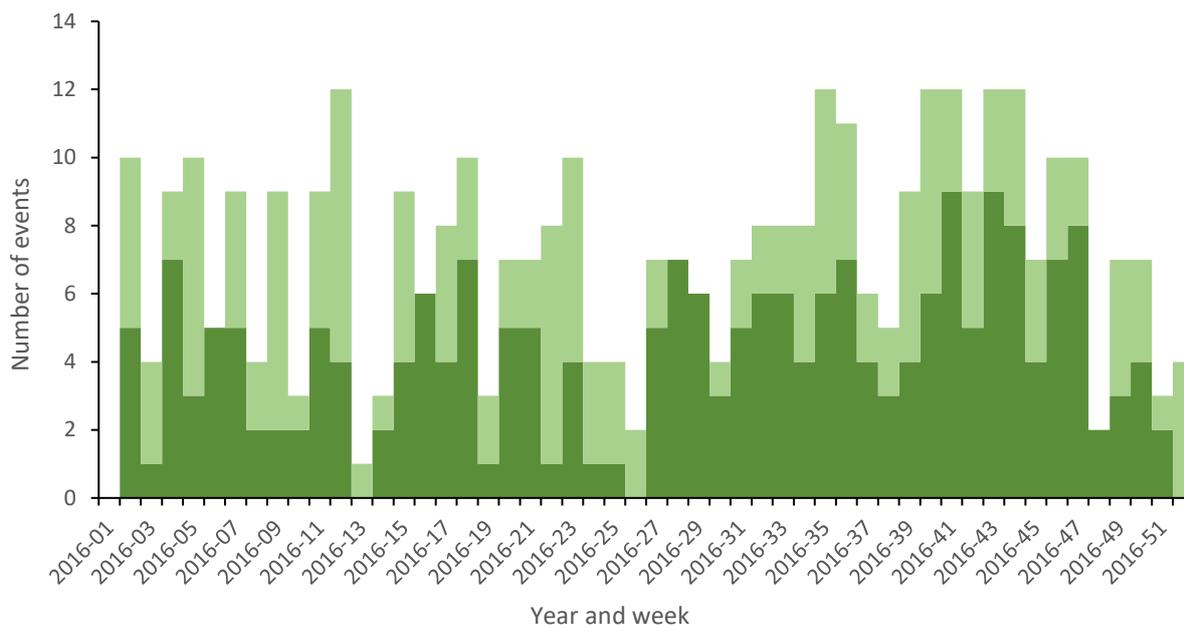
2 Threat detection in 2016

2.1 Sources of threat detection

Events originating from epidemic intelligence screening

In 2016, 371 events were monitored and discussed at the daily RT meetings. Thirty-seven led to the opening and monitoring of a new threat. Of all events, 215 (58%) originated in the EU (Figure 2) and ECDC epidemic intelligence teams reported an average of seven events per week. In 2015, 438 events were monitored, of which 36 led to the opening of a new threat and 240 (55%) originated in the EU.

Figure 2. Number of events detected through epidemic intelligence meeting EWRS criteria by week of reporting, 2016 (excluding already-monitored and opened threats)



Dark green: EU country

Light green: non-EU country.

Events reported through EPIS

Food and waterborne diseases and zoonoses (EPIS-FWD)

In 2016, 53 UIs were initiated by 24 participating countries or ECDC. Most UIs were related to salmonellosis (27), followed by verotoxigenic *Escherichia coli* (*E. coli*) (VTEC, 8) and listeriosis (5). In 28 UIs (53%), the vehicle of infection remained unknown. For one UI, farm animals were the source of infection. For two UIs on hepatitis A, infection occurred through drug injection and among men who have sex with men (MSM). The latter UI was also posted in EPIS-STI (see below). In 2016, 18 reported UIs affected more than one country, of which eight affected two and 10 potentially affected more than two. The largest number of countries potentially involved in one UI was eight.

Eight of the 53 UIs (15%) resulted in ECDC preparing an RRA, including four joint rapid outbreak assessments with the European Food Safety Authority (EFSA). The number of UIs launched in 2016 decreased slightly after a peak of 57 in 2015, 45 in 2014, 42 in 2013 and 49 in 2012. The number of countries that initiated UIs increased to 24 in 2016 compared with 17 in 2015. Similar to previous years, the most frequently reported infections were salmonellosis, VTEC and listeriosis.

Sexually transmitted infections (EPIS-STI)

In 2016, seven messages were posted by three Member States regarding STIs. In addition, 35 monthly 'null reports' (reports with no cases) were posted by four countries: Estonia, Latvia, Lithuania and Malta. This represents an increase in the reporting of STI events (4 in 2015 by three Member States).

- In March 2016, Lithuania reported one case of congenital syphilis notified to national authorities in December 2015.

- In September 2016, the United Kingdom reported three cases of congenital syphilis in mothers who screened negative during the first trimester antenatal visit between July and September 2016 [5].
- In May and September 2016, the United Kingdom posted two updates on the outbreak of high-level azithromycin-resistant gonorrhoea (HL-AziR) (MIC>256 mg/L) that initially started among the heterosexual population in northern England and later spread among MSM in several areas in England [6].
- In October 2016, EPIS-STI was used to disseminate an EWRS message posted from the Netherlands related to hepatitis A infections diagnosed among MSM who participated in EuroPride 2016 Amsterdam. The genetic sequence was shared through EPIS-FWD, EPIS-STI and EPIS-VPD together with the alert for a possible international spread [7].
- In December 2016, Ireland reported a cluster of ciprofloxacin-resistant *Shigella flexneri* 2a affecting MSM in Dublin.

European Legionnaires' disease surveillance network (EPIS-ELDSNet)

In 2016, 1 073 cases of TALD were reported. A total of 142 new clusters were detected in 2016 in 28 countries or onboard ships, 13 of which were non-EU/EEA countries. An additional 105 updates of existing clusters were reported. Thirty-eight summary reports of type 1 (non-EU/EEA clusters) and 24 of type 2 (rapidly evolving clusters where three or more cases result in the onset of illness within a three-month period occurring in the six months preceding the cluster notification or notification update, with this categorisation indicating a possible recent increase of exposure risk) were shared with tour operators. Control measures were implemented in all but four clusters, with ELDSNet receiving feedback from a first risk assessment within two weeks and a final assessment within six weeks. Four accommodation site names were published on the ECDC website in 2016, compared with eight in 2015 and none in 2014.

Vaccine-preventable diseases (EPIS-VPD)

In 2016, 13 messages were posted on EPIS-VPD, generating 22 follow-up reports. Diseases discussed through EPIS-VPD included measles, rubella, meningococcal disease, human papilloma virus (HPV) infection, hepatitis A and poliomyelitis. Vaccine shortages were also mentioned.

In 2015, 14 UIs were posted on EPIS-VPD, generating 57 follow-up reports. Three messages – with four follow-up comments – were made through the disease discussion functionality. Topics discussed included measles and rubella, poliomyelitis, diphtheria, pertussis and programmatic issues such as migrant care and vaccine shortages.

Antimicrobial resistance and healthcare-associated infections (EPIS-AMR-HAI)

In 2016, eight new UIs were launched through EPIS-AMR-HAI:

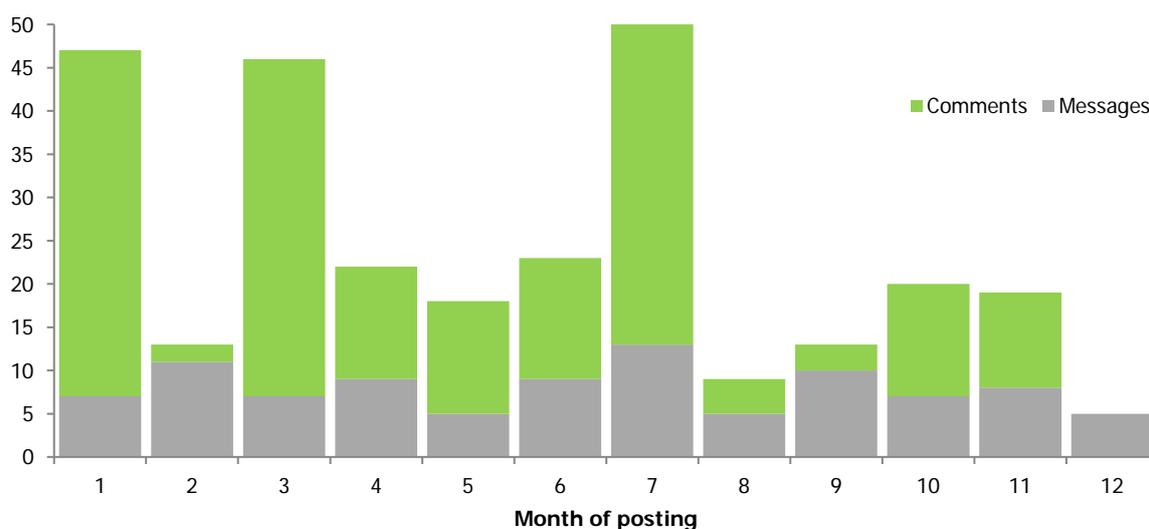
- Three referred to a new pathogen/variant of public health concern.
- Three were related to international outbreaks associated with healthcare material or equipment.
- Two referred to new resistance mechanisms detected in Member States.

The pathogens or resistance mechanisms discussed were *Achromobacter xylosoxidans*, *Burkholderia cepacia*, *Candida auris*, hepatitis C virus, *Elizabethkingia anopheles*, a novel variant (*mcr 1.2*) of plasmid-mediated colistin resistance in *Klebsiella pneumoniae* (*K. pneumoniae*) and the *optrA* gene encoding transferable resistance in enterococci and staphylococci.

Threats reported through the EWRS

In 2016, 96 EWRS messages and 195 comments were posted. Fifty-three messages were classified as alert notifications and 43 as other information (outside the scope of Article 9 in Decision No 1082/2013/EU). Eight messages resulted in the opening of a new threat in the TTT, representing 22% of all threats opened in 2016. All resulted in RRAs.

The number of messages and comments posted on the EWRS has been stable over the past 11 years except in 2009, when 1 400 postings were made in relation to pandemic influenza. From January 2005 until the end of 2016, 4 766 messages and comments were posted in the EWRS, 291 of them in 2016 (Figure 3).

Figure 3. Distribution of EWRS messages and comments by month of posting, 2016 (n=291)

The high volume of messages and comments posted in January 2016 was related to a request from the UK to other Member States on their public health measures regarding the Zika virus epidemic. In March 2016, 33 messages and comments were related to vaccination recommendations for yellow fever for travellers following outbreaks in Angola and the Democratic Republic of the Congo (DRC). In July 2016, 22 messages and comments were related to the shiga toxin-producing *E. coli* (STEC) O157 PT34 outbreak in England and Wales.

2.1 Threats monitored

In 2016, ECDC opened and monitored 37 new threats in addition to the 11 carried over from previous years (Table 1), fewer than the average of 44 new annual threats monitored over the past five years.

In 2016, FWDs represented the disease group for which most of the new threats were opened (9), followed by emerging and vector-borne diseases (EVD) (Table 2). Seven rapidly evolving clusters of Legionnaires' disease were included in the TTT as separate threats. The proportion of FWDs recorded in the TTT has diminished since the launch of EPIS FWD, with FWD threats mainly followed through EPIS. EPIS FWD threats are discussed at the ECDC RT if an urgent inquiry is launched in EPIS or there is an EWRS posting.

Table 1. Threats carried over from previous years

Long-term threats	Creation date
Measles – Multistate (EU) – Monitoring European outbreaks	9 February 2011
Rubella – Multistate (EU) – Monitoring European outbreaks	7 March 2012
Poliomyelitis – Multistate (World) – Monitoring global outbreaks	8 September 2005
Influenza A(H7N9) – China – Monitoring human cases	31 March 2013
Middle East respiratory syndrome coronavirus (MERS-CoV) – Multistate	24 September 2012
Influenza A(H5N1) - Multistate (world) - Monitoring human cases	15 June 2005
Public-health event - Outbreak of Ebola virus disease - West Africa - 2014	22 March 2014
Cholera – Multistate (World) – Monitoring global outbreaks	20 April 2006
Seasonal threats	Creation date
Monitoring environmental suitability of <i>Vibrio</i> growth in the Baltic Sea	6 July 2015
Influenza – Multistate (Europe) – Monitoring season	23 July 2008
West Nile virus - Multistate (Europe) - Monitoring season	2 September 2010

Table 2. Distribution of threats by disease group or health issue and year, June 2005–December 2016

Disease group	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Legionnaires' disease	6	36	44	83	91	28	6	14	5	13	9	7
Food- and waterborne diseases	37	56	31	52	24	7	17	9	8	3	4	9
Emerging and vector-borne diseases	23	27	23	27	18	13	12	9	5	15	9	8
Vaccine-preventable diseases	14	16	14	34	15	12	5	4	4	5	4	3
Influenza and other respiratory viruses	7	10	6	9	12	5	5	7	5	4	3	4
Sexually transmitted infections	1	2	2	1	1	2	1	0	0	0	1	0
Tuberculosis	2	3	15	11	8	0	0	3	0	0	1	2
Antimicrobial resistance	3	0	0	1	0	1	1	2	0	1	3	2
Mass gathering	1	2	0	2	3	8	1	8	1	3	1	2
Other	5	11	7	8	2	7	5	1	2	0	1	0

3 Response to threats

3.1 Rapid risk assessments and epidemiological updates

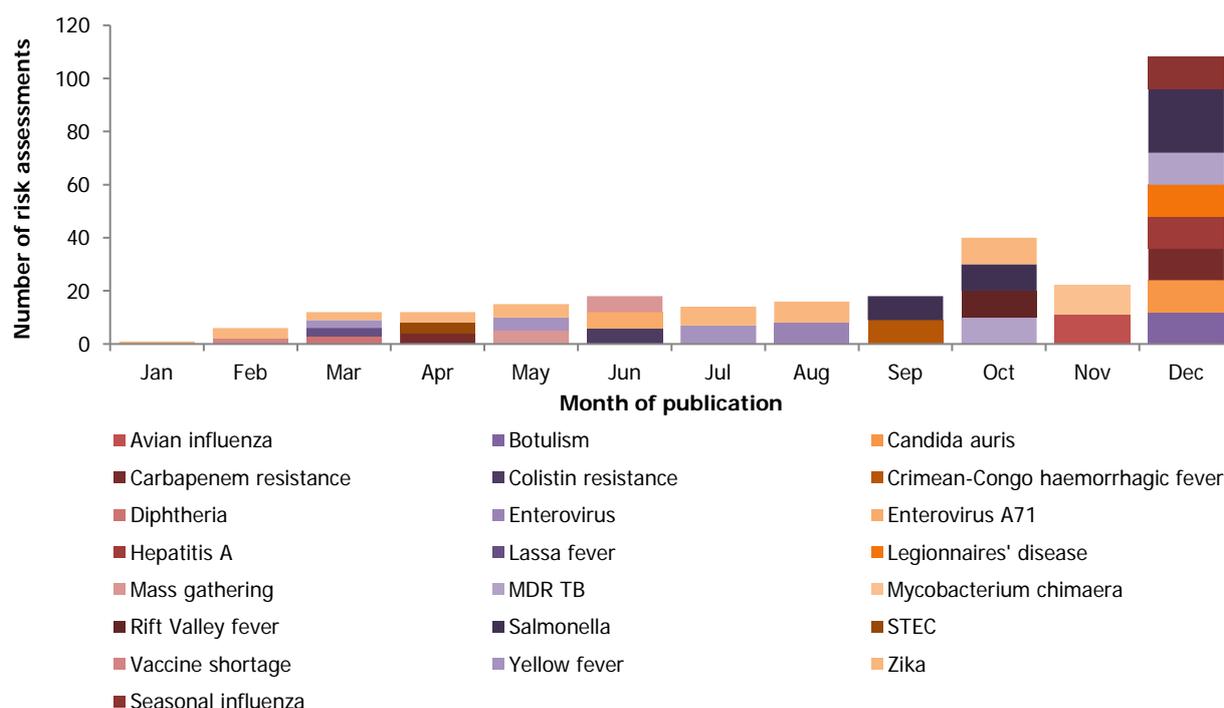
RRAs aim to support EU/EEA countries and the European Commission in their preparedness and response to a public health threat. They provide a timely summary and risk assessment of a public health threat for EU/EEA countries related to a specific event. They also include potential options for responses. As outbreaks or public health events develop, ECDC may issue updated risk assessments. Developments in an outbreak that do not affect the overall assessment result in an epidemiological update.

In 2016, ECDC published 38 RRAs (including three rapid outbreak assessments related to FWD) (Table 3, Figure 4, Annex 1). Fourteen were updates of previously published RRAs. Forty-five epidemiological updates were produced in 2016, of which the majority (39) were updates on the Zika virus.

Table 3. List of published ECDC epidemiological updates by subject and number of publications, January to December 2016

Subject	Number of updates
Zika virus outbreaks and complications potentially linked to Zika virus infection	39
New Ebola virus disease cluster in Guinea	1
West Nile virus transmission season in Europe	1
Measles among asylum seekers in Germany	1
Yellow fever outbreak in Angola	3

Figure 4. Rapid risk assessments published in 2016 by the month of publication and topic (n=38), ECDC, 2016



RRAs are published on the ECDC website. Prior to publication, RRAs are circulated to the European Commission and Member States through the EWRS as per requirement for prior notification stated in Article 10 of Decision No 1082/2013/EU.

3.2 Deployment of experts in 2016

ECDC provides technical support at the request of EU/EEA Member States or third countries involved in assessing or responding to a communicable disease threat.

Within EU Member States, two ECDC experts and one EPIET fellow were deployed to support Romanian authorities in the investigation of an outbreak of Shiga toxin-producing *E. coli* (STEC) O26 that caused several cases of haemolytic uraemic syndrome (HUS) in young children.

Outside of Europe, ECDC organised missions in response to three international outbreaks:

- In May 2016, the European Commission and ECDC, in agreement with Angolan authorities, deployed experts under the EU Civil Protection Mechanism through the newly established European Medical Corps in order to assess the risk of spread of a large ongoing outbreak of yellow fever. The mission team consisted of an ECDC team leader, one ECDC expert, four Member States experts and two experts from the Directorate-General for European Civil Protection and Humanitarian Aid Operations (DG ECHO) of the European Commission.
- In October 2016, in the context of Hurricane Matthew in Haiti, ECDC facilitated the mobilisation of four EU/EEA Member States experts to support the country in the prevention and control of a cholera epidemic.
- In December 2016, an ECDC expert was deployed to the United Arab Emirates to assist with investigations of a persistent increase in the number of cases of TALD in travellers to Dubai. The increase was detected through the ELDSNet surveillance scheme on TALD.

4 Threats of particular interest in 2016

4.1 Haemolytic uraemic syndrome cases in young children – Romania

In February 2016, the Ministry of Health of Romania reported 15 suspected cases of HUS among children aged 5 to 16 months old. The cases were hospitalised in Bucharest and Craiova between 29 January and 26 February 2016. The dates of onset ranged from 25 January–22 February 2016. Three of the cases died, three required dialysis in an intensive care unit (ICU) and five were admitted to a nephrology ward. No causative agent was identified at the time of the notification. Upon request from Romanian authorities, two ECDC experts joined the national outbreak response team. Information collected through exploratory questionnaires and results from environmental investigations indicated a milk processing establishment as a potential source for contaminated dairy products. On 4 March 2016, this establishment closed voluntarily. On 7 March 2016, a Rapid Alert System for Food and Feed (RASFF) news bulletin (reference 16-811) was issued by the Romanian authorities indicating that in 2016, products from this establishment were sold in several EU countries. Since several strains of Shiga toxin-producing *E. coli* (STEC) were identified, multiple contamination sources could not be excluded. On 21 March 2016, Italy reported one case of HUS with an epidemiological link to Romania that triggered the preparation of a joint ECDC/EFSA rapid outbreak assessment. The recall of suspected food products was undertaken by food safety authorities in Romania, Italy and other countries. The investigation of the European dimension of this multi-country foodborne outbreak has demonstrated the added value of collaboration between Romanian and Italian public health and food safety authorities as well as ECDC and EFSA in enabling an appropriate risk assessment and supporting response.

4.2 Measles in Europe

In 2016, 3 767 cases of measles were reported through TESSy by 30 EU/EEA countries. Twenty-eight countries issued monthly reports throughout the year. Romania reported the most cases with 1 582 (42%). In 2016, outbreaks were monitored in Italy, France, Germany, the UK, Ireland and Romania through epidemic intelligence activities.

In Italy, a measles outbreak involving 67 cases caused by a new measles virus B3.1 variant occurred from November 2015 to April 2016 in the Emilia Romagna and Lombardy regions, affecting the Roma/Sinti ethnic population and a nosocomial setting [8].

In France, between 5 January and 11 February 2016, a measles outbreak was reported in a refugee settlement in Calais, resulting in 13 confirmed measles cases among migrants, healthcare workers in a hospital and volunteers working onsite. Ten cases were hospitalised. A large-scale vaccination campaign was carried out in the settlement within two weeks of the outbreak notification. Sixty percent of the estimated target population of 3 500 refugees were vaccinated during the week-long campaign.

In Germany, from mid-May to mid-July 2016, 53 cases of measles were reported from 11 different asylum seeker centres across eight federal states. All cases were in children aged 0 to 13 years old, with the exception of two adults aged 21 and 22 years. Cases had travelled from Chechnya to Germany using different routes crossing Poland, Russia or Belarus. The initial Chechen asylum seeker case was reported on 10 May 2016. Secondary cases were reported among residents and staff at the centres.

The United Kingdom reported several outbreaks in 2016. Between February and 11 March 2016, 20 cases of measles were confirmed across London and the East of England (Cambridge, Essex and Hertfordshire), predominantly in unimmunised adolescents and adults aged 14 to 40 years old without a history of recent travel. Between mid-June and mid-October 2016, 52 cases of measles were reported, linked to 12 music and arts festivals in England and Wales. Most of these cases (47) were confirmed and the remaining five were epidemiologically linked. Nearly half (24 cases) were aged 15 to 19 years old. Scottish health authorities reported 18 confirmed cases in the Edinburgh area as of 12 October 2016. The majority of cases were linked to Edinburgh University. The last confirmed case of measles associated with this outbreak was reported on 17 November 2016.

In Ireland, an outbreak of measles involving 33 cases occurred between April and July 2016.

Romania reported 1 969 laboratory-confirmed or epidemiologically linked cases of measles in 2016, including nine deaths. Thirty-three of 42 districts reported cases, with Arad being the most affected district (462 cases). Infants under 1 year old, children aged 1 to 4 years old and 5 to 9 years old were the most affected, with 339, 846 and 364 cases respectively. Vaccination activities were ongoing in order to cover communities with suboptimal vaccination coverage. In Romania, large outbreaks have previously occurred in 2005–2006 and 2011–2012, with low numbers reported during inter-epidemic periods.

4.3 Yellow fever outbreak in Angola

On 21 January 2016, the National IHR Focal Point of Angola notified WHO of an outbreak of yellow fever. The index case was identified in Luanda Province and had onset of symptoms on 5 December 2015.

The outbreak rapidly spread throughout Angola. Within a few weeks, suspected cases were reported in all 18 provinces of Angola, with confirmed cases reported in 16. The outbreak peaked in late February and early March 2016. By 10 June, 3 137 cases (2 290 suspected and 847 confirmed), including 345 deaths, were reported, with 12 provinces reporting autochthonous transmission. The most affected province remained Luanda throughout the outbreak.

Angolan health authorities implemented response activities, including coordination, epidemiological and entomological investigations, clinical case management, enhanced surveillance, laboratory testing, social mobilisation and vector control. A mass vaccination campaign coordinated by WHO was launched on 2 February, using the yellow fever vaccine emergency stockpile. By 1 July, 11.5 million people had been vaccinated in Angola.

The outbreak spread internationally, with imported cases reported among travellers from Angola in China (11) and Kenya (2). Furthermore, between 1 January and 1 July 2016, DRC reported 1 582 cases (1 514 suspected and 68 confirmed), including 75 deaths. Of the confirmed cases, 59 had recent travel history to Angola and nine were classified as autochthonous. By 30 June, 5.5 million people had been vaccinated in DRC.

ECDC published an RRA on 25 March 2016 that was updated on 30 May and 14 July and produced epidemiological updates on 1 April, 12 May and 13 June.

Experts from Member States and ECDC were deployed in Angola under the EU Civil Protection Mechanism (see above). On 23 December 2016, the Ministry of Health of Angola declared the end of the yellow fever outbreak as no new cases had been reported since 23 June 2016.

4.4 Zika virus infection

From 1 February to 18 November 2016, Zika virus infection and related clusters of microcephaly cases and other neurological disorders constituted a Public Health Emergency of International Concern (PHEIC). The end of the PHEIC was declared after further research demonstrated the causal link between Zika virus infection and microcephaly.

Following the declaration of the PHEIC, ECDC invoked its emergency plan at level 1 from 2 February 2016 to 8 March 2016.

On 2 February 2016, sexual transmission of Zika virus was reported from the US. By December 2016, 13 countries or territories had reported evidence of person-to-person transmission of the virus, probably via sexual transmission.

In March 2016, ECDC deployed a liaison officer to the US CDC. Throughout 2016, enhanced communication and collaboration between ECDC, the US CDC and WHO were maintained on a regular basis.

Throughout 2016, the epidemic continued to evolve and reached new countries and territories. Zika virus infection spread rapidly in the Americas and expanded to the Caribbean and Central America. In the second half of 2016, the US and several Asian countries reported their first locally acquired cases. By the end of December 2016, 71 countries or territories had reported autochthonous cases of Zika virus infection and 29 had reported microcephaly and other central nervous system malformations in newborns potentially associated with Zika virus infection. Brazil reported the highest number of cases (Figure 4). As of 28 December 2016, 21 countries or territories had reported Guillain-Barré syndrome potentially associated with Zika virus infection.

Since June 2015 and as of 29 December 2016, 21 countries (Austria, Belgium, Czech Republic, Denmark, Finland, France, Greece, Hungary, Ireland, Italy, Luxembourg, Malta, the Netherlands, Norway, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and the United Kingdom) had reported 2 055 travel-associated Zika virus infections through TESSy. Over the same time-period, nine EU/EEA Member States reported 100 cases of Zika among pregnant women. During 2016, ECDC published an epidemiological update once a week with maps and nine updates of the Zika RRA.

In addition, ahead of the Olympics and the Paralympic Games that took place in Rio de Janeiro during August and September 2016, ECDC prepared a specific risk assessment for communicable diseases, including an assessment for Zika virus infection. The risk of vector-borne transmission of Zika virus infection during the Olympic Games was expected to be low and no increase in Zika cases linked to these mass gathering events were reported.

5 Conclusions

In 2016, Europe experienced a resurgence of measles, with countries such as Romania and Italy reporting over thousands of cases.

In addition to monitoring the Olympic Games in Rio, ECDC also monitored the 2016 UEFA European Football Championship in France and opened a threat for tracking cases of meningitis following the World Youth Day held in Poland.

There were no increases in threats in any specific disease area compared with previous years. However, several global vector-borne outbreaks, such as Zika virus disease and yellow fever, required special attention from public health authorities.

In May 2016, the European Commission and ECDC, in agreement with Angolan authorities, deployed experts through the newly established European Medical Corps. The mission team consisted of an ECDC team leader, one ECDC expert, four Member State experts and two experts from the European Commission. The aims were to evaluate transmission risks to local populations and EU citizens in Angola and the risk of regional spread and importation into the EU, as well as advise Angolan and EU authorities on control measures.

Annex 1. ECDC risk assessments by subject and month of publication, January to December 2016

Risk assessment name	Publication date
Zika virus disease epidemic: potential association with microcephaly and Guillain-Barré syndrome, first update	22 January 2018
Shortage of acellular pertussis-containing vaccines and impact on immunisation programmes in the EU/EEA, first update	3 February 2018
Zika virus disease epidemic potential association with microcephaly and Guillain-Barré syndrome, second update	8 February 2018
Zika virus disease epidemic potential association with microcephaly and Guillain-Barré syndrome, third update	23 February 2018
Zika virus disease epidemic potential association with microcephaly and Guillain-Barré syndrome, fourth update	9 March 2018
Lassa fever in Nigeria, Benin, Togo, Germany and USA	24 March 2018
Outbreak of yellow fever in Angola	25 March 2018
A fatal case of diphtheria in Belgium	30 March 2018
Joint Rapid Outbreak Assessment: multi-country foodborne outbreak of Shiga toxin-producing <i>Escherichia coli</i> infections associated with haemolytic uraemic syndrome	6 April 2018
Zika virus disease epidemic potential association with microcephaly and Guillain-Barré syndrome, fifth update	12 April 2018
Carbapenem-resistant Enterobacteriaceae	14 April 2018
Potential risks to public health related to communicable diseases at the Olympics and Paralympics Games in Rio de Janeiro, Brazil 2016	10 May 2018
Zika virus disease epidemic potential association with microcephaly and Guillain-Barré syndrome, sixth update	23 May 2018
Outbreaks of yellow fever in Angola, Democratic Republic of Congo and Uganda, first update	30 May 2018
Public health risks related to communicable diseases at the Rio de Janeiro Olympic and Paralympic Games, Brazil 2016, first update	13 June 2018
Plasmid-mediated colistin resistance in Enterobacteriaceae	15 June 2018
Outbreak of enterovirus A71 with severe neurological symptoms among children in Catalonia	16 June 2018
Zika virus disease epidemic, seventh update	12 July 2018
Outbreaks of yellow fever in Angola, Democratic Republic of Congo and Uganda	14 July 2018
Enterovirus detections associated with severe neurological symptoms in children and adults in European countries	8 August 2018
Zika virus disease epidemic, eighth update	31 August 2018
Multi-country outbreak of <i>Salmonella</i> Enteritidis phage type 8, MLVA type 2-9-7-3-2 infections	6 September 2018
Crimean-Congo haemorrhagic fever in Spain	9 September 2018
Outbreak of Rift Valley fever in Niger - Risk for the European Union	10 October 2018
Extensively drug-resistant tuberculosis – multi-country cluster, Romania, 21 October 2016	24 October 2018
Joint Rapid Outbreak Assessment : Multi-country outbreak of <i>Salmonella</i> Enteritidis phage type 8, MLVA type 2-9-7-3-2 and 2-9-6-3-2 infections	27 October 2018
Zika virus disease epidemic. ninth update	31 October 2018
Outbreaks of highly pathogenic avian influenza A(H5N8) in Europe	18 November 2018
Invasive cardiovascular infection by <i>Mycobacterium chimaera</i> associated with the 3T heater-cooler system used during open-heart surgery	21 November 2018
Multi-country outbreak of <i>Salmonella</i> Enteritidis PT8 infection, MLVA type 2-10-8-5-2, associated with handling of feeder mice	5 December 2018
Carbapenem-resistant <i>Acinetobacter baumannii</i> in healthcare settings	9 December 2018
Increase in <i>Salmonella</i> Stourbridge infections in Germany during 2016	19 December 2018
Multidrug-resistant tuberculosis in migrants, multi-country cluster, first update	19 December 2018
<i>Candida auris</i> in healthcare settings	20 December 2018
Hepatitis A outbreaks in the EU/EEA mostly affecting men who have sex with men	20 December 2018
Joint Rapid Outbreak Assessment : Type E botulism associated with fish product consumption – Germany and Spain	21 December 2018
Increase of cases of Legionnaires' disease in EU travellers returning from Dubai, October–December 2016	23 December 2018
Risk assessment of seasonal influenza, EU/EEA, 2016/2017, 24 December 2016	26 December 2018

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