

# Determinants and Drivers of Infectious Disease Threat Events in Europe

*[Announcer] This program is presented by the Centers for Disease Control and Prevention.*

The Middle East respiratory syndrome coronavirus, or MERS, coronavirus outbreak, and the large Ebola outbreak in West Africa are striking examples of how emerging and reemerging infectious diseases can threaten international public health and strain governmental resources. Historically, novel pathogens have emerged and reemerged repeatedly in human populations and affected public health; similarly, pathogens that have been present in a population at low levels have increased rapidly in incidence or geographic range with equally grave consequences. The context of infectious disease emergence has changed over the centuries, but Europe has remained and even intensified as a hot spot for emerging infectious diseases over recent decades. Many of the fundamental and basic determinants of emerging infectious diseases have persisted over time, but dynamic global trends provide more opportunities for emerging infectious diseases to occur and expand swiftly.

In 2008, a study was conducted by the European Centre for Disease Prevention and Control (ECDC). It was based on expert consultation and literature review. It projected how the risk of emerging infectious diseases in Europe will be shaped in the future. This study determined that drivers can be categorized into 3 main groups: globalization and environment, sociodemographic, and public health systems.

The effect of ITDEs on public health can be attenuated by strengthening the detection of, and early response to, the threats. However, more important, the likelihood of ITDEs originating in the first place can be reduced by intervening directly on their underlying drivers.

The ECDC's mission is to identify, assess, and communicate current and emerging threats to public health posed by infectious diseases. This charge is accomplished through epidemic intelligence.

Data collection for epidemic intelligence at ECDC was standardized in 2008; the authors analyzed the epidemiologic characteristics of each IDTE in Europe from July 1, 2008, through December 31, 2013. For each IDTE the following data are routinely collected by ECDC: type of disease or pathogen, geographic location of source of infection, source of infection, duration of the epidemic or of surveillance activities, number of countries affected by the event, number of cases, and number of deaths. IDTEs included in this study were restricted to outbreaks affecting more than 5 people in the EU. People infected abroad and returning to the EU also were included in our analysis.

IDTE drivers were organized into 3 categories: globalization and environment, sociodemographic, and public health systems.

Of 274 IDTEs that occurred within the EU during July 2008 through December 2013, a total of 116 met the study inclusion criteria. Foodborne and waterborne IDTEs were the most frequently occurring events, followed by vectorborne and rodentborne, airborne, vaccine preventable, other zoonotic, injection drug use-associated, influenza, healthcare-associated, multidrug resistance-associated, and lastly, sexually transmitted IDTEs. The driver category that was by far the most frequently involved in single IDTEs was globalization and environment at 61 percent, followed

by the public health system failure, 21 percent, and sociodemographic, 18 percent. The individual driver travel and tourism was linked to 9 of the 10 IDTE categories, and the vulnerable groups and lifestyle driver categories were linked to 7 and 6 IDTE categories, respectively. Most IDTEs had a combination of drivers. Foodborne and waterborne diseases and vectorborne diseases were the most commonly occurring drivers in combinations of 2 and 3 drivers. The most common driver combinations were travel and tourism in combination with food and water quality and global trade in combination with food quality, both of which caused foodborne and waterborne diseases.

The foodborne and waterborne category included all types of diseases transmitted through food or water and was responsible for the most IDTEs. The most common cause of the observed foodborne and waterborne outbreaks in Europe was norovirus, followed by hepatitis A and *E. coli*. An example was the norovirus epidemic that affected more than 11,000 schoolchildren in 6 countries; the origin of the epidemic was traced to contaminated frozen strawberries.

Nearly half of the 27 IDTEs within the vectorborne and rodentborne IDTE category were caused by West Nile virus infections. West Nile virus infection and malaria are notifiable diseases in the EU and, therefore, subject to surveillance. The natural environment driver was present in all West Nile virus infection events and a large outbreak of hantavirus infections in Germany in 2010 was attributed to bank vole populations.

Q fever, psittacosis, and diseases caused by cowpox virus and *E. coli* were included in the other zoonoses IDTE category.

Ten IDTEs, including measles, mumps, rubella, and pertussis outbreaks, were reported for the vaccine-preventable IDTE category. A measles outbreak in Bulgaria in 2009 through 2010, which affected predominantly migrant and hard-to-reach Roma populations, resulted in more than 24,000 cases and 24 deaths in 1 year. Measles is still endemic in many European countries because of low vaccination coverage among migrants and hard-to-reach populations and also vaccine hesitancy. Specific vaccination strategies are often necessary for these populations to protect children and adults from infectious diseases, prevent spread of infection due to crowded living conditions, and ensure continuity of childhood immunization schedules. Failure to vaccinate susceptible populations diminishes herd immunity and may trigger outbreaks.

The relatively few healthcare-associated IDTEs picked up by ECDC's epidemic intelligence represent only a fraction of the expected number in Europe. Seven deaths occurred among 49 detected cases; 6 deaths were in newborns who had been infected while in hospitals. The number of events and deaths for other event categories was far below the actual number expected for Europe. An ECDC point-prevalence survey of healthcare-associated infections and antimicrobial use in long-term care facilities in Europe showed that about 4.1 million patients contract a healthcare-associated infection in the EU each year, and approximately 37,000 deaths occur annually as a direct consequence of these infections. Reported infections caused by injection drug use were due to botulism, HIV, and anthrax and caused 69 illnesses and 8 deaths.

Only 1 sexually transmitted IDTE was identified by epidemic intelligence. The event was reported from 3 countries and consisted of invasive meningococcal disease among men who have sex with men; the men had been infected while traveling or through contacts from abroad. Of note, however, many sexually transmitted infections tend to be silent and reach endemic levels that are not captured by epidemic intelligence.

Rather than registering as recurrent IDTEs, influenza precipitated several influenza outbreaks that were recorded as Public Health Events at ECDC. Therefore, the number of IDTEs attributed to influenza is underestimated.

Ten IDTEs were reported for the airborne IDTE category. Most events were due to legionellosis, but the IDTEs also encompassed the emergence of MERS-Coronavirus infections in 2012 through 2013.

We found globalization and environment to be the most noteworthy driver categories for IDTEs in Europe. More specifically, travel and tourism, food and water quality, natural environment, global trade, and climate were the top 5 drivers of all IDTEs identified. Among these, travel and tourism proved to be significantly distinct in the hierarchical cluster analysis and cluster dendrogram. In this analysis of epidemic intelligence data, travel and tourism was not only the most distinct but also the most recurrent driver implicated in the emergence of IDTEs. The volume of international travelers on commercial flights with a final destination in Europe has increased steadily over the years. International travel from areas with epidemic and endemic diseases has resulted in continuous importation of infected people into Europe. Similarly, pathogen introduction into competent vector populations can result in local transmission and threaten the safety of the blood supply. Restricting international travel in a globalized world to reduce the likelihood of IDTEs is both unrealistic and undesirable; however, monitoring and modeling air traffic patterns for pathogen importation risk can potentially accelerate early case detection and rapid response and effective control of IDTEs.

Food and water quality was the second most frequent driver of IDTEs in Europe. Suboptimal food safety systems, even if they are distant to the outbreak, become an international public health issue in an interconnected world in which food and humans move freely. The occurrence of an IDTE can potentially be mitigated by addressing this driver. Fostering multisectorial collaboration between the food industry, public health, and environmental agencies can prevent IDTEs.

Changes in the natural environment are increasing on a nonlinear scale with habitat destruction and the loss of ecosystem services. Monitoring and modeling environmental precursors of IDTEs can help to anticipate, or even forecast, an upsurge of IDTEs.

In summary, we have taken a systematic approach to categorize and rank the underlying drivers of observed IDTEs in Europe to help anticipate, respond to, and recover from probable, imminent, or current impacts of these events. Drivers of IDTEs can arise as epidemic precursors of IDTEs. Monitoring and modeling these drivers can serve as early warning systems of IDTEs and accelerate responses. However, it is desirable to proactively prevent possible public health emergencies rather than respond to IDTE after they have occurred. Therefore, the most cost-effective strategy would be to directly tackle the underlying drivers of an IDTE. Intervening directly on drivers may prevent the occurrence of IDTEs and reduce the human and economic cost associated with IDTEs.

You can read the entire article, “Determinants and Drivers of Infectious Disease Threat Events in Europe,” in the April 2016 issue of *Emerging Infectious Diseases* at [cdc.gov/eid](http://cdc.gov/eid)

I’m Reginald Tucker for *Emerging Infectious Diseases*.

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