

Botulism

Annual Epidemiological Report for 2021

Key facts

- In 2021, 82 confirmed cases of botulism were reported in the EU/EEA.
- Among 30 reporting countries, 19 countries notified zero cases.
- The overall notification rate was 0.02 cases per 100 000 population.
- Denmark reported the highest notification rate (0.10 cases per 100 000 population), followed by Romania (0.06 cases per 100 000 population) and Italy (0.05 cases per 100 000 population).

Introduction

Botulism is a serious paralytic illness caused by botulinum neurotoxins (BoNTs), which are mainly produced by the bacterium *Clostridium botulinum*. BoNTs are one of the most lethal known substances and are included among potential bioterrorism threats. *C. botulinum* spores exist widely in the environment and can grow and produce neurotoxins in anaerobic conditions.

Botulism occurs naturally in three forms:

- food-borne botulism, an intoxication caused by eating food that contains BoNTs;
- intestinal botulism, caused by the consumption of *C. botulinum* spores, which then germinate into bacteria and release BoNTs within the intestines of adults (adult intestinal toxæmia) or babies under one year of age (infant botulism); and
- wound botulism, caused by *C. botulinum* spores infecting a wound, germinating into bacteria, then releasing BoNTs.

There are two other forms of the disease that do not occur naturally:

- inhalation botulism, caused by inhaling BoNTs that have been accidentally or deliberately released in the form of aerosols (e.g. in bioterrorism events), and
- iatrogenic botulism, the most recent human-made form of botulism, which may occur as an adverse event after the administration of BoNTs for medical or cosmetic reasons.

Food-borne botulism is the most common form of the disease. It is frequently caused by inadequately processed, often home-canned, preserved or fermented foods (e.g. vegetables, meat or fish). Symptoms of botulism are characterised by descending, flaccid paralysis that can cause respiratory failure. The symptoms may be very severe and require intensive-care treatment, as well as the administration of an antitoxin. Even where these treatments are available, complete recovery usually takes weeks to months, and 5–10% of cases are fatal.

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Methods

This report is based on data for 2021 retrieved from The European Surveillance System (TESSy) on 9 October 2022. TESSy, hosted at ECDC, is a system for the collection, analysis and dissemination of data on communicable diseases.

For a detailed description of the 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].

For 2021, data on botulism were reported by 30 EU/EEA countries. The notification of botulism is compulsory in all reporting countries. Botulism data were collected through surveillance systems with national coverage in 29 of the 30 countries (Spain did not have national coverage). The following case definitions were used: 12 countries reported using the 2018 EU case definition, 4 countries reported using the 2012 EU case definition, 6 countries reported using the 2008 EU case definition and 8 countries reported using other or unspecified/unknown case definitions. Unlike the 2008 and 2012 EU case definitions of botulism, the 2018 EU case definition also covers other species of BoNT-producing *Clostridia* and allows genotypic tests for laboratory confirmation.

No data for 2020 and 2021 were reported by the United Kingdom, due to its withdrawal from the EU on 31 January 2020.

Epidemiology

In 2021, 30 EU/EEA countries reported 82 confirmed cases of botulism (Table 1, Figure 1). The EU/EEA notification rate was 0.02 cases per 100 000 population. The countries with the highest number of cases were Italy (32 cases), Romania (11 cases) and Spain (10 cases). These three countries accounted for 65% of the cases reported in the EU/EEA in 2021. The highest notification rate, 0.10 cases per 100 000 population, was reported by Denmark, followed by Romania, with 0.06 cases per 100 000 population. Eight countries reported from one to seven cases each and nineteen countries reported zero cases. Among 40 cases (49%) with known travel information, 2 cases were travel related, having reported travel to Italy (1 case) and Romania (1 case) prior to illness onset.

Among 73 cases (89%) with available information, all were infected with *C. botulinum*. The BoNT type was reported for 56 of 82 cases (68%). BoNT/B (46 cases; 82%) was most frequently reported, followed by BoNT/A (5 cases; 9%), BoNT/E (3 cases; 5%) and BoNT/F (2 cases; 4%).

In 2021, half of the reported botulism cases (41 of 82 cases; 50%) had information on hospitalisation, of which all 41 cases were hospitalised. Among 24 hospitalised cases with known toxin type, 18 cases were intoxicated with BoNT/B, 3 cases with BoNT/A and 3 cases with BoNT/E.

Among 40 cases with known outcome (49%), 3 deaths were reported. One of these cases was intoxicated with BoNT/B. The neurotoxin type was not reported for the other two cases.

The mode of transmission was known for 17 cases (21%), all of which were reported as food borne. Cases were linked to consumption of canned food (four cases), vegetables (four cases), pig meat (one case), other meat (one case) and other or unspecified foods (seven cases).

Table 1. Number of confirmed botulism cases and rates per 100 000 population, by country and year, EU/EEA, 2017–2021

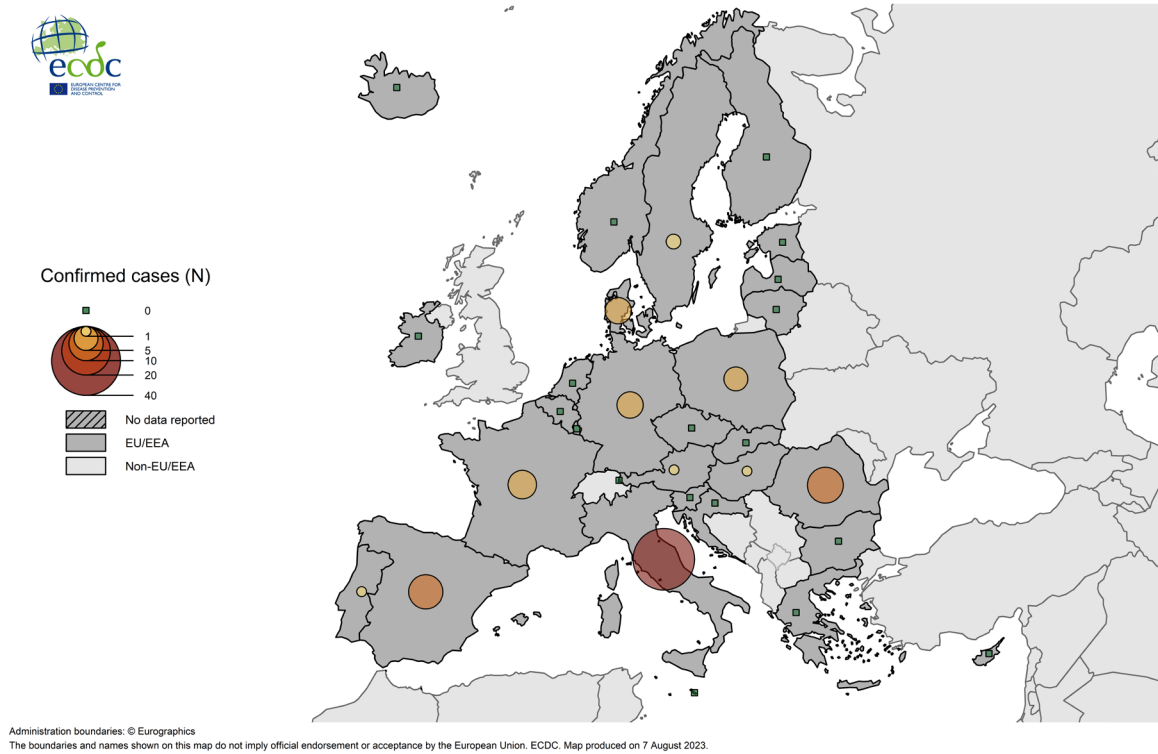
Country	2017		2018		2019		2020		2021		
	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate	ASR
Austria	4	0.05	1	0.01	2	0.02	1	0.01	1	0.01	0.01
Belgium	0	0.00	0	0.00	1	0.01	1	0.01	0	0.00	0.00
Bulgaria	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0.00
Croatia	0	0.00	1	0.02	1	0.02	1	0.02	0	0.00	0.00
Cyprus	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0.00
Czechia	1	0.01	0	0.00	0	0.00	0	0.00	0	0.00	0.00
Denmark	2	0.03	11	0.19	0	0.00	0	0.00	6	0.10	0.10
Estonia	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0.00
Finland	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0.00
France	4	0.01	7	0.01	10	0.01	11	0.02	7	0.01	0.01
Germany	3	0.00	7	0.01	8	0.01	3	0.00	6	0.01	0.01
Greece	2	0.02	0	0.00	0	0.00	0	0.00	0	0.00	0.00
Hungary	5	0.05	5	0.05	2	0.02	0	0.00	1	0.01	0.01
Iceland	0	0.00	0	0.00	0	0.00	1	0.27	0	0.00	0.00
Ireland	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0.00
Italy	21	0.03	26	0.04	13	0.02	46	0.08	32	0.05	0.05
Latvia	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0.00
Liechtenstein	NDR	NDR	NDR	NDR	NDR	NDR	NDR	NDR	0	0.00	0.00
Lithuania	2	0.07	1	0.04	1	0.04	1	0.04	0	0.00	0.00
Luxembourg	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0.00
Malta	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0.00
Netherlands	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0.00
Norway	2	0.04	1	0.02	1	0.02	1	0.02	0	0.00	0.00
Poland	14	0.04	14	0.04	6	0.02	6	0.02	5	0.01	0.01
Portugal	3	0.03	0	0.00	2	0.02	1	0.01	1	0.01	0.01
Romania	13	0.07	15	0.08	23	0.12	6	0.03	11	0.06	0.05
Slovakia	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0.00
Slovenia	0	0.00	1	0.05	0	0.00	0	0.00	0	0.00	0.00
Spain	6	0.01	3	0.01	8	0.02	3	NRC	10	NRC	NRC
Sweden	4	0.04	1	0.01	0	0.00	0	0.00	2	0.02	0.02
United Kingdom	1	0.00	0	0.00	5	0.01	NDR	NDR	NDR	NDR	NDR
EU/EEA	87	0.02	94	0.02	83	0.02	82	0.02	82	0.02	0.02

ASR: age-standardised rate

NDR: no data reported

NRC: no rate calculated

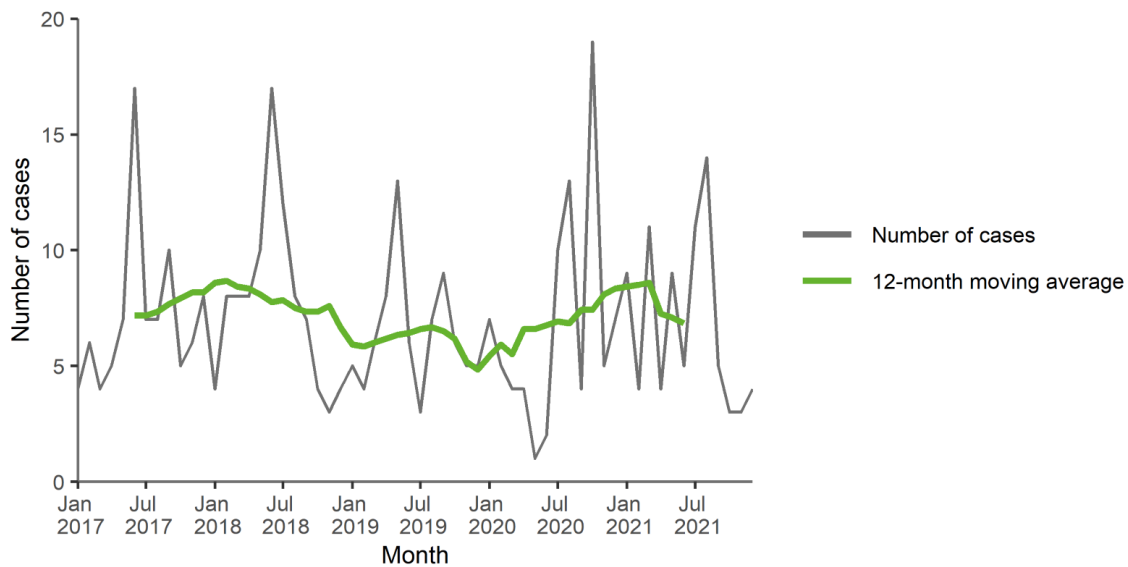
Figure 1. Number of confirmed botulism cases by country, EU/EEA, 2017–2021



Source: Country reports

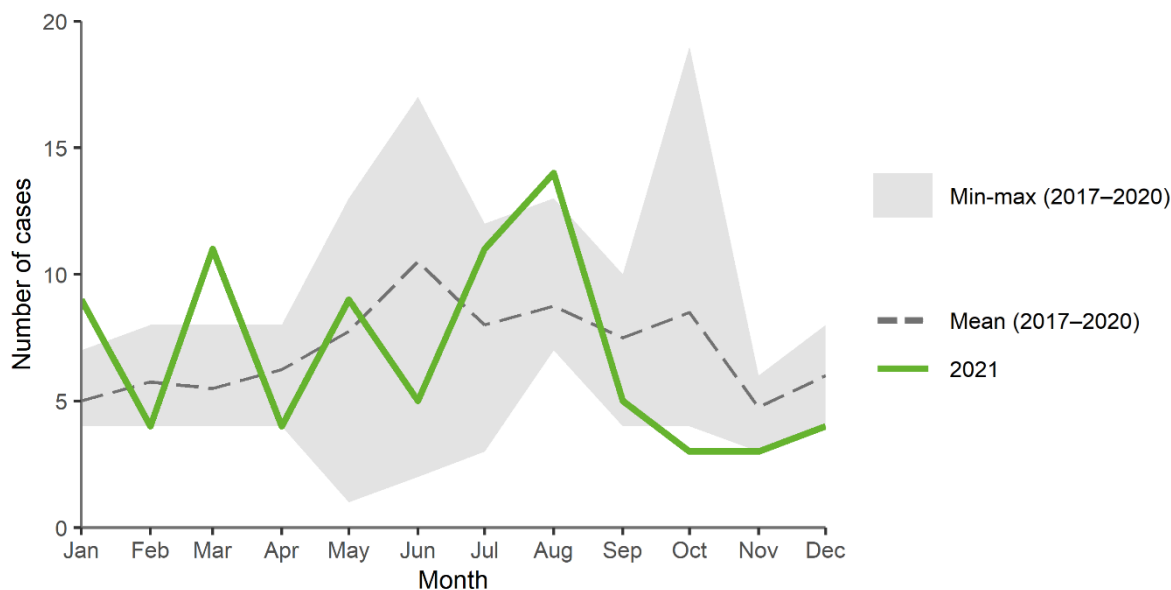
From 2017 to 2021, the number of botulism cases in the EU/EEA remained stable (Table 1, Figure 2). Consistent with previous years, data from 2021 show irregular, random peaks, rather than seasonality (Figure 3).

Figure 2. Number of confirmed botulism cases by month, EU/EEA, 2017–2021



Source: Country reports from Austria, Belgium, Bulgaria, Cyprus, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain and Sweden

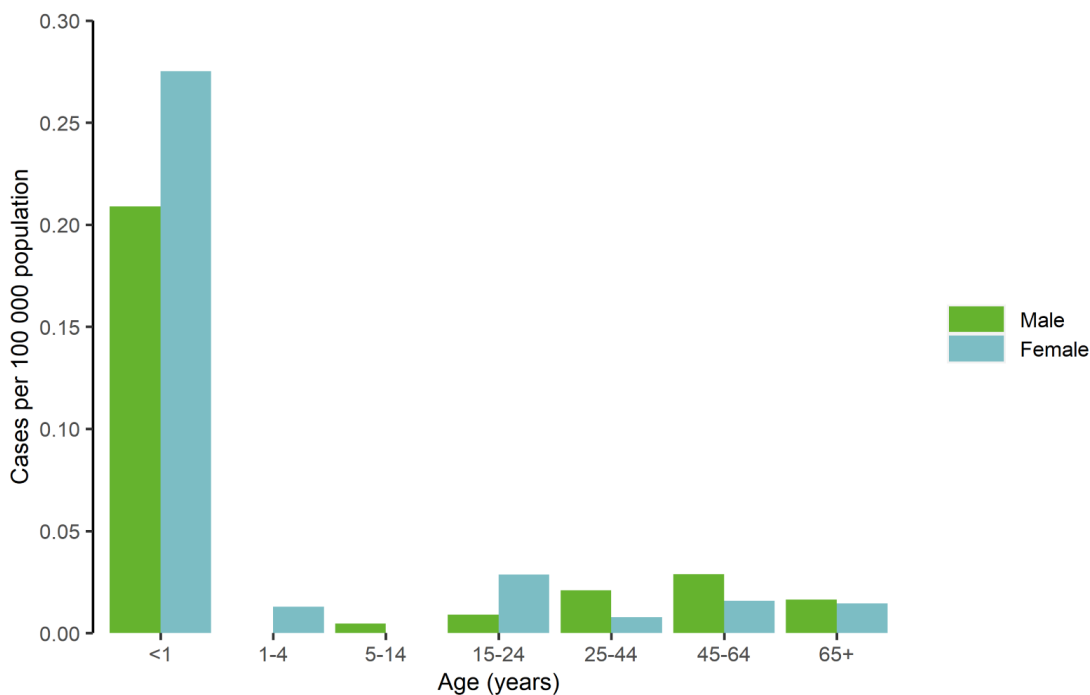
Figure 3. Number of confirmed botulism cases by month, EU/EEA, 2017–2020 and 2021



Source: Country reports from Austria, Belgium, Bulgaria, Cyprus, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain and Sweden

The gender was known for all reported cases: 54% were male and 46% were female, with a male-to-female ratio of 1.2:1. The highest notification rate reported was among infants under one year of age, both in males and in females (0.21 and 0.28 cases per 100 000 population, respectively; Figure 4). The highest number of cases (58 of 82 cases; 71%) was reported among adults in the age groups over 25 years.

Figure 4. Number of confirmed botulism cases per 100 000 population, by age and gender, EU/EEA, 2021



Source: Country reports from Austria, Belgium, Bulgaria, Croatia, Cyprus, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain and Sweden

Outbreaks and other threats

In the summer of 2021, there was a transition from the Epidemic Intelligence Information System for Food and Waterborne Diseases (FWD-EPIS) to the new EpiPulse system for the reporting of food- or waterborne disease outbreaks or unusual events. No national or multi-country botulism outbreaks were reported through EpiPulse in 2021.

Discussion

The number of botulism cases reported by national surveillance systems in the EU/EEA remained stable from 2017 to 2021. Botulism is a relatively rare disease in the EU/EEA, but cases continue to occur sporadically and as small clusters of the various disease forms. Of note, the number of reported botulism cases was not impacted by the COVID-19 pandemic, unlike several other food-borne diseases. This finding shows that severe conditions such as botulism are unlikely to go undiagnosed. Furthermore, food products contaminated with BoNTs remained the most common source of botulism during the COVID-19 pandemic (2020–2021).

The presentation of different forms of human botulism cases, along with disease incidence, vary between countries depending on dietary habits, culinary traditions and food preparation methods. Three countries (Italy, Poland and Romania) reported the highest annual number of cases in the last five years. Studies in these countries have shown that the most common source of botulism in Italy was home-canned vegetables [5]; in Poland was home-canned pork products, as well as mixed or unknown types of canned meats [4]; and in Romania was home-preserved canned pork and ham products [6].

In 2021, seven food-borne botulism outbreaks — of which four were considered strong-evidence outbreaks — were reported to the annual zoonoses data collected by the European Food Safety Authority (EFSA). A total of 24 human botulism cases were involved in these outbreaks, of which 15 were hospitalised; no deaths were reported. A food vehicle was reported in four of these strong-evidence outbreaks, in the categories 'vegetables and juices and other products thereof' (two outbreaks), 'fish and fish products' (one outbreak) and 'cereal products including rice and seeds/pulses (nuts, almonds)' (one outbreak) [7].

Botulinum neurotoxins (BoNTs) are mainly produced by the bacterium *C. botulinum*, but in rare instances they can also be produced by other *Clostridium* species (e.g. *C. argentinense*, *C. baratii* and *C. butyricum*). In the EU/EEA, from 2017 to 2021, BoNT type B caused the majority (89%) of human cases, followed by type A (8%). In contrast, BoNT type E and F were recorded in only 2% of cases. Type F typically presents with a more rapid and severe illness than those caused by other BoNTs.

Clostridia can be found in various food products, both raw and cooked, mainly in the form of spores. Spores can germinate to form vegetative cells and produce BoNTs under suitable environmental conditions (e.g. during the processing of food). Food-borne botulism is most commonly caused by canned food, often homemade or from small-scale producers. Ready-to-eat food products, which are minimally processed and eaten without heating, are also of concern [8].

While the food-borne form of botulism is most common, other forms of the disease are sporadically reported. In the EU/EEA, the most affected age group are infants below one year of age. In contrast to food-borne botulism, infant botulism occurs due to the ingestion of *C. botulinum* spores, which germinate into bacteria and release BoNTs in the gut when the natural defences in the intestines of infants have not fully developed. Cases of wound botulism among people who inject drugs are also sporadically reported. In some European countries, this is the most commonly reported form of botulism.

Botulism outbreaks are rare, but they are public health emergencies that require rapid recognition to identify the disease sources and distinguish outbreak types to prevent additional cases. Successful treatment strongly depends on early diagnosis and rapid administration of botulinum antitoxin. The differential diagnoses of botulism include several neuromuscular diseases and central nervous system disorders.

Public health implications

To reduce the number of botulism cases, preventive measures should be strengthened by adopting a multidisciplinary approach that considers all routes of infection and intoxication. Care should be taken when canning food, either commercially or at home, to make sure that *C. botulinum* spores are destroyed by sufficient heat treatment before storage and consumption. Traditionally, infant botulism has been associated with the consumption of honey. The development of filters for people who inject drugs to remove spore-forming bacteria may reduce the incidence of intoxication in this risk group [9].

Symptoms of botulism vary depending on the type of toxin, the age and pre-existing conditions of the patient, and the amount of toxin consumed. As these symptoms are not disease-specific, diagnosis can be challenging. Food-borne outbreaks due to BoNT type F are of concern because bivalent AB antitoxin and trivalent ABE antitoxin may lack the required effectiveness for the treatment of type F botulism, which can rapidly progress to respiratory failure requiring ventilation support [10]. It should be noted that the treatment of type F botulism with heptavalent antitoxin is approved in the EU/EEA. Due to the extremely high potency of the toxin, botulism is included among potential bioterrorism threats in preparedness and response activities.

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