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## A Decade of Spore-Forming Bacterial Infections Among European Injecting Drug Users: Pronounced Regional Variation

Vivian D. Hope, PhD, MMedSc, Norah Palmateer, MSc, Lucas Wiessing, MSc, Andrea Marongiu, MSc, Joanne White, BSc, FFPH, Fortune Ncube, BMedSci, BM/BS, DRCOG, MSc PHM, FFPHM, and David Goldberg, MD, DSc

The recent anthrax outbreak among injecting drug users (IDUs) in Europe has highlighted an ongoing problem with severe illness resulting from spore-forming bacteria in IDUs. We collated the numbers of cases of 4 bacterial illnesses (botulism, tetanus, *Clostridium novyi*, and anthrax) in European IDUs for 2000 to 2009 and calculated population rates. Six countries reported 367 cases; rates varied from 0.03 to 7.54 per million people. Most cases (92%) were reported from 3 neighboring countries: Ireland, Norway, and the United Kingdom. This geographic variation needs investigation. (*Am J Public Health*. 2012;102:122–125. doi:10.2105/AJPH.2011.300314)

The emergence of anthrax among injecting drug users (IDUs), mostly of heroin, in Scotland in 2009<sup>1</sup> constituted the second major cluster of severe bacterial illness among IDUs in the country in a decade. In 2000 and 2001, an outbreak of *Clostridium novyi* affected IDUs across Great Britain and Ireland,<sup>2,3</sup> with the majority of cases observed in Scotland. Since then, there have been ongoing reports of illness and death among IDUs taking heroin in the United Kingdom. These cases have been associated with a range of spore-forming bacteria, with wound botulism and tetanus cases continuing to occur since being first reported in the early

**TABLE 1—Reports of Clinically or Microbiologically Confirmed Cases of Spore-Forming Bacterial Infection Among Injecting Drug Users: European Union, Croatia, and Norway, 2000–2009**

Country	Population in 2005	Estimated IDUs			Bacterial Infections						Rate/1000 IDUs	Summary of Responses to Request for Further Information on IDU Cases	References	
		Range	Central Estimate, No.	Year	Method	Botulism, No.	Tetanus, No.	<i>Clostridium novyi</i> , No.	Anthrax, No.	Total No.				Rate/Million People
Austria	8 206 524	12 000–23 000	NA	2000	MM				0	0	0	0	No cases reported <sup>a</sup>	
Belgium	10 445 852	23 200–28 400	NA	1997	HM				0	0	0	0	No cases reported <sup>b</sup>	
Bulgaria	7 761 049												No data on injecting status	
Croatia	4 443 901	2521–4167	3145	2009	MM				0	0	0	0	No cases reported	
Cyprus	749 175	379–646	481	2009	OT				0	0	0	0	No cases reported	
Czech Republic	10 220 577	34 200–36 400	35 300	2009	TM				0	0	0	0	No cases reported	
Denmark	5 411 405	10 066–16 821	12 754	2006	CR				0	0	0	0	No cases reported	
Estonia	1 347 510	8132–34 443	13 886	2004	CR				0	0	0	0	No cases reported	
Finland	5 236 611	12 200–19 700	15 650	2002	OT				0	0	0	0	No cases reported	
France	62 637 596	NA	122 000	1999	HM				0	0	0	0	No cases reported	
Germany	82 500 849	78 000–110 500	NA	2005	MM	21			0	0	0	0	No cases reported	
Greece	11 082 751	8999–12 713	10 658	2009	CR	1	2	1	22	22	0.20–0.28	0.24–0.33	Botulism: 4 more cases Botulism: 1 case; tetanus: 2 cases <sup>c</sup>	12–17
Hungary	10 097 549	NA	5699	2008–2009	OT				0	0	0	0	No cases reported <sup>d</sup>	
Ireland	4 109 173	4694–7884	NA	1996	MM	9			31	7.54	3.9–6.6		No additional cases	18–20
Italy	58 462 375	NA	326 000	1996	HM	2			2	0.03	0.0061		Botulism: 2 cases	
Latvia	2 306 434								0	0			No cases reported	
Lithuania	3 425 324								0	0			No cases reported <sup>e</sup>	
Luxembourg	461 230	1253–1919	1485	2007	OT				0	0			Unable to provide data	
Malta	402 668								0	0			No cases reported	
The Netherlands	16 305 526	2336–2444	2390	2008	TM	1	1		2	0.12	0.82–0.86		No additional cases	21,22
Norway	4 606 363	8810–12 480	10 238	2008	MM	5		1	7	1.52	0.56–0.79		Botulism: 4 more cases	23
Poland	38 173 835								0	0			No cases reported <sup>f</sup>	
Portugal	10 529 255	13 183–16 285	NA	2005	TM				0	0	0	0	No cases reported	
Romania	21 658 528								0	0			No cases reported	
Slovakia	5 384 822	13 732–34 343	18 841	2006	TM				0	0	0	0	No cases reported	
Slovenia	1 997 590	NA	7320	2001	OT				0	0	0	0	No cases reported	
Spain	43 038 035	NA	83 972 <sup>g</sup>	1998	MM				0	0	0	0	No cases reported	
Sweden	9 011 392								0	0			No cases reported	
United Kingdom	60 059 900	143 298–156 017	147 900	2006–2007	OT	160	34	93	13	300	5.00	1.9–2.1	Not applicable	
Total <sup>h</sup>	491 851 520					199	37	116	15	367	0.75			
Total <sup>h</sup> (excluding UK)	431 791 620					39	3	23	2	67	0.16			

Note. CR = capture-recapture; EMCDDA = European Monitoring Centre for Drugs and Drug Addiction; HM = HIV multiplier; IDU = injecting drug user; MM = mortality multiplier; NA = not available; OT = other or multiple methods; TM = treatment multiplier. A blank cell indicates either that there were no data as in relation to estimated IDU numbers or that nothing was reported as in relation to the breakdown of the number of cases of infections.

Source. Estimates of numbers of IDUs are from the EMCDDA.<sup>24</sup>  
<sup>a</sup>No cases reported through the Austrian early warning system.  
<sup>b</sup>Data from 2006–2009.  
<sup>c</sup>Data from 2003–2009, drug user or IDU. Data on drug use not systematically collected.  
<sup>d</sup>Data from 2004–2009 for tetanus, and from 2006–2009 for botulism.  
<sup>e</sup>No information on these infections occurring among injecting drug users.  
<sup>f</sup>Drug use not routinely collected; however, in all known cases, other routes were implicated.  
<sup>g</sup>Opiate injectors only.  
<sup>h</sup>Excluding Bulgaria and Luxembourg.

2000s.<sup>4-6</sup> Contaminated heroin, mainly supplied to the United Kingdom and other European countries via trafficking routes emanating from Afghanistan,<sup>7,8</sup> is considered to be the likely source of infection in most, if not all, instances. However, the basic geographic epidemiology of these infections among IDUs in Europe has not been described. To ascertain whether what is being observed in the United Kingdom is unique or is similar to what is occurring elsewhere in Europe, we explored differences in rates of severe infections among IDUs caused by 4 spore-forming bacteria that have been associated with contaminated heroin. Such analysis might provide insights into where, for example, contamination of heroin is occurring.

## METHODS

We collated reports of clinically or microbiologically confirmed infections caused by *Clostridium botulinum* (botulism), *Clostridium tetani* (tetanus), *C. novyi*, and *Bacillus anthracis* (anthrax) among IDUs in Europe. For the United Kingdom, we extracted cases with dates of onset between January 2000 and December 2009 from national surveillance systems operated by Health Protection Agency and Health Protection Scotland.<sup>5</sup> Through searches of PubMed and European public health journals, we identified published reports of cases in other European countries during the 10-year period. We then consulted the European Monitoring Centre for Drugs and Drug Addiction (EMCDDA)<sup>9</sup> network of infectious disease experts<sup>10,11</sup> to identify further published and unpublished reports. Of the 28 EMCDDA member countries (excluding the United Kingdom) contacted, all responded. There are problems with the comparability of available estimates of number of IDUs in each country; therefore, we used both available IDU estimates and 2005 population data to calculate rates.

## RESULTS

We identified 367 infections over the 10-year period. Of these cases, 300 occurred in the United Kingdom; 160 were caused by *C. botulinum*, 34 by *C. tetani*, 93 by *C. novyi*, and 13 by *B. anthracis*, giving an overall rate of 5 infections per million people and 1.9 to 2.1 infections per 1000 IDUs (Table 1). Six other

European countries (Germany, Greece, Ireland, Italy, Netherlands, and Norway) reported cases since 2000: 39 caused by *C. botulinum*, 3 by *C. tetani*, 23 by *C. novyi*, and 2 by *B. anthracis* (Table 1). Rates of infection with spore-forming bacteria among IDUs in these countries were much lower than were those in the United Kingdom (Table 1), except in Ireland (7.54 infections/million, 3.9–6.6 infections/1000 IDUs). Norway was the only other country to report more than 1 infection per million.

## DISCUSSION

During the period 2000 to 2009, a total of 300 severe infections caused by spore-forming bacteria among IDUs in the United Kingdom were reported. This amount is more than 4 times the number of cases—and 31 times the rate per million population—reported elsewhere in the European Union, Norway, and Croatia. The only country with a higher rate was the United Kingdom's nearest neighbor, Ireland. The country with the third highest rate, Norway, also neighbors the United Kingdom. These 3 countries accounted for 92% of the 367 cases identified, an observation indicating that these infections are concentrated in Europe's northwestern corner.

The uneven distribution of these infections may reflect underreporting; however, the reporting of anthrax, botulism, and tetanus is compulsory in all European Union countries and Norway (excepting Belgium and France, where reporting is voluntary for anthrax and botulism), which should limit underreporting,<sup>25</sup> although a few countries reported data-quality issues (Table 1). Alternatively, variation might result from underdiagnosis of infections in some countries. However, in the context of the severe and distinct nature of the associated illnesses we believe that this is unlikely to account for such large differences. Another possible explanation could be differences in the prevalence of injecting.<sup>26</sup> However, when we examined rates of infection using national IDU population estimates, the wide variations remained.

These infections have been postulated to arise from the environmental contamination of heroin.<sup>2,20</sup> Accordingly, their distribution may reflect regional differences in heroin trafficking routes, heroin cutting and preparation practices,

and injecting drug use practice, including the type of drug injected.<sup>26</sup>

Explaining the excess of spore-forming bacterial infections among IDUs in the northwestern corner of Europe requires further investigation, although the geographic distribution of cases suggests that contamination of heroin might occur along trafficking routes to the affected countries.<sup>7,8</sup> The cutting of heroin with other substances is a potential source of contamination. In light of the recent anthrax outbreak<sup>1,5</sup>—during 2010, there were a further 39 cases in United Kingdom and 1 in Germany<sup>27-30</sup>—health care professionals and IDUs need to remain vigilant. Early recognition of infections arising from potentially contaminated heroin is essential so that investigations can be undertaken and appropriate public health messages disseminated. Improved surveillance of these infections among IDUs, information on bacterial genetic profiles,<sup>31,32</sup> and the public health monitoring of illicit drug contamination<sup>33</sup> could improve the understanding of illicit drug distribution and associated health risks. ■

### About the Authors

Vivian D. Hope, Andrea Marongiu, Joanne White, and Fortune Ncube are with Health Protection Services, Health Protection Agency, London, UK. Norah Palmateer and David Goldberg are with Health Protection Scotland, Glasgow, UK. Lucas Wiessing is with the European Monitoring Centre for Drugs and Drug Addiction, Lisbon, Portugal.

Correspondence should be sent to Vivian D. Hope, Health Protection Services, Health Protection Agency, London NW9 5EQ, UK (e-mail: vivian.hope@hpa.org.uk). Reprints can be ordered at <http://www.aph.org> by clicking the "Reprints/Eprints" link.

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### Contributors

All authors contributed to the writing of the manuscript; the preparation was led by V. D. Hope with assistance from N. Palmateer. The analysis was conceptualized by V. D. Hope and D. Goldberg, and the work was overseen by F. Ncube and D. Goldberg. L. Wiessing coordinated the survey of European countries, and V. D. Hope, N. Palmateer, A. Marongiu, and J. White collated the UK case data.

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