



UK Health
Security
Agency

From notifiable to now: 15 years of Legionnaires' disease surveillance in England and Wales

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National Legionella Epidemiology and Surveillance Lead
UK Health Security Agency



1. Legionnaires' disease surveillance in England and Wales

- Historical context
- Data collection

2. Epidemiology: 2010 to 2024

- Rates
- Mortality
- Demographics
- Risk factors
- Microbiology

3. Challenges ahead



Legionella bacteria under UV light

The UK Health Security Agency (UKHSA) mission

Our goals

Prepare

Be ready for, and prevent, future health security hazards

Strategic priorities

Be ready to respond to all hazards to health

- Improve health outcomes through vaccines

Respond

Save lives and reduce harm through effective health security response

Strategic priorities

Reduce the impact of infectious diseases and antimicrobial resistance

- Protect health from threats in the environment

Build

Build the UK's health security capacity

Strategic priorities

Improve action on public health through data and insight

- Develop UKHSA as a high-performing agency

Achieve more equitable outcomes

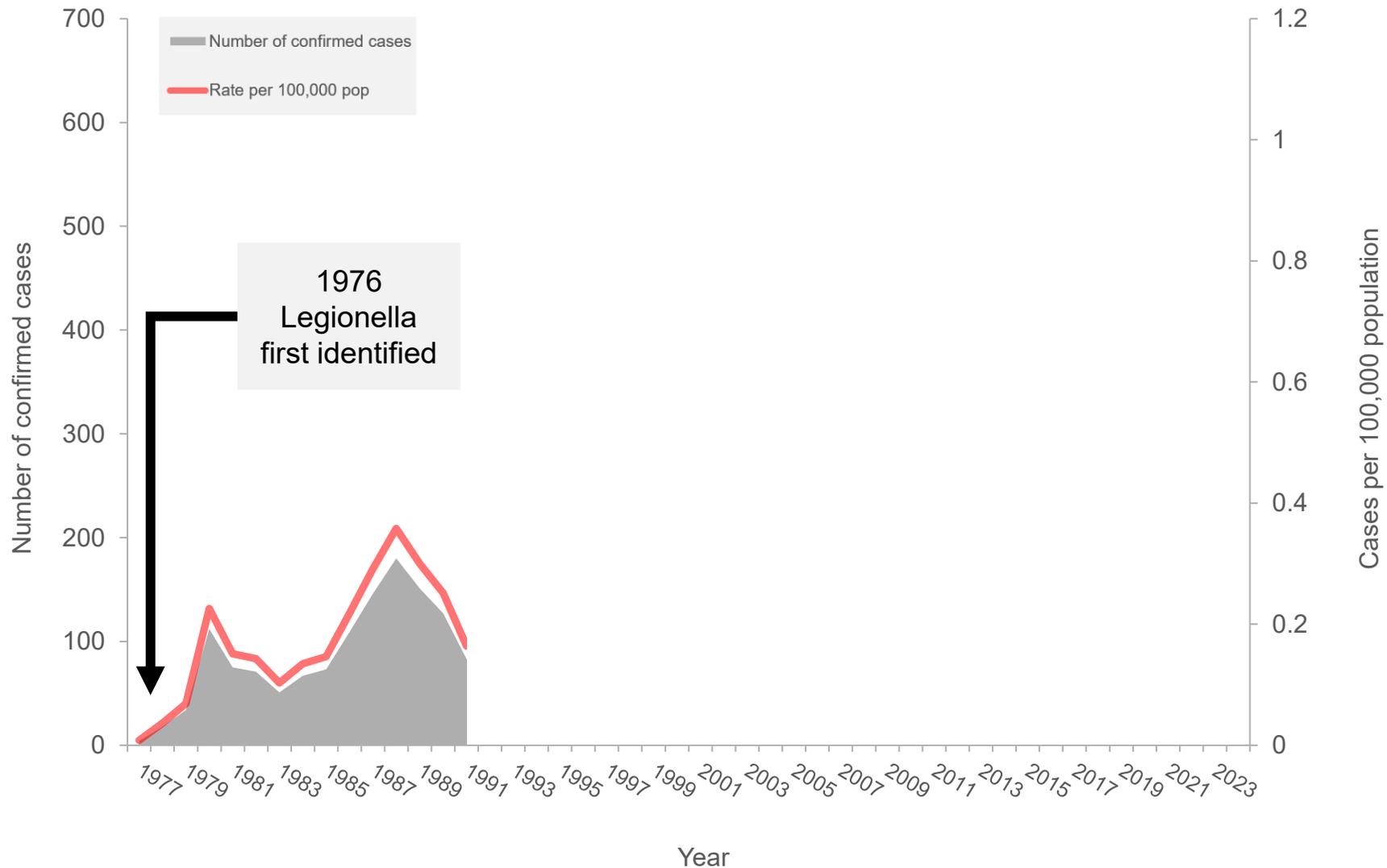
Defining the goal

“A strategy for strengthening national public health surveillance and response systems through an integrated approach to collecting, analysing and using health data for action.”

WHO IDSR Strategy



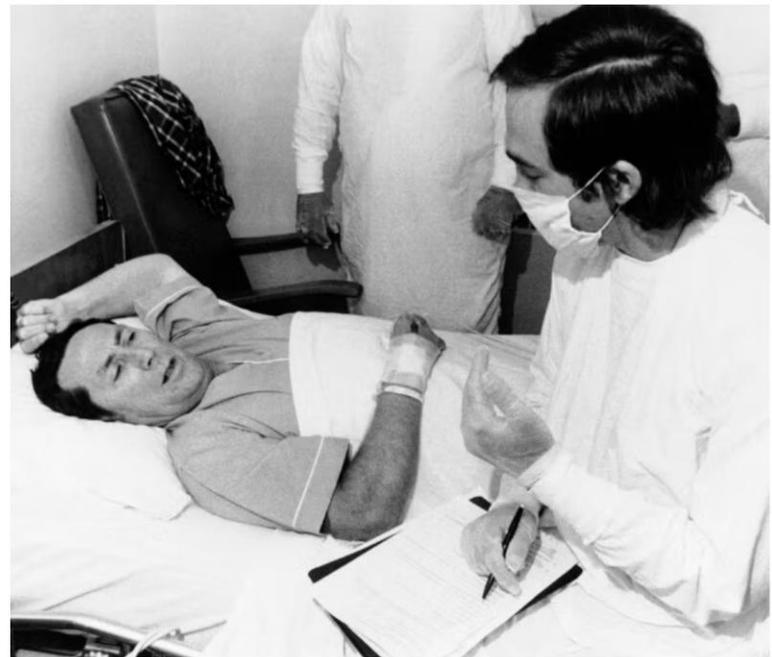
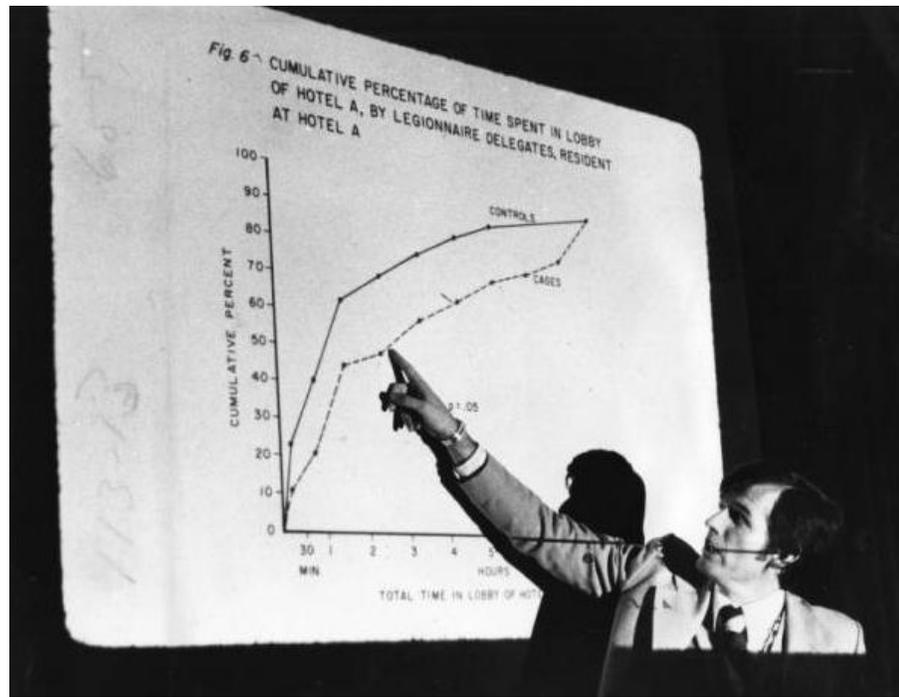
History of Legionnaires' disease epidemiology in England and Wales



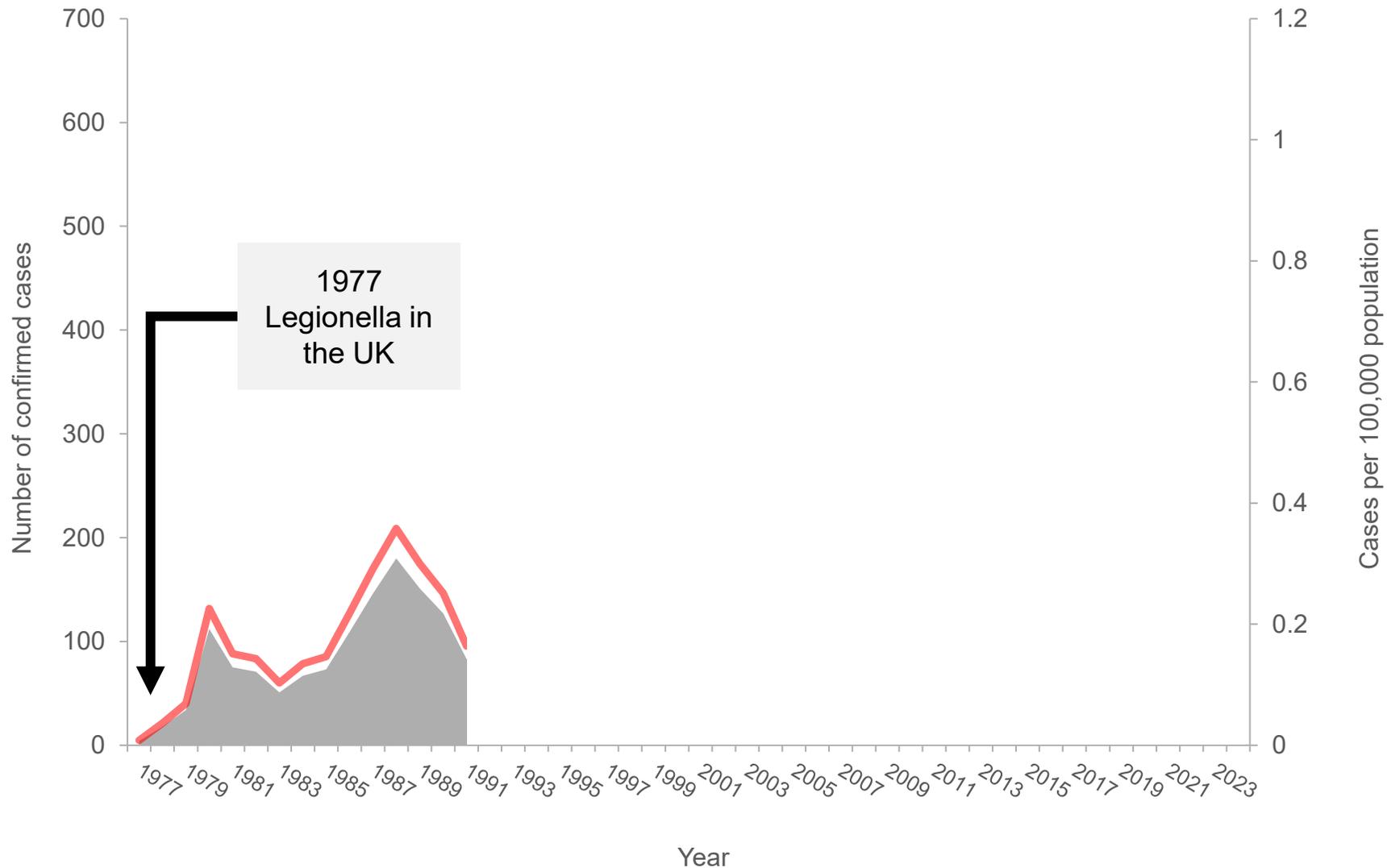
1976

Legionella first identified at an outbreak of over 200 US Army veterans at an American Legion convention in Philadelphia





History of Legionnaires' disease epidemiology in England and Wales



1977

First cases retrospectively identified in the UK

Scot. med. J., 1978, 23:

LEGIONNAIRES' DISEASE—THE BENIDORM EPISODE

J. H. Lawson
Ruchill Hospital, Glasgow

Summary. The clinical pattern of illness in 2 fatal cases of Legionnaires' Disease is described. Common factors in the 2 patients were residence in a hotel in Benidorm, Spain, a severe and progressive pneumonia unaffected by wide-spectrum antibiotics and failure to incriminate an infecting organism. The similarities with the Philadelphia outbreak, in which a bacillus known as the Legionnaire agent was isolated, led to a retrospective diagnosis in the Benidorm episode. Subsequent serological surveys indicate that Legionnaires' Disease is widespread in nature; it is not a new disease.

On the 24th July 1973 members of an organised tour returned from a holiday in Benidorm, Spain. When the aeroplane arrived at Glasgow airport one person was found to be dead, one died 2 days later and the third died 1 week later in Ruchill hospital. All 3 had stayed in the same hotel in Benidorm. All of them suffered from an unexplained respiratory illness associated with pneumonic consolidation. In the third case a retrospective serological diagnosis

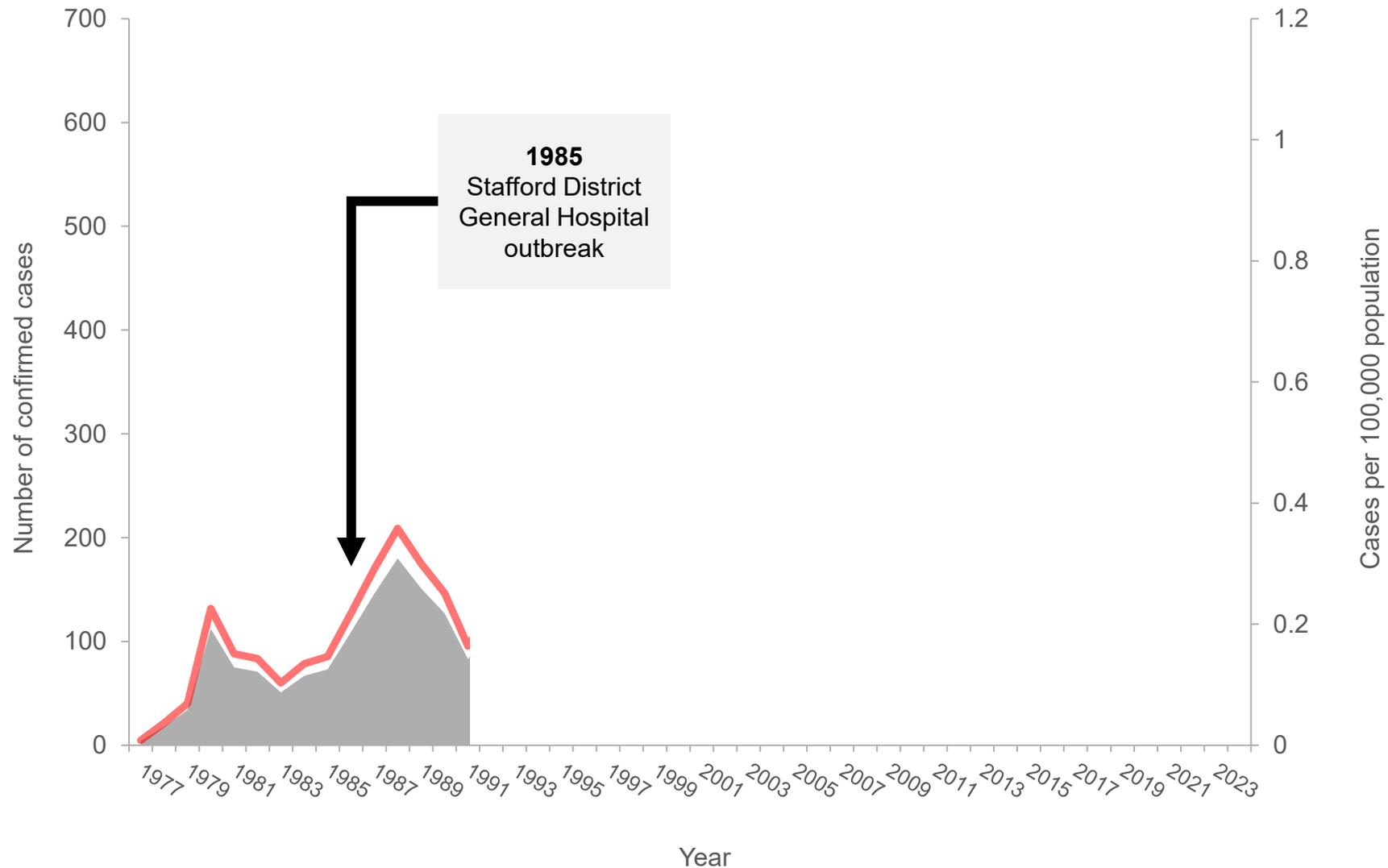
drugs. Two to 3 weeks before going on holiday he was off work with a respiratory illness which responded to tetracycline.

On account of the severity of the illness the patient was treated with continuous oxygen; ampicillin and gentamicin were administered intravenously as a continuous drip saline infusion. Diabetes was controlled satisfactorily throughout the illness with insulin. On the evening of the day of admission bacteraemic shock ensued and intravenous hydrocortisone was added to the therapy. From this shocked state he made a good recovery but the condition of his right lung gave cause for concern.

From the tenth day of the illness abdominal colic was followed by gross distension of the abdomen.

“Members of an organised tour returned from holiday in Benidorm, Spain... All of them suffered from an unexplained respiratory illness”

History of Legionnaires' disease epidemiology in England and Wales



1985

Stafford District General Hospital outbreak

- 175 cases and 28 deaths

The Stafford outbreak of Legionnaires' disease

M. C. O'MAHONY¹, R. E. STANWELL-SMITH¹, H. E. TILLET¹,
 D. HARPER¹, J. G. P. HUTCHISON², I. D. FARRELL²,
 D. N. HUTCHINSON³, J. V. LEE⁴, P. J. DENNIS⁴, H. V. DUGGA⁴,
 J. A. SCULLY⁵ AND C. DENNE⁵

¹Public Health Laboratory Service Communicable Disease Surveillance Centre,
 61 Colindale Avenue, London NW9 5EQ

²Birmingham Public Health Laboratory, East Birmingham Hospital,
 Bordesley Green East, Birmingham B9 5ST

³Preston Public Health Laboratory, Meadow Street, Preston PR1 6PB

⁴Public Health Laboratory Service Centre for Applied Microbiology and Research,
 Porton Down, Salisbury SP4 0JG

⁵Mid-Staffordshire District Health Authority, Corporation Street,
 Stafford ST16 3SR

(Accepted 1 January 1990)

SUMMARY

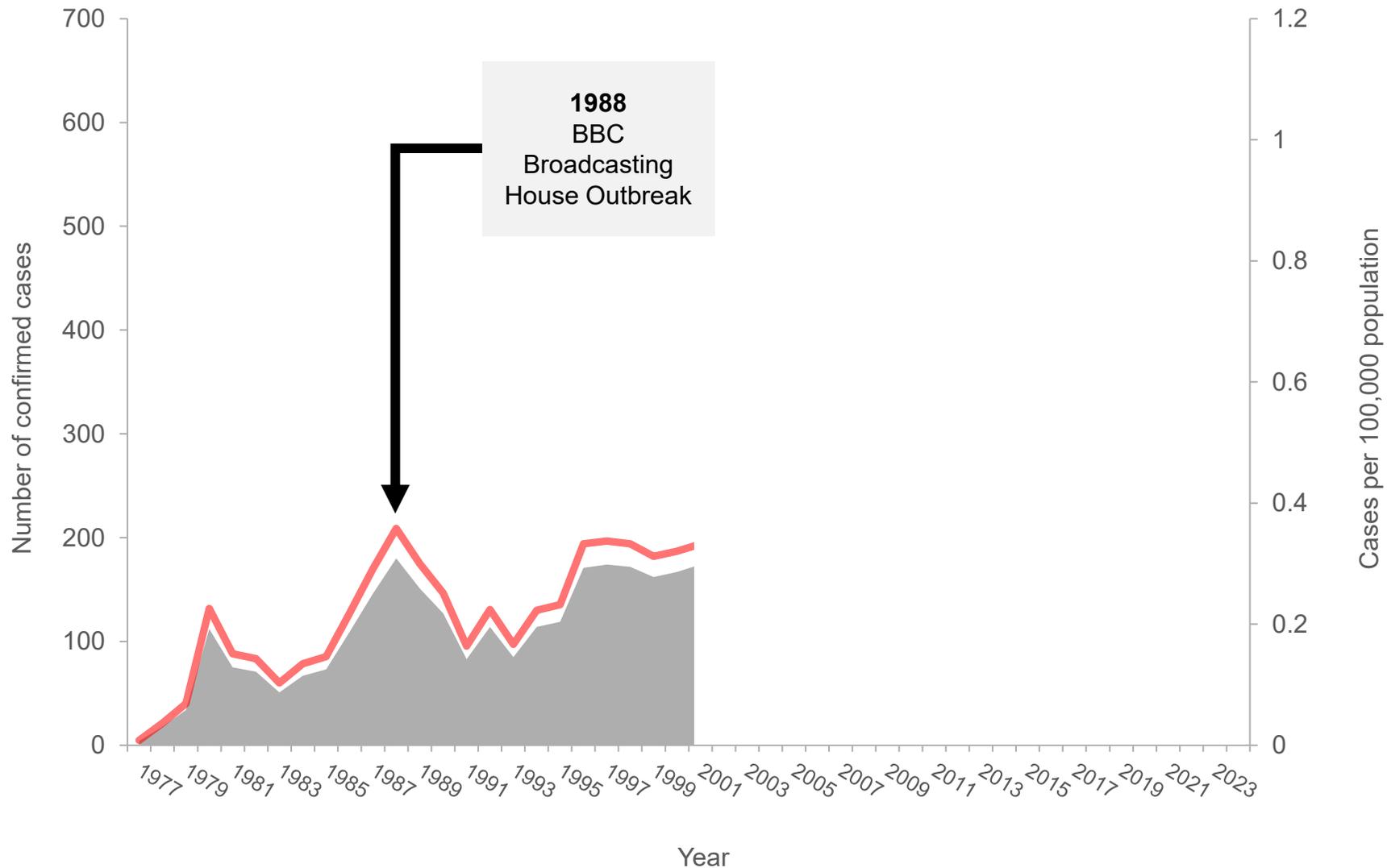
A large outbreak of Legionnaires' disease was associated with Stafford District General Hospital. A total of 68 confirmed cases was treated in hospital and 107 of these patients died. A further 35 patients, 14 of whom were treated at home, were suspected cases of Legionnaires' disease. All these patients had visited the hospital during April 1985. Epidemiological investigations demonstrated that there had been a high risk of acquiring the disease in the out patient department (OPD) but no risk in other parts of the hospital. The epidemic strain of *Legionella pneumophila*, serogroup 1, subgroup Pontiac 1a was isolated from the water system of one of the air conditioning plants. This plant served the OPD and other departments of the hospital including the OPD. The water in the cooling tower was contaminated with the epidemic strain of *Legionella pneumophila*.



- **The Badenoch Inquiry** concluded that the water system in the cooling tower serving the maternity unit, theatres and the out-patient department
- Heavily contaminated with *Legionella pneumophila*, which had multiplied when the system was turned off over the long Easter weekend.
- Infected water draining from the roof cooling-tower drip-trays to be sucked into the air coolers serving the department.

Figure 1: Cartoon illustrating an article in the Observer newspaper on Sunday 11 August 1985, page 19, about Legionnaires' disease following the Stafford Hospital outbreak. *The Observer*, 1985. Reproduced with permission.

History of Legionnaires' disease in England and Wales



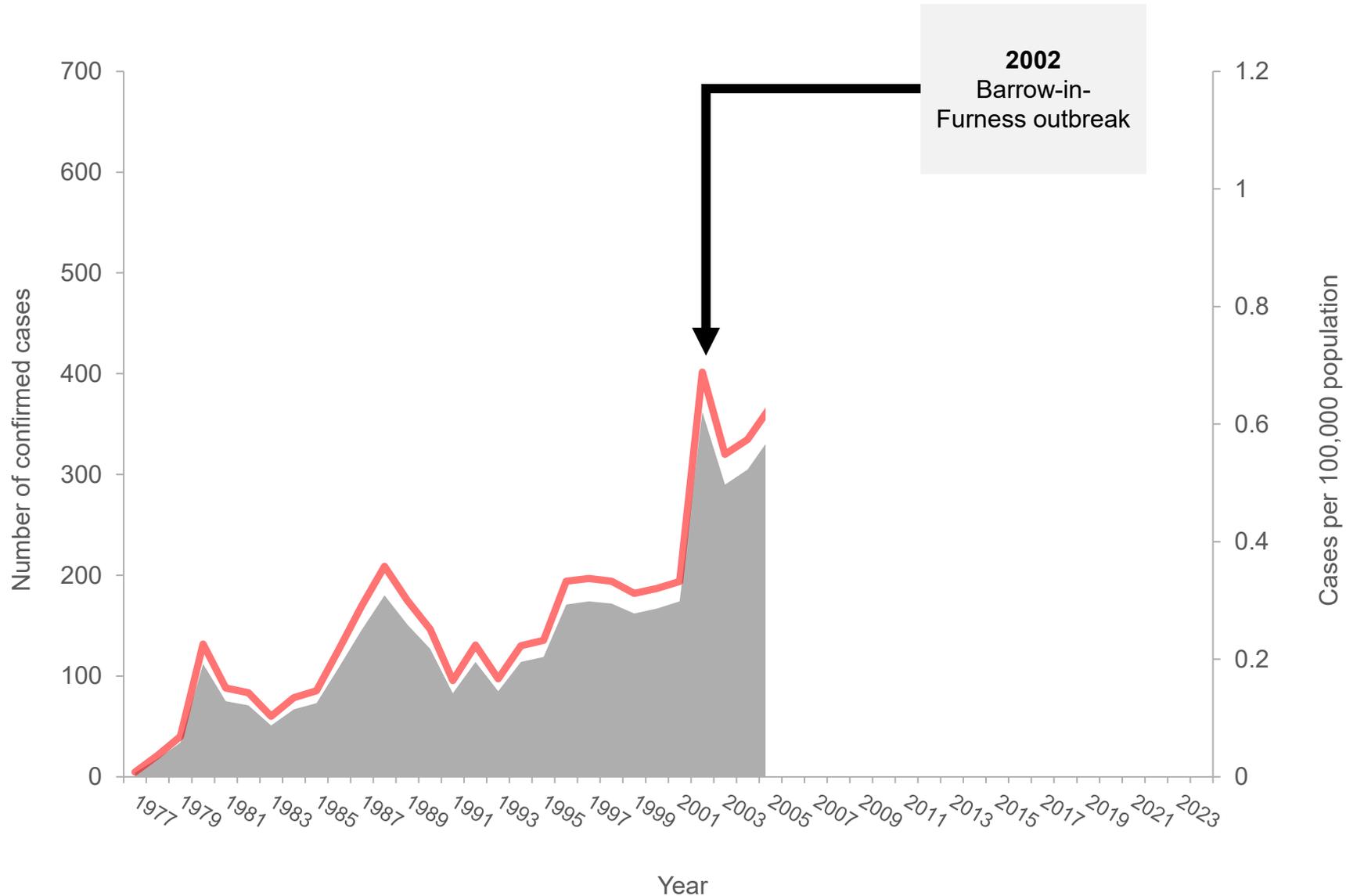
1988

Large outbreak and BBC's broadcasting house in London

79 cases and 3 deaths

Commons employment committee inquiry found cooling tower to be source of outbreak

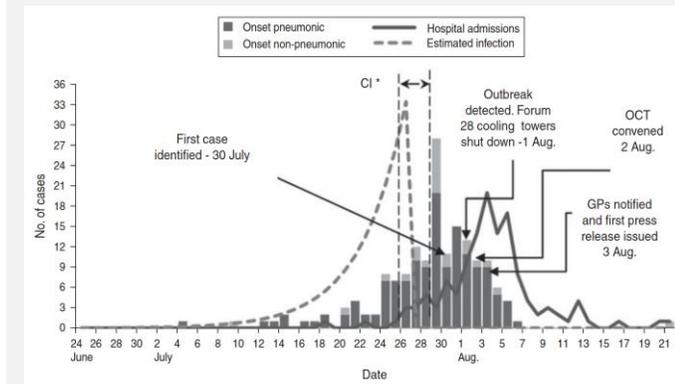
History of Legionnaires' disease in England and Wales



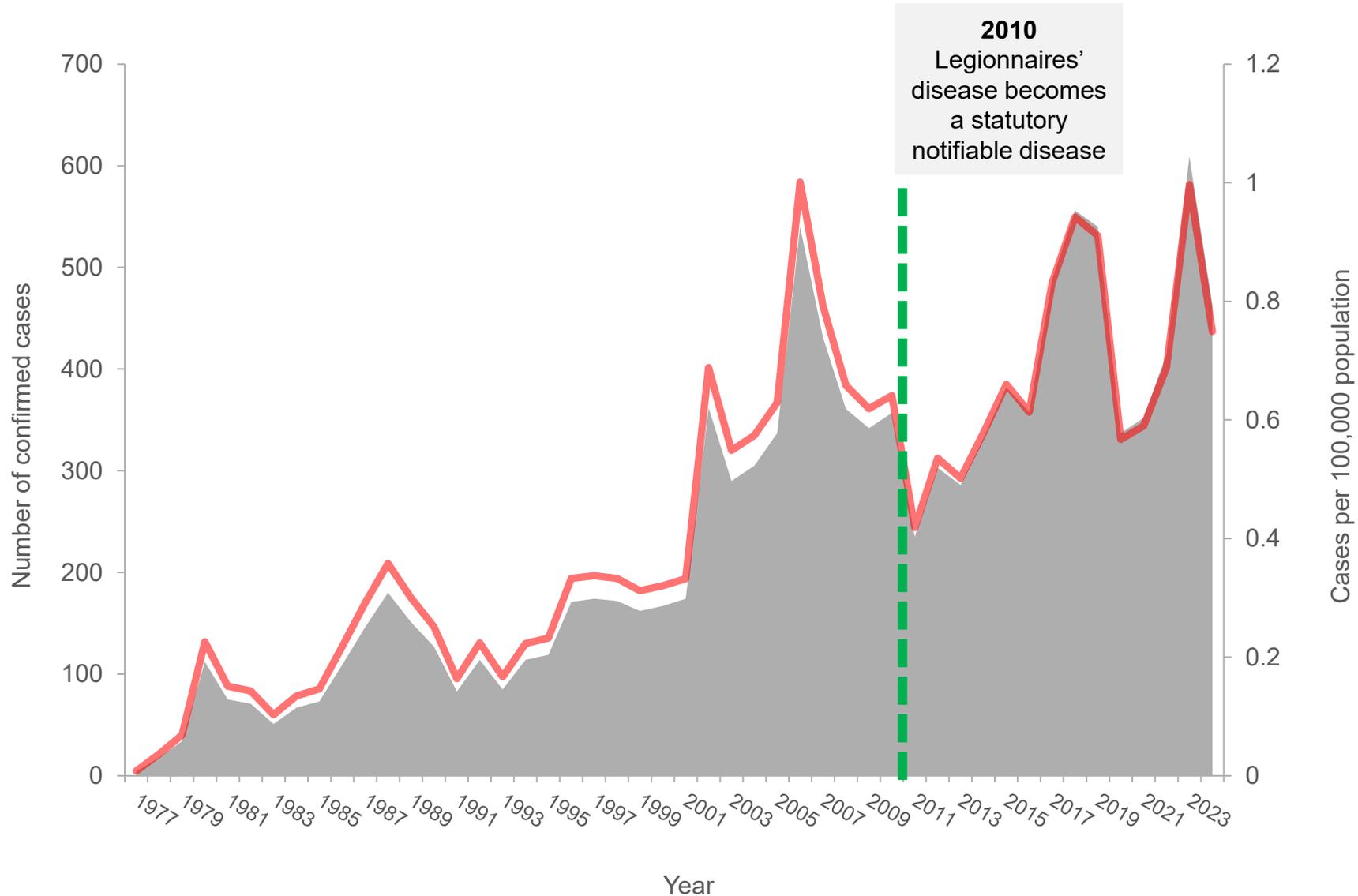
2002

Large community outbreak in Barrow-in-Furness

- 179 cases and 7 deaths
- Outbreak traced to air-conditioning unit at an Arts and Leisure centre



History of Legionnaires' disease in England and Wales



2010

Legionnaires' disease becomes a statutory notifiable disease

- All healthcare professionals legally required to notify public health agency of a suspected or confirmed case of Legionnaires' disease

STATUTORY INSTRUMENTS

2010 No. 659

PUBLIC HEALTH, ENGLAND

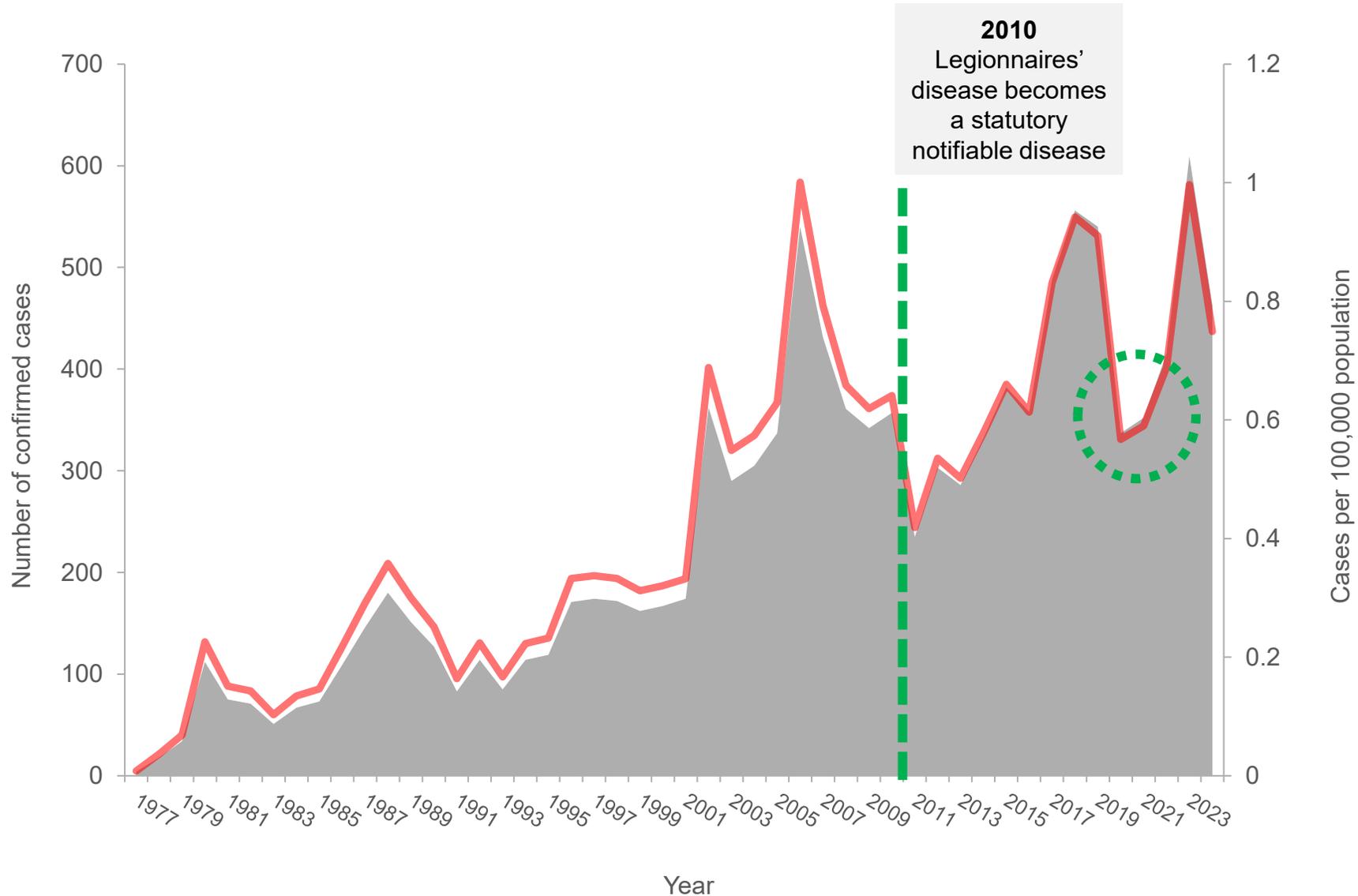
The Health Protection (Notification) Regulations 2010

<i>Made</i>	<i>9th March 2010</i>
<i>Laid before Parliament</i>	<i>11th March 2010</i>
<i>Coming into force</i>	
<i>for the purpose of all regulations except regulation 4</i>	
	<i>6th April 2010</i>
<i>for the purpose of regulation 4</i>	
	<i>1st October 2010</i>

The Secretary of State makes the following Regulations in exercise of the powers conferred by sections 13, 45C(1), (2) and (3)(a), 45F(2)(a) and (b), 45P(2) and 60A of the Public Health (Control of Disease) Act 1984 [M1](#).

In accordance with section 45Q(3) of the Public Health (Control of Disease) Act 1984, the Secretary of State declares that he is of the opinion that these Regulations do not contain any provision made by virtue of section 45C(3)(c) of that Act which imposes or enables the imposition of a special restriction or requirement or any other restriction or requirement which has or would have a significant effect on a person's rights.

History of Legionnaires' disease in England and Wales



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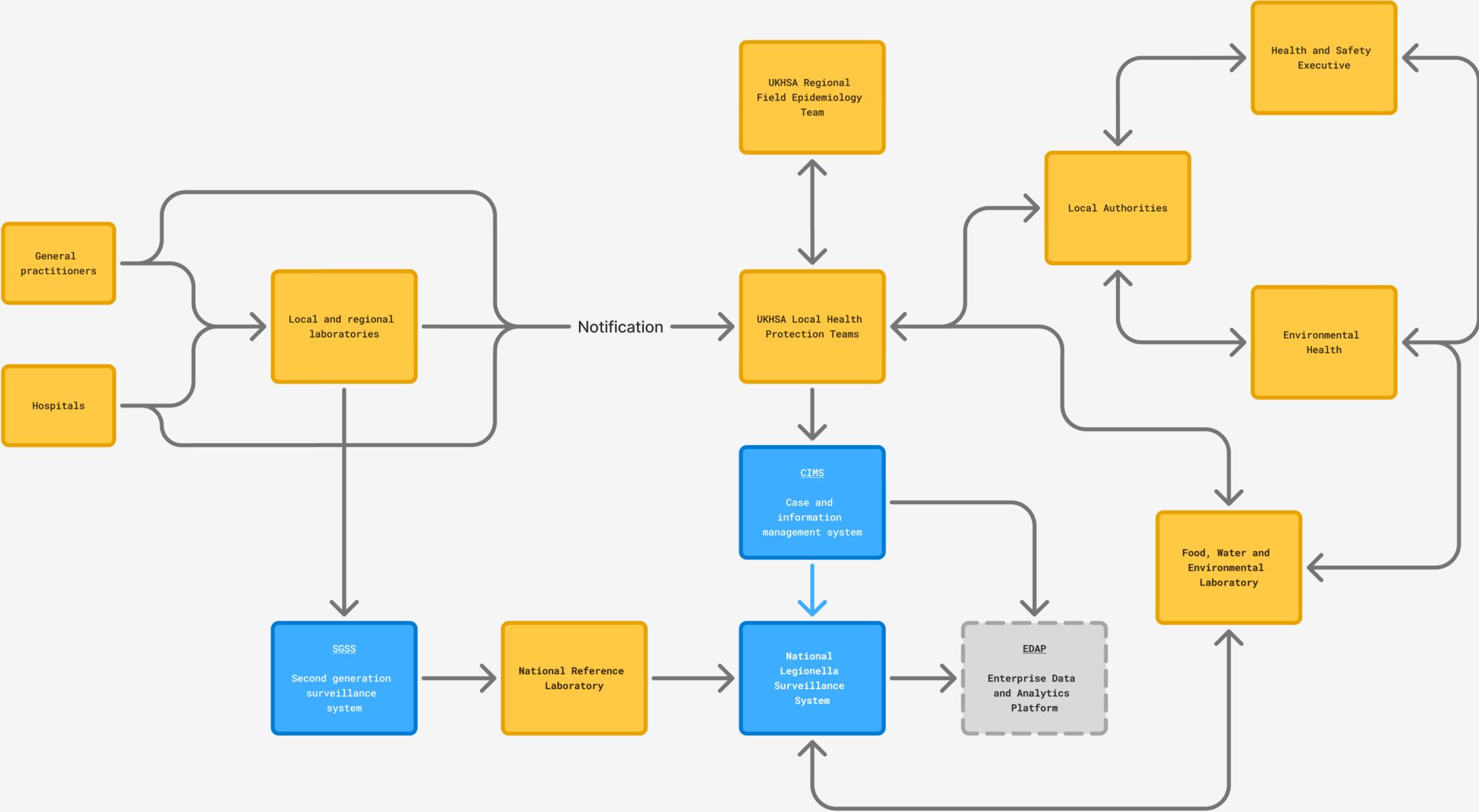
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Systems working



Systems working

Local

General practitioners

Hospitals

Local laboratories

Local authorities

Environmental health

HSE

Regional

Health protection teams

UKHSA Regional Field
Epidemiology teams

FWE Outposted scientists

National

UKHSA National Surveillance
teams

International Health
Regulations National Focal
Point

UKHSA National Reference
laboratory

Food Water and
Environmental laboratory

Health and Safety Executive

International

European Legionella
Networks

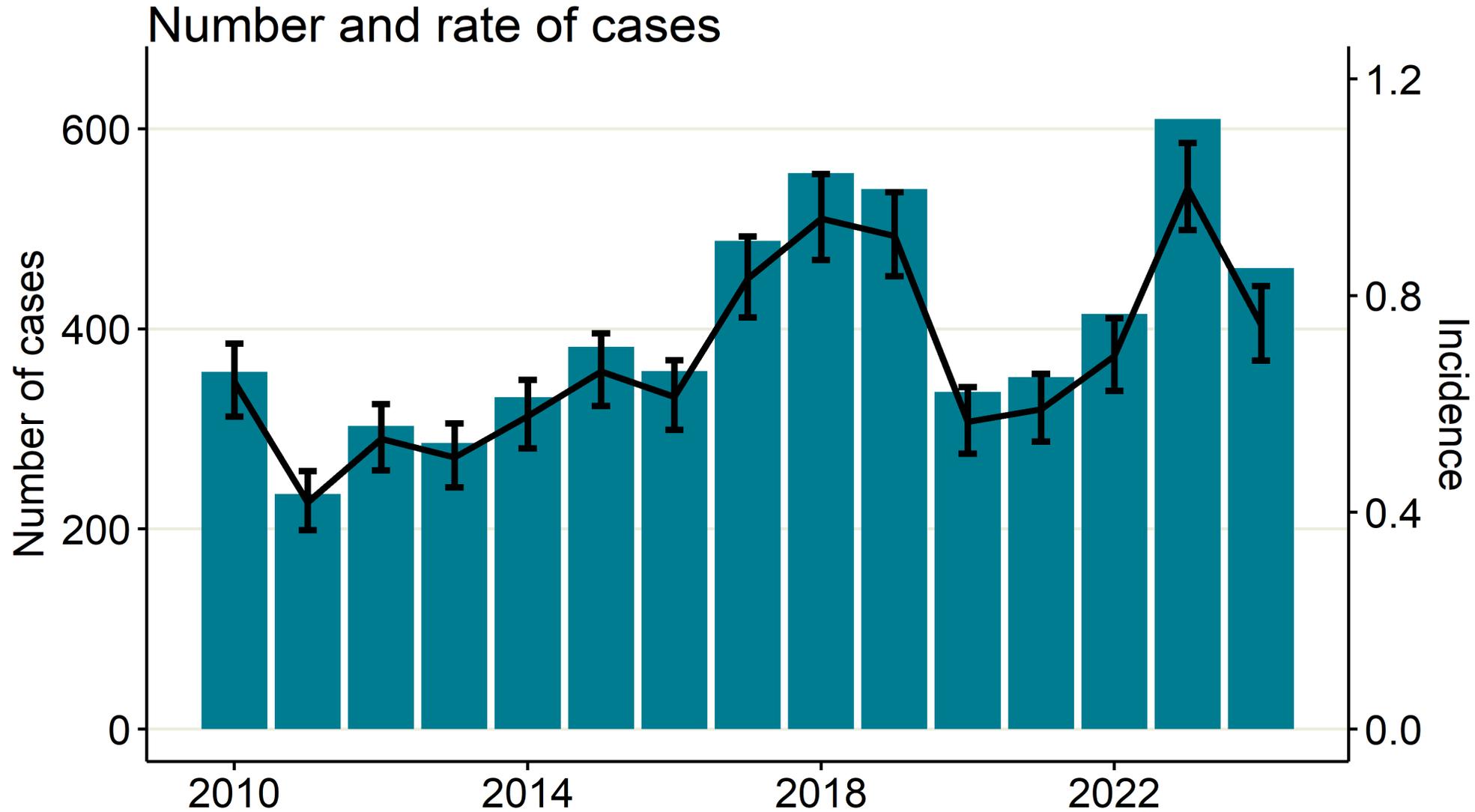
WHO

ECDC

Association of British Travel
Agents

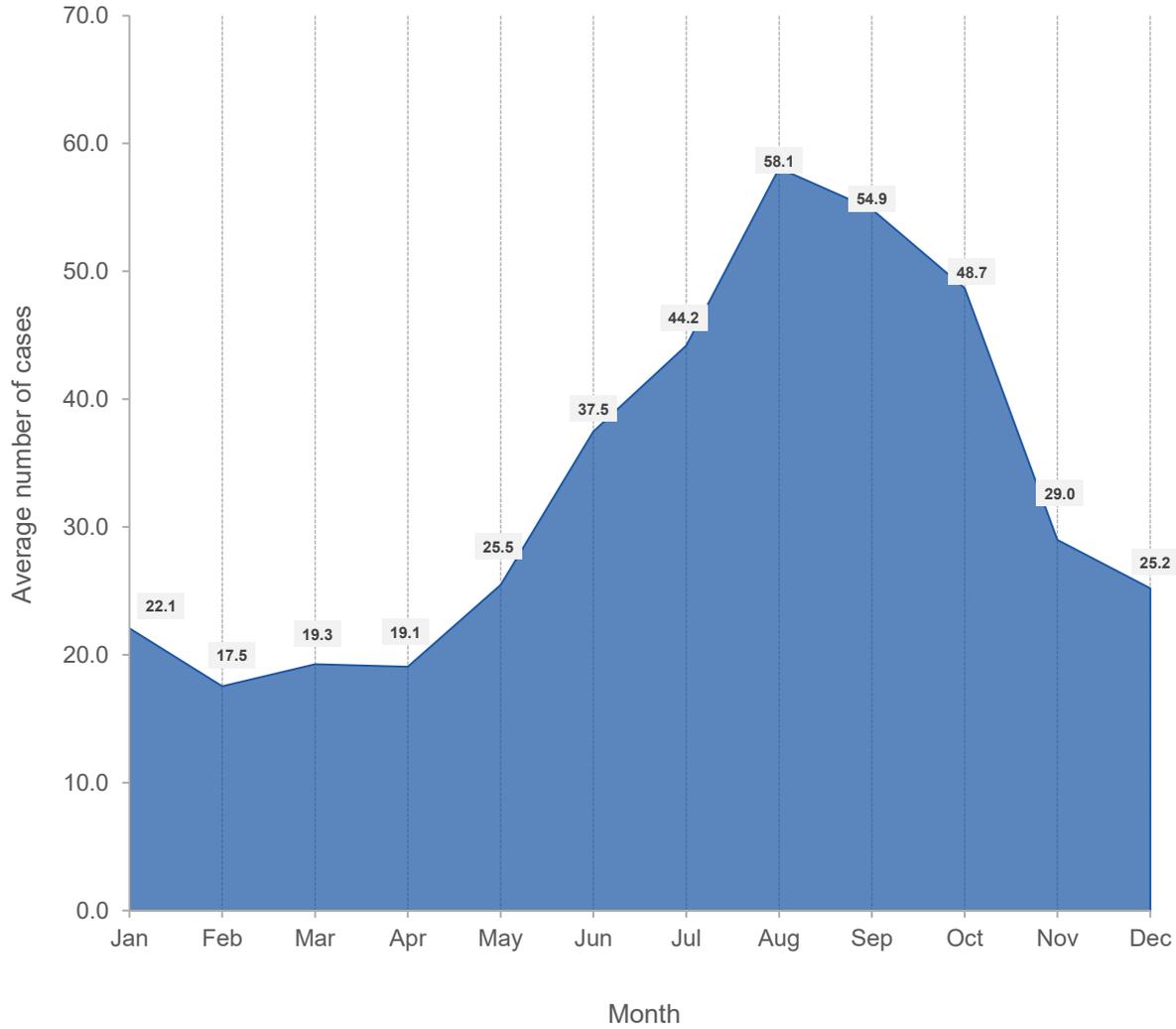
Bilateral relationships

Incidence



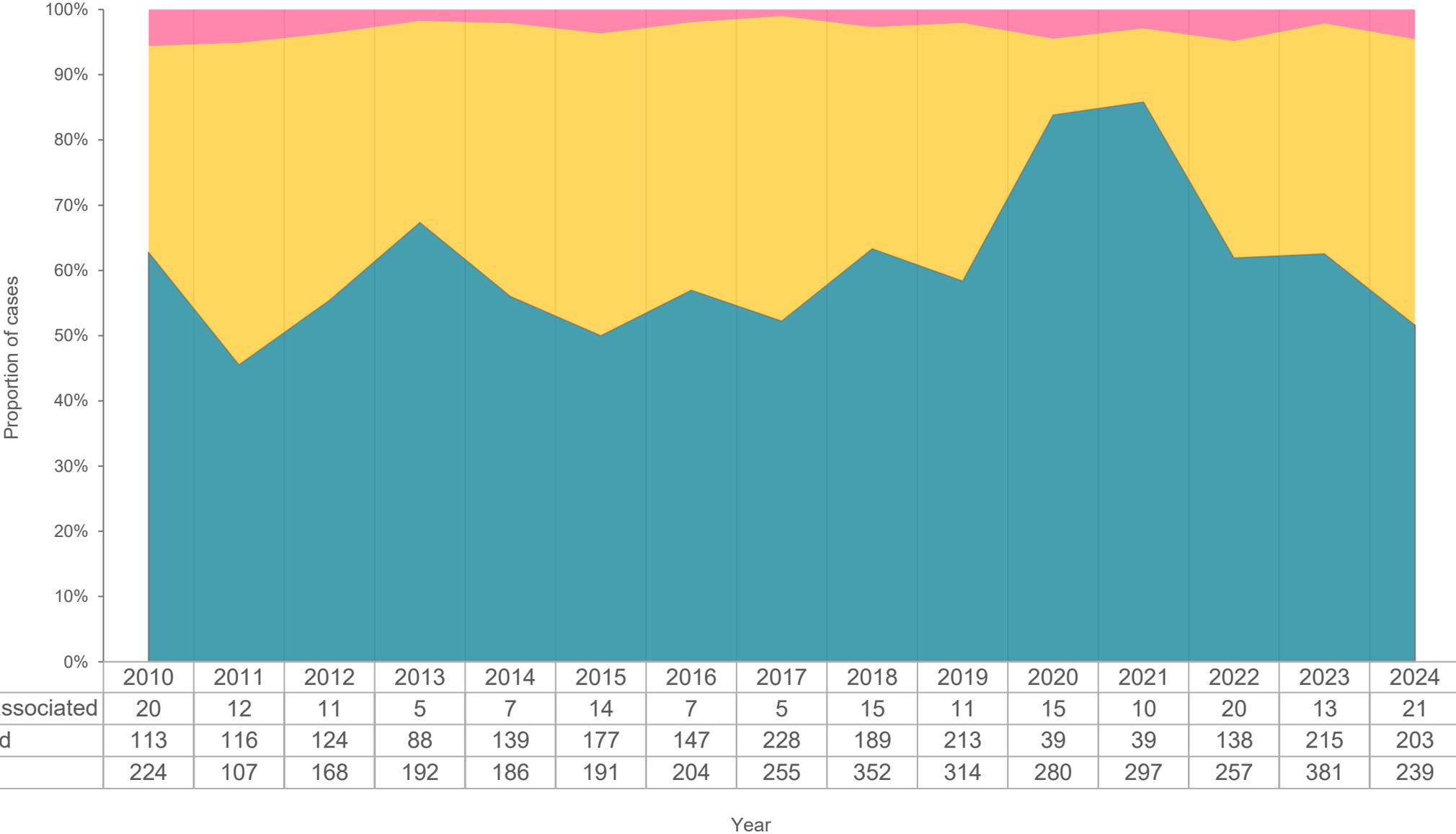
Seasonality

Cases by month, 2010 to 2024



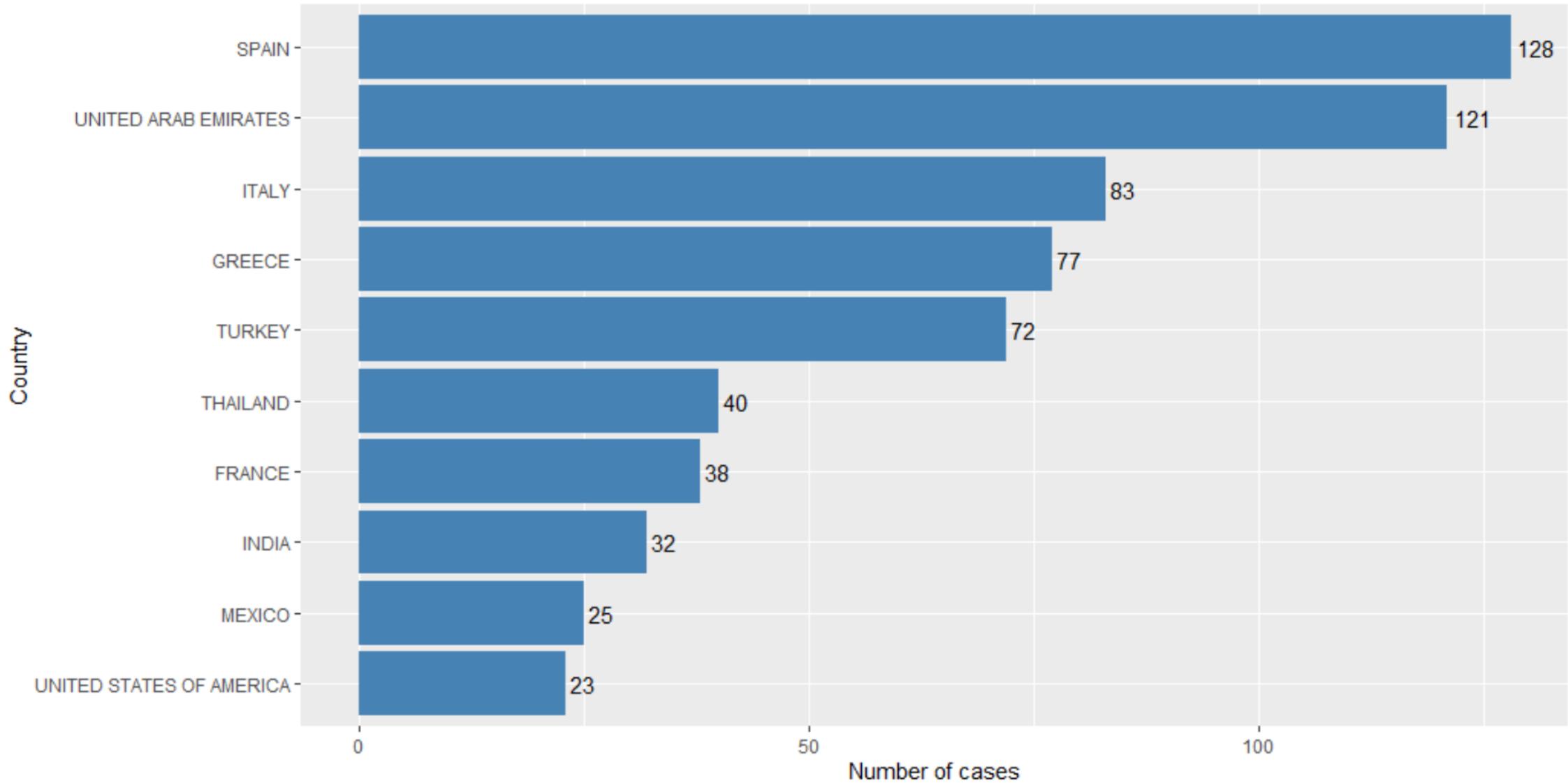
Year / month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2010	30	12	15	16	22	30	37	59	48	36	27	25
2011	15	13	16	11	10	20	19	24	35	31	24	17
2012	23	12	18	13	17	31	40	38	32	43	21	15
2013	15	8	17	12	20	26	22	63	48	29	18	8
2014	24	16	17	17	24	26	42	36	45	56	16	13
2015	19	19	19	14	30	39	39	53	54	33	36	27
2016	23	15	16	14	22	37	31	42	57	50	26	25
2017	19	21	19	27	27	46	55	70	84	60	28	32
2018	17	29	25	20	30	53	38	108	91	64	41	40
2019	29	21	18	26	30	63	66	83	58	69	35	42
2020	32	24	18	16	13	25	51	59	37	41	13	8
2021	11	20	14	23	19	37	40	57	37	41	29	24
2022	16	12	16	22	30	33	37	46	70	57	45	31
2023	33	22	26	17	46	58	103	75	75	67	48	39
2024	25	19	35	38	42	38	43	58	52	53	28	32

Exposure type

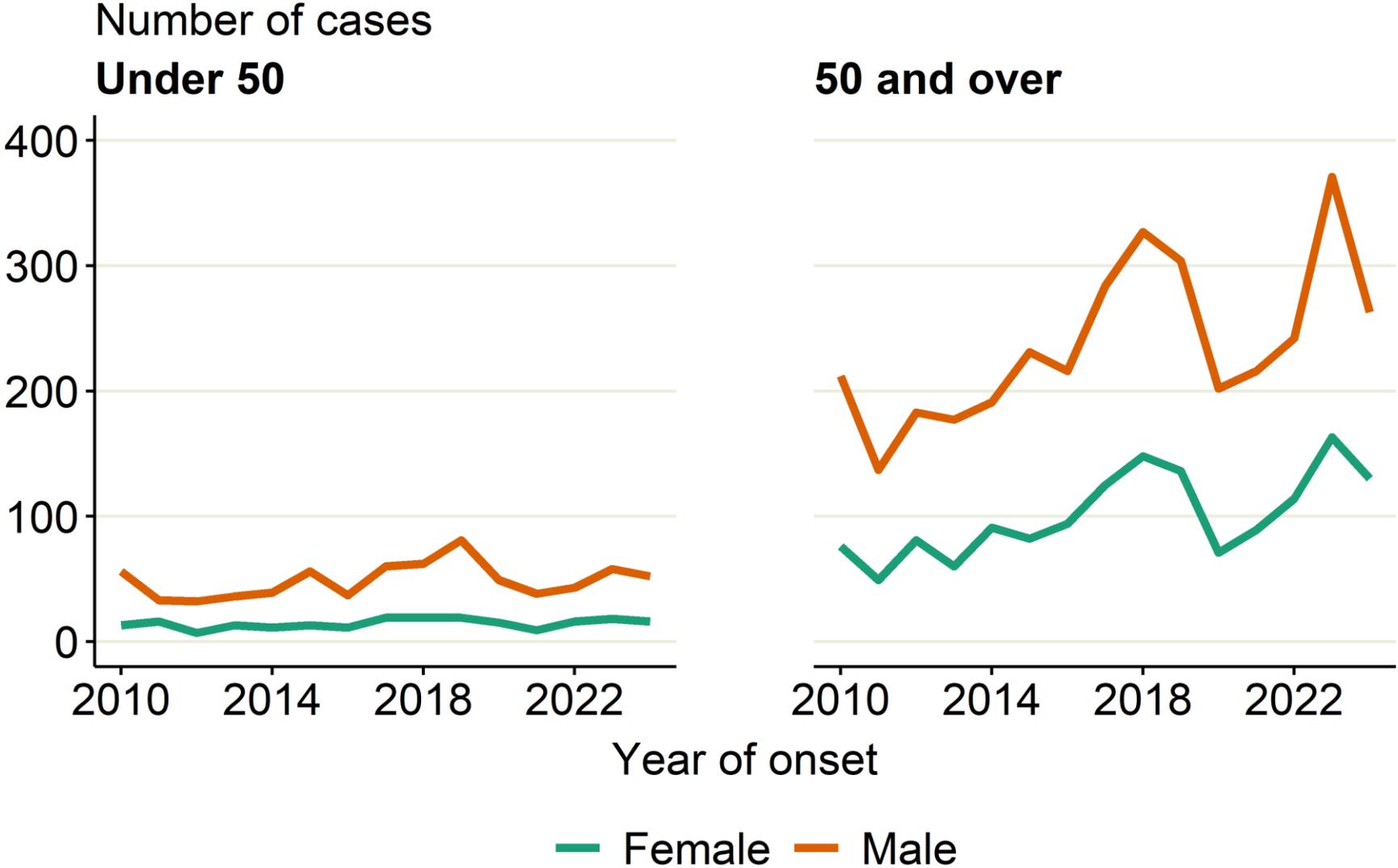


Travel associated cases

Top 10 Countries for Legionella Travel Cases 2020 - 2025

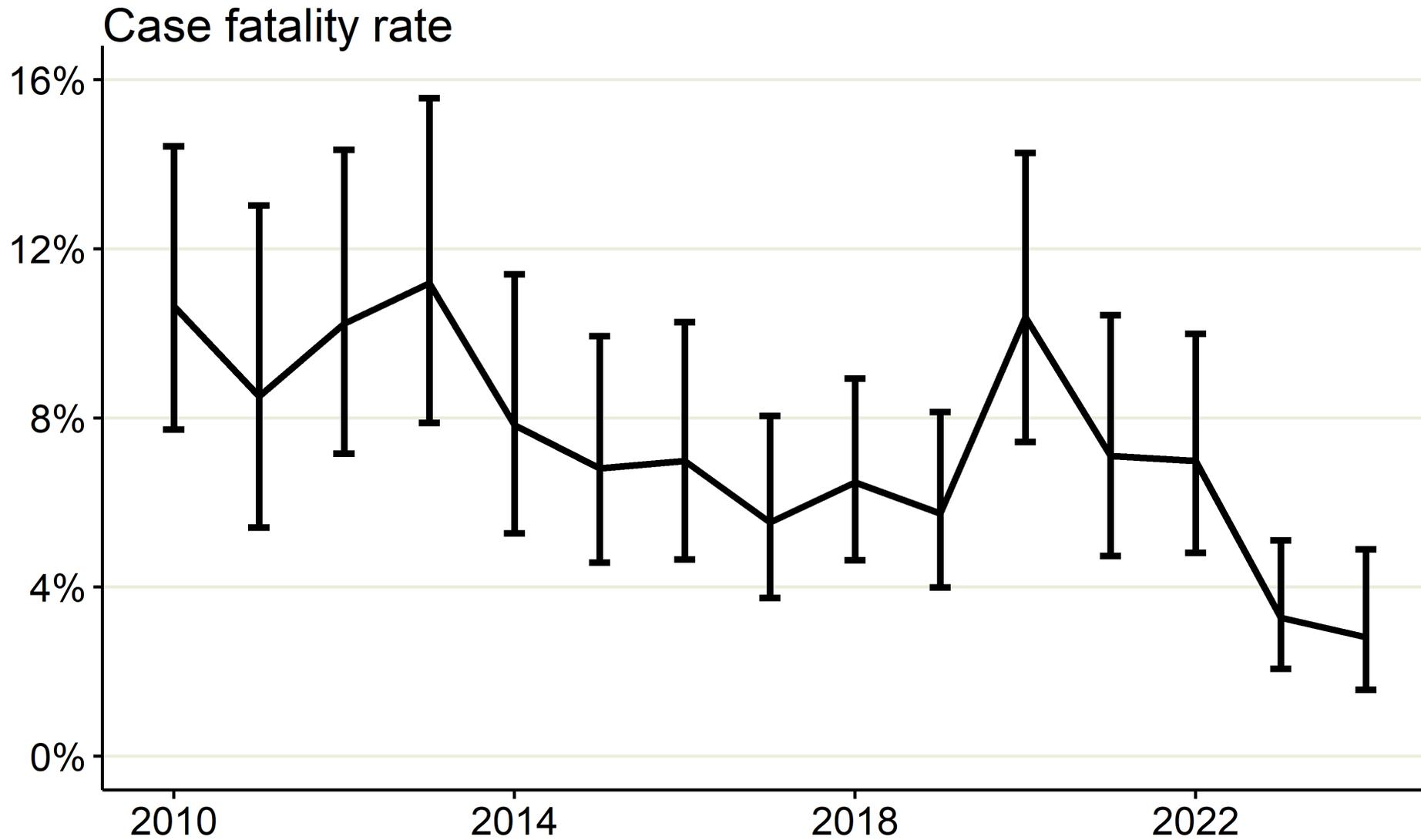


Age and sex

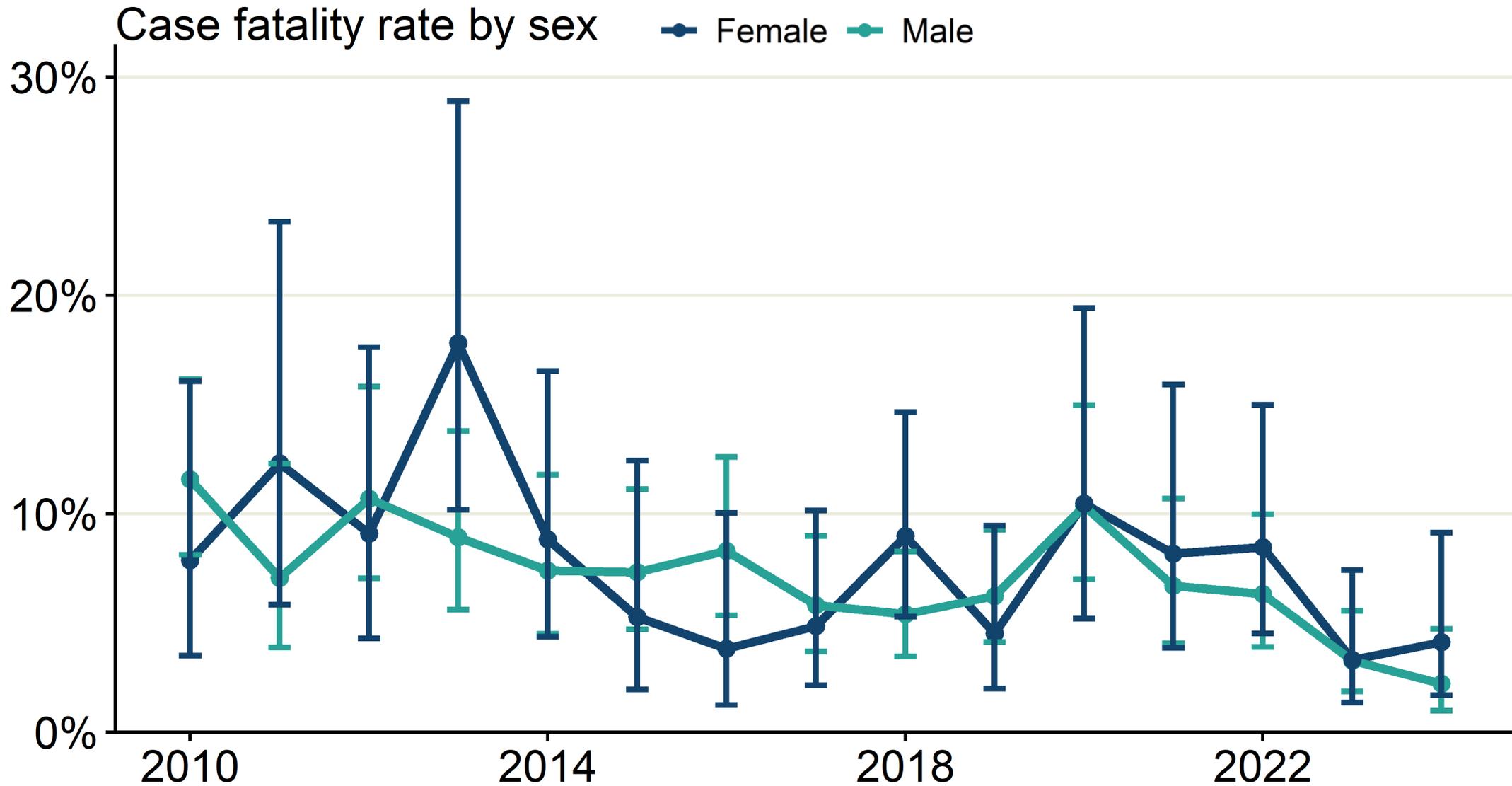


Mortality

Error bars represent 95% confidence intervals

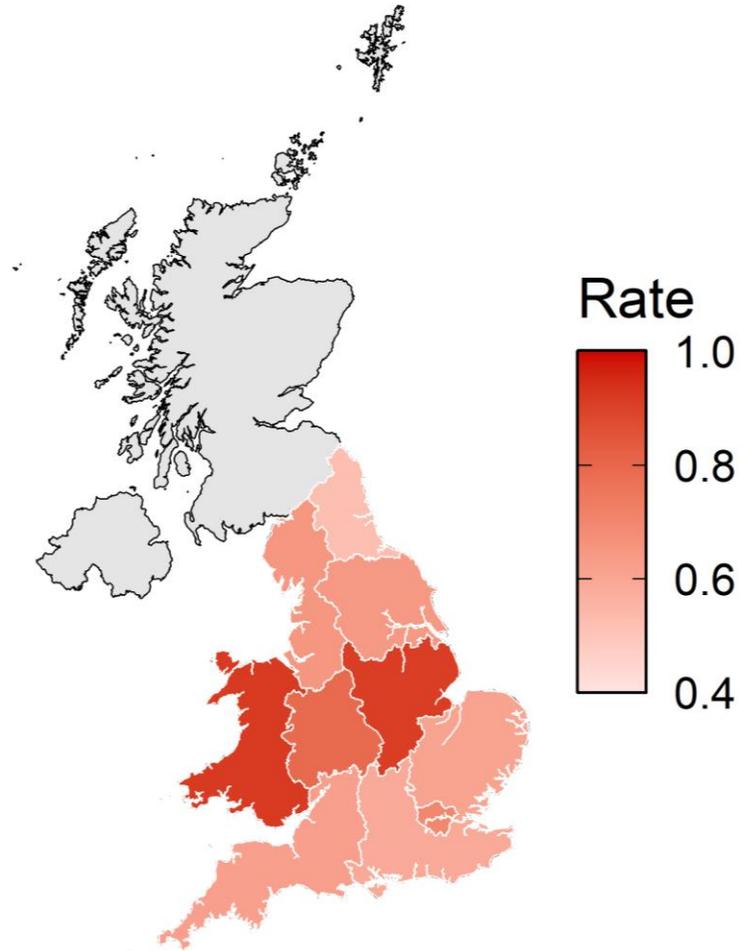


Mortality by sex



Cases by region

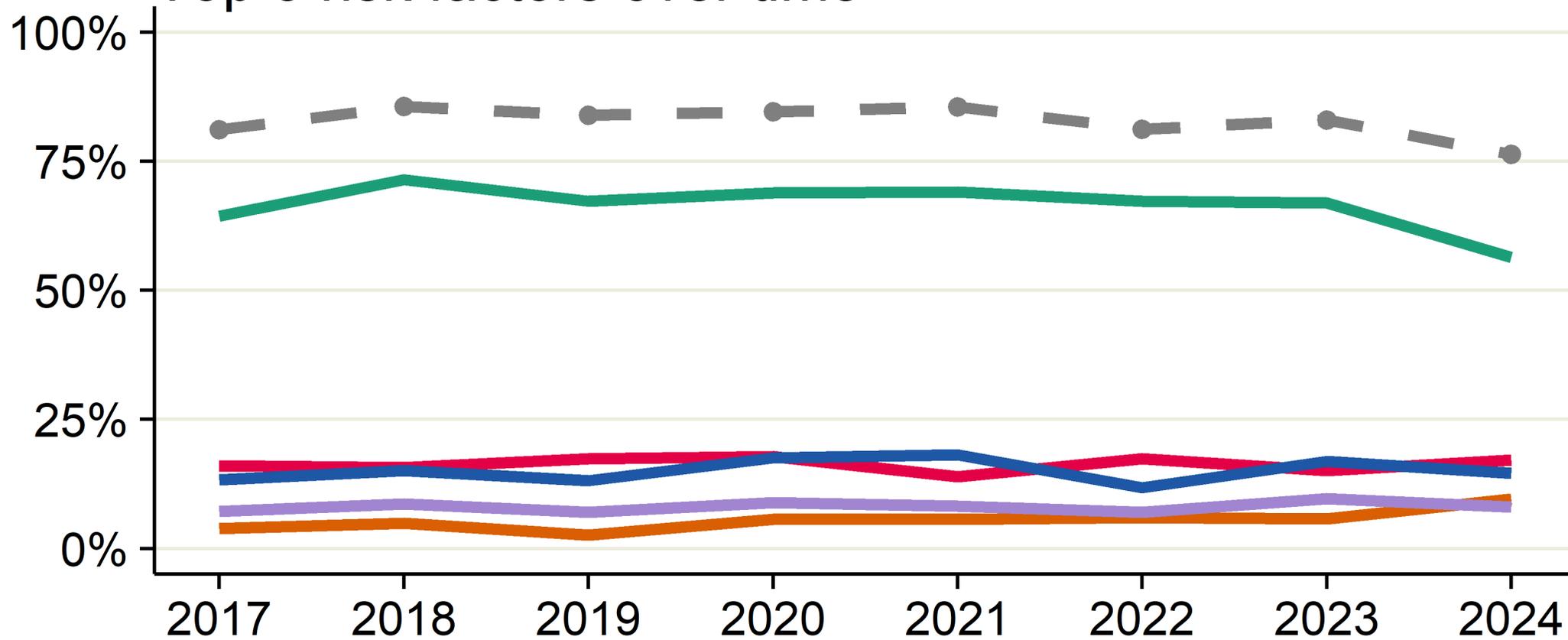
Rate per 100,000 population, 2010 to 2024



Region / Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	Total rate
East Midlands	0.8	0.6	0.7	0.6	1.0	0.7	1.1	1.0	1.3	1.0	0.8	0.7	0.8	1.2	1.3	0.9
Wales	1.4	0.8	0.7	0.5	0.9	0.6	0.7	0.9	1.1	1.3	0.6	1.1	0.8	1.3	1.1	0.9
West Midlands	0.7	0.4	0.9	0.8	0.7	0.8	0.8	0.9	1.1	1.3	0.7	0.5	0.6	1.2	0.6	0.8
London	0.7	0.3	0.5	0.7	0.6	0.7	0.5	0.9	1.1	0.9	0.5	0.7	0.7	1.1	0.7	0.7
North West	0.4	0.4	0.5	0.3	0.6	0.6	0.5	0.9	0.7	1.0	0.5	0.6	0.8	1.1	0.8	0.6
Yorkshire and The Humber	0.7	0.4	0.3	0.4	0.4	0.7	0.6	1.1	1.0	0.9	0.5	0.6	0.7	0.7	0.6	0.6
South West	0.6	0.5	0.6	0.3	0.6	0.7	0.5	0.7	0.9	1.1	0.5	0.5	0.7	0.7	0.6	0.6
East of England	0.6	0.3	0.5	0.6	0.2	0.4	0.6	0.8	1.0	0.7	0.6	0.5	0.6	1.0	0.7	0.6
South East	0.5	0.3	0.3	0.4	0.5	0.6	0.6	0.6	0.7	0.7	0.6	0.6	0.7	1.1	0.7	0.6
North East	0.7	0.5	0.5	0.4	0.6	1.0	0.5	0.5	0.7	0.3	0.3	0.0	0.3	0.6	0.7	0.5

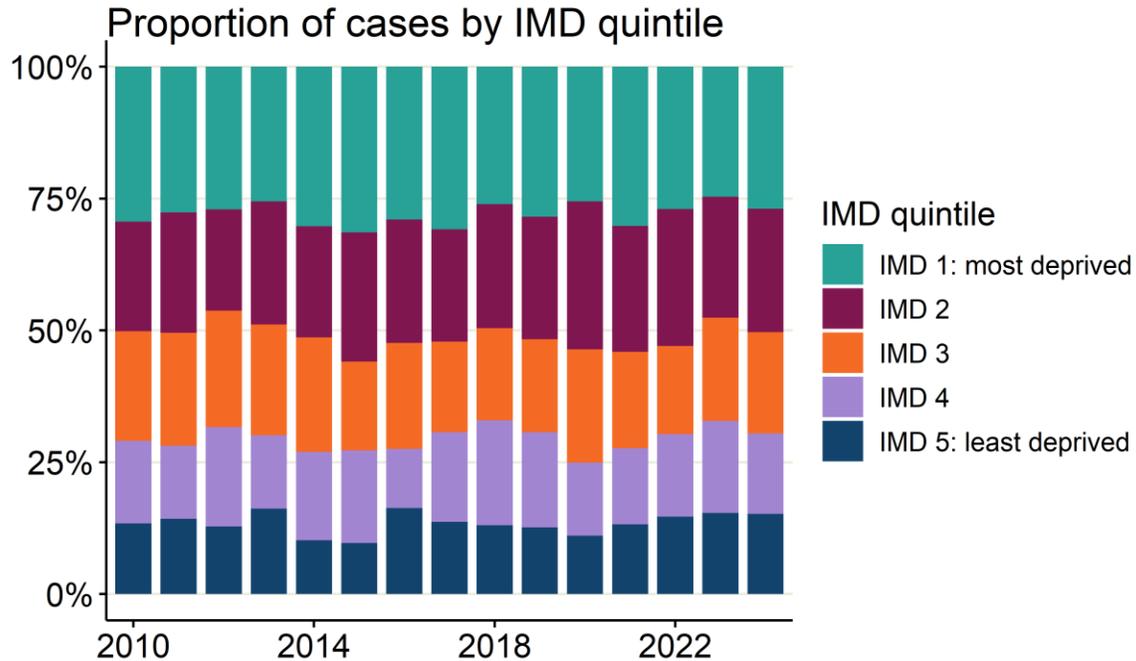
Risk factors

Top 5 risk factors over time



- At least one condition
- Smoking
- Diabetes
- Heart conditions
- Immunosuppressed
- Neoplasms

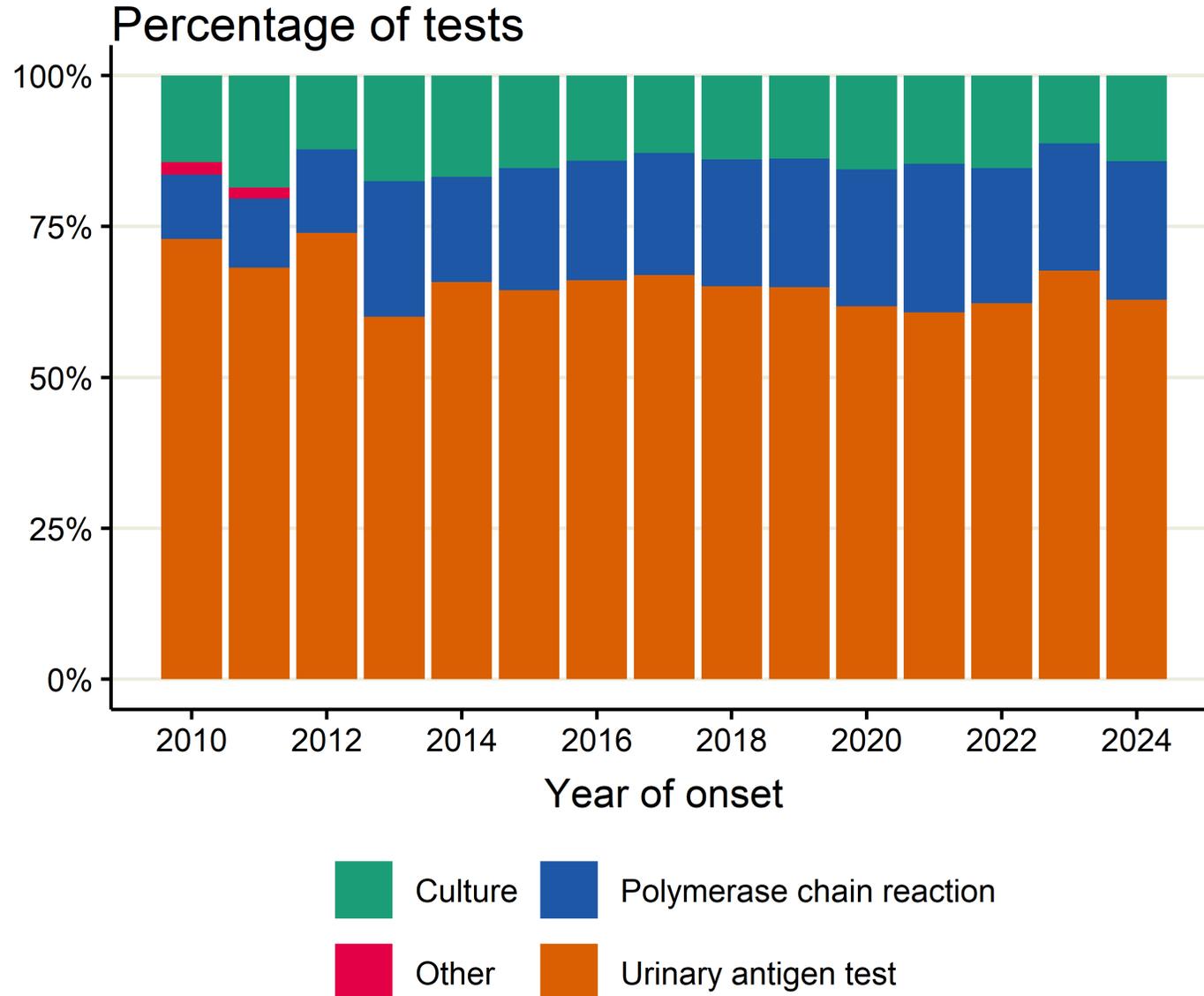
Index of multiple deprivation (IMD)



- There is a consistent association of Legionnaires' disease with deprivation
- 1 in 3 cases of LD live in the most deprived quintiles of England.

IMD Quintile / Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
IMD 1: most deprived	29.4	27.6	27.0	25.6	30.3	31.4	29.0	30.9	26.1	28.5	25.6	30.2	27.0	24.7	26.9
IMD 2	20.8	22.9	19.2	23.3	21.1	24.5	23.4	21.3	23.6	23.2	28.1	23.9	26.0	22.9	23.4
IMD 3	20.8	21.4	22.1	21.1	21.7	16.8	20.1	17.2	17.4	17.6	21.5	18.2	16.7	19.6	19.2
IMD 4	15.7	13.8	18.9	13.9	16.8	17.6	11.2	17.0	19.9	18.0	13.9	14.5	15.7	17.5	15.2
IMD 5: least deprived	13.4	14.3	12.8	16.2	10.2	9.6	16.3	13.7	13.0	12.6	11.0	13.2	14.7	15.3	15.2

Microbiology:



- Majority of cases are confirmed by Urinary Antigen test
- Does not allow for typing or identification of non-pneumophila serogroup 1 species
- Culture of lower respiratory tract samples remains gold standard and allows for sequence typing and whole genome sequencing
- **Enables more detailed matching to environmental sampling for outbreak investigations**
- **CHALLENGE: Currently only 40-50% of cases submit a lower respiratory tract sample**

Key lessons

- Good communication and systems working across organisations is key
- More detailed and granular geolocation data
- Matching environmental samples to clinical samples
- Quicker cluster detection methodologies
- Improve proportion of lower respiratory tract samples to allow for sequence typing

Reflections and challenges

- Impact on climate and weather
 - Better study designs required
- Ageing population
- Prevention
 - Improved international engagement for travel associated cases
- Outbreak detection and response
 - Up to date and geolocated cooling tower registry a major gap
 - Trawling questionnaires for 'sporadic' community cases and clusters with no obvious sources
 - New sources of potential risk – e.g. Heat pumps

The discovery of Legionella



Dr. Joseph McDade is best known for isolating and identifying *Legionella pneumophila*, the bacterium that causes 'Legionnaires' disease'. (Public domain image, CDC)

It was a moment that would play an important part in McDade's future discovery and it took place at a Christmas party among casual acquaintances. McDade had spent months earlier investigating the source of the outbreak with no success.

McDade recalls a man had approached him at the party. They'd never met before.

"I can't remember his name, I can't remember what he looks like, but I can remember what he said. He said he was just really disappointed in the CDC. He said,

'I know some of you scientists are sort of, kind of strange, but we count on you when these sorts of things come up, that you're able to figure these things out,'

The interaction motivated him to go back to the lab immediately and try harder to figure out what he might have missed.

McDade later went on to be the first to successfully isolate and identify *Legionella pneumophila*.

Acknowledgements

- **Bee Afshar** – Head of Legionella Reference Laboratory
- **Sandra Lai** – Head of Colindale Food, Water and Environment Laboratory
- **David Howett** – Principal epidemiologist
- **Hanna Squire** – Senior Epidemiologist
- **Umut Karabacak** – Epidemiologist
- **Rodney Ruhesi** – Analyst
- **Falguni Naik** – Senior Epidemiologist



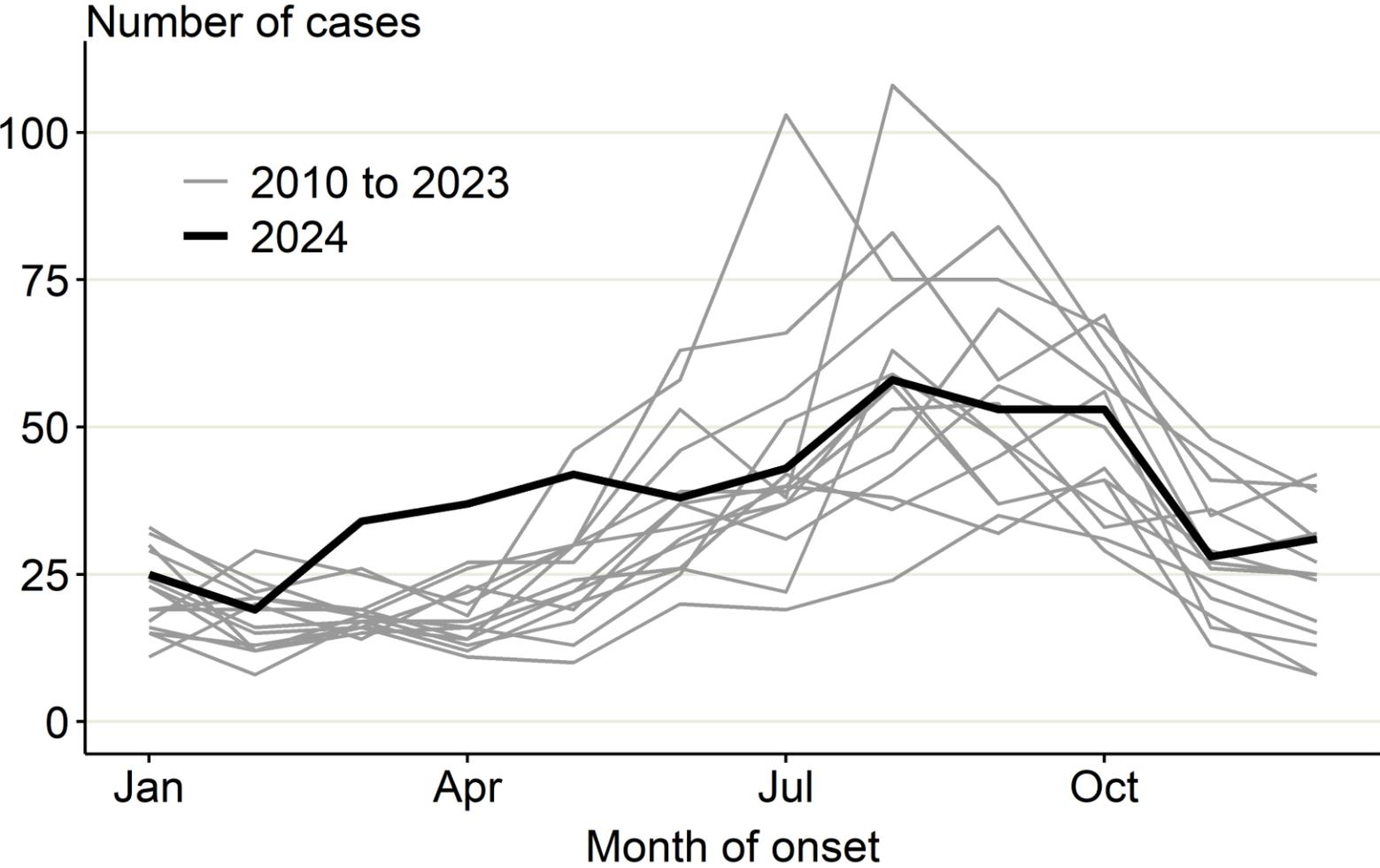


Thank you

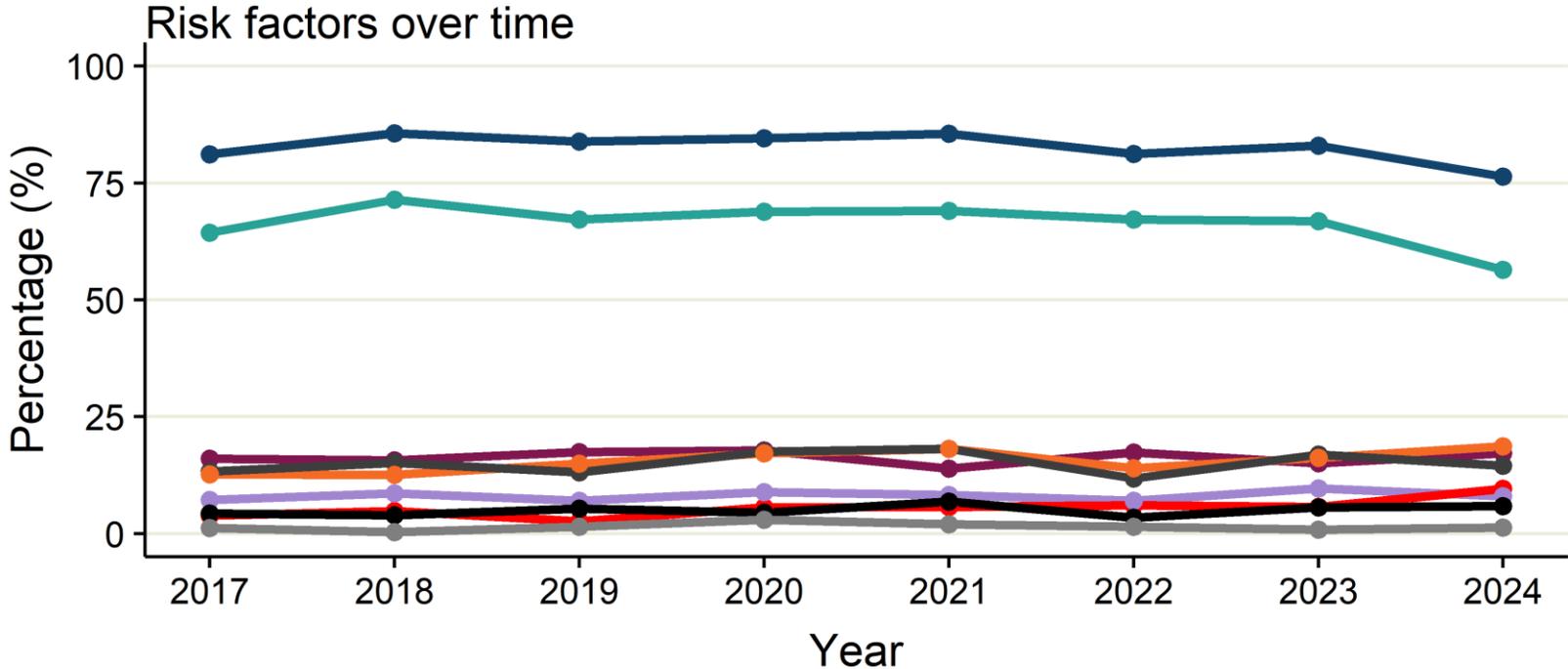
Legionella@ukhsa.gov.uk

Seasonality

Average cases by month, 2010 to 2024



All risk factors over time (2017 to 2024)



- Risk factor
- At least one condition
 - Smoking
 - Diabetes
 - Respiratory conditions
 - Heart conditions
 - Neoplasms
 - Immunosuppression
 - Renal conditions
 - Liver conditions

Cases by species

Species	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
<i>L. pneumophila</i>	357	234	303	285	330	381	358	485	551	539	327	341	408	597	444
<i>L. longbeachae</i>	0	0	0	1	2	1	0	2	4	1	3	9	6	10	13
<i>L. bozemanai</i>	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>L. wadsworthii</i>	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
<i>L. micdadei</i>	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Not established	0	0	0	0	0	0	0	1	1	0	6	1	1	3	4
Total	357	235	303	286	332	382	358	488	556	540	337	352	415	610	461