

SURVEILLANCE REPORT

Gonorrhoea

Annual Epidemiological Report for 2021

Key facts

- In 2021, 27 EU/EEA countries reported a total of 46 728 confirmed cases of gonorrhoea.
- The overall crude notification rate was 13.7 cases per 100 000 population.
- Rates of reported gonorrhoea infection vary considerably across the EU/EEA.
- Men who have sex with men (MSM) accounted for more than half of the reported cases (55%) in 2021.
- The overall notification rate increased between 2012 and 2019, decreased in 2020 (the first year of the COVID-19 pandemic), then increased in 2021 to levels higher than in 2019.

Introduction

Gonorrhoea is a sexually transmitted infection (STI) caused by the *Neisseria gonorrhoeae* bacterium. Typical genital infections present as urethritis among men and as urethritis and cervicitis among women, but a broad spectrum of clinical presentations and complications can occur. These include epididymitis and prostatitis among men and endometritis and salpingitis among women, as well as systemic dissemination with fever and skin and joint involvement. Throat and ano-rectal infections may also occur, as well as transmission to newborns that leads to conjunctivitis. Many infections are asymptomatic, especially among women, resulting in delayed diagnosis, complications and uninterrupted transmission [1].

Methods

This report is based on data for 2021 retrieved from The European Surveillance System (TESSy) on 3 April 2023. TESSy 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, refer to the Methods chapter of the 'ECDC Annual Epidemiological Report' [2].

An overview of the national surveillance systems is available online [3].

A subset of the data used for this report is available through ECDC's online 'Surveillance Atlas of Infectious Diseases' [4].

In 2021, the majority of countries (22/27) reported data using standard EU case definitions [5]. Three countries reported case numbers based on national case definitions and two countries did not report which case definition they used.

The majority of countries (24/27) report gonorrhoea data from comprehensive surveillance systems. Reporting of gonorrhoea infection is compulsory in these countries. The remaining three countries (Belgium, France and the Netherlands) have sentinel surveillance systems that only capture gonorrhoea diagnoses from a selection of healthcare services [3]. These three countries have voluntary reporting systems.

Data from sentinel surveillance systems were not used in the calculation of national or overall rates because coverage was not always known and denominators were therefore not available. Cases were analysed by date of diagnosis. Due to incompatibilities in data presentation and age formats, data from Belgium were excluded from all analyses that involved age groups.

The United Kingdom (UK) contributed surveillance data up to 2019. No data were reported by the UK for 2020 or 2021 due to its withdrawal from the EU on 31 January 2020. The UK data that were reported up to 2019 are presented in Table 1 but are not included in the analysis.

Epidemiology

In 2021, 46 728 confirmed gonorrhoea cases were reported by 27 countries (Table 1). The crude notification rate in 2021 was 13.7 per 100 000 population for countries with comprehensive surveillance systems. The highest rates in 2021 (more than 30 cases per 100 000 population) were observed in Luxembourg (66 cases per 100 000 population), Denmark (48 cases), Malta (47 cases) and Ireland (42 cases). The lowest notification rates (less than 1 case per 100 000 population) were observed in Bulgaria, Croatia, Cyprus, Poland and Romania. Figure 1 shows confirmed cases of gonorrhoea and notification rates per 100 000 population in countries with comprehensive surveillance systems.

Table 1. Confirmed gonorrhoea cases and notification 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
Austria	NDR	NRC	NDR	NRC	NDR	NRC	NDR	NRC	NDR	NRC
Belgium	2 271	NRC	2 822	NRC	2 635	NRC	1 707	NRC	3 635	NRC
Bulgaria	67	0.9	39	0.6	22	0.3	17	0.2	3	0.0
Croatia	30	0.7	38	0.9	40	1.0	13	0.3	17	0.4
Cyprus	2	0.2	3	0.3	2	0.2	7	0.8	5	0.6
Czechia	1 394	13.2	1 428	13.5	1 642	15.4	1 672	15.6	1 807	16.9
Denmark	1 915	33.3	2 197	38.0	2 210	38.1	2 669	45.8	2 819	48.3
Estonia	56	4.3	53	4.0	78	5.9	22	1.7	52	3.9
Finland	598	10.9	501	9.1	605	11.0	482	8.7	510	9.2
France	9 177	NRC	3 990	NRC	3 611	NRC	5 398	NRC	7 077	NRC
Germany	NDR	NRC	NDR	NRC	NDR	NRC	NDR	NRC	NDR	NRC
Greece	129	1.2	147	1.4	201	1.9	161	1.5	248	2.3
Hungary	1 030	10.5	1 249	12.8	1 348	13.8	1 261	12.9	1 309	13.5
Iceland	98	29.0	104	29.8	122	34.2	93	25.5	105	28.5
Ireland	2 250	47.0	2 412	49.9	2 811	57.3	2 049	41.3	2 108	42.1
Italy	850	1.4	905	1.5	813	1.4	333	0.6	NDR	NRC
Latvia	181	9.3	162	8.4	132	6.9	108	5.7	46	2.4
Liechtenstein	NDR	NRC	NDR	NRC	NDR	NRC	4	10.3	5	12.8
Lithuania	70	2.5	72	2.6	56	2.0	31	1.1	30	1.1
Luxembourg	12	2.0	15	2.5	24	3.9	311	49.7	417	65.7
Malta	105	22.8	121	25.4	161	32.6	94	18.3	240	46.5
Netherlands	6 794	NRC	6 424	NRC	6 917	NRC	6 826	NRC	7 966	NRC
Norway	1 399	26.6	1 659	31.3	1 704	32.0	1 045	19.5	555	10.3
Poland	138	0.4	185	0.5	281	0.7	246	0.6	287	0.8
Portugal	474	4.6	846	8.2	1 128	11.0	1 068	10.4	1 193	11.6
Romania	77	0.4	46	0.2	33	0.2	10	0.1	22	0.1
Slovakia	385	7.1	285	5.2	369	6.8	319	5.8	412	7.5
Slovenia	113	5.5	157	7.6	223	10.7	213	10.2	292	13.8
Spain	8 200	17.6	10 505	22.5	10 226	21.8	10 309	21.8	12 875	27.2
Sweden	2 518	25.2	2 717	26.8	3 245	31.7	2 692	26.1	2 693	25.9
United Kingdom	49 156	74.7	61 775	93.2	77 346	116.1	NDR	NRC	NDR	NRC
EU/EEA	89 489	21.6	100 857	26.5	117 985	31.7	39 160	9.5	46 728	13.7

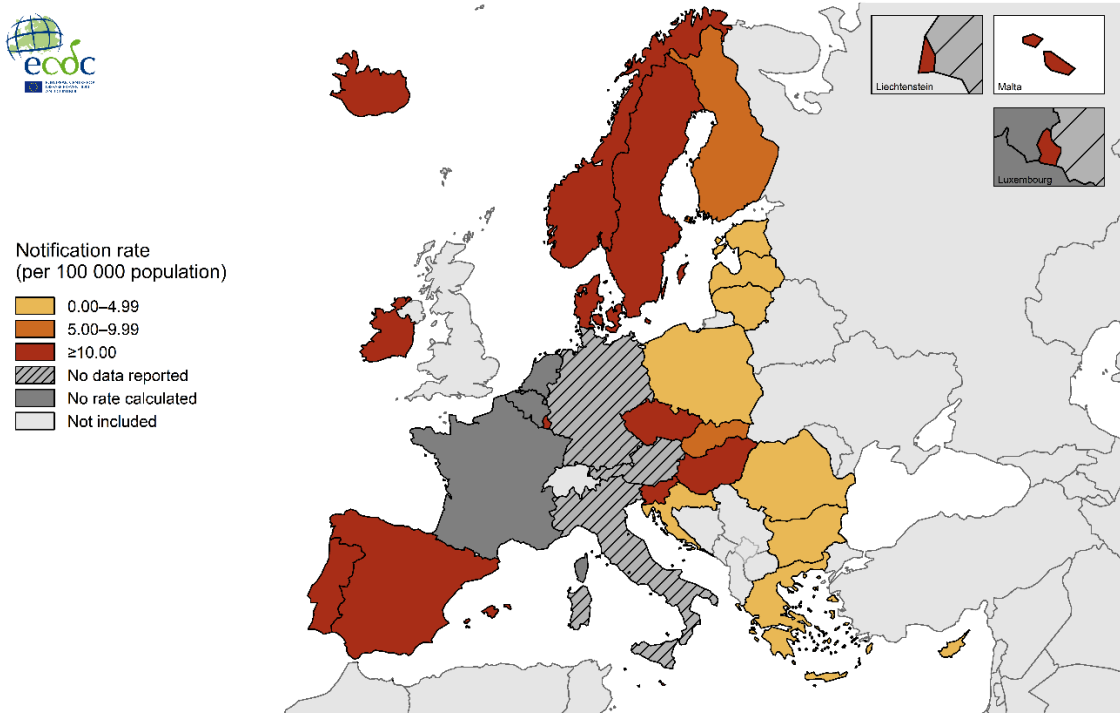
Source: country reports

NDR: no data reported

NRC: no rate calculated

Rates for Belgium, France and the Netherlands were not calculated, as the reported data were from sentinel systems where population denominators were not known. The United Kingdom did not report data for 2020 or 2021 due to its withdrawal from the EU on 31 January 2020.

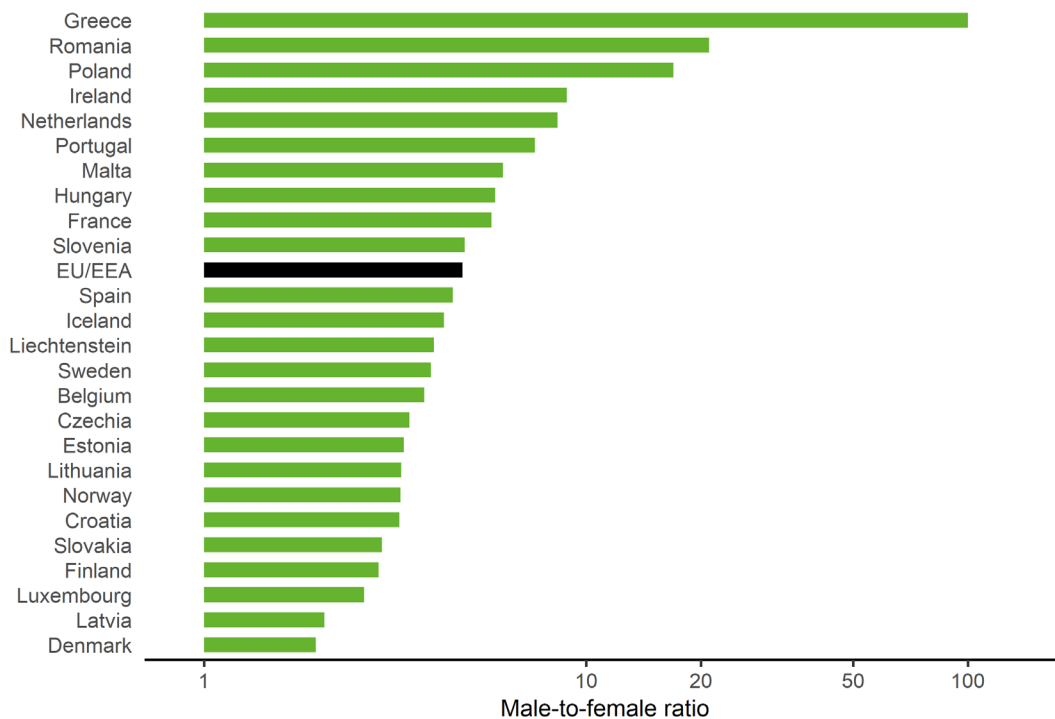
Figure 1. Confirmed gonorrhoea cases per 100 000 population by country, EU/EEA, 2021



Gender

The overall male-to-female ratio in 2021 was 4.8:1 (Figure 2). The notification rate was 23 cases per 100 000 population among men (38 350 cases) and 5 per 100 000 population among women (8 069 cases). Male-to-female ratios below 2.5:1 were reported by Denmark (2.0:1) and Latvia (2.1:1). The highest male-to-female ratios were reported by Greece (123:1), Romania (21:1) and Poland (17:1).

Figure 2. Male-to-female ratios of gonorrhoea cases by country, EU/EEA, 2021

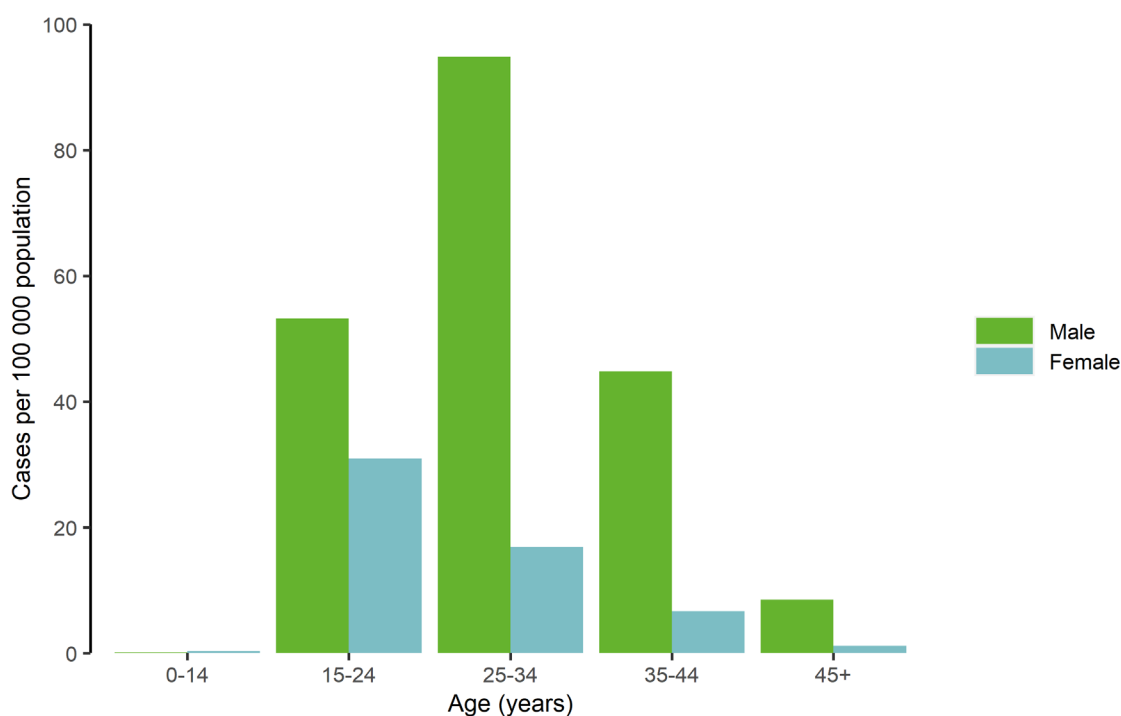


Bulgaria and Cyprus did not report any cases among women, so no male-to-female ratio could be calculated for these countries.

Age

Information on age was available for 24 countries in 2021. It was not available for Belgium, Bulgaria or Poland (8.4% of all cases). The largest proportion of cases reported in 2021 was among the age group 25–34 years (35% of cases), followed by 20–24 years (19%) and 35–44 years (19%). In countries with comprehensive surveillance systems, age-specific rates were highest among the age group 25–34 years (57 cases per 100 000 population; Figure 3). Rates were higher among males in all age groups, except for the age group 0–14 years, in which rates were very low. The highest age- and gender-specific rates were among males aged 25–34 years (94.8 cases per 100 000 population).

Figure 3. Confirmed gonorrhoea cases per 100 000 population, by age and gender, EU/EEA, 2021

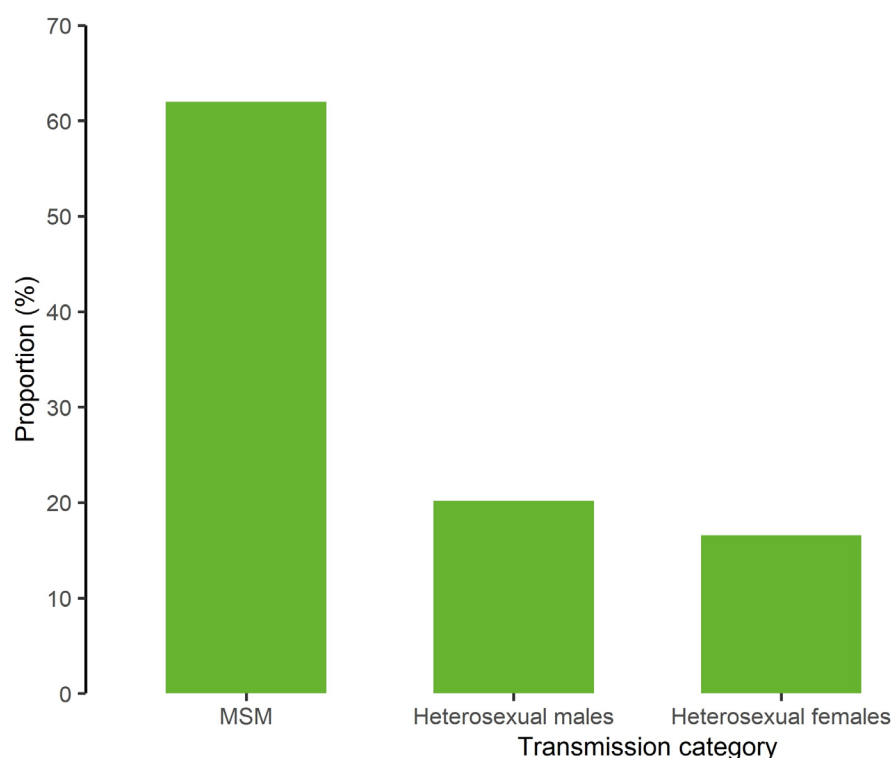


Transmission

In 2021, 18 countries (Czechia, Denmark, Estonia, Finland, France, Greece, Hungary, Iceland, Liechtenstein, Lithuania, Malta, Netherlands, Norway, Portugal, Romania, Slovakia, Slovenia and Sweden) reported data on the mode of transmission for 60% or more of their cases, accounting for 58% of all reported gonorrhoea cases.

Among these 18 countries, 62% of all cases with information on mode of transmission were reported as MSM, 37% were reported as heterosexuals (20% in males and 16% in females) and 1% were reported as 'other' (Figure 4). Cases diagnosed in MSM accounted for 75% ($n = 15\,027$) of the male cases with known mode of transmission. By country, the percentage of all cases with information on mode of transmission that were reported as MSM ranged from below 5% in Lithuania, Romania and Slovakia to over 60% in France, Iceland, Liechtenstein, the Netherlands, Portugal and Sweden.

Figure 4. Proportion of gonorrhoea cases by transmission category and gender, among the 18 countries reporting data on the mode of transmission for 60% or more of their cases, EU/EEA, 2021



Source: Country reports from Czechia, Denmark, Estonia, Finland, France, Greece, Hungary, Iceland, Liechtenstein, Lithuania, Malta, Netherlands, Norway, Portugal, Romania, Slovakia, Slovenia and Sweden

HIV status

Data on the HIV status of cases reported in 2021 were provided by 17 countries (Cyprus, Czechia, Denmark, Estonia, France, Greece, Hungary, Iceland, Ireland, Malta, the Netherlands, Norway, Portugal, Romania, Slovakia, Slovenia and Spain), accounting for 84% of all reported gonorrhoea cases. Of these 39 085 cases, information on HIV status was available for 18 749 cases (48%). Among cases with known HIV status, 11% were HIV positive. Of the 15 222 cases among MSM, the HIV status was known for 11 355 cases (75%) and of these, 16% were HIV positive.

Trends, 2012–2021

From 2012 to 2021, 724 290 cases of confirmed gonorrhoea were reported in 29 countries, with varying degrees of data completeness. The number of reporting countries remained stable, with the exception of Austria (data not reported since 2014), Italy (data not reported in 2021), Liechtenstein (began reporting data in 2020) and the UK (data not reported since 2019, due to its withdrawal from the EU). If the cases from the UK are not included, the total number of cases reported in the EU/EEA during this period was 345 192 cases.

Among the 23 countries that reported consistently between 2012 and 2021, notification rates of gonorrhoea increased continuously between 2012 and 2019, from 6.0 cases per 100 000 population in 2012 to 13.0 cases per 100 000 population in 2019. Rates decreased to 12.1 per 100 000 population in 2020, but increased again in 2021 to 13.7 cases per 100 000 population (Figure 5). Rates were consistently higher in men than in women. Since 2012, notification rates increased by 76% for men and by 38% for women.

The number of cases reported during this period increased in 18 of the 26 countries that reported consistently. The largest increases since 2012 were reported by Portugal (1089%), Malta (728%) and Slovenia (549%).

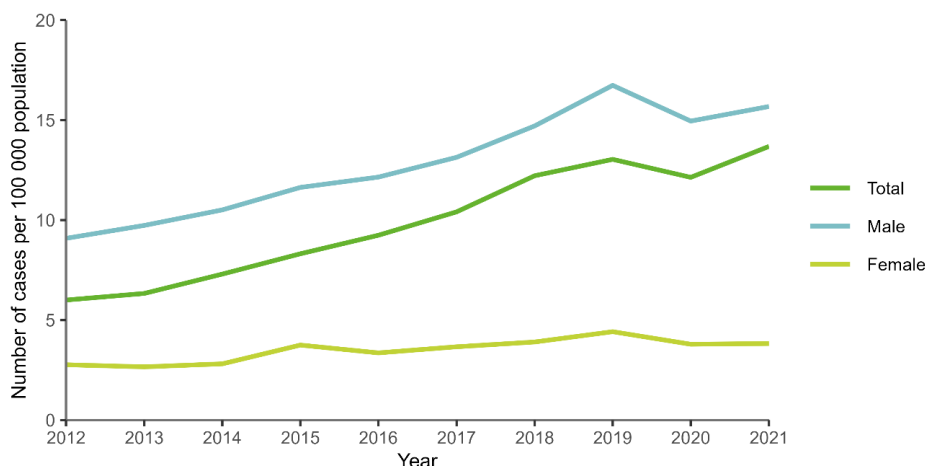
In 2020, decreases in gonorrhoea notifications (as compared with 2019) were reported by the majority (21/27) of countries with available data. Decreases of more than 25% were observed in Belgium, Croatia, Estonia, Ireland, Italy, Lithuania, Malta, Norway and Romania.

In 2021, 22 of 27 countries with available data reported that notifications had increased again compared with 2020. Of these 22 countries, 13 reported levels higher than in 2019 (Belgium, Czechia, Denmark, France, Greece, Luxembourg, Malta, the Netherlands, Poland, Portugal, Slovakia, Slovenia and Spain).

In the 14 countries consistently reporting data on mode of transmission, MSM transmission increased by 286% in 2021 compared with 2012. Heterosexual transmission increased by 50%. In 11 of these countries, HIV status was consistently reported for cases with MSM transmission. Cases among HIV-negative MSM increased by 318% and cases among HIV-positive MSM increased by 224% in 2021 compared with 2012.

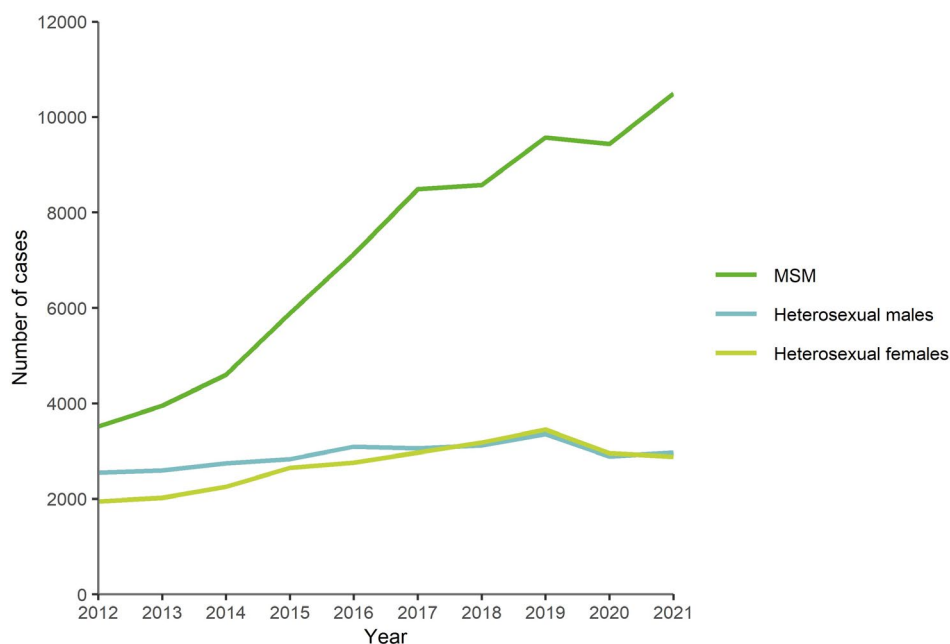
Among countries that consistently reported data on mode of transmission, the number of reported cases increased in all transmission categories from 2012 to 2019, and decreased slightly in 2020 (Figure 6). Among MSM and heterosexual males, reported cases increased again in 2021.

Figure 5. Notification rates of confirmed gonorrhoea cases per 100 000 population in total and by gender in EU/EEA countries reporting consistently, 2012–2021



Source: Country reports from Bulgaria, Croatia, Cyprus, Czechia, Denmark, Estonia, Finland, Greece, Hungary, Iceland, Ireland, Latvia, Lithuania, Luxembourg, Malta, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain and Sweden. The Total category includes all reported cases regardless of whether data on gender were available. No data from Spain are included in the Male and Female categories, as data on gender were not consistently reported during the study period. Cases reported from Belgium, France and the Netherlands are not included, as the reported data were from sentinel systems where population denominators were not known.

Figure 6. Number of confirmed gonorrhoea cases by gender, transmission category and year in EU/EEA countries reporting consistently, 2012–2021



Source: Country reports from Czechia, Denmark, Finland, Greece, the Netherlands, Norway, Romania, Slovenia and Sweden

Outbreaks and other threats

The increasing number of reported gonorrhoea cases across the EU/EEA is concerning, particularly in the context of gonococcal antimicrobial resistance. The European Gonococcal Antimicrobial Surveillance Programme (Euro-GASP) has reported decreasing azithromycin susceptibility, as well as sporadic ceftriaxone resistance [4,6]. The proportion of gonococcal isolates above the azithromycin epidemiological cut-off value has increased substantially from 3.7% in 2017 to 14.1% in 2021. Resistance to cefixime has decreased in recent years, but the proportion of isolates resistant to ciprofloxacin increased from 46.5% in 2017 to 63.2% in 2021 [4,6].

In 2018, a number of isolates with resistance to ceftriaxone and high-level resistance to azithromycin were reported in Australia, Canada, Denmark, Ireland and the UK [8-12]. ECDC published a rapid risk assessment related to the first reported cases in Australia and the UK, highlighting the threat to the currently recommended treatment [7] and the need for a stronger response to extensively drug-resistant *N. gonorrhoeae* [13].

Discussion

Gonorrhoea is the second most commonly notified STI in the EU/EEA after chlamydia. In 2021, a total of 46 728 cases were reported, and the crude notification rate was 13.7 cases per 100 000 population for countries with comprehensive surveillance systems. Increasing rates of gonorrhoea cases were reported between 2012 and 2019. Rates decreased in 2020, then increased again in 2021, surpassing the 2019 level.

The decrease in cases in 2020 may have been due to changes in healthcare-seeking behaviour and testing practices during the COVID-19 pandemic. A survey of a wide range of actors involved in the provision of testing services found that the majority of respondents reported service disruptions and declines in testing volumes, particularly in the early part of 2020 [14]. These findings were similar to those from an ECDC survey of the STI Network, which found that the decrease in 2020 was most likely due to the impact of the COVID-19 pandemic on the availability of and access to STI care services and populations at high risk, changes in sexual behaviour, reduced testing opportunities, and reductions in STI surveillance capacity due to diverting of resources to COVID-19 response (internal ECDC report, data not published).

The increasing trend in the number of reported gonorrhoea cases in many countries continues to be mainly driven by an increasing number of cases in MSM, but the number of cases among women and heterosexual men also increased between 2012 and 2019. Increases among women are of concern due to the risk of reproductive complications from gonorrhoea.

The increase in reported cases in MSM may be related to increased high-risk behaviour involving condomless sex (possibly linked to changing sexual behaviour in the context of the use of HIV pre-exposure prophylaxis (PrEP)) [15-19], increased detection through increased testing among MSM (particularly at extra-genital sites, a practice recommended by recent guidance) [6] and more widespread use of nucleic acid amplification tests. Information on testing location and indication (e.g. regular screening within PrEP programmes) and the proportion of asymptomatic cases among those reported, which are currently not part of the data collected at the EU/EEA level, could provide an indication regarding the proportion of cases that are attributable to increased testing (with or without an absolute increase in the number of infections) in the era of PrEP.

The distribution of reported gonorrhoea cases continues to vary considerably across the EU/EEA, with notification rates ranging from less than 1 case to up to 66 cases per 100 000 population. High rates (above 20 cases per 100 000 population) were reported by Denmark, Iceland, Ireland, Luxembourg, Malta, Spain and Sweden. The variation in rates may be linked to real differences in incidence of infection. However, there are important differences across Europe in terms of testing policies and methods, healthcare systems, access to services, the role of private healthcare providers, inclusion of data in reporting systems and surveillance system structures.

The surveillance data presented in this report are likely an underestimate of the true situation. The majority of countries that report gonorrhoea cases indicate that most of their data on STIs are obtained from dedicated specialist services (i.e. STI clinics). Therefore, it is likely that a proportion of cases—for example, those diagnosed in primary healthcare—are not captured by surveillance systems in many countries. In addition, a few countries obtain data through sentinel surveillance, which again only captures a proportion of diagnoses within a given country and may target specific specialist services. Many cases also remain undiagnosed or unreported for various reasons, such as differences in the availability of diagnostics, which may result in reported figures that do not represent the true extent of the epidemic. Some of the increases reported over time may also be related to improvements in the coverage of surveillance systems, the use of more sensitive tests and increased testing. Given the above limitations, comparisons between countries should be made with caution.

Public health implications

The number of gonorrhoea infections reported each year continues to increase in the majority of EU/EEA countries. There is an urgent need to further strengthen prevention activities aimed at increased testing uptake and testing frequency for those most at risk. This could be achieved by targeting specific risk groups with evidence-based messages and methods. Social media and dating apps should be considered for prevention campaigns, in addition to traditional approaches.

References

1. European Centre for Disease Prevention and Control (ECDC). Factsheet about gonorrhoea. Available at: <https://www.ecdc.europa.eu/en/gonorrhoea/facts>
2. European Centre for Disease Prevention and Control (ECDC). Introduction to the Annual Epidemiological Report. Stockholm: ECDC; 2021. Available at: <https://www.ecdc.europa.eu/en/surveillance-and-disease-data/annual-epidemiological-reports/introduction-annual>
3. European Centre for Disease Prevention and Control (ECDC). Surveillance systems overview for 2021. Stockholm: ECDC; 2021. Available at: <https://www.ecdc.europa.eu/en/publications-data/surveillance-systems-overview-2021>
4. European Centre for Disease Prevention and Control (ECDC). Surveillance Atlas of Infectious Diseases. Stockholm: ECDC; 2022. Available at: <http://atlas.ecdc.europa.eu>
5. European Centre for Disease Prevention and Control (ECDC). EU case definitions. Stockholm: ECDC; 2018 Available at: <https://www.ecdc.europa.eu/en/all-topics/eu-case-definitions>
6. European Centre for Disease Prevention and Control (ECDC). Gonococcal antimicrobial susceptibility surveillance in the EU/EEA: Summary of results for 2020. Stockholm: ECDC; 2022. Available at: <https://www.ecdc.europa.eu/en/publications-data/gonococcal-antimicrobial-susceptibility-surveillance-2020>
7. AB, Gomberg M, Cusini M, Jensen JS. 2020 European guideline for the diagnosis and treatment of gonorrhoea in adults. *Int J STD AIDS*. 2020 Oct 29;956462420949126. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/33121366>
8. Eyre DW, Sanderson ND, Lord E, Regisford-Reimmer N, Chau K, Barker L, et al. Gonorrhoea treatment failure caused by a *Neisseria gonorrhoeae* strain with combined ceftriaxone and high-level azithromycin resistance, England, February 2018. *Euro Surveill*. 2018 Jul;23(27) Available at: <https://www.eurosurveillance.org/content/10.2807/1560-7917.ES.2018.23.27.1800323>
9. Whiley DM, Jennison A, Pearson J, Lahra MM. Genetic characterisation of *Neisseria gonorrhoeae* resistant to both ceftriaxone and azithromycin. *Lancet Infect Dis*. 2018 Jul;18(7):717-8. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/29976521>
10. Golparian D, Rose L, Lynam A, Mohamed A, Bercot B, Ohnishi M, et al. Multidrug-resistant *Neisseria gonorrhoeae* isolate, belonging to the internationally spreading Japanese FC428 clone, with ceftriaxone resistance and intermediate resistance to azithromycin, Ireland, August 2018. *Euro Surveill*. 2018 Nov;23(47) Available at: <https://www.eurosurveillance.org/content/10.2807/1560-7917.ES.2018.23.47.1800617>
11. Berenger BM, Demczuk W, Gratrix J, Pabbaraju K, Smyczek P, Martin I. Genetic Characterization and Enhanced Surveillance of Ceftriaxone-Resistant *Neisseria gonorrhoeae* Strain, Alberta, Canada, 2018. *Emerg Infect Dis*. 2019 Sep;25(9):1660-7. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/31407661>
12. Lahra MM, Martin I, Demczuk W, Jennison AV, Lee KI, Nakayama SI, et al. Cooperative Recognition of Internationally Disseminated Ceftriaxone-Resistant *Neisseria gonorrhoeae* Strain. *Emerg Infect Dis*. 2018 Apr;24(4). Available at: <https://www.ncbi.nlm.nih.gov/pubmed/29553335>
13. European Centre for Disease Prevention and Control (ECDC). Rapid Risk Assessment: Extensively drug-resistant (XDR) *Neisseria gonorrhoeae* in the United Kingdom and Australia. Stockholm: ECDC; 2018. Available at: <https://www.ecdc.europa.eu/sites/default/files/documents/RRA-Gonorrhoea%2C%20Antimicrobial%20resistance-United%20Kingdom%2C%20Australia.pdf>
14. Simões D, Stengaard AR, Combs L, Raben D, partners TEC-iaco. Impact of the COVID-19 pandemic on testing services for HIV, viral hepatitis and sexually transmitted infections in the WHO European Region, March to August 2020. *Euro Surveill*. 2020;25(47):2001943. Available at: <https://www.eurosurveillance.org/content/10.2807/1560-7917.ES.2020.25.47.2001943>
15. Payne L, Lawrence D, Soni S, Llewellyn C, Dean G. Investigating factors for increased gonorrhoea re-infection in men who have sex with men attending a genitourinary clinic: a qualitative study. *Int J STD AIDS*. 2017 Aug;28(9):858-63. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/27810983>
16. Gafos M, Horne R, Nutland W, Bell G, Rae C, Wyal S, et al. The Context of Sexual Risk Behaviour Among Men Who Have Sex with Men Seeking PrEP, and the Impact of PrEP on Sexual Behaviour. *AIDS Behav*. 2018 Oct 10. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/30306439>
17. van Bilsen WPH, Boyd A, van der Loeff MFS, Davidovich U, Hogewoning A, van der Hoek L, et al. Diverging trends in incidence of HIV versus other sexually transmitted infections in HIV-negative MSM in Amsterdam. *AIDS (London, England)*. 2020 Feb 1;34(2):301-9. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/31714354>
18. Hart TA, Noor SW, Berlin GW, Skakoon-Sparling S, Tavangar F, Tan D, et al. Pre-exposure prophylaxis and bacterial sexually transmitted infections (STIs) among gay and bisexual men. *Sex Transm Infect*. 2022 Jun 14. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/35701145>
19. van Wees DA, Diexer S, Rozhnova G, Matser A, den Daas C, Heijne J, et al. Quantifying heterogeneity in sexual behaviour and distribution of STIs before and after pre-exposure prophylaxis among men who have sex with men. *Sex Transm Infect*. 2022 Sep;98(6):395-400. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/34716228>
20. Bennett A, Jeffery K, O'Neill E, Sherrard J. Outbreak or illusion: consequences of 'improved' diagnostics for gonorrhoea. *Int J STD AIDS*. 2017 Jun;28(7):667-71. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/27405582>

21. Low N, Unemo M, Skov Jensen J, Breuer J, Stephenson JM. Molecular diagnostics for gonorrhoea: implications for antimicrobial resistance and the threat of untreatable gonorrhoea. PLoS Med. 2014 Feb;11(2):e1001598. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/24503544>
22. Friedman DS, O'Byrne P. Extragenital testing increases case detection of gonorrhea and chlamydia: The impact of implementing nucleic acid amplification testing. Can Commun Dis Rep. 2020 Sep 3;46(9):285-91. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/33104087>