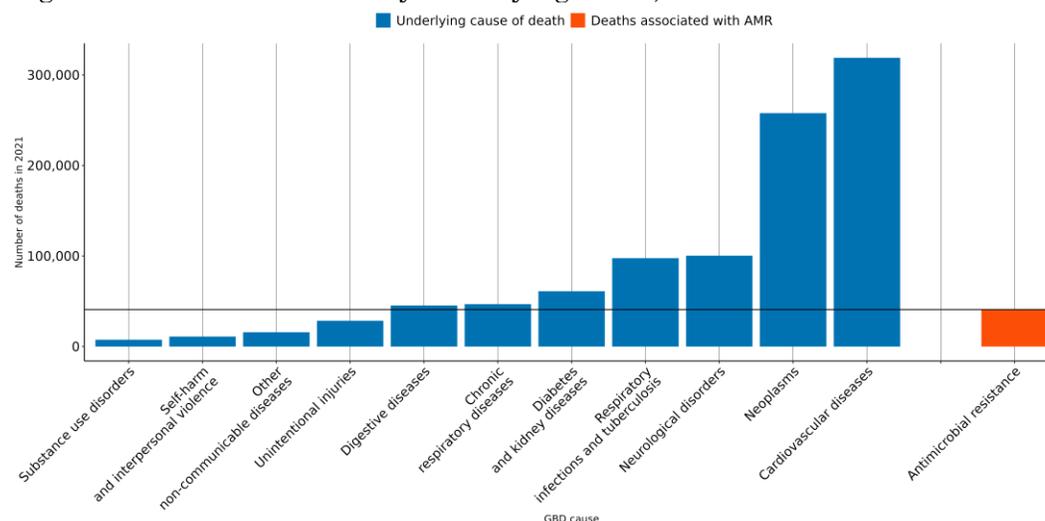


# The burden of antimicrobial resistance (AMR) in Germany

## Executive summary

- Antimicrobial Resistance (AMR) is a major global health threat, over **9,000 lives** have been lost each year since 1990 in Germany due to AMR.
- In 2021, there were an estimated **8,000 UI (6,810-9,200)** deaths attributable to AMR and **40,900 UI (35,900-45,800)** deaths associated with AMR in this location.
- The largest number of deaths associated with AMR in 2021 occurred among those aged **70+** in the country.
- Among the most deadly pathogen-drug combinations in 2021 were *Staphylococcus aureus* resistant to methicillin, *Escherichia coli* resistant to aminopenicillin and *Pseudomonas aeruginosa* resistant to carbapenems.

Figure 1 Number of deaths by underlying cause, and those associated with AMR in 2021



- In 2021, the number of deaths associated with AMR (orange bar in *figure 2*) were high compared to the most relevant underlying causes of death (depicted in blue) in the country. AMR associated deaths occur within multiple Global Burden of Disease (GBD) causes of death and AMR is not an underlying cause of death by itself.
- At the [2024 United Nations General Assembly high level meeting on antimicrobial resistance](#), country members agreed to aim for a **10% reduction** compared to 2019 baseline (**from 4.95 to 4.45 million**) in the global number of deaths associated with AMR by 2030. But [our forecast](#) indicates that in absence of concerted action, deaths associated with AMR could reach **5.5 million** (UI 4.8 - 6.2) if current trends continue. For Germany, a 10% reduction means to decrease the number of deaths associated with AMR to **38,300**, but currently the trend for this country could reach up to **47,300 UI [37,000-55,700]** AMR-associated deaths in 2030.

## AMR in Germany

### Key takeaways

- Antimicrobial Resistance (AMR) is a major global health threat, over *a million lives* have been lost each year since 1990.
- Globally, 4.71 (95% Uncertainty Interval (UI) 4.2-5.2) million deaths were associated with bacterial drug-resistant infections in 2021.
- And 1.14 (UI 1 - 1.3) million deaths were attributable to bacterial drug-resistant infection in the same year.
- *39 (UI 33 - 46) million deaths* directly attributable to bacterial AMR are projected to occur between 2025-2050 unless concerted action is taken. This equates to three deaths every minute.

Figure 2 Comparing 30 years of infection related deaths, and those associated with and attributable to AMR in Germany between 1990 and 2019.



- To look at these and more visualization interactively visit [Measuring Infectious Causes and Resistance Outcomes for Burden Estimation \(MICROBE\)](#)
- In **Germany** in 2021, there were an estimated **8,000 UI (6,810-9,200)** deaths attributable to AMR and **40,900 UI (35,900-45,800)** deaths associated with AMR. Here “*attributable deaths*” are considered to be those that would have been prevented had the drug-resistant bacteria causing the infections not been drug-resistant. “*Associated deaths*” are considered to be those that would not have occurred had the infections been prevented entirely.
- Across 204 countries, **Germany has the 18th lowest** age-standardized mortality rate associated with AMR in 2021.
- *Table 1* shows the bacteria which caused most deaths in 2021 (↑ indicates an increasing estimated annual rate between 1990-2021, ↓ indicates a decreasing annual trend), and *table 2* shows the pathogen-drug combinations which caused most deaths in 2021.

Table 1. Bacteria which cause most deaths in 2021 (Number of deaths in parenthesis)

Burden rank	Overall susceptible and resistant		Associated		Attributable	
	Bacteria	Annualized rate of change (1990-2021)	Bacteria	Annualized rate of change (1990-2021)	Bacteria	Annualized rate of change (1990-2021)
	Staphylococcus aureus 24,200 UI (21,300-27,000)	↑	Escherichia coli 14,100 UI (12,200-16,000)	↑	Escherichia coli 2,550 UI (2,050-3,040)	↑
	Escherichia coli 21,100 UI (18,600-23,700)	↑	Staphylococcus aureus 9,270 UI (8,060-10,500)	↓	Staphylococcus aureus 1,640 UI (1,350-1,930)	↑
	Pseudomonas aeruginosa 8,310 UI (7,330-9,280)	↓	Pseudomonas aeruginosa 4,040 UI (3,520-4,550)	↓	Pseudomonas aeruginosa 1,060 UI (848-1,270)	↓
	Klebsiella pneumoniae 6,310 UI (5,560-7,050)	↓	Klebsiella pneumoniae 2,710 UI (2,150-3,270)	↓	Klebsiella pneumoniae 611 UI (467-755)	↓
	Streptococcus pneumoniae 5,160 UI (4,540-5,780)	↓	Enterococcus faecium 2,510 UI (2,210-2,810)	↑	Enterococcus faecium 496 UI (389-603)	↑
	Group A Streptococcus 3,780 UI (3,260-4,310)	↑	Proteus spp. 1,610 UI (1,250-1,960)	↑	Acinetobacter baumannii 461 UI (371-550)	↓
	Enterococcus faecalis 3,340 UI (2,970-3,710)	↓	Streptococcus pneumoniae 1,430 UI (1,200-1,660)	↓	Enterobacter spp. 252 UI (213-292)	↓
	Proteus spp. 2,830 UI (2,470-3,200)	↑	Acinetobacter baumannii 1,180 UI (929-1,420)	↓	Proteus spp. 222 UI (163-281)	↑
	Enterococcus faecium 2,660 UI (2,340-2,970)	↑	Enterobacter spp. 1,000 UI (841-1,160)	↓	Streptococcus pneumoniae 211 UI (165-257)	↓
	Enterobacter spp. 2,510 UI (2,220-2,800)	↓	Enterococcus faecalis 732 UI (630-834)	↓	Enterococcus faecalis 131 UI (95-167)	↓

Annualized rate of change (1990-2021): <-3% (dark blue), -1.5% to 0% (light blue), 1.5% to 3% (red), >5.0% (dark red), -3% to -1.5% (medium blue), 0% to 1.5% (orange), 3% to 5% (brown)

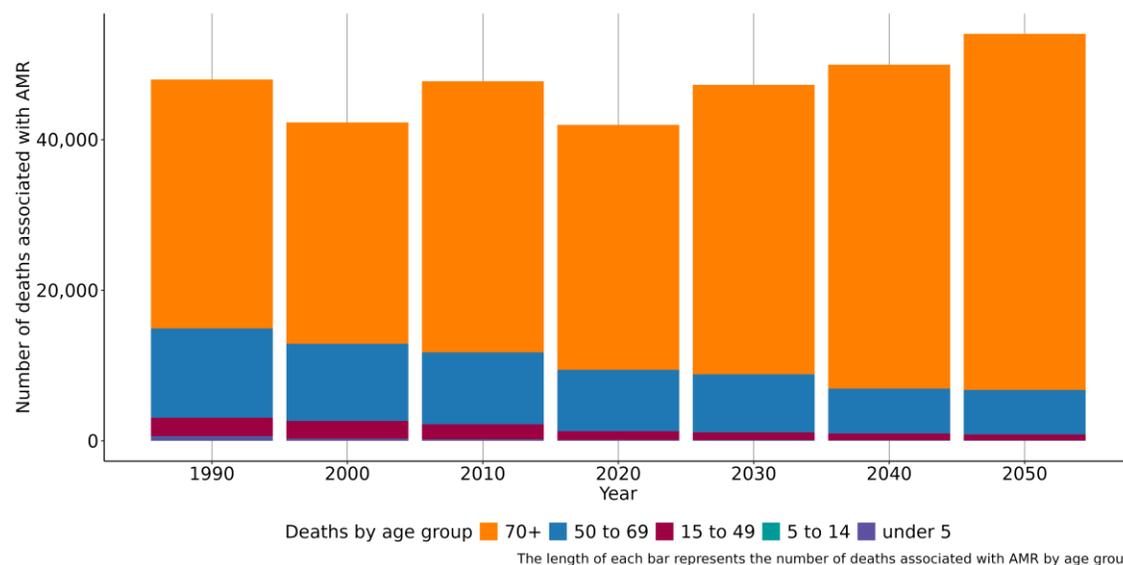
Table 2. Combinations which cause most deaths in 2021 (Number of deaths in parenthesis)

Burden Rank	Associated		Attributable	
	Combination	Annualized rate of change (1990-2021)	Combination	Annualized rate of change (1990-2021)
	Escherichia coli Aminopenicillin 13,500 UI (11,400-15,700)	↑	Staphylococcus aureus Methicillin 731 UI (525-936)	↑
	Escherichia coli Beta-Lactam/Lactamase Inhib. 6,650 UI (5,400-7,900)	↑	Escherichia coli Aminopenicillin 686 UI (441-932)	↑
	Staphylococcus aureus Macrolides 6,610 UI (5,250-7,960)	↑	Pseudomonas aeruginosa Carbapenems 650 UI (459-840)	↑
	Escherichia coli TMP-SMX 6,290 UI (5,060-7,520)	↑	Escherichia coli Beta-Lactam/Lactamase Inhib. 531 UI (181-880)	↑
	Staphylococcus aureus Fluoroquinolones 5,310 UI (4,360-6,260)	↓	Staphylococcus aureus Fluoroquinolones 387 UI (127-647)	↓
	Escherichia coli Fluoroquinolones 5,080 UI (4,280-5,880)	↑	Escherichia coli TMP-SMX 338 UI (187-489)	↑
	Staphylococcus aureus Methicillin 3,170 UI (2,130-4,210)	↑	Escherichia coli Fluoroquinolones 331 UI (195-468)	↑
	Pseudomonas aeruginosa Carbapenems 3,090 UI (2,620-3,570)	↓	Escherichia coli 3GC 307 UI (198-417)	↑
	Escherichia coli 3GC 2,700 UI (2,190-3,220)	↑	Staphylococcus aureus Macrolides 305 UI (201-410)	↑
	Enterococcus faecium Fluoroquinolones 2,470 UI (2,170-2,770)	↑	Enterococcus faecium Vancomycin 255 UI (209-301)	↑

Annualized rate of change (1990-2021): <-3% (dark blue), -1.5% to 0% (light blue), 1.5% to 3% (red), >5.0% (dark red), -3% to -1.5% (medium blue), 0% to 1.5% (orange), 3% to 5% (brown)

- Independently of antimicrobial resistance, the infectious syndromes accounting for the most deaths in 2021 were as follows (estimated thousands of deaths in parenthesis) bloodstream infections (51,400 UI (45,800-57,000)), lower respiratory infection (excl. COVID) (34,400 UI (29,600-39,100)), peritoneal and intra-abdominal infections (17,700 UI (15,400-19,900)), urinary tract infections and pyelonephritis (8,940 UI (7,470-10,400)) and infections of the skin and subcutaneous systems (6,100 UI (5,120-7,080)).

Figure 3. Number of deaths associated with AMR by age group between 1990-2020 and 2050 projection



- In Germany, people aged 70+ saw the largest number of deaths associated with AMR both in 1990 and 2021, which indicates that 70+ continues to be particularly vulnerable to infections which are resistant to antibiotics. In 2021, the number of deaths associated with AMR among the 70+ was 31,600 UI (26,900-36,200), whereas the mortality rate per 100,000 was 233 UI (199-267).

### Data sources for Germany

In total, 520 million individual records or isolates covering 19,513 study-location-years were used as input data to our estimation process. The subset of input data for this country is shown below.

Table 3. Data inputs for Germany by source type

Source type	Years	Sample size	Sample size units
Microbial or laboratory data without outcome	1990-2021	6,736,602	Isolates
Microbial or laboratory data with outcome	1990-2021	251,568	Isolates
Literature studies	1990-2021	13,111	Cases/isolates/susceptibility tests
Single drug resistance profile data	1990-2021	4,224,481	Antibiotic susceptibility test

## More information

### *About GRAM:*

The purpose of the Global Research on AntiMicrobial resistance (GRAM) project is to **generate accurate and timely estimates of the magnitude and trends in antimicrobial resistance (AMR) burden** across the world, which can be used to inform treatment guidelines and agendas for decision-making and research, detect emerging problems and monitor trends to inform global strategies, as well as facilitate the assessment of interventions over time.

GRAM is the flagship project of the University of Oxford–IHME Strategic Partnership. GRAM was launched with support from the United Kingdom Department of Health and Social Care’s Fleming Fund, and the Wellcome Trust.

### *All resources:*

For all resources on AMR analysis at IHME, visit <https://www.healthdata.org/antimicrobial-resistance>.

To look at these and more visualization interactively visit [Measuring Infectious Causes and Resistance Outcomes for Burden Estimation \(MICROBE\)](#).

### *Data sources:*

To download the list of data input sources by country, and AMR results by region, visit the [Global Health Data Exchange \(GHDx\)](#).

### *Contact us:*

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