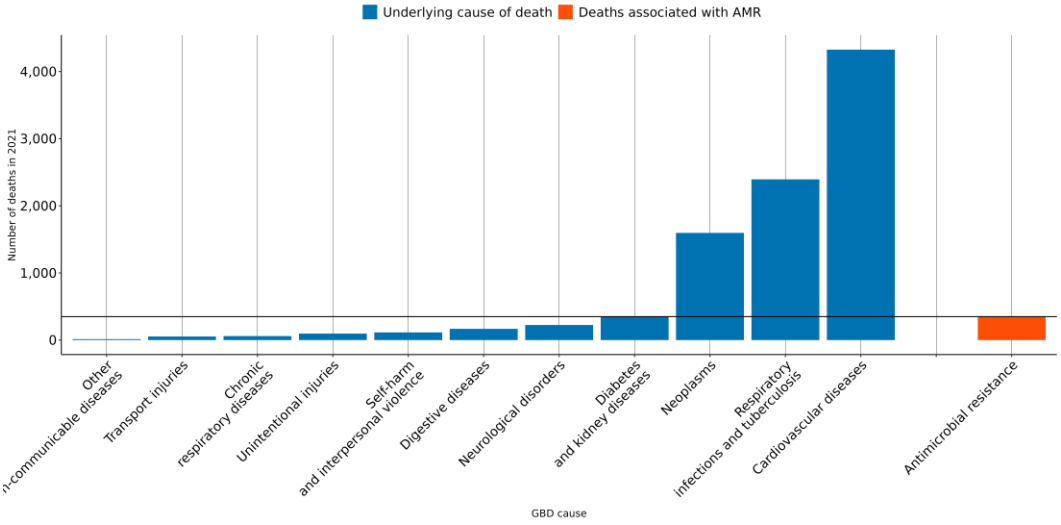
The burden of antimicrobial resistance (AMR) in Montenegro

Executive summary

- Antimicrobial Resistance (AMR) is a major global health threat, over **80 lives** have been lost each year since 1990 in Montenegro due to AMR.
- In 2021, there were an estimated **87 UI (68-107)** deaths attributable to AMR and **349 UI (285-413)** 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, *Acinetobacter baumannii* resistant to carbapenems and *Streptococcus pneumoniae* resistant to carbapenems.

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



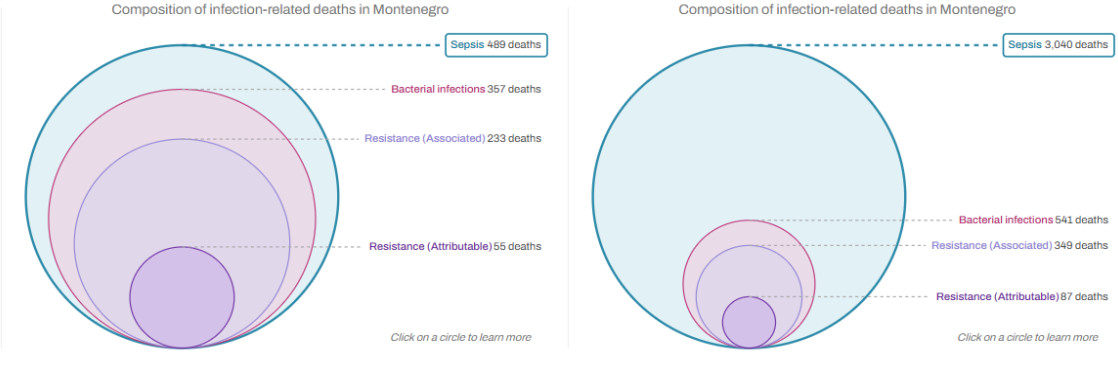
- In 2021, the number of deaths associated with AMR (orange bar in *figure 2*) were high compared to the most relevant underlying causes of death (depicted in blue) in the country. AMR associated deaths occur within multiple Global Burden of Disease (GBD) causes of death and AMR is not an underlying 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 Montenegro, a 10% reduction means to decrease the number of deaths associated with AMR to **334**, but currently the trend for this country could reach up to **363 UI [289-448]** AMR-associated deaths in 2030.

AMR in Montenegro

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 Montenegro between 1990 and 2019.



- To look at these and more visualization interactively visit Measuring Infectious Causes and Resistance Outcomes for Burden Estimation (MICROBE)
- In **Montenegro** in 2021, there were an estimated **87 UI (68-107)** deaths attributable to AMR and **349 UI (285-413)** 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, **Montenegro has the 64th 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
1	Staphylococcus aureus 140 UI (123-158) ↑	Staphylococcus aureus 71 UI (52-90) ↑	Staphylococcus aureus 18 UI (12-24) ↑
2	Streptococcus pneumoniae 74 UI (65-84) ↑	Escherichia coli 59 UI (50-69) ↑	Acinetobacter baumannii 13 UI (11-15) ↑
3	Escherichia coli 66 UI (58-74) ↑	Streptococcus pneumoniae 41 UI (28-54) ↑	Escherichia coli 13 UI (10-16) ↑
4	Pseudomonas aeruginosa 54 UI (48-61) ↑	Pseudomonas aeruginosa 37 UI (30-44) ↑	Streptococcus pneumoniae 10 UI (6-14) ↑
5	Klebsiella pneumoniae 43 UI (37-48) ↑	Klebsiella pneumoniae 36 UI (31-41) ↑	Klebsiella pneumoniae 10 UI (8-12) ↑
6	Acinetobacter baumannii 33 UI (29-37) ↑	Acinetobacter baumannii 33 UI (29-37) ↑	Pseudomonas aeruginosa 9 UI (7-12) ↑
7	Enterococcus faecalis 23 UI (20-26) ↑	Enterococcus faecalis 17 UI (14-19) ↑	Enterobacter spp. 3 UI (2-5) ↑
8	Enterobacter spp. 19 UI (17-22) ↑	Enterobacter spp. 15 UI (13-17) ↑	Enterococcus faecium 3 UI (3-4) ↑
9	Enterococcus faecium 16 UI (14-18) ↑	Enterococcus faecium 13 UI (11-15) ↑	Enterococcus faecalis 3 UI (2-4) ↑
10	Group A Streptococcus 14 UI (11-17) ↑	Proteus spp. 9 UI (7-11) ↑	Serratia spp. 1 UI (1-2) ↑

Annualized rate of change (1990-2021): <-3% | -3% to -1.5% | -1.5% to 0% | 0% to 1.5% | 1.5% to 3% | 3% to 5% | >5.0%

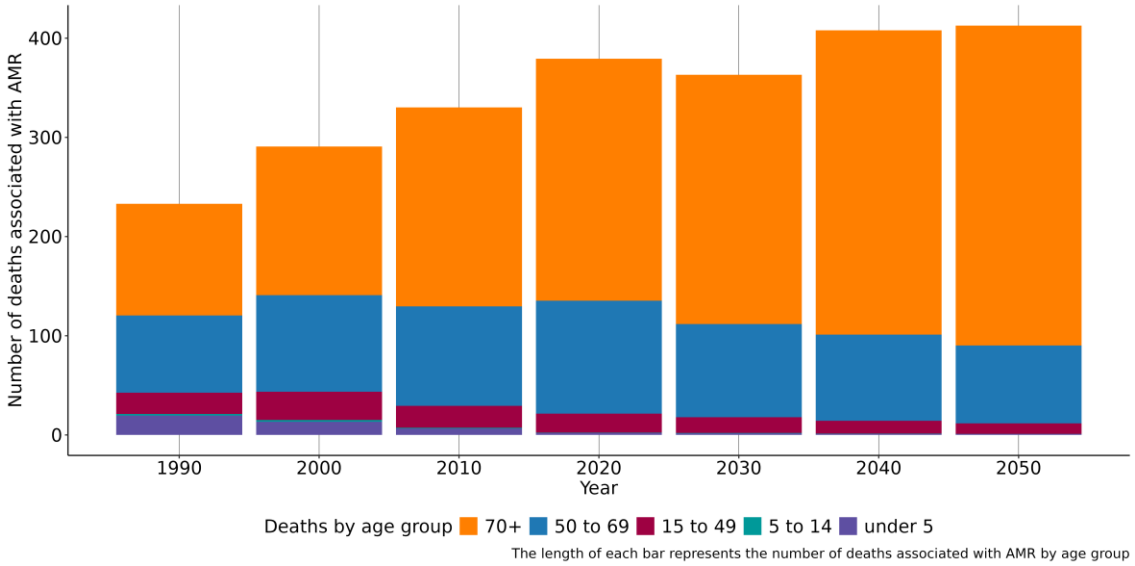
Table 2. Combinations which cause most deaths in 2021 (Number of deaths in parenthesis)

Burden Rank	Associated		Attributable	
1	Escherichia coli Aminopenicillin	57 UI (45-69) ↑	Staphylococcus aureus Methicillin	12 UI (7-17) ↑
2	Staphylococcus aureus Macrolides	52 UI (39-64) ↑	Acinetobacter baumannii Carbapenems	7 UI (5-8) ↑
3	Staphylococcus aureus Methicillin	49 UI (28-71) ↑	Streptococcus pneumoniae Carbapenems	6 UI (3-8) ↓
4	Escherichia coli 3GC	42 UI (33-52) ↑	Escherichia coli 3GC	5 UI (4-7) ↑
5	Klebsiella pneumoniae 3GC	35 UI (31-40) ↑	Acinetobacter baumannii Fluoroquinolones	4 UI (3-5) ↑
6	Acinetobacter baumannii 3GC	32 UI (28-37) ↑	Pseudomonas aeruginosa Carbapenems	4 UI (2-5) ↑
7	Acinetobacter baumannii 4GC	32 UI (28-36) ↑	Pseudomonas aeruginosa Fluoroquinolones	3 UI (2-4) ↑
8	Klebsiella pneumoniae Beta-Lactam/Lactamase Inhib.	32 UI (26-38) ↑	Klebsiella pneumoniae 3GC	3 UI (2-4) ↑
9	Escherichia coli Beta-Lactam/Lactamase Inhib.	31 UI (26-37) ↑	Enterococcus faecalis Fluoroquinolones	2 UI (2-3) ↑
10	Acinetobacter baumannii Anti-pseudomonal	31 UI (27-35) ↑	Klebsiella pneumoniae Fluoroquinolones	2 UI (2-3) ↑

Annualized rate of change (1990-2021): <-3% | -3% to -1.5% | -1.5% to 0% | 0% to 1.5% | 1.5% to 3% | 3% to 5% | >5.0%

- 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 (308 UI (271-346)), lower respiratory infection (excl. COVID) (217 UI (184-250)), peritoneal and intra-abdominal infections (90 UI (76-105)), urinary tract infections and pyelonephritis (31 UI (24-39)) and infections of the skin and subcutaneous systems (29 UI (21-36)).

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



- In Montenegro, 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 227 UI (186-269), whereas the mortality rate per 100,000 was 390 UI (319-462).

Data sources for Montenegro

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 Montenegro by source type

Source type	Years	Sample size	Sample size units
Antibiotic use	1990-2021	197	Study-year datapoints
Single drug resistance profile data	2010-2021	248	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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