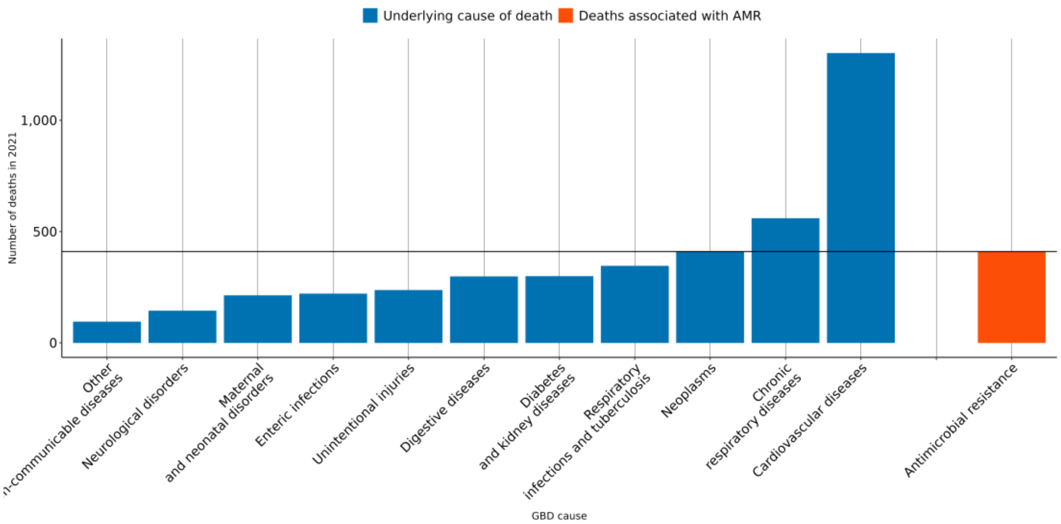
The burden of antimicrobial resistance (AMR) in Bhutan

Executive summary

- Antimicrobial Resistance (AMR) is a major global health threat, over **100 lives** have been lost each year since 1990 in Bhutan due to AMR.
- In 2021, there were an estimated **101 UI (74-128)** deaths attributable to AMR and **410 UI (310-510)** 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 *Escherichia coli* resistant to carbapenems, *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



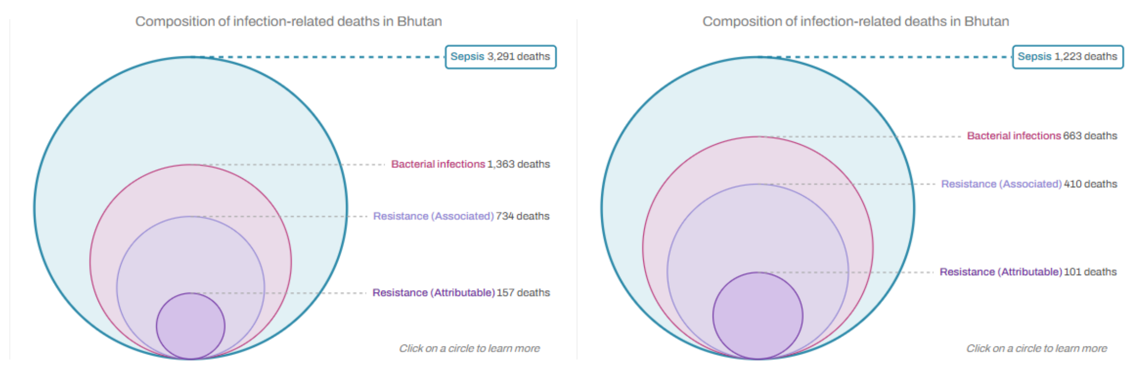
- In 2021, the number of deaths associated with AMR (orange bar in *figure 2*) were high compared to the most relevant underlying causes of death (depicted in blue) in the country. AMR associated deaths occur within multiple Global Burden of Disease (GBD) causes of death and AMR is not an underlying 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 Bhutan, a 10% reduction means to decrease the number of deaths associated with AMR to **383**, but currently the trend for this country could reach up to **475 UI [358-613]** AMR-associated deaths in 2030.

AMR in Bhutan

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 Bhutan between 1990 and 2019.



- To look at these and more visualization interactively visit [Measuring Infectious Causes and Resistance Outcomes for Burden Estimation (MICROBE)]
- In **Bhutan** in 2021, there were an estimated **101 UI (74-128)** deaths attributable to AMR and **410 UI (310-510)** 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, **Bhutan has the 82nd highest** 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	Mycobacterium tuberculosis 104 UI (36-171) ↓	Escherichia coli 86 UI (67-105) ↓	Escherichia coli 23 UI (17-29) ↓
2	Escherichia coli 93 UI (74-112) ↓	Klebsiella pneumoniae 56 UI (43-68) ↓	Klebsiella pneumoniae 16 UI (12-20) ↓
3	Staphylococcus aureus 75 UI (61-89) ↑	Staphylococcus aureus 50 UI (34-66) ↑	Acinetobacter baumannii 11 UI (9-14) ↓
4	Klebsiella pneumoniae 67 UI (54-80) ↓	Streptococcus pneumoniae 48 UI (33-63) ↓	Streptococcus pneumoniae 10 UI (6-15) ↓
5	Streptococcus pneumoniae 64 UI (49-79) ↓	Pseudomonas aeruginosa 31 UI (21-40) ↓	Staphylococcus aureus 10 UI (6-14) ↑
6	Pseudomonas aeruginosa 53 UI (43-63) ↓	Acinetobacter baumannii 29 UI (23-34) ↓	Pseudomonas aeruginosa 8 UI (5-11) ↓
7	Salmonella Typhi 38 UI (16-60) ↓	Salmonella Typhi 17 UI (4-30) ↓	Enterobacter spp. 4 UI (3-5) ↓
8	Acinetobacter baumannii 30 UI (25-36) ↓	Enterobacter spp. 14 UI (11-17) ↓	Mycobacterium tuberculosis 3 UI (0-8) ↑
9	Enterobacter spp. 18 UI (14-21) ↓	Enterococcus faecalis 12 UI (9-14) ↑	Serratia spp. 3 UI (2-3) ↓
10	Enterococcus faecalis 16 UI (13-19) ↑	Proteus spp. 10 UI (8-12) ↑	Enterococcus faecalis 2 UI (1-3) ↑

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%

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

Burden Rank	Associated			Attributable		
1	Escherichia coli Aminopenicillin	82 UI (63-101)	↓	Escherichia coli Carbapenems	9 UI (6-12)	↑
2	Escherichia coli Fluoroquinolones	57 UI (38-75)	↑	Streptococcus pneumoniae Carbapenems	7 UI (4-10)	↓
3	Escherichia coli TMP-SMX	52 UI (38-65)	↓	Acinetobacter baumannii Carbapenems	5 UI (4-7)	↑
4	Klebsiella pneumoniae Aminoglycosides	51 UI (40-62)	↓	Klebsiella pneumoniae Carbapenems	5 UI (4-7)	↓
5	Escherichia coli Beta-Lactam/Lactamase Inhib.	51 UI (38-63)	↓	Staphylococcus aureus Methicillin	5 UI (2-7)	↑
6	Escherichia coli 3GC	50 UI (31-68)	↓	Klebsiella pneumoniae Aminoglycosides	4 UI (3-5)	↓
7	Klebsiella pneumoniae Beta-Lactam/Lactamase Inhib.	44 UI (31-57)	↓	Escherichia coli Fluoroquinolones	4 UI (2-5)	↑
8	Klebsiella pneumoniae 3GC	44 UI (34-54)	↓	Klebsiella pneumoniae Fluoroquinolones	3 UI (2-4)	↑
9	Klebsiella pneumoniae Fluoroquinolones	42 UI (31-52)	↑	Escherichia coli 3GC	3 UI (2-5)	↓
10	Streptococcus pneumoniae TMP-SMX	40 UI (25-55)	↓	Pseudomonas aeruginosa Carbapenems	3 UI (1-4)	↑

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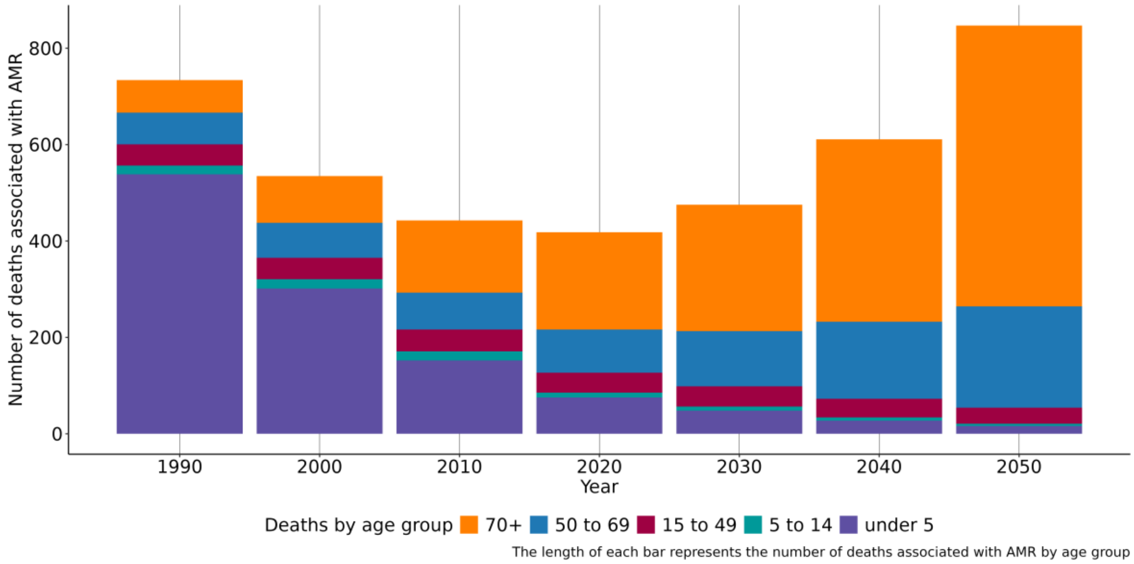
- Independently of antimicrobial resistance, the infectious syndromes accounting for the most deaths in 2021 were as follows (estimated thousands of deaths in parenthesis) bloodstream infections (290 UI (230-350)), lower respiratory infection (excl. COVID) (229 UI (174-285)), diarrhea (179 UI (31-328)), tuberculosis (104 UI (36-171)) and peritoneal and intra-abdominal infections (49 UI (35-63)).

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



- In Bhutan, people aged under 5 experienced the largest number of deaths associated with AMR in 1990 but this changed by 2021 as the largest number of deaths occurred among the 70+. This indicates that prevention of infections among the under 5 has contributed to the reduction in the number of AMR associated deaths. In 2021, the number of deaths associated with AMR among the 70+ was 203 UI (164-242), whereas the mortality rate per 100,000 was 630 UI (509-751).

Data sources for Bhutan

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 Bhutan by source type

Source type	Years	Sample size	Sample size units
Antibiotic use	2010-2021	882	Study-year datapoints
Microbial or laboratory data without outcome	2010-2021	112	Isolates
Literature studies	2010-2021	841	Cases/isolates/susceptibility tests
Single drug resistance profile data	2010-2021	871	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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