Global burden of antimicrobial resistance and forecasts to 2050

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The growing challenge of antimicrobial resistance (AMR) is now recognised as a global public health emergency that requires concerted efforts by all stakeholders.[1] There is compelling evidence that AMR is associated with increased mortality and longer hospitalisation, and has a negative effect on the economies of communities and countries, more so in low-income and middle-income countries (LMICs) where the burden of infectious diseases is much higher, partially because water, sanitation, and hygiene (WASH) infrastructure and practice are inadequate, and vaccine coverage is low.[2] Previous estimates published in 2022[3] estimated 4·95 million (95% UI 3·62–6·57) deaths were associated with bacterial AMR, including 1·27 million (0·911–1·71) deaths attributable to bacterial AMR in 2019. Having data on the trends of the burden of AMR and the prediction of this burden in the coming three decades provides additional motivation for effective intervention measures by all stakeholders.

The current study by the GBD 2021 Antimicrobial Resistance Collaborators[4] in *The Lancet* used a statistical modelling approach based on different datasets to provide estimates of the AMR burden for different parts of the world, including seven countries or territories with no input data, with outputs and reference from the comprehensive assessment of the global burden of AMR from 1990 to 2021, and with data forecasting the burden of AMR until 2050. This estimate of the burden of AMR builds on death from infection and selected incidence estimates for different underlying conditions from the Global Burden of Diseases, Injuries, and Risk Factors Study 2021.[5] In addition, the authors obtained datasets not previously available for AMR research, including multiple cause of death data, hospital discharge, microbiology data with and without patient outcome, studies published in scientific journals, reports from networks that monitor bacteria resistant to antibiotics, pharmaceutical sales, antibiotic use surveys, mortality surveillance, linkage data, outpatient and inpatient linked insurance claims data, and publicly available data. This innovative and collaborative approach enables a comprehensive assessment of AMR burden data, not previously available, covering a wide array of pathogens and pathogen–drug combinations—with global and regional estimates for 204 countries and territories, and allows us to observe trends from 1990–2021, whereas the previous study was a brief overview of 2019 only.

The model successfully evaluated the changing trends in AMR mortality across time and location which is necessary to understand how the burden of AMR is developing, and to provide evidence for action by all stakeholders to make informed decisions regarding interventions. Using this model, authors estimate that AMR burden is forecasted to increase to 1·91 million (1·56–2·26) attributable and 8·22 million (6·85–9·65) associated deaths in 2050. Although there was a 50% reduction in number of deaths among children younger than 5 years, the pathogens with the largest number of deaths attributable to AMR in 2021 were *Klebsiella pneumoniae, Streptococcus pneumoniae,* and *Escherichia coli*. For all age groups, the pathogen–drug combination with the largest increase in attributable burden was meticillin-resistant *Staphylococcus aureus* (MRSA), doubling from 57 200 (34 100–80 300) attributable deaths in 1990 to 130 000 (113 000–146 000) attributable deaths in 2021. In addition, AMR-related mortality deaths in adults older than 70 years more than doubled between 1990 and 2021, probably due to multiple comorbidities as risk factors. Carbapenem resistance in Gram-negative bacteria saw a substantial increase in attributable burden from 1990 to 2021. Without additional intervention measures, 10% reduction in AMR mortality by 2030 proposed in the 10-20-30 WHO target will not be met.[6] If new antimicrobials are developed for currently antimicrobial-resistant Gram-negative bacteria, a forecasted 11·1 million (9·08–13·2) AMR deaths could be averted by 2050. This calls for additional investment in the search for new antibacterial molecules.[7,8] Yet, this would not be enough as 28·03 million (23·7–32·8) annual AMR deaths will still occur by 2050 even after accounting for deaths averted by the Gram-negative scenario. Under a scenario of better care of severe infections and improved access to antibiotics, across all age groups, 92·0 million deaths

(82·8–102·0) could be cumulatively averted between 2025 and 2050.

The reduction in deaths of children younger than 5 years with sepsis, by more than 60% over the past 31 years, coincides with widespread vaccination efforts and improved access to WASH, and infection prevention and control strategies that proved highly effective in reducing AMR burden.[4] For LMICs where the burden of bacterial infections and AMR is particularly high, Lewnard and colleagues[9] estimate that improving infection prevention and control programmes could prevent at least 337 000 (95% CI 250 200–465 200) AMR-associated deaths annually. Improved access to WASH infrastructure and practice would prevent another 247 800 (160 000–337 800) AMR-associated deaths, whereas use of paediatric vaccines would prevent an additional 181 500 (153 400–206 800) AMR-associated deaths, from both direct prevention of resistant infections and reductions in antibiotic consumption.

Statistical modelling using robust datasets provides much needed data to estimate burden of disease and drive action, but these have several limitations. Scarcity of data in many LMIC settings was a major drawback for the analysis, and even if some data were available, it was highly fragmented and not robust enough for time trend analysis. This can be attributed to insufficient laboratory infrastructure and capacity, scarce or absent microbiological facilities, weak health systems governance and information systems, and scarce resources for systematic data collection. This calls for renewed efforts (eg, resources, political support, and enhanced capacities) in LMIC settings to fully implement national action plans to combat and control AMR.

Significant analytical errors might occur when consolidating and standardising data from different providers and origins of infection due to selection bias in passive microbial surveillance data, biases in diagnostic culture use, differences in antimicrobial usage between the private and public health-care sector, and uneven temporal distribution of available data from various regions and countries, which complicates the accurate representation of global, regional, and national AMR dynamics, thus affecting reliability and interpretation of time trend analyses.

The forecast and scenarios of AMR burden to 2050 are also subject to the limitations in the historical estimates, including availability and quality of historical data. The forecast models also do not consider emergence of AMR superbugs and might lead to underestimation if new pathogens arise.

Overall, these limitations do not dampen the importance of the current study that is the first to provide comprehensive assessment of the global burden of AMR from 1990 to 2021, with results forecasted until 2050. These data should drive investments and targeted action towards addressing the growing challenge of AMR in all regions.

I declare no competing interests.

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1 WHO. Antimicrobial resistance: accelerating national and global responses. WHO strategic and operational priorities to address drug-resistant bacterial infections in the human health sector, 2025–2035. April 11, 2024. https://apps.who.int/gb/ebwha/pdf_files/WHA77/A77_5-en.pdf (accessed Aug 31, 2024).

2 Kariuki S, Kering K, Wairimu C, Onsare R, Mbae C. Antimicrobial resistance rates and surveillance in sub-Saharan Africa: where are we now? *Infect Drug Resist* 2022; **15:** 3589–609.

3 Antimicrobial Resistance Collaborators. Global burden of bacterial antimicrobial resistance in 2019: a systematic analysis. *Lancet* 2022; **399:** 629–55.

4 GBD 2021 Antimicrobial Resistance Collaborators. Global burden of bacterial antimicrobial resistance 1990–2021: a systematic analysis with forecasts to 2050. *Lancet* 2024; published online Sept 16. https://doi.org/10.1016/S0140-6736(24)01867-1.

5 GBD 2021 Diseases and Injuries Collaborators. Global incidence, prevalence, years lived with disability (YLDs), disability-adjusted life-years (DALYs), and healthy life expectancy (HALE) for 371 diseases and injuries in 204 countries and territories and 811 subnational locations, 1990–2021: a systematic analysis for the Global Burden of Disease Study 2021. *Lancet* 2024; **403:** 2133–61.

6 The Lancet. Antimicrobial resistance: an agenda for all. *Lancet* 2024; **403:** 2349.

7 Brüssow H. The antibiotic resistance crisis and the development of new antibiotics. *Microb Biotechnol* 2024; **17:** e14510.

8 WHO. Bacterial priority pathogens list, 2024: bacterial pathogens of public health importance to guide research, development and strategies to prevent and control antimicrobial resistance. Geneva: World Health Organization, 2024.

9 Lewnard JA, Charani E, Gleason A, et al. Burden of bacterial antimicrobial resistance in low-income and middle-income countries avertible by existing interventions: an evidence review and modelling analysis. *Lancet* 2024; **403:** 2439–54.