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Economics of antimicrobial resistance

Anthony McDonnell | 21st of January 2025 | CGDev.org

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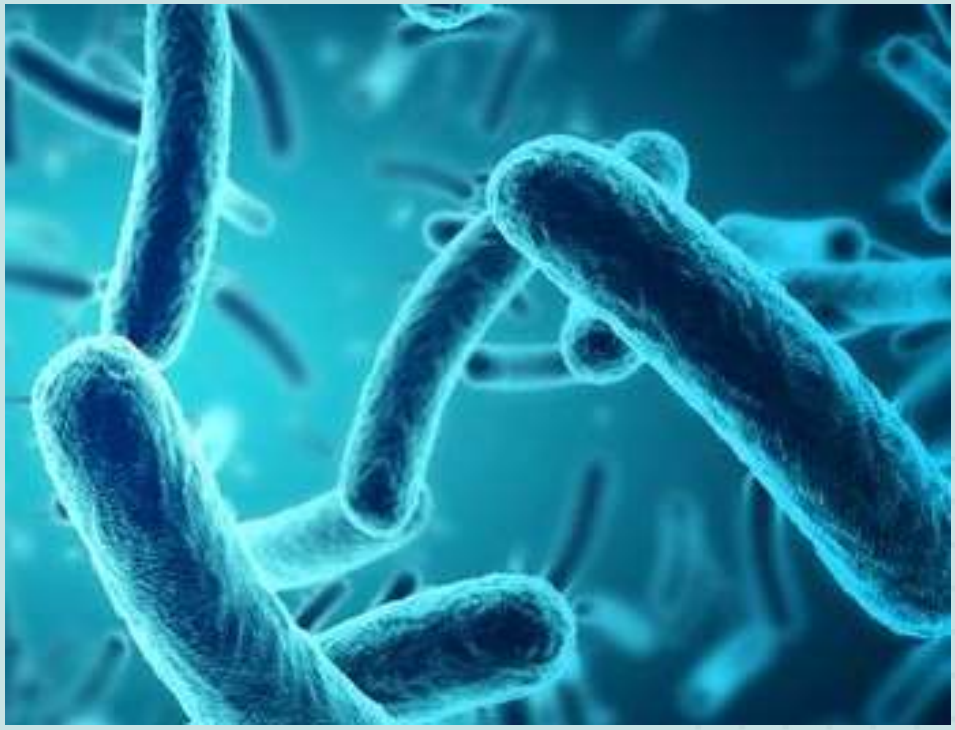
What is antimicrobial resistance?

What are antimicrobials?

- Microbes are tiny organisms like bacteria, virus, or fungus, that cause infections.
- Antimicrobials kill or stop microbes from growing. The most important antimicrobials are antibiotics which were first used in 1941.
- In this talk I will focus primarily on antibiotic resistance.



Antibiotics sustain health systems

- They have greatly reduced deaths from infections

US infectious disease deaths per 100,000 people

1900 = 797

Late 1930s = 293

1980 = 36

Image: Public Broadcasting Service

Source: Armstrong et al. *Trends in Infectious Disease Mortality in the United States During the 20th Century* (1999)

Antibiotics sustain health systems

- They have greatly reduced deaths from infections
- Allow surgery, transplants, oncology care
- Like water, they allow a health system to thrive

Image: Public Broadcasting Service

Following science requires good economics

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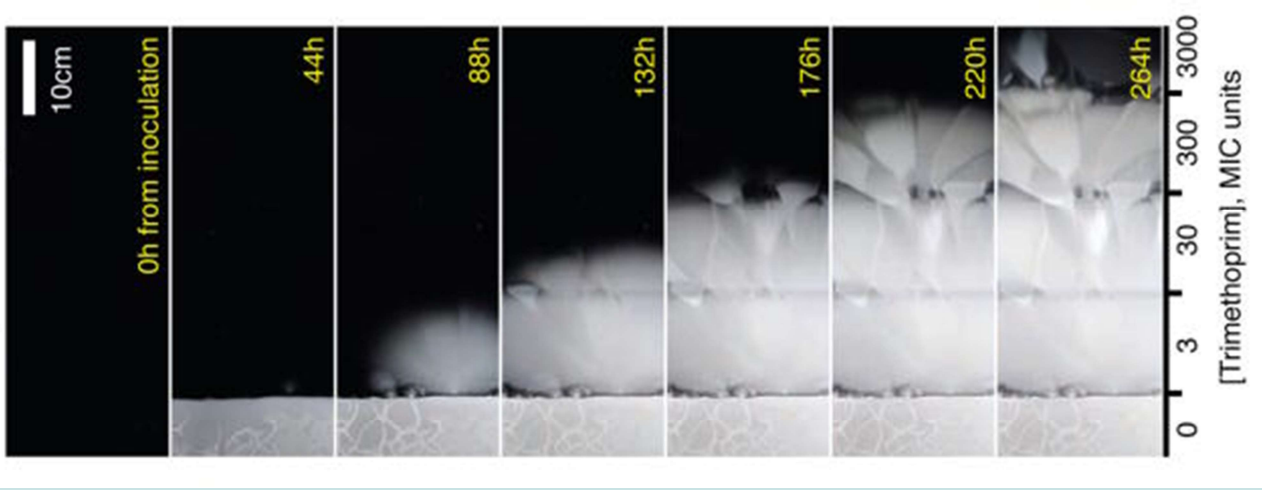
"It is not difficult to make microbes resistant to penicillin in the laboratory by exposing them to concentrations not sufficient to kill them[.]"
Alexander Fleming, 1945



From Baym et al., *'Spatiotemporal microbial evolution on antibiotic landscapes'*, 2016

- For almost as long as we've known about antibiotics, we've known about resistance, and how to stop it.
- Economic failures undermine our response.

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A common pool problem:

Our stock of effective antibiotics is a finite resource for which there is no effective mechanism to moderate demand. The result is a tragedy of the commons: everyone uses antibiotics a little too much, and we will be left with none that work.

The Pool of Effective Antibiotics is Drying Up

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PRODUCTION IS SLOWING

Insufficient funding constrains resources

Academic research favors more "cutting-edge" topics

Clinical research is logistically challenging

Limited markets prevent antibiotics from reaching some countries

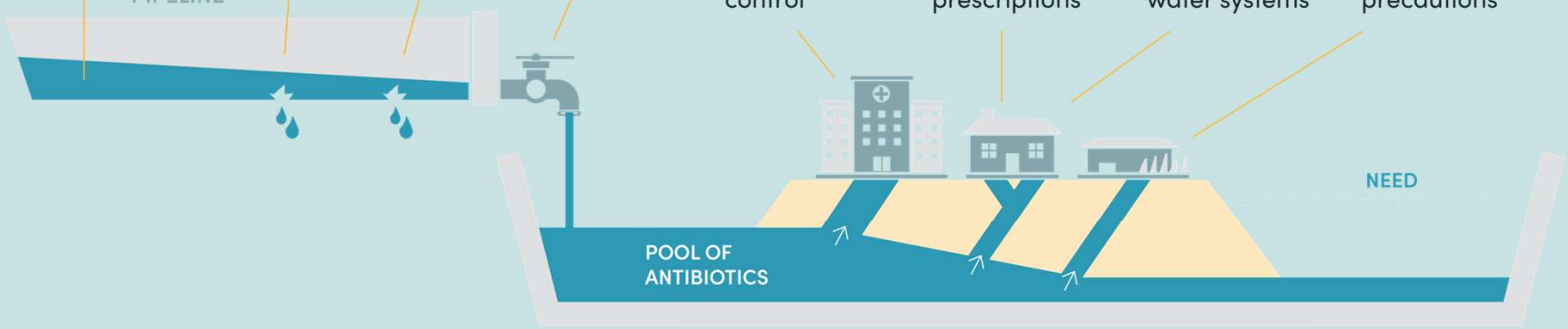
RESISTANCE IS INCREASING

Overuse in treatment due to poor infection control

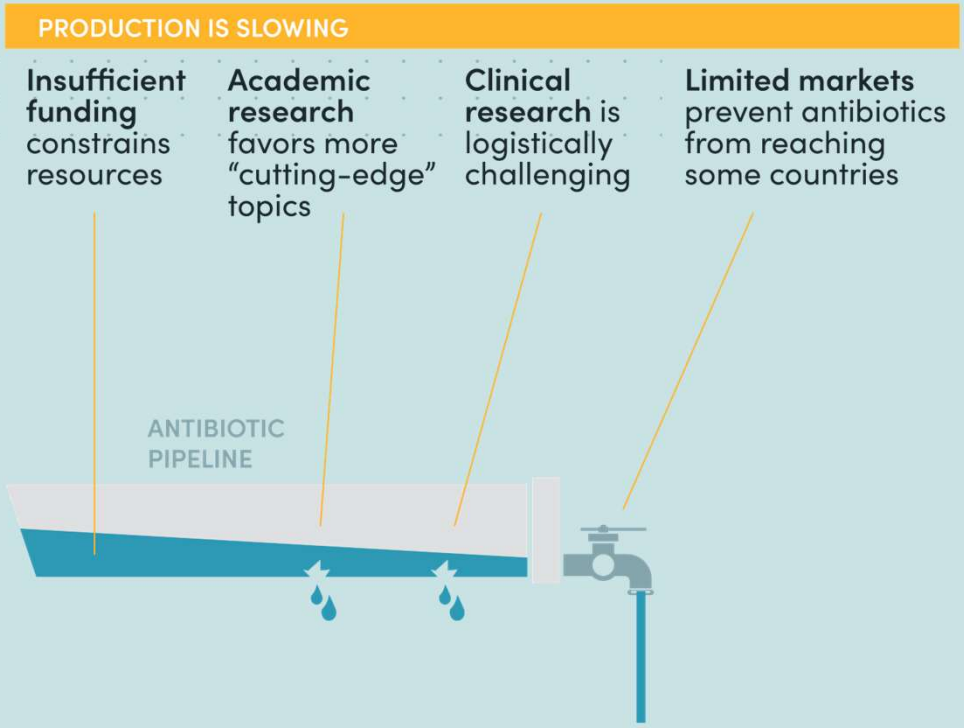
Inappropriate use in treatment via unnecessary prescriptions

Environmental pollution dumps antibiotics into water systems

Inappropriate use in agriculture via unnecessary precautions



Source: McDonnell, Dissanayake, Klemperer, Toxvard and Sharland. *The Economics of Antibiotic Resistance (2024)*



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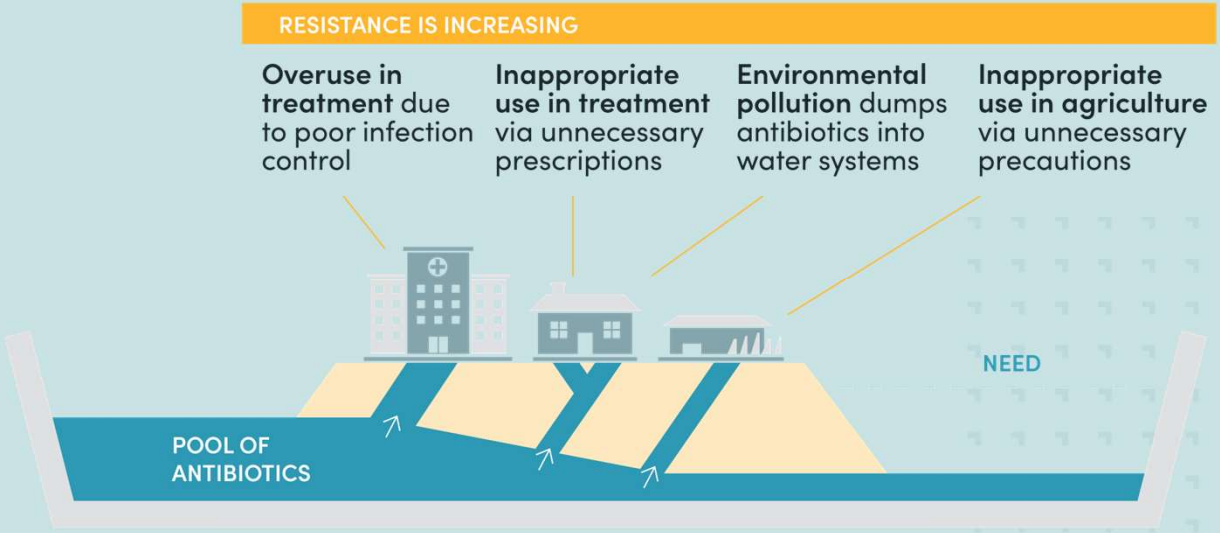
Five failures holding the pipeline back

1. Antibiotics are public goods (non rivalrous, non-excludable)
2. The social and private value of new antibiotics are poorly aligned
3. Regulatory failures exacerbate these market failures
4. Antibiotics have an insurance value that we do not pay for
5. Market fails to provide access to treatments

Source: McDonnell, Dissanayake, Klemperer, Toxvard and Sharland. *The Economics of Antibiotic Resistance (2024)*

Four failures causing excessive demand

1. Infection control is also a public good
2. Mismatching problem
3. Negative externalities: environmental pollution
4. Negative externalities: Antibiotic use in agriculture



Source: McDonnell, Dissanayake, Klemperer, Toxvard and Sharland. *The Economics of Antibiotic Resistance (2024)*

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Understanding the economic impact of AMR

Understanding the economic burden

- Research as part of a consortium

Institute for Health Metrics and Evaluation

- IHME projected the future burden of AMR
- CGD led work on the economic burden of resistance in human health

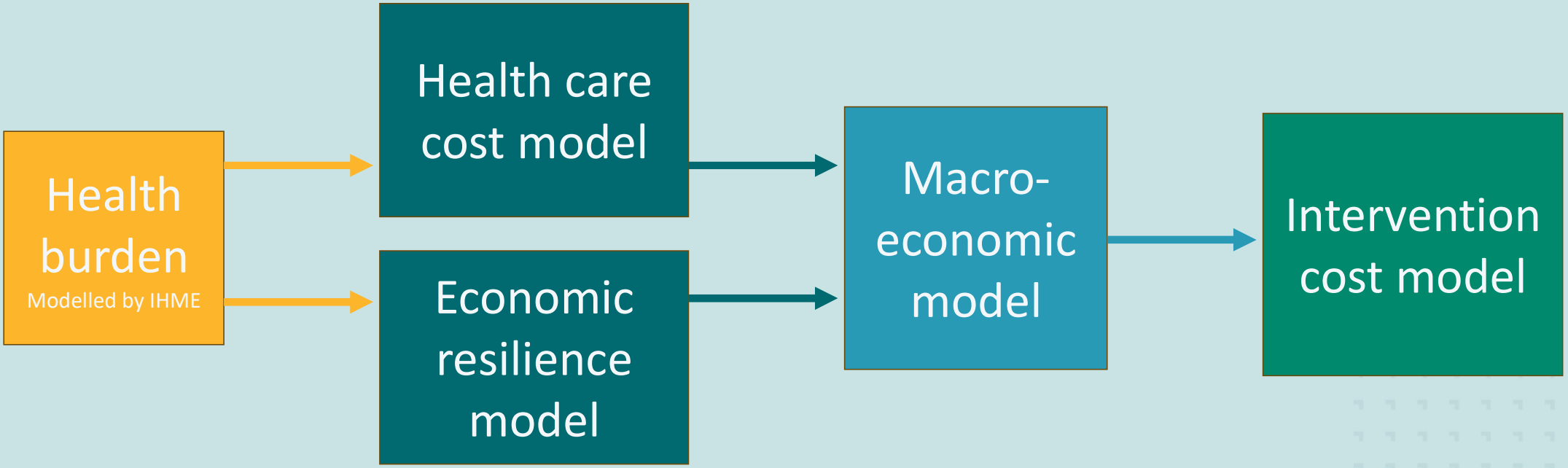
What are IHME's results?

- IHME's results are based on:
    1. Estimating historical rates of ABR from 1990-2021
    2. Projecting forward those trends to 2050
    3. Adjusting results for demographic changes
    4. Generating intervention scenarios and a pessimistic scenario
- They expect the percentage of infections that are resistant to increase
- But this will be roughly cancelled out by a reduction in the total number of infections
- The age profile of people dying will get much older

Scenarios

1. Business-as-usual scenario assumes that resistance follows historical trends
2. Better treatment of bacterial infections is provided
3. Increased innovation and roll-out of gram-negative antibiotics
4. Better treatment is provided, along with increased innovation
5. Better treatment is provided; increased innovation; and improved access to vaccines, sanitation and clean water
6. An accelerated rise in resistance scenario that assumes resistance increases at the rate of the bottom 15% of countries

Modelling four aspects of resistance



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Health Model

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Overall modelling strategy

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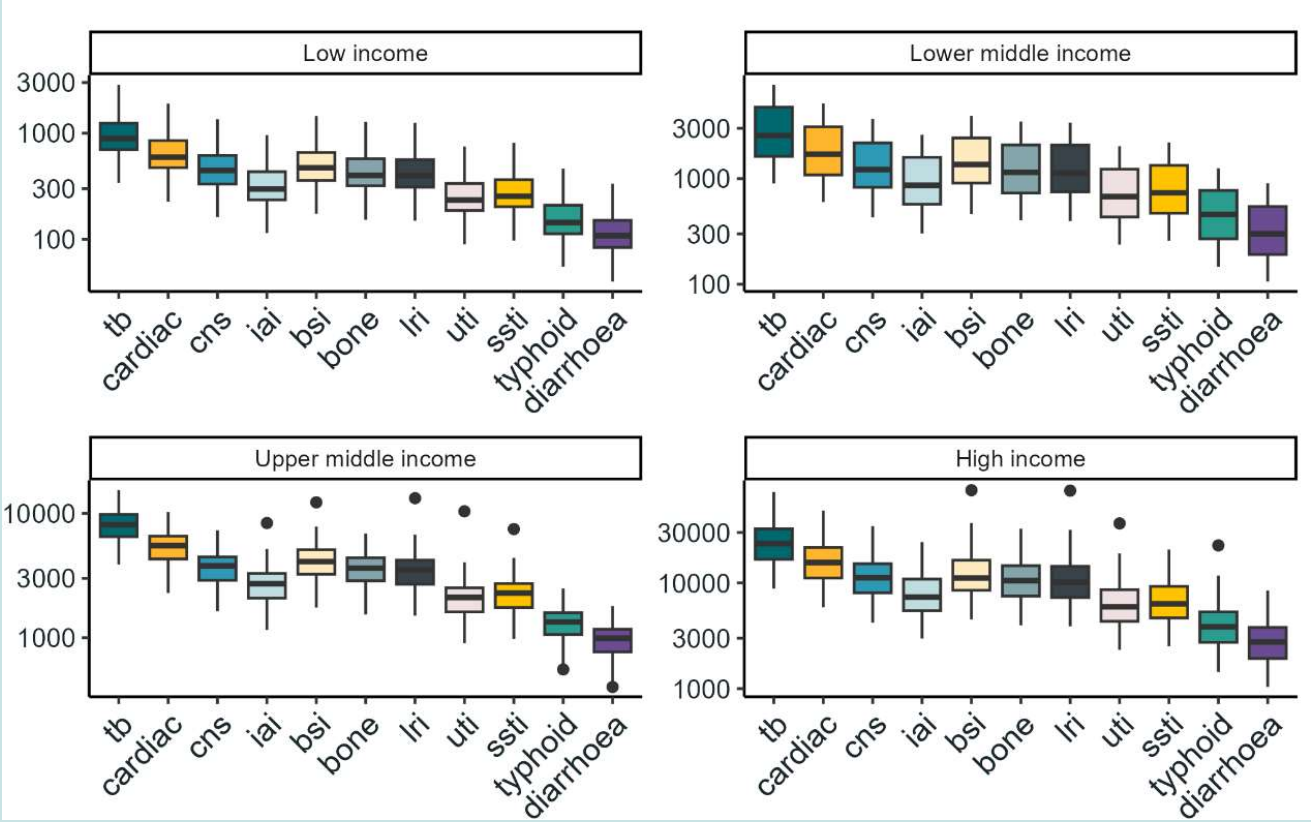
Estimate cost per inpatient admission based on a literature review of over 234 relevant studies and 911 data points

Generate estimates for 11 indications in 204 countries; building a model to impute missing variables

Estimate current total direct inpatient cost of ABR by combining cost per patient estimates with estimates of hospitalisation from IHME and a second literature review

Estimate scenarios of future inpatient cost of ABR based on IHME burden scenarios

Cost estimates for an admission with a resistant infection



Healthcare costs: methods

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- Treating drug-resistant tuberculosis is ten times more expensive; other diseases double

Resistant infections are far more prevalent in low- and middle-income countries

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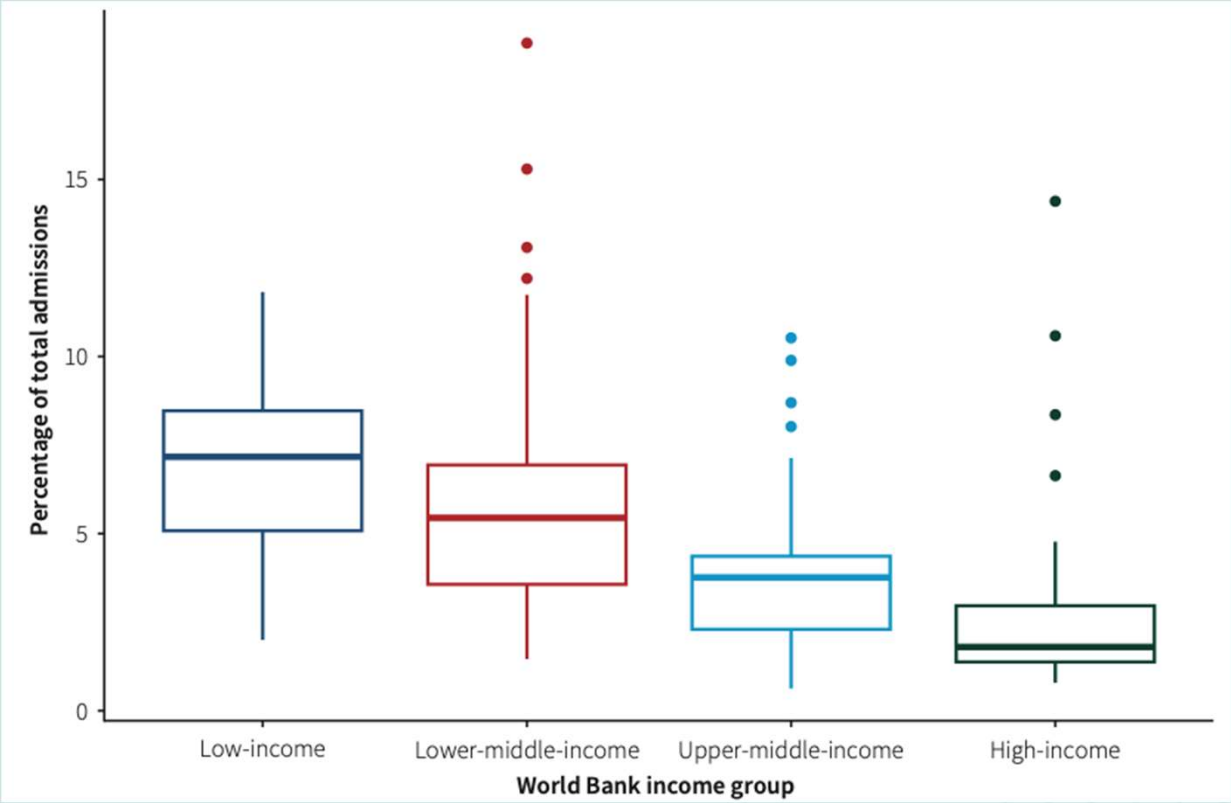
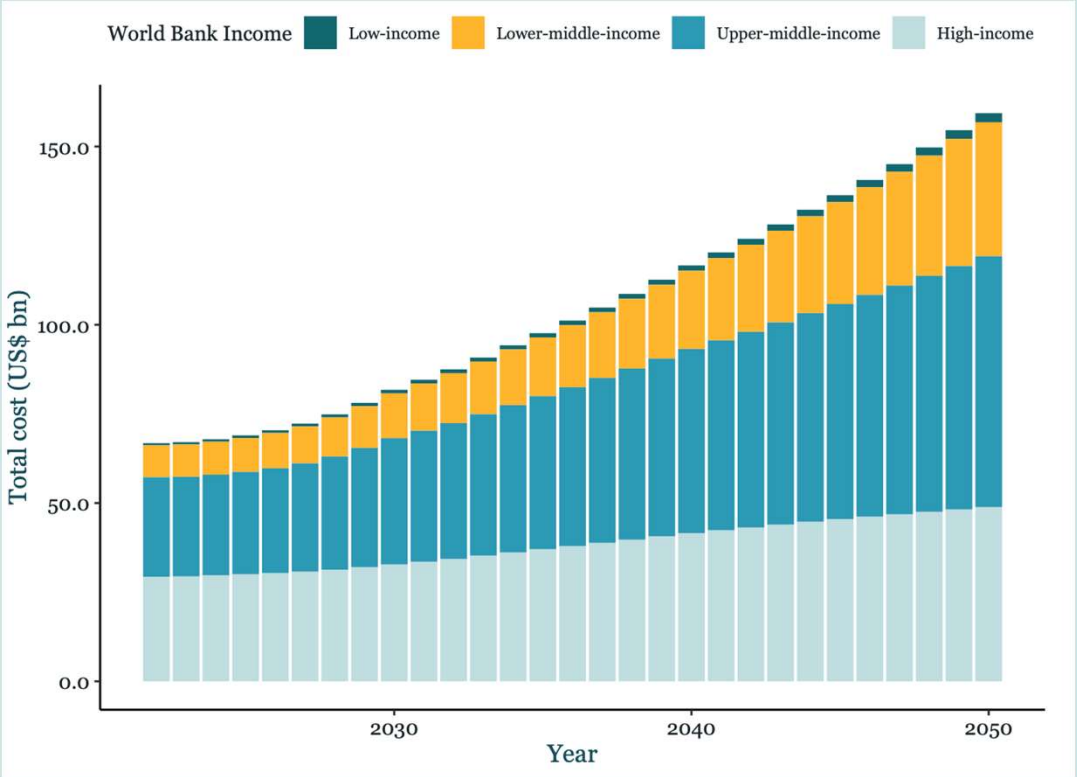
Figure shows percentage of hospital admissions that involve an antibiotic-resistant infection

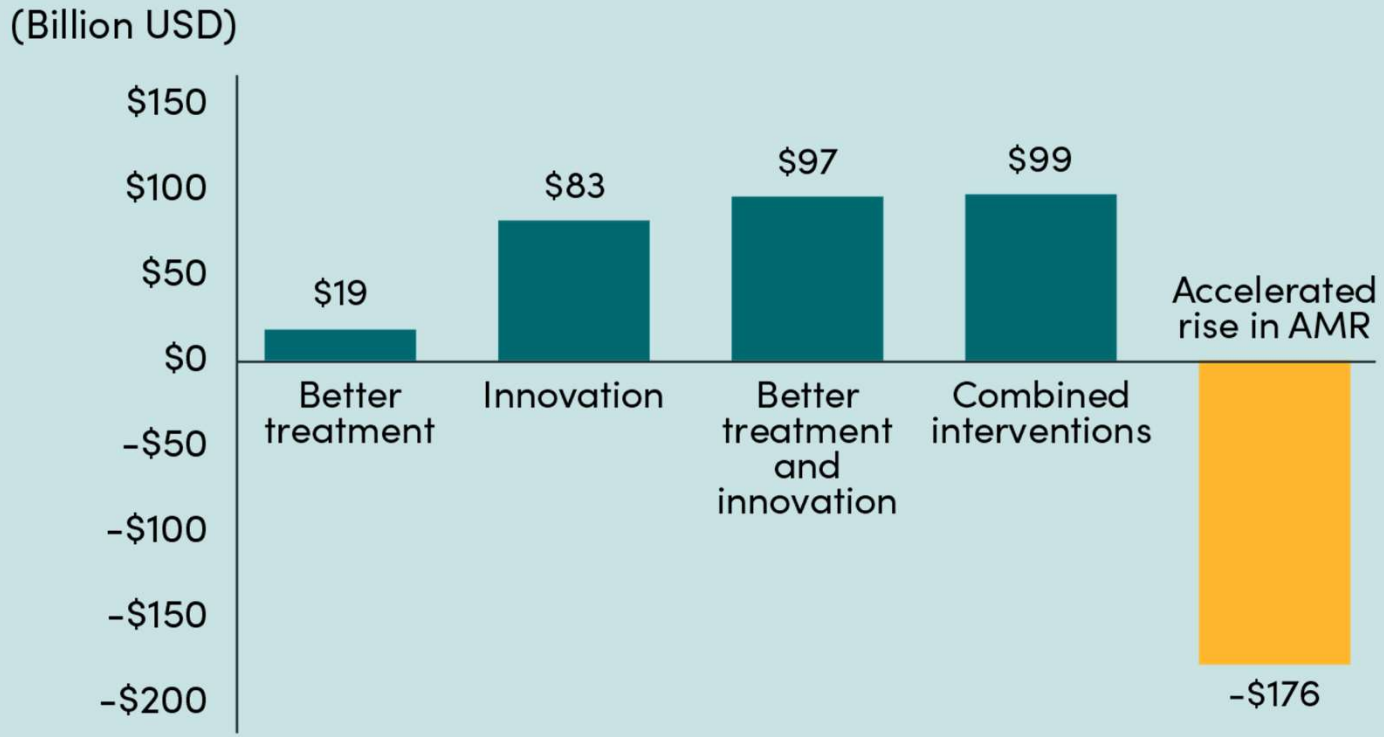


Costs increase into the future

- Total treatment cost for people in hospital with ABR infections is between **USD 150 billion**
- Of this **USD 66 billion** is caused by resistance.
- Following historical resistance rates will see a large increase of spending on AMR.
- Costs rising to $159bn in 2050.



Tackling AMR will save money



Macroeconomic impact

Direct impact on labour market

- Labour force participation: about 1/5th of population fall. Most people are too old or too young to work
- Morbidity: only about 5% of the health burden from AMR (according to IHME)
- Care responsibility: Close to zero given morbidity
- Bereavement: impact of death on friends and family, through absenteeism and presenteeism

Other parts of the economy will be disrupted

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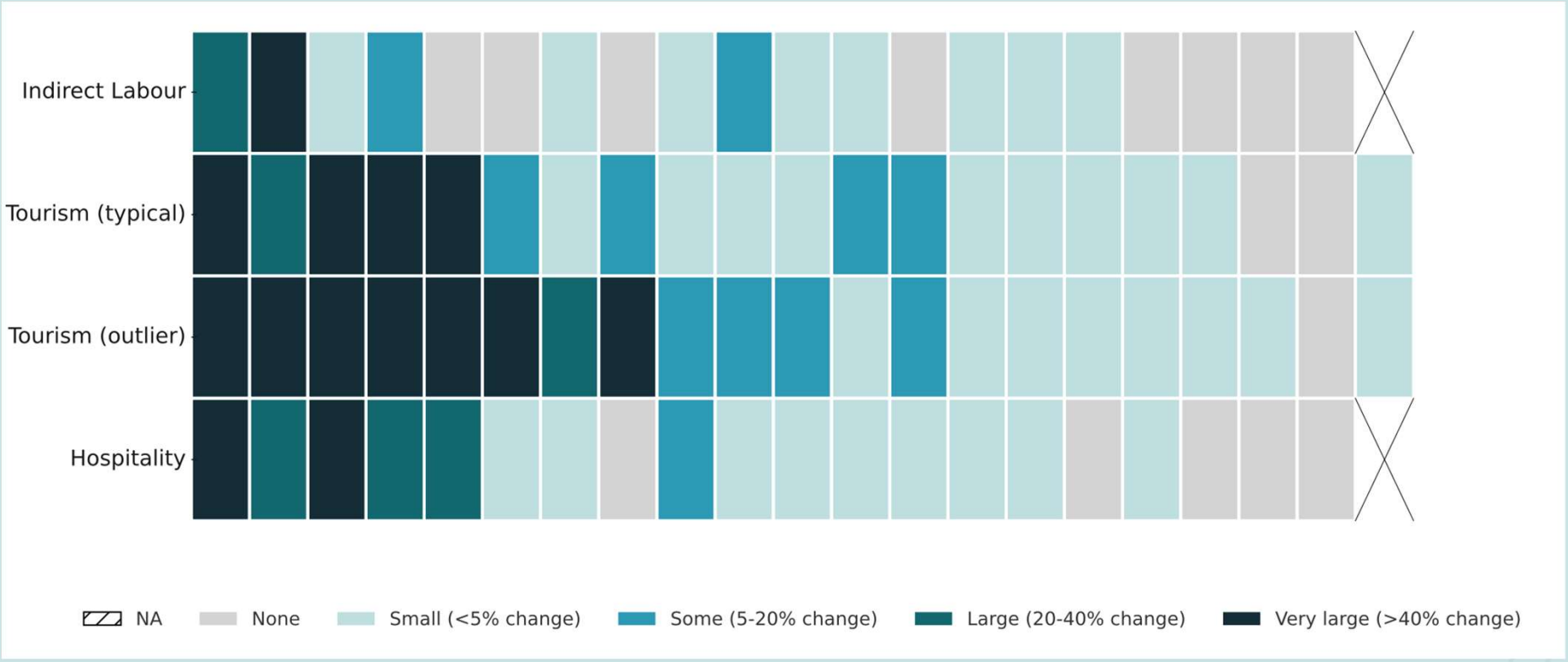

Expert assessment on the impact of AMR on tourism

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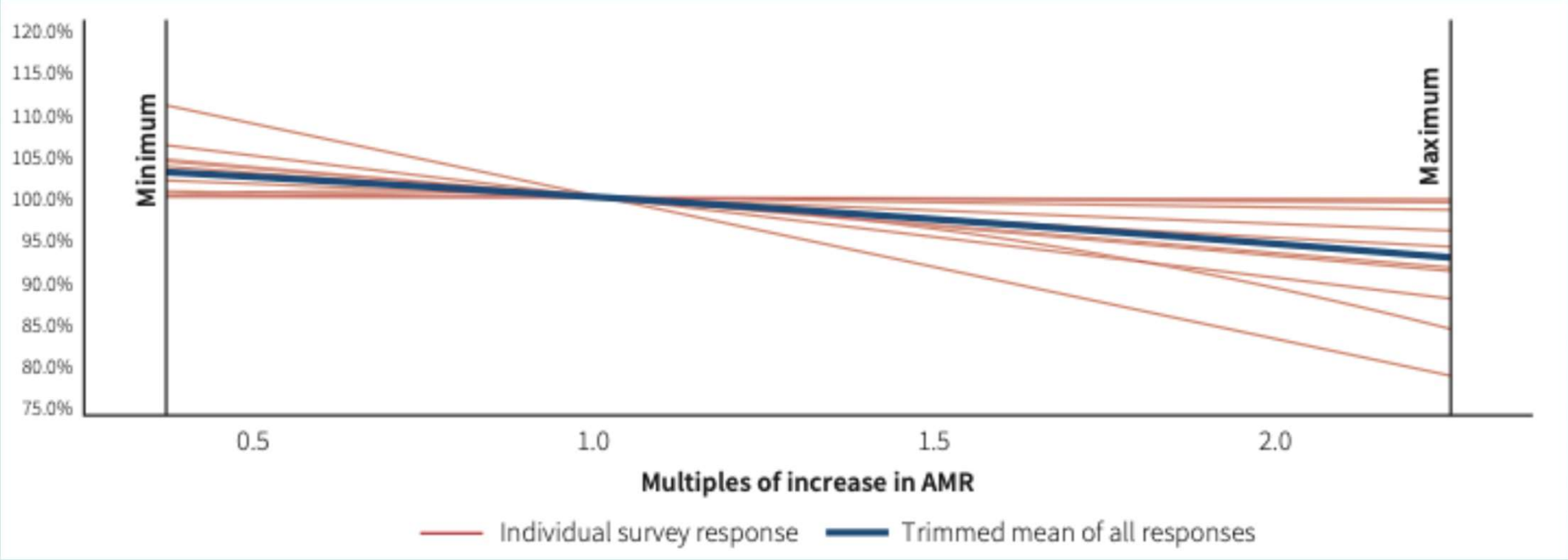
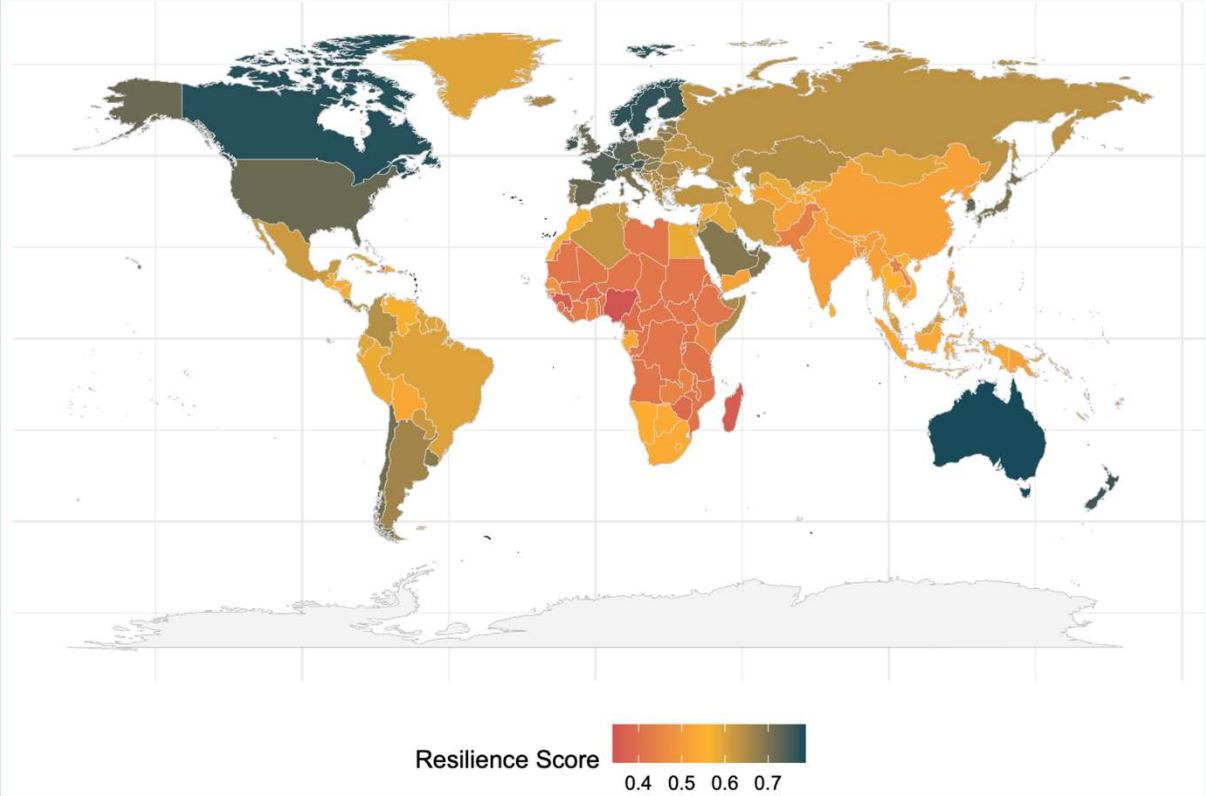
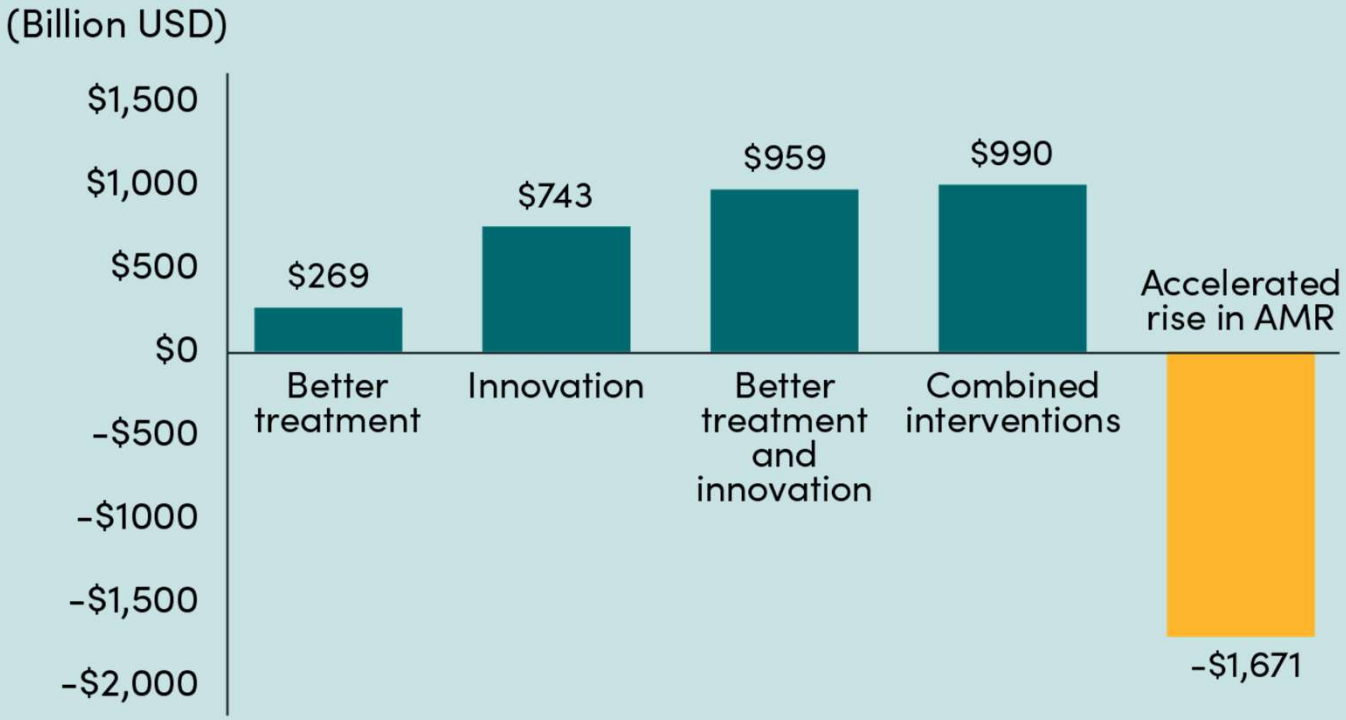


Impact will vary by country

- Some countries were thought to be better able to withstand the shock from resistance.
- Particularly wealthy, good health systems, stronger state capacity

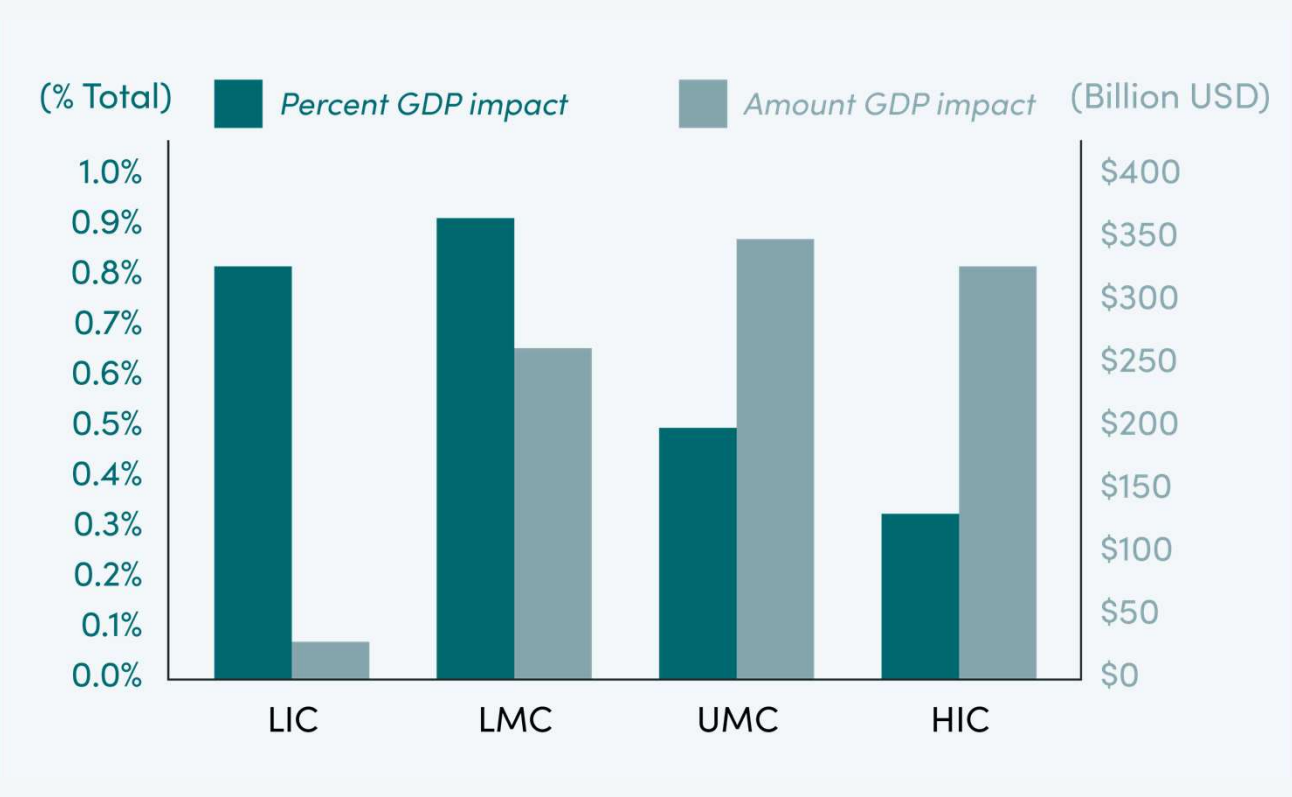


Choices we make now impact cost

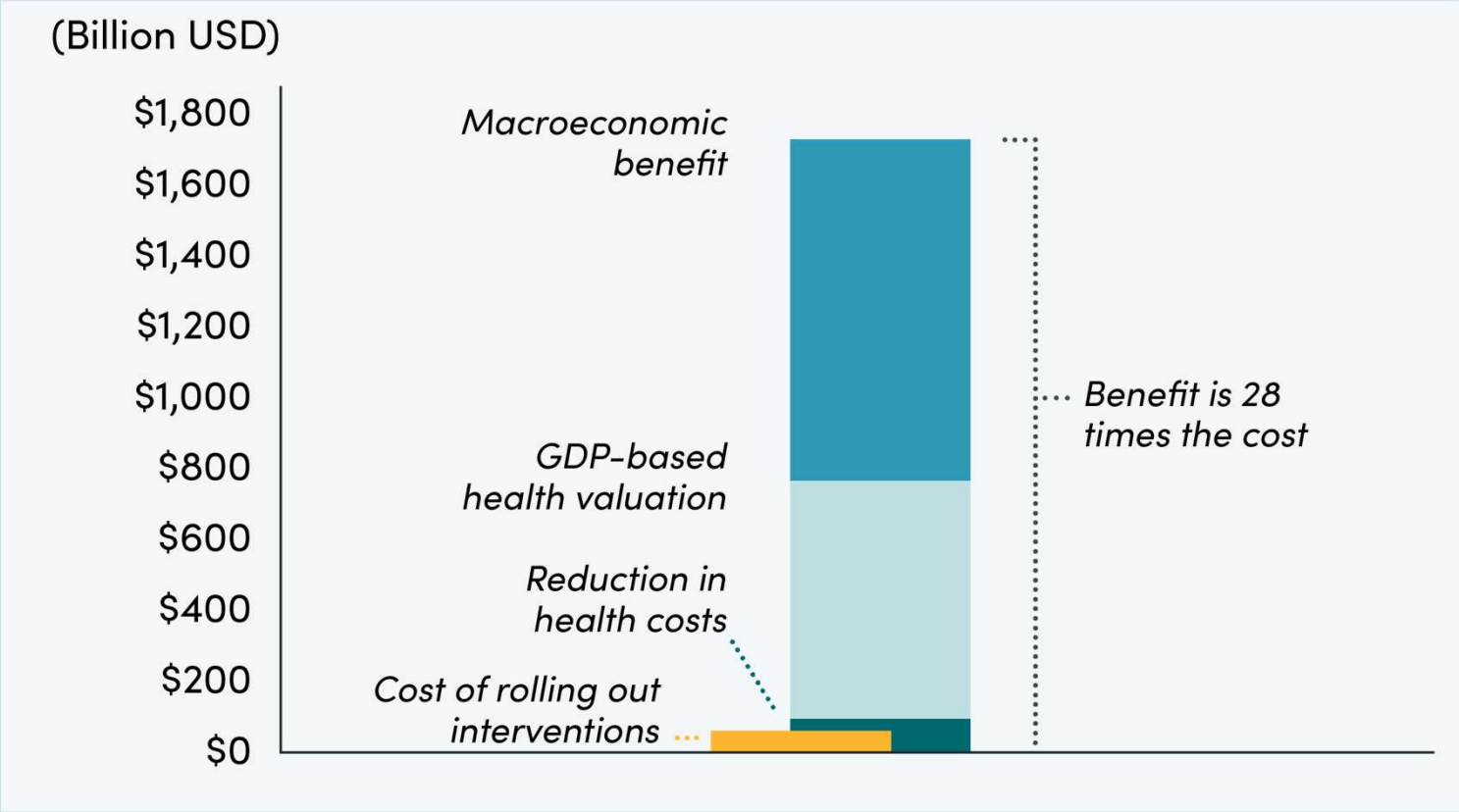


Burden falls harder on poorer people

- While in absolute terms these costs hit HICs the hardest, relatively the impact is hardest on LMICs



Cheaper to combat AMR



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Discussion