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In collaboration with Centre for Impact Investing and Practices and Philanthropy Asia Alliance

Targeted Action and Financing the Fight Against Antimicrobial Resistance in Asia

INSIGHT REPORT

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Images: Getty Images

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Foreword

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Mobilizing the financial resources required to reduce deaths associated with antimicrobial resistance (AMR) around the world could save more than 100 million lives by 2050.

In an era of remarkable medical advancement, a silent threat is lurking in our hospitals, homes and communities, turning once-treatable infections into potentially fatal conditions. "Superbugs" – the ominous result of antimicrobial resistance (AMR) – are rapidly evolving to outsmart our most potent antimicrobials.

Imagine a world where a simple cut could lead to a life-threatening infection, or where routine surgeries become high-risk gambles with mortality. This is a looming reality that threatens to unravel decades of progress in modern medicine. As these microscopic adversaries continue to adapt and spread, they do not discriminate between victims; however, those in lower-income countries are most at risk.

The stark truth is that by 2050, superbugs could claim more lives annually than cancer, with an estimated 10 million deaths per year.[1] Equally alarming is the estimated timeline of 10-15 years needed to develop enough new antimicrobial drugs to protect us. The time to act is now, before we find ourselves in a post-antibiotic era where even the most "simple" infections could once again become lethal.

This mounting threat carries a significant economic cost that could run into the trillions of dollars. The World Bank warns that unmitigated AMR could wipe out between 1.1% and 3.8% of annual global GDP by 2050.[2] In Asia, where climate change worsens the spread of diseases and increases antibiotic misuse, especially by farmers, tackling AMR is essential for health security, sustainable development and economic stability.

In a bid to start tackling this critical issue, global leaders at the United Nations (UN) General Assembly High Level Meeting on AMR in September 2024 committed to targets that include reducing deaths from bacterial AMR by 10% per year by 2030, boosted by $100 million of catalytic finance to ensure a majority of countries have funded national action plans on AMR by the end of this decade.[3]

Following the UN declaration, the World Economic Forum's Global Future Council on the Future of Tackling Antimicrobial Resistance launched the Davos Compact on AMR at the Forum's Annual Meeting in January 2025. The Davos Compact highlights how the private sector can best participate in a collaborative response to the challenge of AMR, in particular by unlocking significant and sustainable financial resources to develop innovative solutions to drug-resistant infections.

This report is the result of a partnership between the Forum's Giving to Amplify Earth Action (GAEA) initiative, the Centre for Impact Investing and Practices (CIIP) and the Philanthropy Asia Alliance (PAA). The partnership aims to identify areas at the intersection of climate and health where funders across the spectrum of capital can make meaningful contributions. Through this report, we hope to inform and encourage private funders, impact investors and philanthropists to support the fight against the deadly threat of AMR.

This report offers a focused perspective on the challenges and opportunities in addressing AMR in Asia. It is intended to highlight the severity of this global threat and encourage greater engagement from investors and funders. We hope that the report can serve as a foundation and catalyst for further research and dialogue. The authors welcome additional studies and insights that can enhance collective understanding and strengthen global efforts to combat AMR.

Executive summary

Investment in solutions to fight antimicrobial resistance in the Asia-Pacific could generate healthcare savings of $10-15 billion per year while cutting annual socio-economic costs by $35-40 billion.

Antimicrobial resistance (AMR) is not just a looming health crisis – it is already a deadly reality, demanding urgent and coordinated global action. Globally, AMR was associated with approximately 4.71 million deaths in 2021, a figure projected to surge to 8.22 million by 2050, potentially surpassing cancer as the leading cause of death worldwide. This escalating crisis threatens to unravel decades of progress in modern medicine, turning treatable infections into potentially fatal conditions. The economic consequences are equally dire, with the World Bank warning that unmitigated AMR could wipe out between 1.1% and 3.8% of annual global GDP by 2050, disproportionately impacting low- and middle-income countries (LMICs).

Asia faces a perfect storm of factors that exacerbate AMR, including limited healthcare infrastructure, unsustainable agricultural practices, inadequate sanitation and the impacts of climate change. Overuse and misuse of antibiotics – driven by unequal access to healthcare, insufficient capacity building and the availability of counterfeit drugs – accelerate the development of these "superbugs". Additionally, Asia's rapidly ageing population finds itself in the crosshairs, with deaths from AMR among the over-70s increasing by more than 80% from 1990 to 2021. This alarming trend highlights the imperative for urgent and coordinated action to tackle AMR in the region.

In agriculture, the pressure to meet rising food demand leads to the rampant use of antibiotics in livestock farming, while improper aquaculture practices contaminate waterways. Widespread water insecurity and inadequate water, sanitation and hygiene (WASH) facilities further compound the problem, particularly in the face of climate hazards that disrupt sanitation systems and spread pollutants.

To turn the tide against AMR, this report proposes a strategy built on three sprints and one marathon:

1. **Sprint: Educate** – Improve the knowledge and behaviour of clinicians, patients and farmers in responsible antimicrobial use and infection prevention.
2. **Sprint: Prevent** – Strengthen health systems and services by enhancing diagnostic capabilities and investing in WASH infrastructure.
3. **Sprint: Monitor** – Enhance regional surveillance, data collection and data sharing to improve monitoring and to inform policy.
4. **Marathon: Treat** – Invest in research and development (R&D) and increase access to novel and essential medicines.

Philanthropy, investors and innovative financing can all play critical roles in supercharging these efforts. Within the next decade, investments in innovative AMR solutions in the Asia-Pacific are projected to generate potential healthcare savings of $10-15 billion per year, along with an additional $35-40 billion of annual savings in socio-economic costs. Ultimately, addressing AMR requires a whole-ecosystem approach, with concerted efforts and collaboration across sectors and borders to create a healthier future for Asia and the world.

1 The global threat of antimicrobial resistance

AMR was associated with around 4.7 million deaths in 2021. Without urgent action now, it could overtake cancer as the leading cause of death worldwide by 2050.

1.1 The scale of the crisis

AMR is now recognized as one of the greatest threats to health and development worldwide, contributing to about 9% of all global deaths.[4] In 2021, bacterial AMR was directly responsible for 1.14 million deaths, claiming the lives of as many people as HIV/AIDS and malaria combined. If the issue is left unaddressed, deaths from AMR are projected to hit 1.91 million per year by 2050.[5]

In 2021, the annual number of deaths associated[6] with AMR totalled 4.71 million. If no imminent action is taken, this figure could almost double to 8.22 million,[7] propelling AMR past cancer as the leading cause of death worldwide by 2050.[8]

1.2 The background

> Penicillin didn't just save lives on the battlefield; it revolutionized medicine for all.

The discovery of penicillin in 1928 by Alexander Fleming was a serendipitous moment that changed the course of history. As penicillin made its way to the frontlines of World War II, the impact was staggering – the mortality rate from bacterial pneumonia in soldiers plummeted from 18% to less than 1%.[9] Penicillin did not just save lives on the battlefield; it revolutionized medicine for all.

However, the misuse of antibiotics in healthcare, agriculture and everyday life has accelerated the natural process of bacterial evolution. AMR develops when bacteria, viruses or fungi adapt and no longer respond to medicines (antimicrobials) used to treat them.

Globally, half of all antibiotic regimes are initiated without a clear diagnosis and employ the wrong drug.[10] Unwitting misuse of antibiotics creates an environment where microbes thrive and multiply, creating "superbugs" that are resistant to the existing armoury of antibiotics.

Antibiotics and antimicrobials
Antibiotics are a type of antimicrobials, which are drugs that treat infections caused by microorganisms. Antimicrobials can target bacteria, viruses, fungi and parasites, while antibiotics are only effective against bacteria.

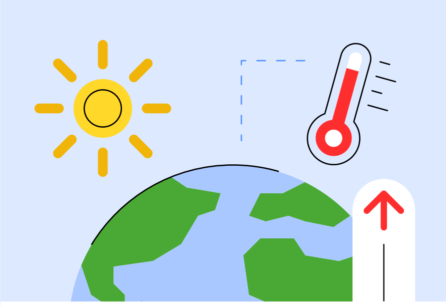
Food meant to nourish and sustain has also become an unwitting accomplice in the spread of AMR. The use of antimicrobials in livestock and crop farming, which greatly surpasses antimicrobial consumption in humans, is creating a silent pandemic that finds its way onto dinner plates.[11] As people consume antibiotic-laden foods, they ingest the invisible enemy. Even more alarmingly, up to 90% of these antibiotics are excreted back into the environment, seeping into the soil and freshwater, creating a vast reservoir of resistance everywhere.[12]

FIGURE 1 | **Drivers and impacts of the antimicrobial crisis**

1

Food systems and farming

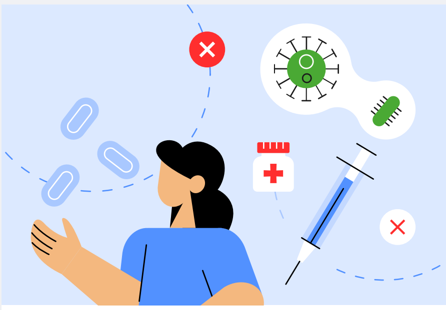
- **Use of antibiotics in livestock** farming is rampant and leads to antibiotic-laden foods.
- **~90% of these antibiotics** are excreted back into the environment, creating more resistance.



2

Climate change

- **Temperature rises** increase rates of bacterial and fungal infection, spreading diseases to unaffected regions.
- **Flooding** overwhelms sanitation and wastewater treatment, increasing exposure to bacteria and viruses.
- **Floodwater transports AMR organisms** to new, previously unaffected locations.
- **Extreme weather** disrupts access to health services (e.g. routine immunization), increasing risk of disease outbreaks.



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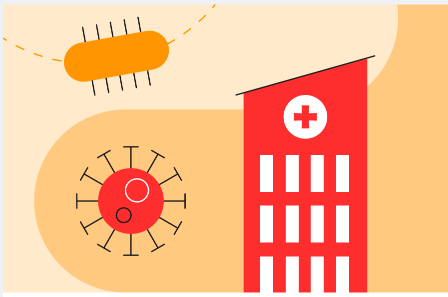
Misuse of antibiotics

- **Half of all treatments** using antibiotics start off without a proper diagnosis and prescribe the wrong drug.
- **Lack of education and awareness** leads to the unwitting misuse of antibiotics, creating an environment where microbes thrive and multiply.



4

Impact on hospitals

- **AMR aggravates hospital-acquired infections and sepsis**. AMR makes routine diseases traditionally treated by antibiotics (e.g. urinary tract infections) increasingly difficult to tackle.
- **AMR increases the risks involved in medical procedures and treatments** (e.g. surgeries, transplants, intensive care, caesarean sections), by complicating treatment of infections.

5

Impact on economies

- **$66 billion (PPP)** – the current annual cost of AMR across 34 OECD and European countries.
- **1.1-3.8% of annual global GDP** could be wiped out by unmitigated AMR by 2050.
- **>5% of annual GDP** could be wiped from the economies of low- and middle-income countries by 2050.

6

Research and development challenges

- **10 years and $1 billion** – the journey from lab to market for a new antibiotic is time and capital intensive.
- **Average returns** on investment fall well short of recouping the cost of drug development and commercialization.

● Drivers of AMR ● Impacts and challenges of AMR

Source: Centre for Impact Investing and Practices (CIIP).

1.3 Not just a health issue

AMR threatens to wipe more than 5% of annual GDP from the economies of low- and middle-income countries by 2050.

AMR is not a standalone issue – it jeopardizes many advances in modern medicine. It complicates the treatment of infections and increases the risks associated with medical procedures and treatments, including surgeries, transplants, intensive care and caesarean sections.[13] It threatens the health of people with weakened immune systems, such as cancer patients, for whom a simple infection can be lethal.

Hospital-acquired infections and sepsis[14] are exacerbated by AMR – of the 21.36 million deaths attributed to sepsis worldwide in 2021, 22% were associated with AMR and 5% were directly attributable to AMR.[15] Common diseases that have traditionally been treated with antibiotics, such as urinary tract infections (UTIs), are becoming increasingly difficult to treat due to AMR. A study conducted in 2021 found a high prevalence of resistance (up to 90%) against four of the most commonly used antibiotics used to treat UTIs – with significant levels of AMR reported in Bangladesh, India, Sri Lanka and Indonesia.[16]

The impact of AMR also extends to agriculture and the environment. The World Bank projects that by 2050, global livestock production could decline by between 2.6% and 7.5% per year due to AMR.[17] Another study by the World Organisation for Animal Health (WOAH) estimates that current resistance rates could lead to losses of 0.84% in the production of cattle milk, 2.05% losses for chicken meat and 0.92% for pork production.[18] The misuse of antimicrobials continues to contaminate ecosystems and waterways. Freshwater serves as the main reservoir for antimicrobial-resistant bacteria in South-East Asia.[19] In Malaysia, 40% of Escherichia coli (E. Coli) and Salmonella isolates tested in drinking water treatment plants were found to be multidrug-resistant.[20]

AMR is not just a public health crisis – it is an economic threat. If the world does not act, AMR threatens to wipe more than 5% of annual GDP from the economies of low- and middle-income countries by 2050.[21]

1.4 Market failures and economic impact

As superbugs ravage hospitals and communities, healthcare costs are stacking up. Analysis by the Organisation for Economic Co-operation and Development (OECD) finds that the annual cost of AMR across 34 OECD and European countries totals nearly $66 billion (adjusted by purchasing power parity, or PPP) every year. Health systems alone bear an estimated $28.9 billion (PPP) of this burden, while the broader economies in these countries are hit by the remaining $36.9 billion.[22]

The primary obstacles to tackling AMR are economic rather than scientific, as the production and distribution of antibiotics are plagued by market and government failures. For example, the lack of suitable and sufficient antibiotics leads to a rampant trade in substandard, counterfeit antibiotics: according to the World Health Organization (WHO), an estimated 70,000 to 170,000 deaths in under-five children suffering from pneumonia can be attributed to counterfeit drugs.[23]

The golden era of antibiotic discovery has given way to a dark age of lacklustre innovation, with just 15 new antibiotics approved between 2000 and 2018, compared to 63 in the preceding two decades.[24] In fact, 1987 marked the last time that a new class of antibiotics was successfully introduced as treatment – all new antibiotics introduced since then have been optimizations or combinations of already known compounds.

The journey from laboratory to market for a new antibiotic is a monumental task, demanding over a decade of time and more than $1 billion in investment. Given the time- and capital-intensive nature of the endeavour, fewer than 1 in 70 candidates make it to market, according to analysis by Wellcome.[25] For the few that do make it to market, the average return on investment – a cumulative revenue of $440 million over 10 years – falls well short of recouping the costs of drug development and commercialization.[26]

A major challenge facing the commercialization of new antibiotics is that, in good clinical practice, clinicians reserve newer antimicrobials as the last line of defence in treating infections, in order to prevent resistance from developing. This disincentivizes investment into antimicrobial drug development. "The result is a tragedy of the commons: everyone uses antibiotics a little too much and we will be left with none that work," write Katherine Klemperer and Anthony McDonnell in their article for the World Economic Forum, "*Market failures cause antibiotic resistance. Here's how to address them*."[27]

> **Antimicrobial resistance is only getting worse yet we're not developing new products fast enough to combat the most dangerous and deadly bacteria. Innovation is lacking, yet even when new products are authorized, access is a serious challenge. Antibacterial agents are simply not reaching the patients who desperately need them, in countries of all income levels.**
>
> Yukiko Nakatani, Assistant Director-General for Antimicrobial Resistance *ad interim*, WHO.[28]

1.5 The impact of climate change

> **A comprehensive study examining 375 known infectious diseases found that close to 60% of such diseases could be aggravated by climate change.**

Climate change and AMR are two of the most pressing global health challenges of our time. Recent research has revealed a worrying synergy between these issues, with climate change potentially exacerbating the spread and impact of AMR.

A comprehensive study examining 375 known infectious diseases found that close to 60% of such diseases could be aggravated by climate change.[29] Freak climate hazards can damage health infrastructure and sewage systems, forcing people into unsafe situations that facilitate disease outbreaks. For example, drought forces people to drink unsafe water, while floods and storms are associated with wastewater overflow that leads to direct and foodborne transmission of viruses.

As global temperatures rise, bacterial and fungal infection rates are likely to increase and diseases may spread to previously unaffected regions at higher altitudes and latitudes.[30] Heatwaves increase the heat resistance of viruses, causing greater virulence in human populations as viruses can cope better with the human body's main immunity defence response of fever. Consistent exposure to life-threatening climate hazards induces stress, which can reduce the body's capacity to deal with pathogens. Atmospheric warming and precipitation changes can also lead to the range expansion and increased biting rates of vectors such as mosquitoes, causing diseases such as dengue and malaria. While such diseases are viral in nature, they are often mistakenly treated with antibiotics, leading to the development of drug resistance over time.[31]

> 60-90% of antimicrobials used in medicine and farming end up as active residues in the environment, potentially promoting the growth of antimicrobial resistance.

Additionally, inappropriate storage of antimicrobials can expose them to environmental conditions such as higher temperatures, humidity or light, which degrade their potency. When these compromised antimicrobials are administered to humans or animals, the pathogens that are targeted may not be eradicated effectively and completely, leaving them within the body. Non-eradication despite exposure to antimicrobials would cause pathogens to evolve and develop resistance.

Extreme weather events, which are becoming more frequent due to climate change, trigger a cascade of additional risks.[32] Flooding can overwhelm sanitation and wastewater treatment infrastructure, increasing human exposure to pathogenic bacteria and viruses. This can lead to outbreaks of waterborne diseases such as cholera, typhoid and polio. Floodwater also serves as a vector for the spread of antibiotic resistance and can transport resistant organisms to new locations, potentially introducing them to previously unaffected areas.

Climate change is impacting food production systems as well, leading some farmers to increase their use of antimicrobials in an attempt to boost yields amid changing weather conditions. This practice, while potentially beneficial in the short term, contributes to the acceleration of AMR in both animal and human pathogens. A significant proportion (60%-90%) of antimicrobials used in medicine and farming ends up as active residues in the environment, potentially promoting the growth of antimicrobial resistance in microorganisms present in the environment.[33]

The complex interplay between climate change and AMR will require a coordinated global effort calling on actors from across healthcare, agriculture, business and government to work together in solving the crisis.

1.6 The global response

In 2015, the World Health Assembly endorsed a Global Action Plan on Antimicrobial Resistance, the first globally coordinated effort to address the growing problem of AMR.[34] Introducing the initiative, Margaret Chan, the Director-General of WHO at the time, wrote: “This action plan underscores the need for an effective “One Health” approach involving coordination among numerous international sectors and actors, including human and veterinary medicine, agriculture, finance, environment and well-informed consumers. The action plan recognizes and addresses both the variation in resources nations have to combat AMR and the economic factors that discourage the development of replacement products by the pharmaceutical industry.”

Since then, regional as well as national action plans (NAPs) have been adopted and the issue has gained increasing attention at the global level. However, although 178 countries had drafted plans by November 2023, “only 25% are effectively implementing and monitoring their NAPs; LMICs in particular, face substantial barriers”, according to Nigerian microbiologist Iruka Okeke and her team, writing in *The Lancet.*[35]

In 2019, in response to a request from the UN Secretary-General, the Food and Agriculture Organization (FAO), WHO and WOAH established a coordinating mechanism on AMR. This formally became the Quadripartite Joint Secretariat (QJS) on AMR, with the incorporation of the UN Environment Programme (UNEP) in 2022.[36] QJS coordinates the work of these four organizations on AMR and works to establish global governance structures and coordinating efforts to control AMR across human, animal and planetary health.[37] QJS has developed a joint strategic framework for collaboration on AMR as well as the One Health Joint Plan of Action, with AMR as one of the six action tracks.

In September 2024, a significant new push at the UN General Assembly saw global leaders adopting a political declaration in which they committed to reducing deaths from bacterial AMR by 10% a year by 2030.[38] The declaration called for $100 million of catalytic finance to ensure at least 60% of countries are able to fund their national action plans on AMR by the end of this decade. The aim is to diversity funding sources and steer more finance towards the Antimicrobial Resistance Multi-Partner Trust Fund,[39] and is a call-to-action for more actors – corporates, funders of catalytic capital and philanthropies – to join the efforts to address this silent pandemic.

BOX 1

What is a "One Health" approach?

"One Health is an integrated, unifying approach that aims to sustainably balance and optimize the health of people, animals and ecosystems," according to the WHO, "It recognizes the health of humans, domestic and wild animals, plants and the wider environment (including ecosystems) are closely linked and inter-dependent."[40]

The approach mobilizes multiple sectors, disciplines and communities at varying levels of society to work together to foster well-being and tackle threats to health and ecosystems, while addressing the collective need for clean water, energy and air, safe and nutritious food, taking action on climate change and contributing to sustainable development.

A One Health approach is urgently needed to reduce the burden of AMR and prevent deaths. The approach is cost-saving and addresses multiple threats at the same time.

Following the UN General Assembly's adoption of the political declaration, the Forum's Global Future Council (GFC) on the Future of Tackling Antimicrobial Resistance developed the Davos Compact on AMR. After seeking input from the Quadripartite Joint Secretariat on AMR,[41] the Forum launched the compact on 23 January 2025 at its Annual Meeting in Davos.

BOX 2

Davos Compact on AMR

The Davos Compact defines crucial priorities for private-sector involvement and partnership in addressing the UN Political Declaration on AMR. It underscores the primary themes and areas of influence for the Forum's ongoing efforts to combat AMR in collaboration with the Unified Coalition for AMR Response (UCARE). Its goal is "to unlock sustainable and synergistic financing from both public and private sources to reduce the global deaths associated with AMR, saving more than 100 million lives by 2050."[42]

Through UCARE, governments and philanthropic institutions will join forces to establish an environment that incentivizes private-sector investments in tackling AMR. Meanwhile, businesses worldwide will dedicate substantial financial resources to supporting and implementing groundbreaking solutions against AMR.

UCARE's key priorities include:

– Advancing innovation and ensuring equitable access to antimicrobials, diagnostics and vaccines.

– Raising awareness and advocating for AMR among policy-makers and the public.

– Developing resilient and sustainable food and agriculture systems.

– Strengthening cross-sector collaboration and mobilizing funding.

2 Asia: The perfect crucible for AMR

Countries in South-East and East Asia have launched national action plans to combat AMR, but greater investment is needed to ensure a One Health approach across people, food, animals and ecosystems.

2.1 The scale of the problem

Forecasts indicate that AMR-related costs in Asia could reach $550-700 billion by 2050, which would consume 0.8-1% of the continent's GDP.

Asia faces a huge challenge from the AMR crisis, accounting for more than half of the 4.71 million deaths worldwide associated with AMR in 2021.[43] As shown in Figures 2 and 3, Asia's share is by far the largest as a region.[44] Future projections are particularly alarming across all sub-regions within Asia. By 2050, the number of lives lost every year to diseases associated with AMR is expected to reach 2.4 million in South Asia and 1.94 million in South-East Asia, East Asia and Oceania.[45]

The economic implications of AMR in Asia are equally concerning. Forecasts indicate that AMR-related costs in the region could reach $550-700 billion by 2050, which would consume 0.8-1% of the continent's GDP.[46] The effect on healthcare systems in the region is significant, with estimated additional treatment costs ranging from 2.5% to 10% of healthcare expenditure.[47] These increased costs strain already-burdened healthcare systems and can lead to reduced access to effective treatments for many patients. Meanwhile, the economic burden continues to pose a threat to productivity, economic growth and overall development in the region.

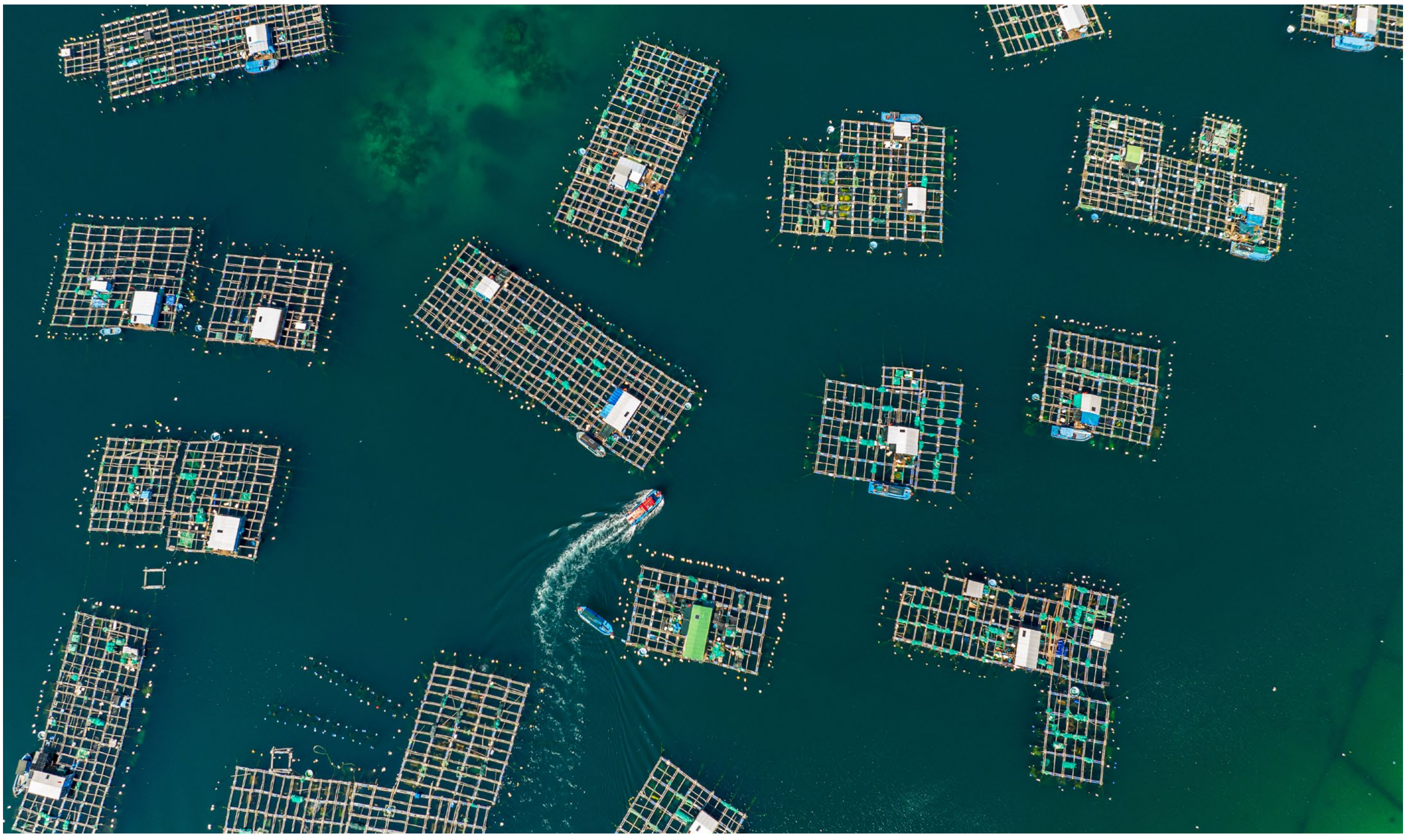
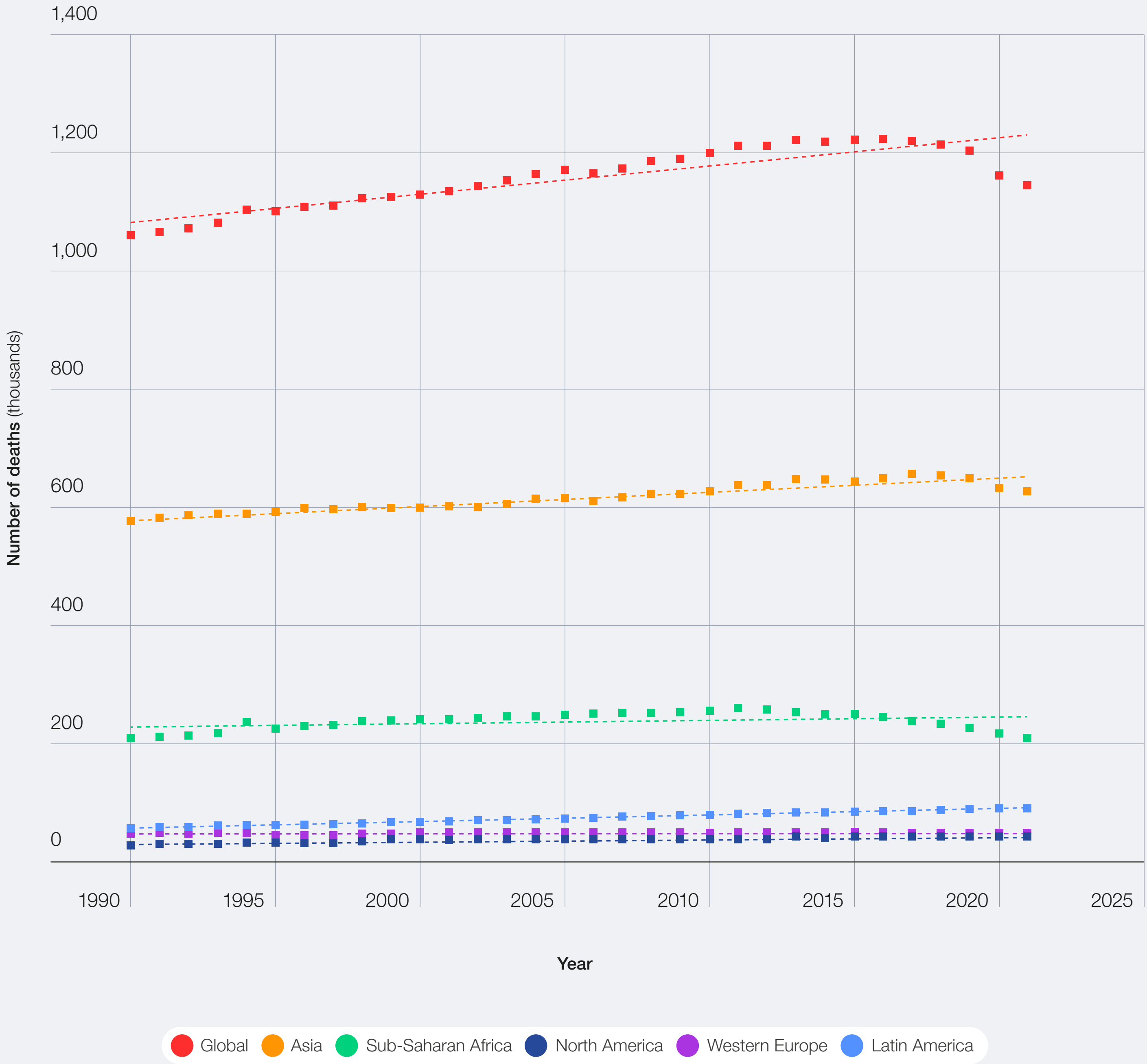


FIGURE 2 | **Deaths attributable to bacterial antimicrobial resistance, globally and by region (1990-2021)**



Note: See endnote for geographical coverage included in each region on this graph.[48]

Source: The raw data for this graph comes from Naghavi et al. *The Lancet,* 2024.[49]

FIGURE 3 | **Deaths attributable to bacterial antimicrobial resistance, globally and by sub-regions in Asia (1990-2021)**

Note: See endnote for geographical coverage included in each region on this graph.[50]

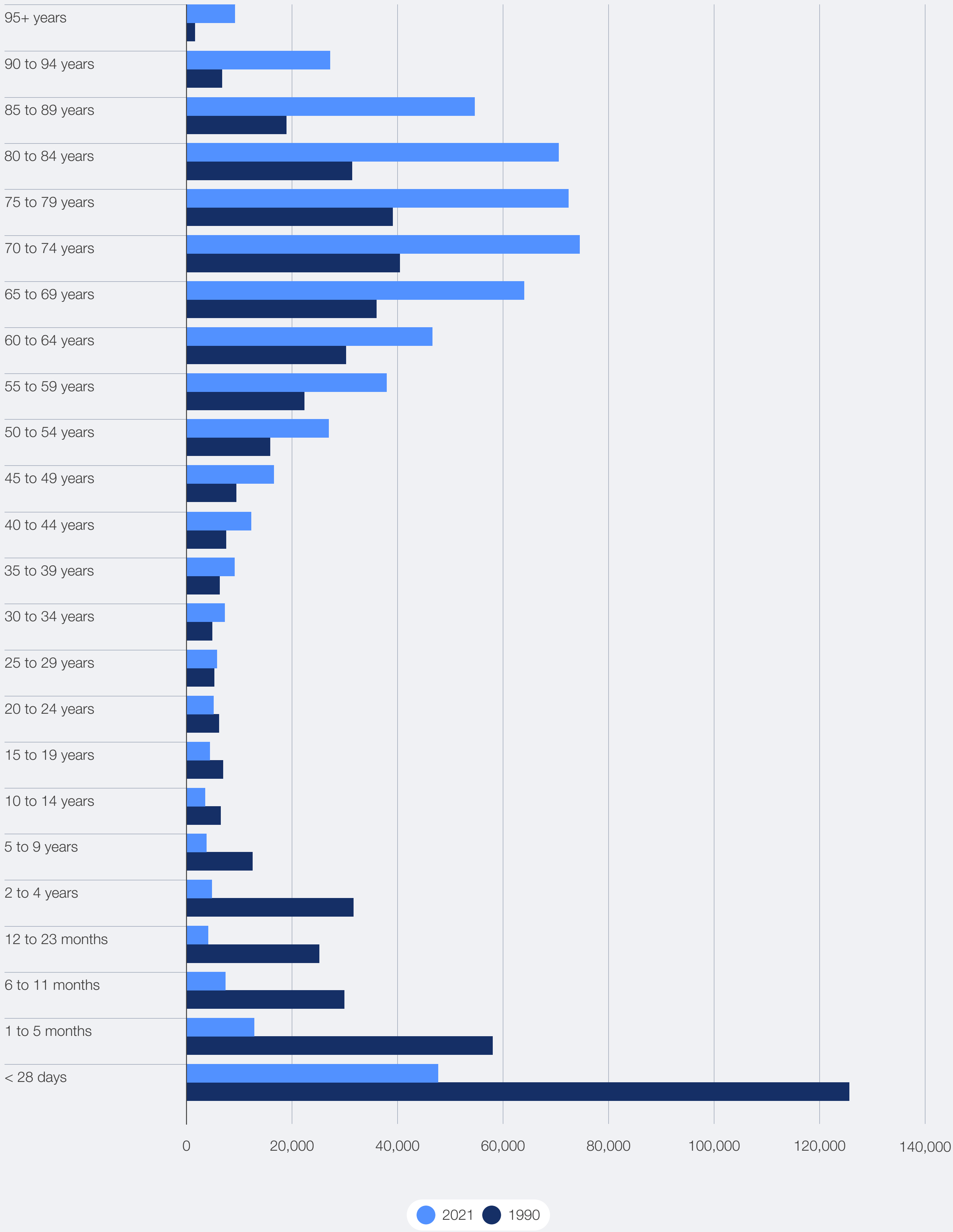
Source: The raw data for this graph comes from Naghavi et al. *The Lancet,* 2024.[51]

2.2 Asia's rapidly changing demographics

> Deaths from AMR among the over-70s increased by more than 80% from 1990 to 2021.

Ageing populations are particularly vulnerable to AMR. A recent longitudinal analysis by *The Lancet* showed that while deaths from AMR in under-fives fell by more than half from 1990 to 2021 (due mainly to prevention of infection), deaths among the over-70s increased by more than 80% over the same period.[52] As shown in Figure 4, this global trend holds true in Asia. The region's rapidly ageing population therefore finds itself in the crosshairs.[53] By 2050, one-quarter of Asia's population will be over 60 years old.[54] This shift in demographics highlights the imperative for urgent and coordinated action to tackle AMR in Asia.

FIGURE 4 | **Deaths attributable to bacterial antimicrobial resistance in Asia, by age group (1990 vs. 2021)**



Source: The raw data for this graph comes from Naghavi et al. *The Lancet,* 2024.[55] Refer to endnote 50 for list of Asian countries covered.

2.3 The factors influencing AMR in Asia

FIGURE 5 **Asia – The perfect crucible to incubate AMR**

Limited healthcare infrastructure

- **Unequal access to healthcare**
  Millions lack access to quality healthcare and universal health coverage is insufficient.
- **Lack of prevention**
  Risk of hospital-acquired infections is ~2-20x higher in the Asia-Pacific. Insufficient vaccination increases this risk.
- **Skills shortage**
  Lack of skilled healthcare practitioners and technical capacity leads to weak AMR monitoring and stewardship.
- **Counterfeit drugs**
  Rampant use of counterfeit or low-quality antibiotics undermines treatment, increases resistance and erodes trust in health systems.
- **Misuse of antibiotics**
  Antibiotics are misused and overused due to a lack of understanding, ineffective regulations, inadequate monitoring and absence of dedicated stewardship programmes.

Unsustainable agriculture and aquaculture

- **Rising food demand**
  More intensive livestock production increases the amount of antibiotics use throughout the food chain, as farmers overuse/misuse antibiotic to treat illness, prevent disease and promote growth.
- **Contamination of waterways**
  Rising sea temperatures increase mortality of aquatic animals, prompting farmers to increase prophylactic use of antimicrobials.
- **Resistant fungi**
  Widespread use of fungicides in crop protection encourages more resistant strains of fungal pathogens in the environment.

Inadequate clean water and sanitation

- **Lack of adequate WASH facilities**
  75% of Asia's population faces water insecurity. Fewer than 40% of healthcare facilities in LMICs have even rudimentary water, sanitation and hygiene (WASH) amenities.
- **Impact of climate change**
  WASH infrastructure can be compromised by climate-driven hazards (e.g. floods, droughts).

Source: Centre for Impact Investing and Practices (CIIP).

> South Asia and South-East Asia are home to the highest number of major bacterial pathogens for which there is AMR.

While the broader risk factors of ageing populations and climate change discussed above are not easily addressed at a national level, this section presents risk factors relating to human activities – including healthcare, agriculture and sanitation – which can be controlled and addressed more locally.

The combination of challenges arising from Asia's limited healthcare infrastructure, unsustainable agriculture practices and inadequate sanitation creates the perfect crucible for the proliferation of AMR (see Figure 5). As a consequence, South Asia and South-East Asia are home to the highest number of major bacterial pathogens for which there is AMR.[56]

Limited healthcare infrastructure

Several challenges in Asia's healthcare systems exacerbate the AMR crisis, such as unequal access to healthcare; lack of appropriate infection prevention, control and vaccination programmes; rampant availability of counterfeit and substandard drugs; and overuse and misuse of antibiotics.

Unequal access to healthcare

Millions of people in Asia lack universal health coverage. This affects individual health outcomes but also contributes to the spread of resistant pathogens within communities. In India, for example, the combination of a high burden of disease, poor public health infrastructure and cheap, unregulated antibiotics has created an ideal environment for resistant infections to thrive.[57]

Lack of appropriate programmes for vaccination, and infection prevention and control

The risk of hospital-acquired infections (HAIs) is estimated to be two to 20 times higher in the Asia-Pacific region, with up to 25% of hospitalized patients reported to have acquired infections.[58] Lack of high-quality evidence and data impedes the enhancement of infection prevention and control practices, while gaps in education, organizational and cultural barriers, infrastructure, fiscal resources and key leadership continue to obstruct the implementation of infection prevention and control measures as a core component of patient safety programmes across the region.[59]

A study found that South-East Asia produced more than three-quarters (78%) and consumed almost half (44%) of counterfeit antimicrobials globally.

Meanwhile, strengthening childhood vaccination programmes could avert 181,500 deaths by curbing antibiotic usage and limiting the conditions for resistance to develop. Much of the reduction in under-five mortality, for example, can be linked to widespread vaccination efforts, improved access to water and sanitation, and other public health interventions. This underscores the importance of infection prevention as a highly effective intervention in reducing the burden of AMR.[60]

Shortage of skilled practitioners

In parts of Asia with a shortage of skilled healthcare practitioners and insufficient technical capacity, antimicrobial monitoring and stewardship efforts are correspondingly weak.[61] This in turn can lead to inappropriate antibiotic use and inadequate infection control measures.

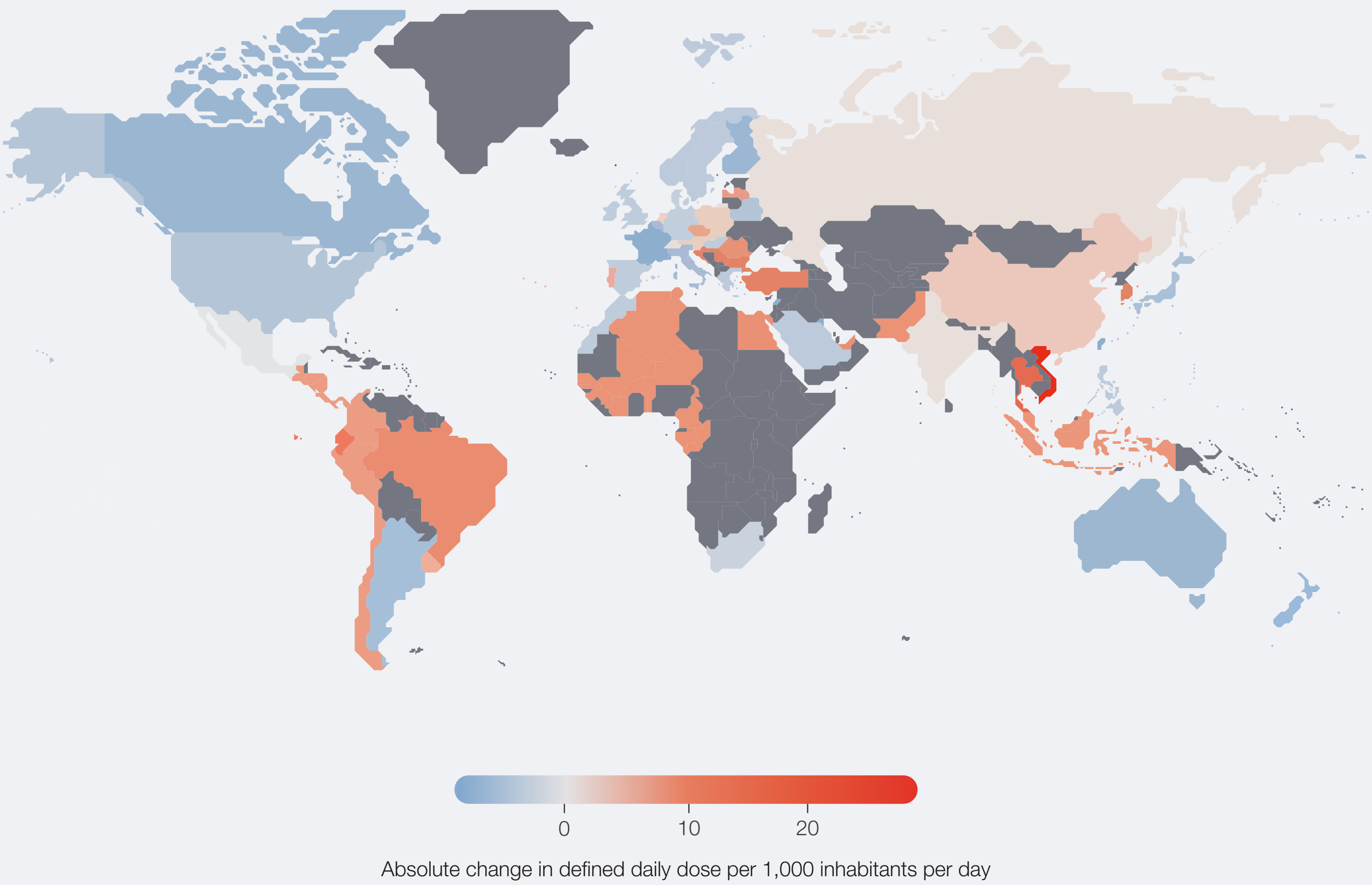
Rampant use of counterfeit and substandard drugs

The widespread availability of counterfeit or low-quality antibiotics in the region undermines treatment outcomes, increases resistance rates and erodes trust in healthcare systems.[62] These substandard medications may contain insufficient active ingredients, promoting the survival and spread of resistant bacteria. A study found that South-East Asia produced more than three-quarters (78%) and consumed almost half (44%) of counterfeit antimicrobials globally.[63] In November 2024, the Philippine Food and Drug Administration intercepted close to $450,000 worth of counterfeit medicines and health devices under its "Oplan Katharos" initiative.[64]

Overuse and misuse of antibiotics

Inappropriate antibiotic usage can come from a lack of understanding, ineffective regulations, inadequate monitoring and the absence of dedicated stewardship programmes. Most countries in Asia were found to have a high absolute change in antibiotic consumption rate (measured in daily defined doses, or DDDs, per 1,000 inhabitants per day), with Viet Nam, Thailand and Malaysia among the top five countries with the greatest increases (see Figure 6).[65] Misuse occurs among both patients and healthcare providers, highlighting the need for comprehensive education and regulatory efforts.

FIGURE 6 **Change in global antibiotic consumption, by country and country income classification (2016-2023)**



Notes: Absolute change in antibiotic consumption rate between 2016 and 2023 by country in DDDs per 1,000 inhabitants per day. Countries in gray have no data in the database. Data source: Based on IQVIA MIDAS® sales data for period 2016-2023.

Source: Klein et al., PNAS, 2024.[66]

AMR-related mortality in LMICs could be reduced by 5.7% through water and sanitation improvements.

Unsustainable agriculture and aquaculture practices

Agricultural practices are another significant driver of AMR in Asia.

Pressure to meet rising food demand

Asia accounts for around 43% of global meat production and more than 86% of aquaculture.[67] As the region catches up with rising demand, the use of antibiotics will continue to escalate, in turn exacerbating AMR.

To meet demand, intensive livestock production models are increasingly being used, causing a build-up of antibiotics in the food chain as farmers overuse and misuse antibiotics to prevent disease and promote growth.[68] A lack of regulation around proper agricultural practices further compounds this problem – veterinarians are in short supply in many parts of the world, with 73% of Asian countries reporting a shortfall of vets in a survey conducted by WOAH.[69] It is observed that in South-East Asia, multi-drug resistance has been found in chickens, ducks and pigs, including resistance to classes of antibiotics used to treat humans.[70]

The European Union has taken a strong stance on the misuse of antibiotics in livestock – it has banned the use of antibiotics for growth promotion since 2006 and the preventive use of antibiotics in certain groups of animals since 2022.[71] While Thailand and Viet Nam are forerunners to ban or restrict the use of antibiotics for growth promotion in livestock, regulations on the use of antibiotics remain generally less enforced in Asia. Although it is projected that global animal antimicrobial consumption could reduce by 80%[72] through efforts such as regulatory caps and price increases of veterinary antibiotics, a lack of data on antimicrobial use and the absence of a global veterinary antimicrobial sales database casts doubt on this estimate.[73]

Contamination of waterways from improper aquaculture practices

Asia dominates global aquaculture production, contributing nearly 92% of the world's supply, which amounts to close to 120 million tonnes.[74] Rising sea temperatures have increased mortality among cultured aquatic animals, prompting farmers to increase the prophylactic use of antimicrobials. Additionally, farmers may use antimicrobials to protect their fish from the inputs and diseases that are transmitted from neighbouring countries through shared water bodies.

Antibiotic-resistant bacteria and multiple antibiotic-resistance genes (ARGs) have been found at fish farms and transect sites in Singapore.[75] Similarly, ARGs have been found in aquaculture farms in Malaysia's Johor Strait, raising the risk of transmission to nearby aquaculture facilities.[76] Indoor fish farming, using an independent water circulation system, could be a direct solution to this problem. However, many fish farms in Asia cannot afford this alternative due to the high cost of investing in the necessary infrastructure and technology.[77]

Emergence of resistant fungal pathogens

Unsustainable agricultural practices in Asia are contributing to the rise of antifungal-resistant pathogens. The widespread use of fungicides in crop protection across Asian countries contributes to the development of more resistant strains of fungi in the environment. For example, when *Aspergillus* (a fungus that causes pigmentation, rotting, development of off-odours and off-flavours in crops)[78] is exposed to fungicides, it can develop resistance to the anti-fungal medicines used to treat infections in humans.[79] Invasive aspergillosis (infection of *Aspergillus*) is the most frequently reported fungal infection in immunocompromised individuals in the Asia-Pacific.[80]

Inadequate clean water and sanitation

AMR is further exacerbated by lack of access to clean water and proper water, sanitation and hygiene (WASH) infrastructure. It is estimated that AMR-related mortality in LMICs could be reduced by 5.7% through water and sanitation improvements.[81]

Lack of access to WASH facilities and availability of clean water

Three-quarters of the Asian population faces water insecurity, with up to 84% of water sources in the South-East Asia region identified as contaminated.[82] In addition, fewer than four in 10 healthcare facilities in LMICs are estimated to have even rudimentary WASH amenities.[83] Further, climate-driven disasters, particularly storms and floods, risk damaging this fragile infrastructure. Interventions such as universal access to WASH services could prevent nearly 247,800 deaths annually.

Where clean water is scarce and expensive, families are often forced to prioritize higher-quality water only for drinking. This creates fertile conditions for bacteria and other pathogens to spread through water used for other purposes, such as cooking and personal hygiene.[84] The use of contaminated water for non-drinking purposes can lead to higher incidence of waterborne diseases such as cholera, which can also become resistant as the bug continues to evolve amid a lack of sanitation. For example, while endemic cholera is already causing 100,000 cases in Bangladesh annually, a resistant strain could double caseloads as untreated infections are prolonged and secondary infections extended.

> Lack of early warning systems, regulation of antimicrobial sales and enforcement of proper antimicrobial use continue to be key gaps in the national action plans of countries in Asia.

Impact of climate change on WASH

WASH infrastructure is vulnerable to damage from climate-driven hazards. Floods can compromise sewage systems, in turn contaminating freshwater used both for drinking and irrigation. Droughts will necessitate rationing of water, affecting its quality and quantity. These factors will likely lead to more frequent outbreaks of diseases such as cholera.[85]

Commitment to change

Despite these challenges, Asia continues to demonstrate strong political commitment to combating AMR.

Global and regional platforms

Collaboration among governments, international organizations and local communities is essential for sustainable solutions that protect animal and human health.[86] As mentioned earlier, the QJS consolidates cooperation on AMR between three UN agencies and WOAH at a global level.

At a regional level, the Jaipur Declaration for Prevention and Control of Antimicrobial Resistance was adopted by health ministers from 11 countries in the WHO's South-East Asia Region in 2011.[87] The declaration recognized AMR as a critical public health issue requiring urgent attention and called for a comprehensive approach to combatting AMR, which included strengthening surveillance systems, improving healthcare facilities and enhancing public awareness. In addition, the ASEAN Strategic Framework (2019-2030) sealed the commitment of regional governments and stakeholders to adopt a One Health approach to combatting AMR.[88]

Country-specific plans

Following the global and regional frameworks, countries across the region have developed national action plans aligned with 2015's Global Action Plan on AMR.[89] China, Japan and South Korea have launched national action plans outlining One Health approaches to combatting AMR. South-East Asian countries have each developed their own national action plans for AMR. In addition, surveillance networks for AMR in humans, livestock and companion animals have been set up to monitor local trends of antimicrobial-resistant bacteria. For example, the International Vaccine Institute (IVI) has led an initiative to expand the volume of historical data for AMR, antimicrobial consumption and use across 12 countries in South and South-East Asia.[90]

Gaps in implementing national action plans

These efforts demonstrate a growing commitment to combating AMR through a One Health approach, involving collaboration across human, animal, food and environmental sectors.

While almost all countries in the region have human AMR surveillance systems, laboratory networks and infection prevention programmes, none has established early warning systems. Most countries in Asia regulate antimicrobial sales and oversee their use; however, the enforcement and integration of these measures remain inconsistent, highlighting the need for stronger and more inclusive implementation.[91]

2.4 An urgent call to action

Kenneth Mak, Singapore's Director-General of Health, has described AMR as a "slow-burn pandemic" that demands urgent and coordinated global action.[92]

The battle to control AMR demands a multifaceted approach that embraces improved healthcare, expanded prevention and control measures, and the development of new antibiotics.

> **AMR is what many might call a 'slow burn pandemic'. So far, it has not caused lockdowns as was seen with COVID-19. However, its impact on our healthcare systems and communities can be profound.**
>
> Kenneth Mak, Director-General of Health, Singapore

AMR is not an isolated issue – it is a multisectoral crisis that touches every aspect of life in Asia. From healthcare to agriculture, and from sanitation to climate resilience, AMR demands a coordinated and sustained response. The challenges are significant, but the region has demonstrated a strong commitment to addressing this crisis through collaborative efforts and comprehensive strategies.

By continuing to strengthen healthcare systems, improve agricultural practices, enhance sanitation infrastructure and address the impacts of climate change, Asia can make significant progress in combating AMR. While there must be continued emphasis on improving access to and appropriate use of antimicrobials, the importance of developing innovative diagnostics and vaccines to support antimicrobial development and build the therapeutic pipeline cannot be overstated.

Greater investments in line with a One Health approach are needed to strengthen AMR-related knowledge and behaviour, healthcare systems, surveillance and stewardship across the region. With concerted efforts and collaboration across sectors and borders, the region can turn the tide on AMR and work towards a healthier future for Asia and the world.

3 Supercharging the fight against superbugs

Three sprints and a marathon could turn the tide against AMR. More investment in education, prevention and monitoring are the sprints needed now. The marathon is the search for novel therapeutics and ensuring access to essential medicines for all.

3.1 Opportunities ripe for capitalizing

In September 2024, shortly before the UN General Assembly's second high-level meeting on AMR, 80 major investors called on global leaders to scale-up their efforts in tackling AMR, calling it "a systemic risk akin to COVID-19 and the 2008 financial crisis". The group, known as the Investor Action on AMR (IAAMR) initiative, highlighted that AMR-related productivity losses alone could cost the world $443 billion per year by 2035.[93]

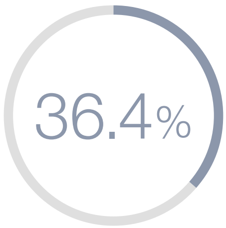
> **AMR is a systemic risk akin to COVID-19 and the 2008 financial crisis – by 2035, AMR-related productivity losses alone could cost the world $443 billion per year.**
>
> Investor Action on Antimicrobial Resistance (IAAMR) initiative

Within the next decade, investments in innovative AMR solutions in the Asia-Pacific are projected to generate healthcare savings of $10-15 billion per year.

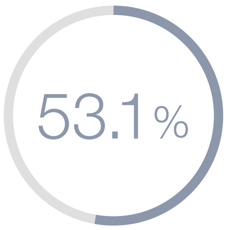
In the Asia-Pacific region, timely investments in innovative AMR solutions over the next decade are projected to generate healthcare savings of $10-15 billion per year, along with an additional $35-40 billion of annual savings in other socio-economic costs[94]. There are also ample opportunities to invest in health and agri-food systems in Asia.

Governments across the region see improving accessibility to healthcare as a key priority, with sub-regions such as South-East Asia accelerating expansion and improvement of healthcare infrastructure.[95] In a global analysis of investment opportunity areas (IOAs) that are commercially viable and have the potential to contribute towards delivering the Sustainable Development Goals, more than one-third (36.4%) of health-related IOAs are in Asia, of which more than half (53.1%) are in healthcare provision.

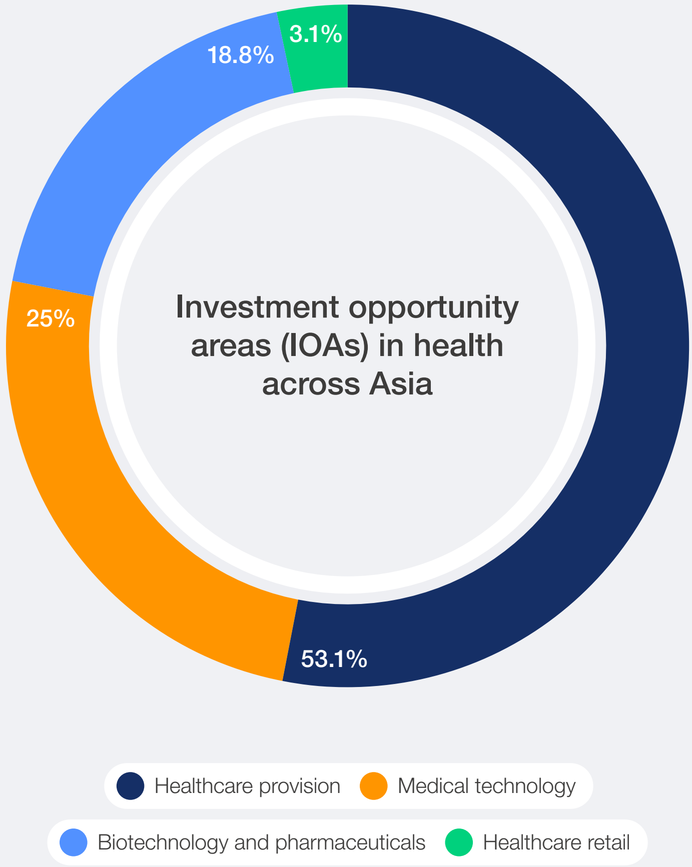
FIGURE 7 | **Distribution of investment opportunity areas (IOAs) in health across Asia**



of the 88 health-related investment opportunity areas (IOAs) identified by UNDP's SDG Investor Maps are in **Asia**



of the Health IOAs in Asia are identified in **healthcare provision**, which includes setting up independent clinical laboratories, affordable hospital infrastructure development, low-cost hospital satellite care units and telemedicine



Source: UN Development Programme, *Private Finance for the SDGs* and author's analysis.[96]

Areas for intervention across the antimicrobial value chain

Tackling AMR requires a multisystem approach across One Health actors. An important part of the solution to reducing the impact of AMR is to create more effective therapeutics, such as drugs and vaccines. On average, it takes 10-15 years to develop one antimicrobial, from initial discovery to regulatory approval.[97] However, while the marathon runners of drug discovery are settling into their stride, microbes continue to become stronger and more drug-resistant. Combating AMR is a race against time – some quick fixes are needed too.

This chapter proposes intervention in four areas:

1 Sprint: Educate

Improve knowledge and behaviour.

2 Sprint: Prevent

Strengthen health systems and services.

3 Sprint: Monitor

Enhance regional surveillance, data collection and data sharing.

4 Marathon: Treat

Invest in R&D and increase access to novel and essential medicines.

The sprints buy time for novel therapeutics to be discovered and launched in the market. These sprints are practical measures that can be implemented now as foundations for longer-term strategies. They include improving antimicrobial stewardship and strengthening health services. Meanwhile, constant surveillance and data sharing can help identify gaps in innovation, predict and pre-empt future superbugs and build monitoring capabilities across the region. The aim is to create a synergistic environment that enables discovery, development and implementation.

Philanthropy, investors and innovative financing play a critical role in combating AMR by funding key interventions across these four areas and in supporting One Health actors across the human, animal, plant and environmental contexts to develop and scale solutions.

FIGURE 8 | **The race to tackle AMR – three sprints and a marathon**

1 Sprint: Educate

Improve knowledge and behaviour by:

- Improving antimicrobial stewardship by doctors and health professionals.
- Strengthening awareness among community health workers and the wider public.
- Educating and regulating farmers on proper use of antibiotics in agriculture.

2 Sprint: Prevent

Strengthen health systems and services by:

- Enhancing diagnostic capabilities for surveillance and targeted treatment prescription.
- Supporting solutions for simple, rapid, affordable and accurate diagnostics in agriculture and livestock.
- Investing in prevention, WASH and clean water access.

3 Sprint: Monitor

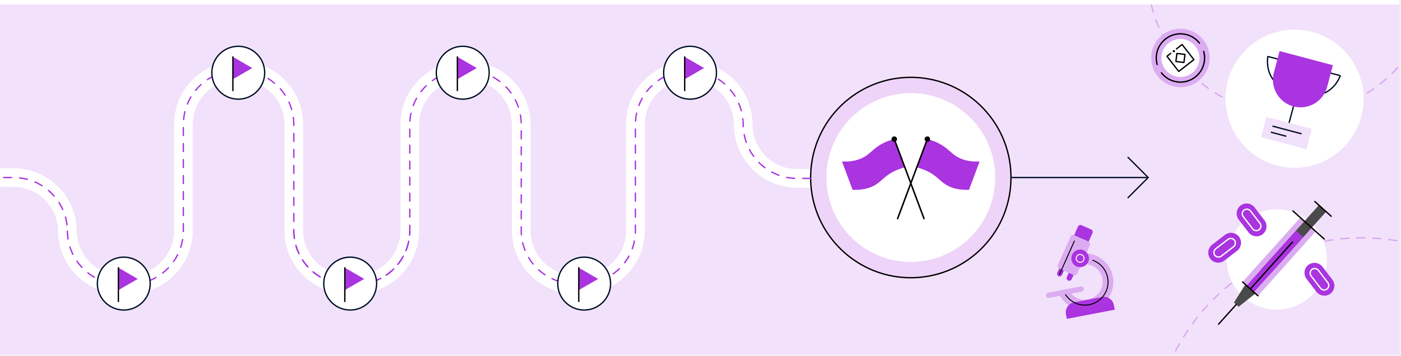
Enhance regional surveillance, data collection and data sharing by:

- Improving data collection and sharing across One Health actors.
- Building data analysis capabilities for disease modelling and drug discovery.

4 Marathon: Treat

Invest in research and development (R&D) and increase access to novel and essential medicines by:

- Funding productization and commercialization of later-stage projects.
- Pooling resources to ensure sufficient antimicrobial supply across Asia.



Businesses | Hospitals and healthcare institutions

Governments | Funders and investors | Non-profits and philanthropies

Source: Centre for Impact Investing and Practices (CIIP).

1 **Sprint:** Educate

Improve knowledge and behaviour

This sprint aims to strengthen the awareness of AMR among clinicians, patients and farmers, focusing on the critical importance of avoiding the overuse or abuse of antimicrobials, as well as on strategies to prevent infections in the first place, such as better biosecurity measures around livestock.

A survey of 349 hospitals across 10 countries in Asia revealed that most hospitals lacked antimicrobial stewardship programmes that would meet the required standard.

Improve antimicrobial stewardship among doctors, health and allied professionals (including vets and field workers)

Antimicrobial stewardship (AMS) serves "to optimize clinical outcomes while minimizing the unintended consequences of antimicrobial use, including toxicity, the selection of pathogenic organisms and the emergence of resistance," according to guidelines from the Infectious Diseases Society of America (IDSA).[98] Healthcare systems are strongly encouraged to implement AMS programmes to ensure that doctors and health professionals – the front line for safeguarding the effectiveness of antimicrobial medicines[99] – are fully aware of the dangers of AMR and uphold the good practice of prescribing only what is necessary, along with educating their patients on proper antimicrobial consumption.

However, there is inconsistent implementation of AMS programmes across hospitals and healthcare systems in Asia. A survey of 349 hospitals across 10 countries in the region revealed that most hospitals that participated lacked AMS programmes that would meet the required standards, and needed urgent attention to tackle deficits in the funding and resourcing of effective AMS.[100]

Another study uncovered a severe lack of trained professionals who could tackle AMR – only 15.8% of surveyed hospitals had more than 10 physicians specializing in adult and/or paediatric infectious diseases, despite most of them (75.5%) working in large hospitals. Some centres do not even have clinical microbiologists on-site, which makes disease identification and subsequent control and management more cumbersome.[101] To strengthen the front line of defence against AMR, enhancing AMS is of utmost importance.

CASE STUDY 1

Manipal Hospitals

With a group of 33 hospitals spread across 17 cities, Manipal Hospitals (Manipal) is the second-largest hospital chain in India. For the past two decades, Manipal has been accredited by the National Accreditation Board for Hospitals & Healthcare Providers (NABH) of India, which testifies to their effective infection prevention and control programme, including the establishment of an antimicrobial management programme and monitoring of antimicrobial usage across the organization.[102]

Beyond the NABH requirements, Manipal has set up a closed intensive care unit (ICU) model in several of its hospitals in Tier 1 cities. The closed ICU model ensures proper containment of infection and engages a cross-disciplinary critical care team that synchronizes and streamlines antibiotic prescriptions for individual patients with multiple comorbidities.

Additionally, Manipal has implemented its own electronic medical records (EMR) system, which notifies multiple parties including the central infection control officer whenever an antimicrobial is prescribed and guides attending clinicians on antibiotic administration. Such measures help build a robust infection control system within Manipal and in turn prevent clinicians from over-prescribing antimicrobials for fear of hospital-acquired infections.

Despite these measures, Manipal is gearing up to address the growing threat of community-acquired infections.

This is not just a problem in hospitals, as drug-resistant bacteria are becoming endemic in the population. For instance, in recent years, incidence of community-acquired methicillin-resistant staphylococcus aureus (CA-MRSA) has increased.[103] This increase can be attributed to low public awareness of proper antimicrobial usage. Given that most medications are available over the counter (OTC), patients often self-medicate rather than seeking professional advice, leading to errant dosage and consumption. Such improper use of antimicrobials contributes to AMR, making community-acquired infections increasingly difficult to treat.

Additionally, according to the chairperson of the infection control committee at Manipal, the threat of multi-drug resistant (MDR) or extensively drug-resistant (XDR) infections is increasing by “leaps and bounds”, with a substantial increase in such pathogens seen in the last two decades. A steady increase in resistant infections threatens hospital systems with ballooning costs of treatment, as multiple expensive antibiotics and infection control measures are required.

Manipal is also concerned about the problem of counterfeit drugs in India, where one in four drugs was found to be fake, counterfeit or substandard in a 2022 study.[104] The lack of proper treatment continues to exacerbate the threat of AMR and mounts a growing challenge to healthcare providers such as Manipal.

Source: Interview and further response from Manipal Hospitals.

Strengthen awareness among the general public and community health workers

Investing in public awareness campaigns on AMR offers a powerful opportunity to drive behavioural change and reduce misuse of antibiotics in the Asian context (in both humans and animals). Asia’s diverse and densely populated communities are particularly vulnerable to AMR, making it essential to educate individuals on responsible antibiotic use, the risks of OTC access and the importance of preventive healthcare, such as vaccinations and sanitation improvements.

Innovative initiatives, such as leveraging digital platforms, using culturally tailored messaging and implementing school-based education programmes, can ensure widespread reach and impact. Public-private partnerships and collaboration with media outlets and local influencers can further amplify these efforts. Targeted investments in awareness not only empower communities but also alleviate pressure on healthcare systems, paving the way for sustainable solutions to the AMR crisis.

Addressing self-medication and OTC antibiotic sales through improved knowledge among the public, alongside investments to strengthen health systems, is key to tackling AMR. Tailored, context-specific strategies that consider local socio-cultural determinants of antibiotic use will maximize the impact of these efforts.[105]

CASE STUDY 2

The challenge of drug-resistant tuberculosis in Indonesia

Although Indonesia has the second-largest number of tuberculosis (TB) cases globally, WHO has estimated that 41% of cases go unreported.[106] People with TB can often delay seeking medical help and advice due to low awareness and knowledge. While TB medications are covered under Indonesia's national health insurance and do not require significant out-of-pocket payments by patients, not all citizens are aware of this coverage.

Many people with TB continue to buy drugs (to treat symptoms, or antibiotics) over the counter and through online platforms, with uptake of formal, clinically-prescribed TB treatment remaining low. The lack of timely and appropriate treatment enables TB to turn into drug-resistant TB, which increases the difficulty of diagnosis and treatment in due course.

Engaging patients, healthcare practitioners and community health workers to tackle drug-resistant TB in Indonesia will be key. Although 75% of initial healthcare visits are to private practitioners, a study conducted in 2024 found that most private practitioners do not adhere to national TB guidelines. Challenges cited include incoherence between national and international TB management guidelines, complex financing systems and lack of access to appropriate diagnostic tools and drugs. The majority of private practitioners do not report TB cases to the National Tuberculosis Programme (NTP), leading to an information gap for monitoring and surveillance of both TB and drug-resistant TB.

Another key actor within primary healthcare systems is the community health worker (CHW). CHWs engage directly with citizens on the ground and can be strong advocates for greater TB education and awareness in the community. They also conduct active case-finding and provide psychosocial support to people with TB.

However, many CHWs in Indonesia work voluntarily without any formal contract, which undermines their commitment to the role due to lack of job security. CHWs also lack training and supervision, with only 13% of them reporting they had received pre-service training. To ensure that CHWs are equipped and empowered to educate, monitor and treat TB in the community, it is important to provide them with resources and support their livelihoods and capabilities.

Sources: See endnote.[107]

In Asia and Oceania, sales of antibiotics to farmers are nearly four times higher, per head of livestock, than they are in Europe.

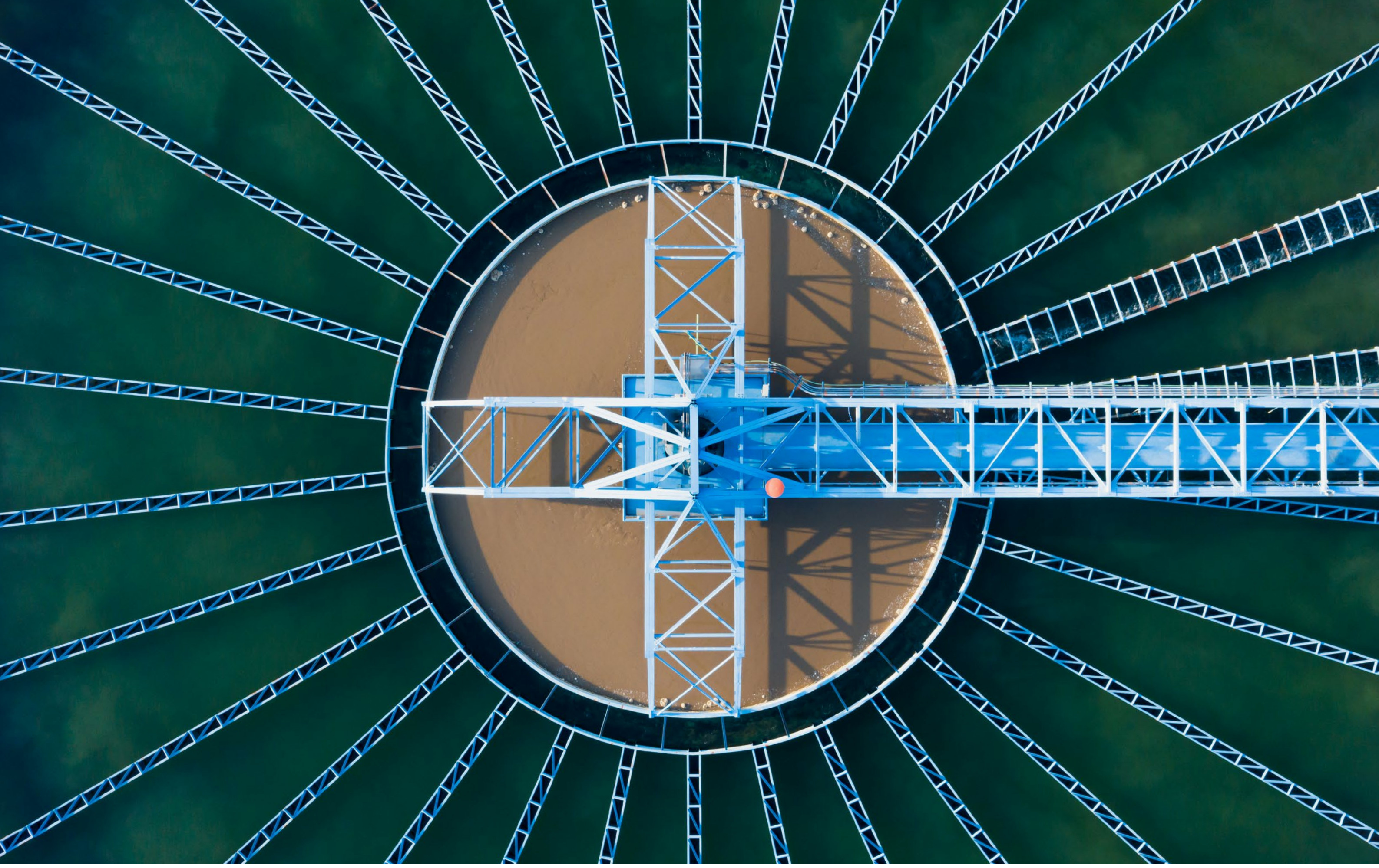
Educate and regulate farmers on proper use of antibiotics in agriculture

Globally, farm animals account for an estimated two-thirds of all antibiotic use.[108] This practice is routine in farming to prevent livestock from falling sick, especially when they are kept in poor husbandry conditions where disease easily spreads. Antibiotics can also be used to boost animals' growth to meet food demand. According to a report published by WOAH in 2024, nearly one-quarter of their member countries (36 out of 152) reported using antimicrobial agents in animals to promote growth. Colistin, one of the highest-priority critically important antimicrobial drugs for use in humans, is still reported as being used for animals by four member countries.[109] In Asia and Oceania, sales of antibiotics to farmers are nearly four times higher, per head of livestock, than they are in Europe.[110]

Farmers often resort to antibiotics as they are relatively cheap – in China, for example, antibiotics are just 1-3% of production costs.[111] Antibiotics are also considered more convenient than vaccines, which have to be administered well before infection to allow the animal time to develop an immune response. Bacteriophages, or viruses that infect and eliminate bacterial cells, must be administered around the time of infection and can only work effectively when bacteria are present in abundance within the animal.[112]

Alternatives to antibiotics are available, but farmers need to be educated in the proper use of such alternatives to shift their mindsets away from over-reliance on antibiotics. In any case, dependence on antibiotics is not sustainable in the long run, as the animals may build up their own resistance and in turn require treatment with even more antibiotics, creating a vicious cycle. Ultimately, rather than focusing on a single drug or approach, a more effective solution is to invest in better farm management and biosecurity, combined with a range of alternative drugs.[113]

To demonstrate this, FAO's Emergency Centre for Transboundary Animal Diseases (ECTAD) has partnered with Viet Nam's Department of Livestock Production (DLP) to develop eight small-scale biosecurity model pig farms in the northern provinces of Bac Giang and Nam Dinh that have high pig populations to demonstrate better farm management measures and alternatives to antibiotic utilization. Additionally, to improve AMR monitoring and surveillance in Viet Nam, the farmers at the model farms have been trained to record production data and provide better monitoring of antibiotic usage.



CASE STUDY 3

Farm2Vet brings online vet platform to Viet Nam's smallholder farmers

Farm2Vet is an award-winning AI-powered platform that aims to provide veterinary services to farms, promote responsible antimicrobial use and revolutionize livestock production in low- and middle-income countries.

High-density livestock production is a recent phenomenon in Viet Nam – previously, most agricultural activities were household-based with only a few animals. However, the demand for protein in Viet Nam has increased, leading to a growing need to increase the scale of livestock cultivation. Switching to larger-scale husbandry with higher animal density leads to increased transmission of infectious disease in these facilities. Coupled with a severe lack of qualified and independent vets to serve the industry, especially smallholder producers in remote locations, this has led to greater consumption of antimicrobials in livestock rearing – with more than 2,700 tonnes of antimicrobials used in Viet Nam's animal production every year.[114]

Amid growing demand and changing husbandry practices, the Ministry of Agriculture and Rural Development, which banned the use of antimicrobials to stimulate growth in livestock in 2018, has plans to completely prohibit antimicrobial use for disease prevention in livestock by 2026.[115] However, Viet Nam's farmers lack knowledge of proper livestock cultivation and farm biosecurity. For example, most veterinary students go into the companion animal industry rather than agriculture, and those who choose to work with livestock work for agriculture supply or service companies. Coupled with difficulties in enforcement of such bans on the ground, antimicrobial misuse in livestock cultivation remains rampant.

To tackle the need for veterinarian services, Farm2Vet is working with vets, producers and farmers to design and build an online platform to support livestock production in Viet Nam. Backed by a knowledge base developed with veterinarians in Viet Nam and the United States (US), the platform allows farmers to submit their questions to receive recommendations based on this reliable veterinary knowledge base. The platform also generates privacy-protected information on outbreaks to allow for more accurate and locally-based recommendations on livestock for farmers and producers, such as certification of antibiotics-responsible production, social learning about livestock production, and connection with potential retailers and buyers. Additionally, the data gathered is helpful for corporates such as agricultural service companies, which can now better understand whether their antimicrobial products are effective and whether there will be sustained demand for these products in future.

Source: See endnote.[116]

Strengthen health systems and services

This sprint involves boosting preventive measures, such as improving diagnostic capabilities including technologies for antimicrobial susceptibility testing (AST) and investing in better WASH measures.

> Much work is needed to get to a diagnosis that is cheap enough and simple enough to be used in the field and at the point of care.

Enhance diagnostic capabilities for surveillance and targeted treatment prescription

Asian communities, especially the most underserved, need access to low-cost, rapid and accurate diagnostics. Diagnostics are vital in the fight against AMR, as they help identify the specific infectious agent causing an infection and determine which antimicrobials are most likely to be effective against it, allowing for the selection of the most appropriate treatment option.

It is also important to note that existing analyses and forecasts on the burden of AMR are dependent on available data. The accuracy of these forecasts is compromised by scarce, fragmented, under-sampled or non-representative data, including a lack of data from medically underserved populations.[117] According to QJS's first biennial report, "AMR rates and trends are difficult to interpret in most LMICs due to insufficient testing coverage and weak laboratory capacity."[118]

However, conventional methods of antimicrobial susceptibility testing (AST) tend to be labour-intensive and expensive,[119] with a turnaround time of at least 48 hours. New forms of AST – including pioneering advancements in the field, such as whole genome sequencing (WGS), advanced spectroscopy and microfluidics technology – are costly techniques that require significant investment upfront. Meanwhile, multiple iterations of diagnostics are often needed to investigate the exact pathogen that is causing the infection, which can cause overall healthcare cost to increase significantly.

For example, according to Manipal Hospitals, it costs around Rs 70,000-100,000 ($ 800-1,150) per day to test and treat a patient with sepsis. In contrast, supportive care only would cost around Rs 50,000 per day. While diagnostic tests are included under health insurance, most patients in India – especially if they reside in Tier 2 cities and below – are not covered by either public or private insurance and are ill-able to afford the extensive diagnostics required to identify the cause of infection as well as the corresponding treatment. Much work is needed to get to a diagnosis that is cheap enough and simple enough to be used in the field and at the point of care.

Equipping a laboratory with a full suite of AST capabilities requires large capital expenditure and a constant supply of energy and water – as well as skilled talent that may not be readily available in rural parts of Asia. Within South-East Asia, there is heavy reliance on a handful of reference laboratories that can conduct "gold-standard" testing. However, during the COVID-19 pandemic, some countries were able to decentralize their test load to trained laboratories at the sub-national levels, reducing the turnaround time for testing. More investment and support for laboratory accreditation and standardization would improve diagnostic testing capacities across South-East Asian countries.[120]

Diagnostics rely heavily on consistent, reliable imports of laboratory supplies and equipment, such as chemical reagents and consumables. One way to enhance diagnostic capabilities would be to strengthen supply chains of these consumables across Asia. However, in South-East Asia for example, while some countries maintain small stockpiles of medical supplies, none seem to have diagnostics stockpiles or a system that enables them to have rapid, sustained and reliable access to reagents and other diagnostic supplies.[121] In building supply chain resilience, there is merit in building up national or regional diagnostic supply stockpiles to ensure that diseases can always be accurately identified in times of both peace and crisis.

CASE STUDY 4

Wellcome's low-cost laboratory information management system (LIMS)

While surveillance is critical to global AMR containment and control, many countries find it challenging to generate suitable, high-quality data for analysis of the AMR burden or to submit to international AMR surveillance systems. This is mainly due to the lack of resources and technical capabilities of their diagnostic laboratories to capture data systematically.

To plug this gap, Wellcome, with the Surveillance and Epidemiology of Drug-Resistant Infections Consortium (SEDRIC) think-tank, embarked on the development of an open-source, freely available laboratory information management system (LIMS), referred to as SEDRILIMS.

SEDRILIMS can help laboratories manage specimens linked to a patient database, support bench workflow within the laboratory, and access and analyse their own data more easily. The system, which has also achieved interoperability with laboratory equipment, has flexible deployment modes enabling it to run in remote labs without the internet, as well as in sophisticated labs with cloud connectivity. In Sierra Leone, SEDRILIMS is run on a single laptop and has been tested in remote areas where internet and power outages are frequent.

SEDRILIMS was piloted for three months at five representative sites, of which two were in Asia (Cambodia and Laos). Since 2022, the SEDRILIMS platform has been implemented in over 15 countries across Africa and Asia, including Cambodia, India, Laos and Thailand. SEDRILIMS enables laboratories to use data at individual patient level to guide treatment, as well as aggregating data at a local level within a hospital to guide outbreak investigations or write antibiotic guidelines. Laboratories equipped with SEDRILIMS are also better able to report to and interface with regional, national and international surveillance networks, such as WHO's Global Antimicrobial Resistance and Use Surveillance System (GLASS).

Sources: See endnote.[122]

Support solutions for simple, rapid, affordable and accurate diagnostics in agriculture and livestock

Asia is becoming a hub of innovation to tackle AMR, with start-ups developing rapid diagnostic tools and AI-powered monitoring systems to reduce antibiotic use. In agriculture, advancements in probiotics, vaccines and precision-farming aim to minimize antimicrobial use while maintaining productivity. Countries such as China and Thailand have made significant reductions in their antimicrobial use in animal husbandry.[123] Many markets in Asia are dominated by small- and medium-scale farms that require tailored approaches.[124] Scaling up initiatives across Asia to reduce antimicrobial use through cross-sector collaborations and investments in veterinary innovations like vaccines and probiotics is key to addressing AMR.

Finally, while reducing antimicrobials in agriculture is critical, strategies must also consider food security. Strengthening value chains and ensuring sustainable livestock management can balance health and nutritional needs while addressing AMR.

CASE STUDY 5

Forte Biotech's farmer-friendly PCR (polymerase chain reaction) test

Forte Biotech has designed and built an award-winning, rapid, easy-to-use, on-site PCR test system that allows farmers to easily run tests on their own farms and get results within an hour. Shrimp farmers in South-East Asia commonly rely on antibiotics to control diseases – but without timely and accessible diagnostics, they tend to over-rely on these treatments, leading to high mortalities, increased costs and significant environmental impact.

With less reliance on antibiotics, farmers can now detect diseases early and increase farm efficiencies and yields through sustainable solutions such as better husbandry or probiotic immune boosters. This enables farmers to strengthen biosecurity, minimize losses when diseases strike and reduce overall antibiotic use and feed waste.

One shrimp farmer who worked with Forte Biotech's solution has reduced his antibiotic usage by 80% with a target to stop the usage entirely, while reporting higher shrimp survival rates, improved yields and increased shrimp sizes – helping grow profits by almost 40 times. Forte's kits are easy to use, do not require laboratory equipment or cold chain/storage, and are fully farm-ready. Most importantly, Forte's solution is built for farmers — requiring just $420 in upfront payment.

In 2024, this solution had reached over 60 users of varying sizes across South-East Asia, from smallholder farmers to commercial farms and feed-mills.

Source: See endnote.[125]

Invest in prevention, WASH and clean water access

In 2019, nearly 80% of South-East Asia's population still relied on groundwater, often dirty and unsafe, as their main source of drinking water.[126] While most countries have developed and periodically revise their AMR national action plans, the crucial role of WASH and wastewater management is often inadequately addressed. Climate hazards make the situation worse, as floods and storms disrupt access to clean water and sanitation, especially in LMICs with vulnerable infrastructure. By integrating science-based WASH, wastewater management and clean water access into national action plans, LMICs can ensure that investments align with best practice and local needs.[127]

CASE STUDY 6

Wateroam

Wateroam is a Singapore-based water innovation enterprise offering low-cost, scalable water filtration to make clean water accessible for all. The flagship product uses ultrafiltration membrane technology, capable of filtering out viruses and parasites from contaminated sources to produce safe drinking water for up to 100 people, and has a lifespan of two years. To date, Wateroam has provided clean water to more than 350,000 people in 40+ countries, including Cambodia, Laos, Malaysia, Myanmar, Nepal and the Philippines. The company also partners with NGOs, private corporations, local authorities and "local champions" to deliver its filters to communities in need.

Specially designed for communities in disaster-hit and rural developing areas, Wateroam's products are portable, easy to maintain and operate without electricity. The company conducts community profiling and mapping to ensure its systems are deployed in accessible locations taking into account geographical proximity to everyday communal spaces and walking time to water sources. To maximize impact, the company provides technical training through local workshops and demonstrations to educate communities on filter usage and maintenance.

Wateroam sets up communication channels on messaging platforms used by the community and establishes lasting relationships with local leaders to ensure long-term sustainability. The company also invests in public education campaigns in target communities to promote behavioural change with regard to health and sanitation practices.

Source: See endnote.[128]

3 | **Sprint:** Monitor

Enhance regional surveillance, data collection and data sharing

This sprint focuses on the vital role of AMR surveillance, which depends on the effective collection and sharing of data between actors, especially in lower-income countries.

Targeted funding for national surveillance systems will not only mitigate AMR but also help secure global food security and public health.

Wastewater surveillance, for example, is emerging as an important method of monitoring AMR both regionally and globally,[129] with wastewater treatment plants becoming a focal point for identifying antibiotic resistant bacteria and genes.[130] Artificial intelligence is also playing an increasingly important role in helping build data analysis capabilities for disease modelling and drug discovery.

Improve data collection and sharing across One Health actors

Effective strategies to tackle AMR require accurate data on how pathogens and drugs interact. However, significant data gaps persist, especially in low- and middle-income countries, where stronger data collection systems and laboratory capacity are urgently needed.[131] Comprehensive surveillance across regions, including data collection from non-human sources like livestock and aquaculture is crucial for[132] informed policy-making and effective responses.[133]

Investing in cross-sectoral surveillance systems, such as FAO's International FAO Antimicrobial Resistance Monitoring (InFARM) system,[134] WHO's Global Antimicrobial Resistance and Use Surveillance System (GLASS) platform,[135] and WOAH's ANImal antiMicrobial USE (ANIMUSE) global database,[136] will enhance data flow and decision-making. Strengthening national surveillance and capacity-building within the One Health framework will improve data quality and usage, supporting stronger AMR strategies. Targeted funding for these systems will not only mitigate AMR but also help secure global food security and public health.

Despite global commitments to ensure multisectoral governance, less than 50% of countries have functional, multisectoral coordination committees in place.[137] While coordination and information-sharing across sectors occur in some contexts in Asia, it is often within the government, across line ministries or in local government structures. The information and analysis rarely reach other stakeholders such as academia or the private sector.[138] While the process of surveillance and data collection may be conducted most effectively within a sector or sub-sector, it is essential to share the resulting information across sectors.

The need for cross-sector cooperation is recognized in some countries' NAPs: for example, the Philippines has started implementing AMR monitoring programmes in the agriculture and aquaculture sectors.[139] Additionally, as the country heads into the next phase of its NAP (2024-2028), there has been growing emphasis on integrating human, animal, plant and environmental policies as well.[140]

CASE STUDY 7

One Health Trust and ResistanceMap

Formerly known as the Centre for Disease Dynamics, Economics & Policy (CDDEP), the One Health Trust was founded in 2010 to improve the health and well-being of the planet and its inhabitants. In relation to AMR, the One Health Trust characterizes its work as: "closing knowledge gaps, explaining the complexity of the issue, advocating for vaccination and infection prevention control to stop infections from happening in the first place and reduce demand for antibiotics and supporting the appropriate use of antibiotics through stewardship and evidence-based treatment guidelines".[141]

One of the earliest initiatives that the trust implemented was the ResistanceMap, "a web-based collection of data visualization tools that allows interactive exploration of AMR and antibiotic use trends in countries across the globe".[142] The latest iteration of ResistanceMap is funded by the Gates Foundation and includes up-to-date AMR data from 46 countries and antimicrobial usage data from 76 countries, collected primarily from public and private laboratory networks in each of the countries. In addition to updated and expanded AMR data, the current iteration includes antibiotic consumption data from 76 countries from 2000-2015, obtained from IQVIA's MIDAS and Xponent databases.[143]

Build data analysis capabilities for disease modelling and drug discovery

Artificial intelligence (AI) is becoming an important tool in the fight against infectious diseases and AMR due to advances in technology, computational power and the availability of big data.

Recent developments include the use of machine learning to explore the global microbiome, leading to the identification of nearly a million potential antibiotics, many effective in preclinical models.

CASE STUDY 8

ADVANCE-ID ACORN-HAI

ADVANCing Clinical Evidence in Infectious Diseases (ADVANCE-ID) is a network of more than 100 hospitals worldwide that collaborate to improve the evidence base for the optimal treatment of seriously ill patients with infections associated with AMR. Set up in 2022 with support from major academic centres in Singapore and Asia, the University of Oxford and Wellcome, ADVANCE-ID is currently housed in the National University of Singapore's Saw Swee Hock School of Public Health. ADVANCE-ID has grown rapidly over the past three years, with over 500 clinical investigators and numerous partners in the pharmaceutical industry and among global health agencies and funders.

ADVANCE-ID's flagship initiative, ACORN-HAI (Clinically-Oriented Antimicrobial Resistance Surveillance Network for Healthcare Associated Infections), is a large-scale, multi-centre protocol that builds upon WHO's GLASS. As the largest patient-based AMR surveillance study to date, ACORN-HAI aims to quantify the burden of disease from the perspective of individual patients, focusing on mortality and health economic outcomes.

Over a three-year period, the study enrolled more than 10,000 patients across 41 hospitals in 19 countries in Asia. ACORN-HAI has identified *Acinetobacter spp*. and *Enterobacterales* as bacteria of critical priority in the region, with infections linked to mortality rates exceeding 40% and substantial economic impact. These highly resistant infections lack established standard-of-care treatments — a situation further compounded by limited access to newer antibiotics across much of Asia.

ACORN-HAI represents a critical contribution to the global fight against AMR, providing urgently needed patient-level evidence to guide R&D in antibiotics and diagnostics, policy development and priority-setting at both national and international levels.

Source: See endnote.[144]

However, there is a dearth of data analysis capabilities throughout Asia, whether in terms of trained talent or the robustness of research conducted. Globally, biotech talent is in short supply: research into talent trends by Randstad in 2022 found that "a third (33%) of C-suite and human capital leaders in the life sciences and pharmaceuticals sector say talent scarcity is a major pain point for the sector".[145] In Singapore, there is a lack of researchers proficient in AI and machine learning skills relevant to biotech production – an area which, if well-staffed, could help accelerate drug discovery and development.[146] This talent shortage is expected to grow almost 30% by 2032.[147]

CASE STUDY 9

AMRSense educates community health workers in India

AMRSense, a project of the Indraprastha Institute of Information Technology Delhi (IIIT-Delhi), is an innovative research initiative focused on combating AMR in India through a community-centred, data-driven approach. Team leader Tavpritesh Sethi describes the specific problem AMRSense is addressing as "the engagement, motivation and training of community health workers (CHWs) in antimicrobial resistance (AMR) surveillance and management, compounded by the lack of a comprehensive data ecosystem and analytics capabilities."

Developed in collaboration with partners including the Indian Council of Medical Research (ICMR) and the Centre for Health Research and Innovation (CHRI-PATH),[148] AMRSense equips CHWs with AI-powered tools to improve AMR data collection and surveillance. The initiative integrates diverse data sources, including antibiotic consumption and sales, to build a unified ecosystem that supports evidence-based decision-making. Key components include predictive analytics for monitoring AMR trends and the AMRaura Scorecard, a tool for evaluating intervention effectiveness and guiding policy.

The project also emphasizes raising public awareness and educating CHWs on responsible antibiotic use. By empowering communities and leveraging advanced analytics, AMRSense aims to fill critical gaps in AMR management at the local and national levels. Its comprehensive strategy supports sustainable AMR containment while contributing to global health security efforts.

Source: See endnotes.[149]

Invest in R&D and increase access to novel and essential medicines

The process of discovering and commercializing new treatments (i.e. antibiotics and antimicrobials) for use with humans, agriculture and livestock is a long-term endeavour. Improving access to existing treatments is equally time-consuming.

> Existing AMR funds are largely focused on early-stage target and drug discovery – far more resources are required to develop the drug candidate further and propel it across the finish line.

To date, it has taken 10-15 years and over $1 billion of investment to develop each successful new antimicrobial drug. Equally, increasing access to both novel and existing essential medicines requires patient and consistent effort to coordinate global supply chains, negotiate manufacturing and technology transfer agreements, and fulfil last-mile delivery of therapeutics to communities in need. Both these aspects of "treating" AMR can be characterized as a marathon – but it is one that must begin now.

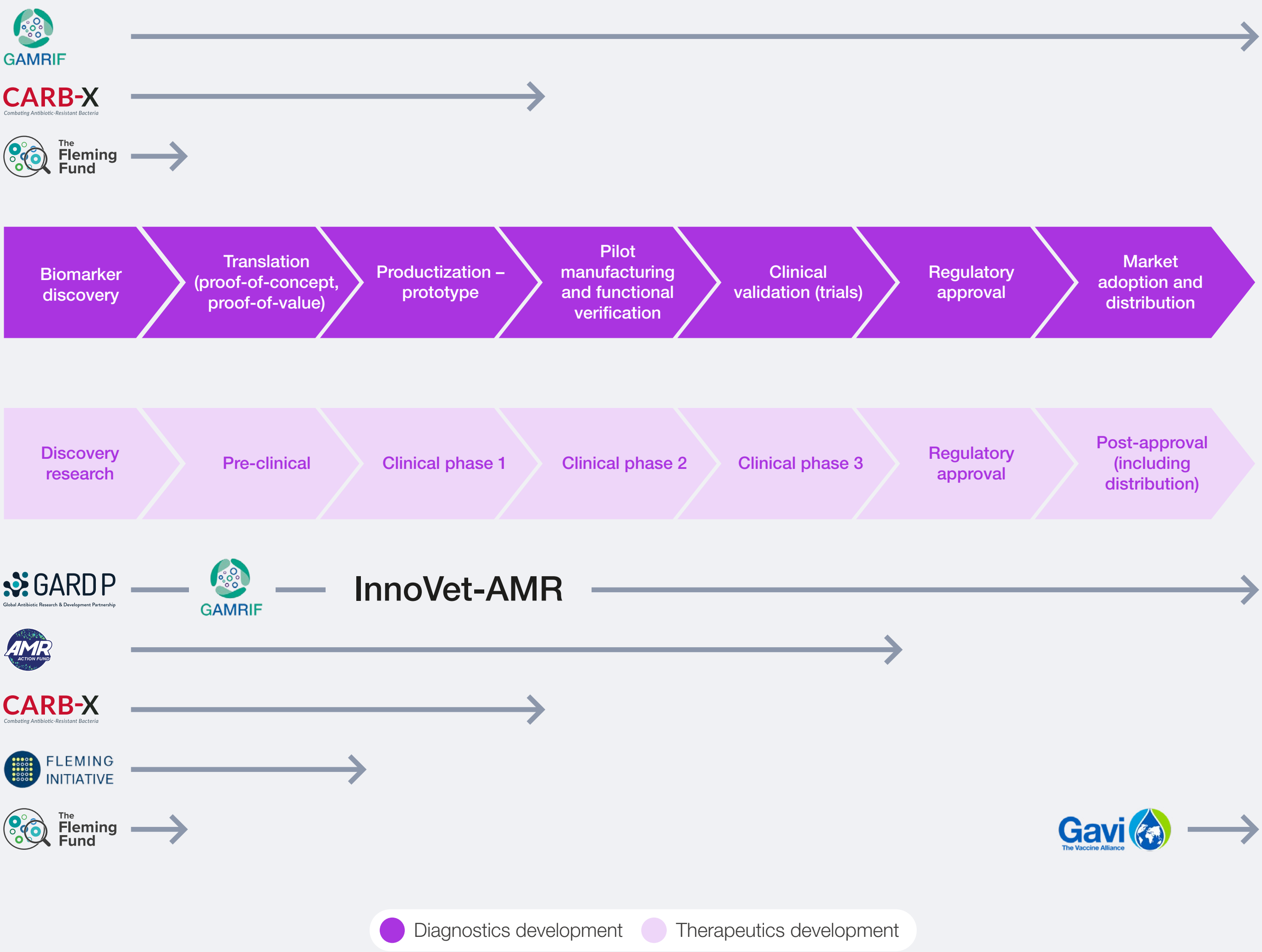
Fund productization and commercialization of later-stage projects

Investing in the development of new antibiotics presents a significant opportunity to address AMR while ensuring the sustainability of global health. The current barriers to antibiotic discovery, including low returns on investment, high scientific risks and challenges in the early stages of drug development, create a need for innovative financing models. Academic groups and small companies often struggle with the cost and complexity of initial research, leaving many potential antibiotics in the exploratory phase. A strategic investment in early-stage research, alongside risk mitigation through public-private partnerships, can overcome these challenges, as demonstrated in successful models for malaria and neglected tropical diseases.[150]

However, building a more robust therapeutic pipeline also includes ensuring that drug candidates can cross the proverbial "valley of death" that lies between early-stage drug development and the process of productization (the process of selling a standardized service or product), regulatory approval and eventual launch to market.

Existing AMR funds are largely focused on early-stage target and drug candidate discovery, stretching at most into Phase 1 clinical trials. Yet, far more resources are required to develop the drug candidate further and propel it across the finish line. There is a pronounced gap in later-stage projects, as well as in ensuring market adoption and distribution, highlighting windows of opportunity for greater involvement by funders. There is economic benefit in doing so as well – the global antibiotics market size is expected to reach around $86 billion by 2033, with the Asia-Pacific accounting for the highest market share.[151]

FIGURE 9 **Fund productization and commercialization of later-stage projects**



Note: Public and research funding tends to be concentrated around early discovery and prototyping; more capital is needed to fund later-stage development, to ensure innovative products are brought to market and made available for all.

Source: Centre for Impact Investing and Practices (CIIP).

CASE STUDY 10

Novo Nordisk Foundation, Wellcome and Gates Foundation invest $300 million to tackle climate impacts, infectious diseases and AMR

In May 2024, the Novo Nordisk Foundation, Wellcome and the Gates Foundation launched a new three-year initiative to support critical scientific R&D for global health, with an emphasis on advancing solutions that are accessible and affordable in low- and middle-income countries (LMICs). This signals an interest in frugal innovations that could be implemented at scale within regions such as Asia.

With a combined fund of $300 million, the initiative seeks to finance solutions that address the health impacts of climate change, infectious diseases and antimicrobial resistance (AMR), as well as to build understanding around the interplay between nutrition, immunity, disease and developmental outcomes.

In February 2025, the initiative announced the launch of the Gram-Negative Antibiotic Discovery Innovator (Gr-ADI), a $50 million investment focused on combatting AMR. "We need global collaboration and cooperation more than ever to build healthier futures and for society to thrive," said John-Arne Røttingen, Chief Executive Office of Wellcome.

Sources: See endnote.[152]

As funding for development of new drugs grows, it is essential to tie finance for product development to access conditions.

Pool resources to ensure sufficient antimicrobial supply across Asia

Efforts to address the market infrastructure for antibiotics focus on overcoming economic barriers that hinder their development and distribution. Initiatives include incentivizing pharmaceutical innovation through public-private partnerships, subsidies and pull mechanisms such as market-entry rewards. Strengthening supply chains and regulatory frameworks ensures equitable access to quality antibiotics while preventing counterfeit drugs too. These measures aim to create a sustainable market that supports innovation, availability and responsible use of antibiotics globally.

As funding for development of new drugs grows, it is essential to tie finance for product development to access conditions. Donors could require developers to register and supply novel or essential antibiotics in high-burden countries within a set time frame or provide sub-licences to organizations that can distribute them.

Beyond these conditions, investments in pooled procurement systems, not-for-profit partnerships and innovative financing – models that have proved successful in other global health areas – can ensure broader access.[153]

Addressing the growing threat of AMR requires innovative funding models that balance the needs of public health, equitable access and sustainable development. The following three funding mechanisms showcase diverse and impactful approaches to tackling AMR globally. Together, they pave the way for a more collaborative, equitable and effective global response to one of the most pressing health threats of our time.

FUNDING MECHANISM 1

Subscription model, e.g. UK National Health Service

In 2024, the United Kingdom's National Health Service (NHS) launched the NHS antimicrobial products subscription model. This innovative scheme pays pharmaceutical companies a fixed annual fee for antimicrobials, "based primarily on a health technology assessment of their value to the NHS, as opposed to the volumes used". In this way, the model de-links revenue generation from the quantity of antibiotics prescribed, thereby removing the incentive for companies to encourage the over-prescription of antimicrobials to bring in returns.[154] According to the NHS, it is the first health system in the world to try this approach.

Often, pharmaceutical companies deprioritize the development of new antimicrobials due to a lack of certainty around funding commitments and market demand,[155] given how hard it is to predict where the next wave of infection might happen and when antimicrobial treatment might be needed. The principle of antimicrobial stewardship also restricts the use of the latest antimicrobials except when absolutely needed. However, the NHS's subscription model tackles this challenge by providing an assurance of guaranteed returns for effective new antimicrobials through a fixed annual subscription fee.

Source: See endnote.[156]

According to the Clinton Health Access Initiative (CHAI), a significant barrier for new medicines lies in the regulatory process. Innovation for newer drugs tends to be in higher-income countries where there are more resources and funding available. This leads the product developer to register their product for regulatory approval in these countries rather than elsewhere. Even if the patent is waived or expires, generic drug manufacturers are not able to produce the same drug in other countries where regulatory approval has not already been obtained. Without a reference product, generic manufacturers may need to conduct clinical trials all over again to obtain regulatory approval – an often tedious and costly process that can delay drug access for the rest of the world.[157]

Equally, it is dangerous to assume that generic manufacturers could produce such new drugs in the first place – given the lack of knowledge transfer, shortage of raw materials and insufficient capacity that continue to impede the manufacture of these life-saving, innovative drugs for the communities that need them the most.[158]

FUNDING MECHANISM 2

Sub-licensing for LMICs, e.g. GARDP, CHAI and Shionogi

In 2022, the Global Antibiotic Research and Development Partnership (GARDP), the Clinton Health Access Initiative (CHAI) and Japanese pharmaceutical company Shionogi signed a licence and technology transfer agreement to enhance access to cefiderocol, an antibiotic used in the treatment of certain serious, resistant bacterial infections among adults. While cefiderocol is part of the WHO's Essential Medicines List, access to this antibiotic remains lacking in LMICs.

Under the agreement, GARDP sought to obtain a sub-licence from Shionogi to unlock rights and manufacturing know-how. CHAI's role was to identify suitable manufacturers to bring into the project as sub-licensees. Thereafter, if any of these manufacturers made a request for a technology transfer, Shionogi would share details of manufacturing processes and relevant know-how with the sub-licensee. By providing proper technology transfer, the issue of counterfeit or substandard drugs could be averted.

Through this partnership, the licensed territories offering access to cefiderocol expanded to 135 countries (70% of all countries), encompassing a significant proportion of people affected by AMR. To support affordable access to cefiderocol even further, Shionogi waived its cost recoupment fees on net sales of the drug in LMICs within the licensed territory.

Sources: See endnote.[159]

Beyond funding or licensing from pharmaceutical companies directly, there is merit in exploring other models or channels to increase access to antimicrobials. Additionally, investing in building market infrastructure in Asian countries, where commercial support for novel antibiotics and diagnostics is limited, would expand access to these crucial tools. Strengthening these markets would ensure that innovations in AMR reach both high- and low-income countries, especially in regions such as Asia, where the AMR burden is significant.[160]

FUNDING MECHANISM 3

Testbed of new ideas and models, e.g. The Trinity Challenge on Antimicrobial Resistance

The Trinity Challenge supports the creation of data-driven solutions to help protect against global health threats. Launched in response to the COVID-19 pandemic and funded by diverse stakeholders across academia and philanthropy, the challenge seeks to support data-driven solutions that can help the world prepare for and respond to global outbreaks and health emergencies. While its first edition focused on pandemic preparedness and response, the following two focused on AMR.

The second edition of The Trinity Challenge, launched in 2024, called for solutions that address the threat of AMR, specifically antibiotic resistance in bacteria. In all, 285 solutions from 57 countries were received, which included ideas on developing new capabilities and tools to collect and use data from community settings, and optimizing the use of citizen-related data and LMIC data to inform action and policy for tackling antibiotic resistance at local, national and regional levels.

The third edition, launched in February 2025, focuses on "community access to effective antibiotics" and calls for solutions to manage antibiotic stock control. The challenge prioritizes solutions relevant to LMICs, given that substandard and falsified antibiotics are estimated to make up 10% of antimicrobials used by humans[161] and 6.5% of veterinary medicines across these countries.[162]

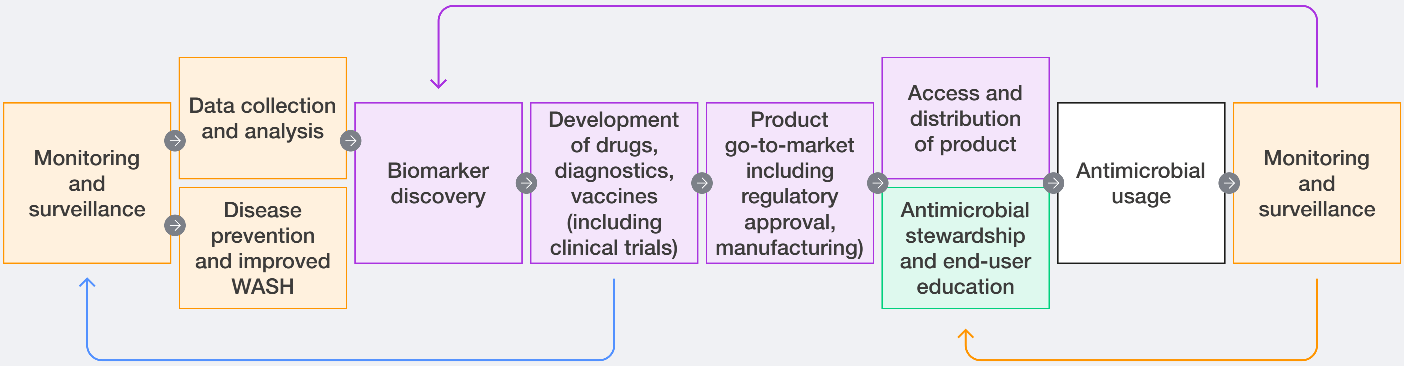
Sources: See endnote.[163]

There are many areas for intervention across the AMR value chain. However, none of these interventions is the sole responsibility of any one funder – rather, funders are needed across the spectrum of capital to join forces and participate in innovative models to close the funding gap for AMR. The traditional strategy of antibiotic stockpiling can be a stop-gap measure when infection occurs, but preventing the infection in the first place would prove a more effective strategy with longer-term pay-offs. Although different funders may have their own objectives, horizons and metrics of success, it is worthwhile for them to engage in open conversation and align with one another to launch a coordinated response to the threat of AMR. Ultimately, substantial and sustained funding, with everyone playing their part, is crucial to ensure there is sufficient end-to-end financing. A summary of the proposed solutions across the AMR value chain is presented in Figure 10.

FIGURE 10 | **Solutions to antimicrobial resistance across the AMR value chain**

Spotting the next bug

Data from monitoring and surveillance efforts, such as epidemiological (i.e. disease outbreak) data or disease evolution (e.g. bacteria morphology and phenotyping) can help to expedite biomarker discovery through sequencing and genome-based prediction.



Better diagnostics

More affordable and more accurate diagnostics can contribute to better data collection and monitoring of antimicrobial usage.

Closing the feedback loop

Monitoring and surveillance is needed to measure actual antimicrobial usage and assess the effectiveness of stewardship and education.

1 **Sprint:** Educate 2 **Sprint:** Prevent 3 **Sprint:** Monitor 4 **Marathon:** Treat

Source: Centre for Impact Investing and Practices (CIIP).

How Asian businesses and philanthropies can support the fight against AMR

While there must be continued emphasis on fostering innovation to support antimicrobial development and to build the drug pipeline that will ultimately address AMR, more work is needed in tandem to mitigate the ongoing impacts of AMR while innovative solutions emerge. There are many areas where business owners can act within their own spheres of influence to reduce AMR deaths in their communities (see Figure 11).

In the agriculture or food sectors, for example, businesses could take actions across all three sprints of education, prevention and monitoring as well as the marathon of treatment. By partnering with farmers and producers, businesses could advocate for better controls in farming practices with proper antibiotic use, as well as set supplier requirements to report on antimicrobial use and monitor use across the supply chain. Within businesses themselves, staff training programmes on the risks of AMR and how to establish proper infection control protocols could help in the fight against AMR.

FIGURE 11 **Actions that Asian corporations can take**

Partner with farmers and producers

- Develop educational materials for farmers and producers on responsible antimicrobial use.
- Invest in model farms to demonstrate better farming practices and proper antibiotic use in agriculture and livestock husbandry.
- Advocate for better farming practices (e.g. alternatives to antimicrobials and vaccination) to improve immunity of animals and prevent disease spread.
- Adopt more affordable and accurate diagnostic solutions as part of farming and livestock husbandry.

Collaborate with industry peers

- Explore new ways of collaborating with other companies or stakeholders to pool resources and efforts.

Manage supply chains

- Set supplier requirements to report on antimicrobial use.
- Ensure supply chain keeps up with export requirements on food safety and acceptable levels of antimicrobials.
- Collect data on antimicrobial use across supply chains and contribute data to shared databases to support AMR surveillance.

Champion best practices within their business

- Implement training programmes for staff on proper antimicrobial use and AMR risks.
- Establish antimicrobial stewardship programmes within the business.
- Contribute to better healthcare and sanitation infrastructure for vulnerable communities as part of CSR.
- Establish proper infection prevention and control protocols as part of workplace safety.
- Monitor and collect data on antimicrobial use within processing and manufacturing facilities.

1 **Sprint:** Educate 2 **Sprint:** Prevent
3 **Sprint:** Monitor 4 **Marathon:** Treat

Source: Centre for Impact Investing and Practices (CIIP).

CASE STUDY 11

Industry commitment to Indonesia's National Action Plan for Antimicrobial Resistance Control

During World Antimicrobial Awareness Week 2022, representatives from Indonesia's Ministry of Agriculture, WOAH, FAO and the poultry and pharmaceutical industries in Indonesia signed a joint declaration committing to the responsible use of antimicrobials. The poultry and pharmaceutical sectors were represented by six corporations – Charoen Pokphand Indonesia, Japfa Comfeed Indonesia, Medion Farma Jaya, Satya Samitra Niagatama, Agrinusa Jaya Santosa and Elanco Animal Health Indonesia.

The declaration outlined five key points to guide the implementation of policies for the industry:

1. Wise use of antimicrobials of the right type and dosage for the recommended period according to prescription.
2. Improvements to biosecurity and vaccination to reduce infection rates.
3. Reduced use of antimicrobials on farms and implementation of good waste management.
4. Investments into vaccines, innovative antimicrobials and new technologies.
5. Collaboration with academia to share data and information to combat AMR.

The joint declaration followed from commitments made during the G20 meeting in Bali and aligned with Indonesia's National Action Plan for Antimicrobial Resistance Control. Given the growth expected in the country's livestock production sector and a shift towards integrated production companies, these six corporations are well positioned to encourage other industrial actors to join the fight against AMR.

Sources: See endnote.[164]

Similarly, catalytic funders have an important role to play in helping to build better health systems and infrastructure, enhance education and awareness, and cultivate skilled talent for the long term (see Figure 12). In the fight against the superbugs that threaten to cast a shadow over every hospital bed, every surgical theatre and every scraped knee, there is a pressing need for everyone to step up and preserve the efficacy of the life-saving drugs that exist, as well as invest in the talent and capabilities needed to find new treatments.

FIGURE 12 | **Actions that Asian funders can take**

Contribute to better infrastructure

- Build better diagnostic capabilities at sub-national levels (e.g. laboratories, diagnostic machinery).
- Enhance primary healthcare in rural areas by building more hospitals and medical centres.
- Improve WASH facilities in communities.
- Support the establishment of data and surveillance networks at national and regional levels.

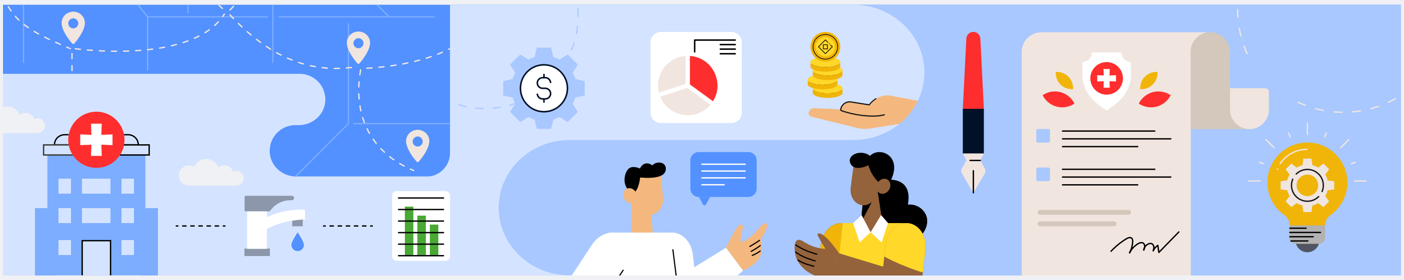
Build up protection in the community

- Support community programmes that seek to educate farmers and patients on proper antibiotic use.
- Contribute to awareness building through innovative models (e.g. supporting establishment of model farms, training community-based healthcare agents).
- Invest in innovative funding mechanisms (e.g. subscription model, sub-licensing, test-bedding new ideas and models) to ensure sustainable supply of critical and necessary antimicrobials for humans and animals, such as drugs and vaccines.

Enhance capacity building and training

- Provide scholarships to cultivate more talent in human health (e.g. medical personnel, allied health professionals, community health workers) and in animal and plant health (e.g. veterinarians, agronomists).

1 **Sprint:** Educate 2 **Sprint:** Prevent
3 **Sprint:** Monitor 4 **Marathon:** Treat



Source: Centre for Impact Investing and Practices (CIIP).

CASE STUDY 12

ClavystBio helps bridge the valley of death

ClavystBio is a Singapore-based life sciences investor and venture builder founded in 2022, which seeks to accelerate commercialization of life sciences breakthroughs from initial concept to global health impact. The company has built a portfolio spanning therapeutics, medical technology and digital health, including solutions addressing prevention and treatment of infectious diseases.

One of its investees, CoVBio, is an early-stage biotech company focused on novel pan-sarbecovirus therapeutics and vaccines to address the mutating nature of coronaviruses. In 2024, ClavystBio and co-investor Polaris Partners brought CoVBio into Leyden Labs, a Netherlands-based biotech company developing antibody-based nasal sprays, a pioneering non-vaccine approach to protect against respiratory viruses. CoVBio, now Leyden Labs Asia, benefits from Leyden Labs' global management team and clinical development capabilities, while Leyden Labs gains unique access to Singapore's innovation and the Asian market. ClavystBio sees its support as extending beyond simply capital input – in this case, it brought together companies with complementary capabilities to advance innovative, global solutions for infectious diseases.

Venture capital funding for start-ups developing novel vaccines and therapeutics for infectious diseases is significantly lower than for other major diseases like cancer and cardio-metabolic diseases. This funding gap – seen across large pharma and biotech companies, public investors and venture capital – creates a particularly deep "valley of death" for infectious disease innovations to pass through on their journey towards commercialization.

ClavystBio advocates an integrated approach to tackle this challenge. Public and grant funding can be used to increase awareness of infectious diseases and the urgent need for novel solutions to treat or prevent them. Catalytic capital can help de-risk novel technologies to the "proof-of-value" point, paving the way for big pharma to commercialize and distribute them. Successful innovation requires partners with sufficient development and commercial muscle, combined with the right networks and resources, to bridge the chasm into which so many biotech innovations fall.

Source: Key informant interview.[165]

Conclusion

Antimicrobial resistance is on track to become the deadliest health threat facing humanity. But with urgent action and targeted finance, over 100 million deaths could be prevented by 2050.

AMR presents an urgent and significant risk to global public health, agriculture and food security. It contributes to the deaths of 4.71 million people every year, of whom well over one million people die as a direct result of AMR – as many as from HIV/AIDS and malaria combined. Left unchecked, it could claim more lives than cancer by 2050.

AMR is not simply a concern for health professionals. Two-thirds of all antibiotics are used by farmers. Business owners – especially in sectors related to healthcare and food systems – also need to take action. The World Bank warns that unmitigated AMR could cost the global economy between 1.1% and 3.8% of annual GDP by mid-century.

This report has focused mainly on the threat posed by AMR to countries in the Asia-Pacific, but the lessons learned have global application. There are opportunities – especially for philanthropic funders – to make a difference in a range of areas. The report proposes concurrent action on four tracks.

Three sprints are needed: to educate clinicians, patients and farmers to improve their awareness of AMR and appropriate usage; to prevent the spread of AMR by strengthening health systems and services; and to improve monitoring through more effective surveillance and data sharing.

The fourth track is a marathon – the multi-year quest to research, develop and scale-up new therapeutics to treat AMR. Most of the finance for this is currently focused on early-stage target and drug discovery. The challenge is to secure more resources to bridge the "valley of death" that promising, innovative drugs must pass through to ensure commercial production and widespread access. It could hardly be more urgent work – by 2050, it could save the lives of over 100 million people.

The scale and urgency of the AMR crisis require bold and sustained investment from philanthropic funders and private capital. Targeted funding can accelerate progress in strengthening health systems, improving global surveillance and supporting innovative financing models that de-risk investment and enable the rapid scale-up of solutions. While this report highlights key challenges and opportunities, it also acknowledges potential gaps that can serve as starting points for future research and action.

Funders have a critical opportunity to drive systemic change by fostering cross-sector collaboration and scaling up solutions that protect global health and economic stability. Now is the time to mobilize resources and collective action to prevent AMR from becoming the next global health catastrophe.

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ADVANCE-ID

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Jhpiego

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   - Asia: Bangladesh, Bhutan, Brunei, Cambodia, China, India, Indonesia, Japan, Laos, Myanmar, Malaysia, Nepal, North Korea, Pakistan, the Philippines, Singapore, South Korea, Sri Lanka, Taiwan, Timor Leste, Thailand and Viet Nam.
   - Western Europe: Andorra, Austria, Belgium, Cyprus, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Israel, Italy, Luxemburg, Malta, Monaco, The Netherlands, Norway, Portugal, San Marino, Spain, Sweden, Switzerland and the United Kingdom.
   - Latin America: Antigua and Barbuda, Argentina, the Bahamas, Barbados, Belize, Bermuda, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominica, Dominican Republic, Ecuador, El Salvador, Grenada, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, Puerto Rico, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Suriname, Trinidad and Tobago, United States Virgin Islands, Uruguay and Venezuela.
   - Sub-Saharan Africa: Angola, Benin, Botswana, Burkina Faso, Burundi, Cabo Verde, Cameroon, Central African Republic, Chad, Comoros, Congo, Côte d'Ivoire, Democratic Republic of the Congo, Djibouti, Equatorial Guinea, Eritrea, Eswatini, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Sierra Leone, Somalia, South Africa, South Sudan, Togo, Uganda, United Republic of Tanzania, Zambia, Zimbabwe.

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   - East Asia: China, Japan, North Korea, South Korea and Taiwan.
   - South Asia: Bangladesh, Bhutan, India, Nepal, Pakistan and Sri Lanka.
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