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Participation of South Centre Member Countries in the WHO GLASS: Progress and Gaps in AMR Surveillance and Stewardship Efforts

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SOUTH CENTRE

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PARTICIPATION OF SOUTH CENTRE MEMBER COUNTRIES IN THE WHO GLASS: PROGRESS AND GAPS IN AMR SURVEILLANCE AND STEWARDSHIP EFFORTS

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SOUTH CENTRE

In August 1995, the South Centre was established as a permanent intergovernmental organization. It is composed of and accountable to developing country Member States. It conducts policy-oriented research on key policy development issues and supports developing countries to effectively participate in international negotiating processes that are relevant to the achievement of the Sustainable Development Goals (SDGs). The Centre also provides technical assistance and capacity building in areas covered by its work program. On the understanding that achieving the SDGs, particularly poverty eradication, requires national policies and an international regime that supports and does not undermine development efforts, the Centre promotes the unity of the South while recognizing the diversity of national interests and priorities.

NOTE

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ABSTRACT

This study highlights antimicrobial resistance (AMR) surveillance challenges in LMICs, focusing on the 55 South Centre Member States' enrolment in the WHO Global Antimicrobial Resistance and Use Surveillance System (GLASS). Despite progress since its 2016 launch, significant gaps persist: only 60 percent of South Centre Member States report AMR surveillance to GLASS, and just 38 percent report antimicrobial use (AMU) data to GLASS. The COVID-19 pandemic substantially disrupted surveillance activities, with rates declining from 2020-2021 compared to pre-COVID-19 pandemic levels. Digital infrastructure, such as mobile reporting tools, cloud-based systems, and interactive dashboards, offers significant opportunities to strengthen AMR surveillance in resource-limited settings. The study recommends a holistic and phased approach for South Centre Member States, including developing integrated national AMR action plans with realistic implementation timelines, investing in laboratory and workforce development, establishing interoperable digital infrastructure, and strengthening regional collaboration mechanisms. By systematically addressing core surveillance challenges while strategically incorporating digital innovations where appropriate, countries can develop resilient monitoring systems that support effective stewardship, protect national populations, and contribute to global health security by preserving antimicrobial effectiveness for future generations.

Este estudio destaca los retos que plantea la vigilancia de la resistencia a los antimicrobianos (RAM) en los países de ingresos bajos y medios, centrándose en la participación de los 55 Estados miembros del South Centre en el Sistema Mundial de Vigilancia de la Resistencia a los Antimicrobianos y su Uso (GLASS) de la OMS. A pesar de los avances logrados desde su puesta en marcha en 2016, siguen existiendo importantes lagunas: solo el 60 % de los Estados miembros del South Centre comunican datos de vigilancia de la RAM al GLASS, y solo el 38 % comunican datos sobre el uso de antimicrobianos (AMU) al GLASS. La pandemia de COVID-19 ha perturbado considerablemente las actividades de vigilancia, con una disminución de las tasas entre 2020 y 2021 en comparación con los niveles anteriores a la pandemia. La infraestructura digital, como las herramientas de notificación móviles, los sistemas basados en la nube y los paneles de control interactivos, ofrece importantes oportunidades para reforzar la vigilancia de la RAM en entornos con recursos limitados. El estudio recomienda un enfoque holístico y por fases para los Estados miembros del South Centre, que incluye el desarrollo de planes de acción nacionales integrados contra la RAM con plazos de aplicación realistas, la inversión en el desarrollo de laboratorios y personal, el establecimiento de una infraestructura digital interoperable y el fortalecimiento de los mecanismos de colaboración regional. Al abordar de forma sistemática los principales retos de la vigilancia e incorporar estratégicamente las innovaciones digitales cuando sea apropiado, los países pueden desarrollar sistemas de seguimiento resilientes que apoyen una gestión eficaz, protejan a las poblaciones nacionales y contribuyan a la seguridad sanitaria mundial al preservar la eficacia de los antimicrobianos para las generaciones futuras.

Cette étude met en évidence les défis liés à la surveillance de la résistance aux antimicrobiens. (RAM) dans les pays à revenu faible et intermédiaire, en se concentrant sur l'adhésion des 55 États membres du South Centre au Système mondial de surveillance de la résistance aux antimicrobiens et de leur utilisation (GLASS) de l'OMS. Malgré les progrès réalisés depuis son lancement en 2016, des lacunes importantes persistent : seuls 60 % des États membres du South Centre communiquent leurs données de surveillance de la RAM au GLASS, et seulement 38 % communiquent leurs données sur l'utilisation des antimicrobiens (AMU) au

GLASS. La pandémie de COVID-19 a considérablement perturbé les activités de surveillance, les taux ayant diminué entre 2020 et 2021 par rapport aux niveaux enregistrés avant la pandémie. Les infrastructures numériques, telles que les outils de signalement mobiles, les systèmes basés sur le cloud et les tableaux de bord interactifs, offrent des possibilités importantes pour renforcer la surveillance de la RAM dans les environnements aux ressources limitées. L'étude recommande une approche holistique et progressive pour les États membres du South Centre, notamment l'élaboration de plans d'action nationaux intégrés en matière de RAM avec des calendriers de mise en œuvre réalistes, l'investissement dans le développement des laboratoires et de la main-d'œuvre, la mise en place d'une infrastructure numérique interopérable et le renforcement des mécanismes de collaboration régionale. La résolution systématique des principaux défis en matière de surveillance, tout en intégrant stratégiquement les innovations numériques lorsque cela est approprié, permettra aux pays de développer des systèmes de surveillance résilients qui favorisent une gestion efficace, protègent les populations nationales et contribuent à la sécurité sanitaire mondiale en préservant l'efficacité des antimicrobiens pour les générations futures.

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1. INTRODUCTION

1.1. The AMR Crisis and Its Global Impact

Antimicrobial resistance (AMR) occurs when microorganisms, such as bacteria, viruses, fungi, and parasites, evolve to resist the effects of medications, rendering standard treatments ineffective and infections harder to treat. AMR has emerged as one of the most pressing global health challenges of the 21st century, threatening to undermine decades of progress in infectious disease management.[1]

The global burden of AMR is staggering, with drug-resistant infections directly responsible for approximately 1.27 million deaths annually and contributing to an estimated 5 million associated deaths recorded in 2019 alone.[2] This crisis has evolved into a multifaceted threat with profound implications for health systems, economies, and sustainable development worldwide.[3]

The burden of AMR falls disproportionately on low- and middle-income countries (LMICs), where high infectious disease prevalence, inadequate sanitation, limited access to quality medicines, and fragile healthcare infrastructure create ideal conditions for the emergence and rapid spread of resistant pathogens.[4] Without coordinated and immediate action, AMR risks reversing critical medical advancements, potentially relegating humanity to a post-antibiotic era with severe public health and economic consequences.[5]

In recognition of the growing threat, the United Nations General Assembly adopted a High-Level Political Declaration on AMR in September 2024, outlining renewed global commitments and measurable targets to combat this crisis.[6]

1.2. AMR Surveillance and Stewardship

Effective management of antimicrobial resistance requires comprehensive strategies built upon two foundational pillars: robust surveillance systems and antimicrobial stewardship (AMS). Antimicrobial stewardship refers to interventions that promote the optimal selection, dosage, and duration of antimicrobials across healthcare settings, and while its detailed discussion lies beyond the main scope of this paper,[7] it is introduced here as a background given its proven impact in reducing healthcare-associated infections and resistant pathogens. The primary focus of this study is on surveillance, which provides the critical data infrastructure

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[1] World Health Organization. Antimicrobial resistance [Internet]. World Health Organization. 2023. Available from: https://www.who.int/news-room/fact-sheets/detail/antimicrobial-resistance.

[2] University of Oxford. An estimated 1.2 million people died in 2019 from antibiotic-resistant bacterial infections | University of Oxford [Internet]. www.ox.ac.uk. 2022. Available from: https://www.ox.ac.uk/news/2022-01-20-estimated-12-million-people-died-2019-antibiotic-resistant-bacterial-infections.

[3] Aslam B, Asghar R, Muzammil S, Shafique M, Siddique AB, Khurshid M, et al. AMR and Sustainable Development Goals: at a crossroads. Globalization and Health. 2024 Oct 17;20(1).

[4] Kanan M, Ramadan M, Haif H, Abdullah B, Mubarak J, Ahmad W, et al. Empowering Low- and Middle-Income Countries to Combat AMR by Minimal Use of Antibiotics: A Way Forward. Antibiotics. 2023 Oct 1;12(10):1504.

[5] Ahmed SK, Husein S, Qurbani K, Ibrahim RH, Fareeq A, Mahmood KA, et al. Antimicrobial resistance: Impacts, challenges, and future prospects. Journal of Medicine Surgery and Public Health [Internet]. 2024 Mar 1;2(100081):100081–1. Available from: https://www.sciencedirect.com/science/article/pii/S2949916X24000343.

[6] United Nations. UN General Assembly High-Level Meeting on antimicrobial resistance 2024 [Internet]. www.who.int. 2024. Available from: https://www.who.int/news-room/events/detail/2024/09/26/default-calendar/un-general-assembly-high-level-meeting-on-antimicrobial-resistance-2024.

[7] Elshenawy, R.A., Umaru, N. and Aslanpour, Z. (2024). An Evaluation of the Five Rights Antibiotic Safety Before and During COVID-19 at an NHS Foundation Trust in the United Kingdom. Journal of Global Antimicrobial Resistance, [online] 36. doi:https://doi.org/10.1016/j.jgar.2023.12.019.

needed to guide stewardship and inform policy.[8] Within this context, the WHO AWaRe (Access, Watch, Reserve) framework offers a practical structure for prioritizing antimicrobials for monitoring, enabling countries to focus limited resources on tracking agents with the greatest public health significance.[9]

Well-implemented stewardship initiatives have been demonstrated to improve patient outcomes, enhance healthcare safety, and yield substantial cost savings for healthcare systems.[10] However, the effectiveness of these interventions depends critically on the availability of high-quality, timely surveillance data to guide clinical decision-making and policy development. Comprehensive surveillance of antimicrobial resistance patterns and antimicrobial use (AMU) provides the essential foundation for evidence-informed stewardship and public health action. Surveillance systems enable the early identification of emerging resistance threats, facilitate the evaluation of intervention impacts, and guide the allocation of limited resources toward areas of greatest need. In high-functioning systems, surveillance data informs clinical practice guidelines, supports targeted infection control measures, and enables the tracking of long-term trends in resistance and consumption patterns. Surveillance is thus considered fundamental to assessing the spread of AMR and evaluating the effectiveness of stewardship efforts at local, national, and global levels.[11]

1.3. WHO GLASS and Digital Innovation in AMR Surveillance

The World Health Organization's Global Antimicrobial Resistance and Use Surveillance System (WHO GLASS) represents a cornerstone initiative in the international effort to combat AMR. Established in 2015, GLASS provides standardized methodologies for collecting, analyzing, and sharing AMR and antimicrobial use (AMU) data across countries, creating a global platform for coordinated action.[11] Its phased implementation has facilitated the gradual expansion of surveillance parameters, including AMU monitoring. The most recent GLASS Report highlights both progress and persistent gaps in global coverage, with significant under-representation from low- and middle-income countries (LMICs). WHO and associated studies have documented several barriers to participation in GLASS, including limited laboratory capacity, insufficient funding, human resource shortages, and data management challenges.[12,13] For instance, a 2021 WHO review on GLASS implementation identified infrastructure constraints, lack of political commitment, and workforce limitations as recurrent obstacles in LMICs. These systemic challenges contribute to substantial data gaps in regions bearing the highest burden of AMR, thereby limiting the global visibility of resistance trends and AMU patterns.

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[8] Rasha Abdelsalam Elshenawy, Nkiruka Umaru, Amal Bandar Alharbi and Aslanpour, Z. (2023). Antimicrobial stewardship implementation before and during the COVID-19 pandemic in the acute care settings: a systematic review. BMC Public Health, 23(1). doi:https://doi.org/10.1186/s12889-023-15072-5.

[9] AWaRe Classification W. The selection and use of essential medicines, 2025: WHO AWaRe (Access, Watch, Reserve) classification of antibiotics for evaluation and monitoring of use [Internet]. Who.int. World Health Organization; 2025 [cited 2025 Sep 13]. Available from: https://www.who.int/publications/i/item/B09489

[10] UK Health Security Agency. Start smart then focus: antimicrobial stewardship toolkit for inpatient care settings [Internet]. GOV.UK. 2023. Available from: https://www.gov.uk/government/publications/antimicrobial-stewardship-start-smart-then-focus/start-smart-then-focus-antimicrobial-stewardship-toolkit-for-inpatient-care-settings

[11] Naghavi M, Vollset SE, Ikuta KS, Swetschinski LR, Gray AP, Wool EE, et al. Global Burden of Bacterial Antimicrobial Resistance 1990–2021: a Systematic Analysis with Forecasts to 2050. The Lancet. 2024 Sep 28;404(10459):1199–226.

[12] World Health Organization. Global Antimicrobial Resistance and Use Surveillance System (GLASS) [Internet]. www.who.int. 2023. Available from: https://www.who.int/initiatives/glass.

[13] WHO. Countries enabled to address antimicrobial resistance through strengthened surveillance systems, laboratory capacity, infection prevention and control, awareness-raising and evidence-based policies and practices [Internet]. Who.int. 2022. Available from: https://www.who.int/about/accountability/results/who-results-report-2022-mtr/output/2022/countries-enabled-to-address-antimicrobial-resistance-through-strengthened-surveillance-systems--laboratory-capacity--infection-prevention-and-control--awareness-raising-and-evidence-based-policies-and-practices.

Digital innovation has emerged as a transformative force in AMR surveillance, offering promising solutions to overcome some of the barriers in resource-constrained settings. Digital technologies, including electronic laboratory information systems, mobile data platforms, and cloud-based reporting tools, have shown promise in enhancing AMR data collection, analysis, and utilization. While WHO has not systematically published formal surveys on country-level barriers to GLASS participation, existing literature highlights recurring challenges in low- and middle-income countries (LMICs), including inadequate laboratory capacity, weak health system governance, limited digital infrastructure, and constrained financial resources.[14,15]

The WHO GLASS digital dashboard represents a significant advancement, enabling the interactive visualization of AMR and antimicrobial use (AMU) trends across participating countries.

This facilitates reduced reporting delays, improved data quality, and supports integration with national health information systems. Importantly, such digital technologies can also serve as multi-purpose platforms for the surveillance of other priority pathogens, optimizing resource use. However, workforce shortages and laboratory infrastructure deficits remain persistent bottlenecks that cannot be solved by digital tools alone. To realize the full potential of digital innovation, countries must complement technological adoption with targeted investments in workforce development and strengthening of laboratory systems.

1.4. AMR Data Gaps in LMICs and South Centre Member States

Significant data gaps in AMR surveillance persist across countries, including LMICs, undermining global efforts to combat drug-resistant infections effectively. AMR surveillance systems work by systematically collecting, analyzing, and reporting data on how bacteria respond to antibiotics, essentially tracking which infections can still be treated with which drugs. These systems monitor key pathogens (disease-causing bacteria) from clinical samples like blood, urine, and respiratory specimens, testing their susceptibility to standard antibiotics. When surveillance data shows increasing resistance rates to first-line treatments, healthcare providers can adjust prescribing practices, switch to alternative antibiotics, and implement targeted infection control measures. However, LMICs data gaps make this task more difficult. Data gaps in LMICs include weak laboratory infrastructure, insufficient trained personnel, and inadequate digital systems for data collection and sharing. The absence of robust AMR and AMU data leaves healthcare systems vulnerable, preventing evidence-based stewardship initiatives and timely responses to outbreak. Without reliable surveillance data, health authorities cannot accurately identify resistance hotspots, monitor antibiotic consumption trends, or evaluate the effectiveness of interventions, creating a cycle of inadequate response that perpetuates the AMR crisis.[16]

Figure 1 illustrates how AMR surveillance systems function in practice, using India's enrolment in WHO GLASS as a case study. India enrolled in GLASS-AMR in 2017 and has developed one of the most comprehensive surveillance networks among LMICs, with 113 health facilities and hospitals reporting data on key pathogens.

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[14] Iskandar K, Molinier L, Hallit S, Sartelli M, Hardcastle TC, Haque M, et al. Surveillance of antimicrobial resistance in low- and middle-income countries: a scattered picture. Antimicrobial Resistance & Infection Control [Internet]. 2021 Mar 31;10(1). Available from: https://aricjournal.biomedcentral.com/articles/10.1186/s13756-021-00931-w.

[15] ReACT Africa. 4 key reflections on the recently launched WHO GLASS-report – 2020 [Internet]. ReAct. 2024. Available from: https://www.reactgroup.org/news-and-views/news-and-opinions/year-2020/4-key-reflections-on-the-recently-launched-who-glass-report/.

[16] Frost I, Kapoor G, Craig J, Liu D, Laxminarayan R. Status, challenges and gaps in antimicrobial resistance surveillance around the world. Journal of Global Antimicrobial Resistance. 2021 Apr;25.

The surveillance pathway demonstrates the critical steps from sample collection through clinical decision-making: hospitals collect clinical specimens from infected patients, laboratories perform antimicrobial susceptibility testing on identified pathogens, data is analyzed for resistance patterns and reported to national and international systems, and healthcare providers use this information to guide treatment protocols and infection control measures. India's experience exemplifies both the potential and challenges of AMR surveillance in LMICs.

While the country successfully collected data on over 43,000 bloodstream infections in 2022, revealing alarming resistance rates such as 80 percent resistance to third-generation cephalosporins in E. coli, translating this surveillance intelligence into effective clinical practice and policy responses across diverse healthcare settings remains challenging.

This case study highlights why robust surveillance systems are essential. Without reliable data on local resistance patterns, clinicians may continue prescribing ineffective antibiotics, leading to treatment failures, prolonged infections, and further selection pressure for resistant organisms. The Indian model demonstrates that even with substantial surveillance infrastructure, continuous investment in laboratory capacity, workforce training, and data utilization mechanisms is crucial for surveillance systems to effectively combat the AMR crisis.

South Centre Member States

This paper will focus on AMR surveillance in South Centre Member States, focusing on their enrolment in the WHO GLASS. The South Centre is an intergovernmental organization made up of 55 developing countries across Africa, Asia, Latin America, and the Caribbean (Figure 2). These countries collectively face a high burden of infectious diseases, making robust AMR surveillance and stewardship vital for safeguarding public health.[17] The geographical, economic, and epidemiological diversity across South Centre Member States positions them as a critical group for exploring barriers to participation in the WHO GLASS initiative and for developing context-specific strategies to strengthen AMR surveillance capacity.[18]

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[17] South Centre. The South Centre | Antimicrobial Resistance (AMR) [Internet]. Southcentre.int. 2020 [cited 2025 Apr 29]. Available from: https://www.southcentre.int/tag/antimicrobial-resistance-amr/.

[18] Institute for Health Metrics and Evaluation. The Lancet: More than 39 million deaths from antibiotic-resistant infections estimated between now and 2050, suggests first global analysis | Institute for Health Metrics and Evaluation [Internet]. Institute for Health Metrics and Evaluation. 2024. Available from: https://www.healthdata.org/news-events/newsroom/news-releases/lancet-more-39-million-deaths-antibiotic-resistant-infections.

Figure 1.
From Data to Action: India's Role in the GLASS AMU and AMR Surveillance

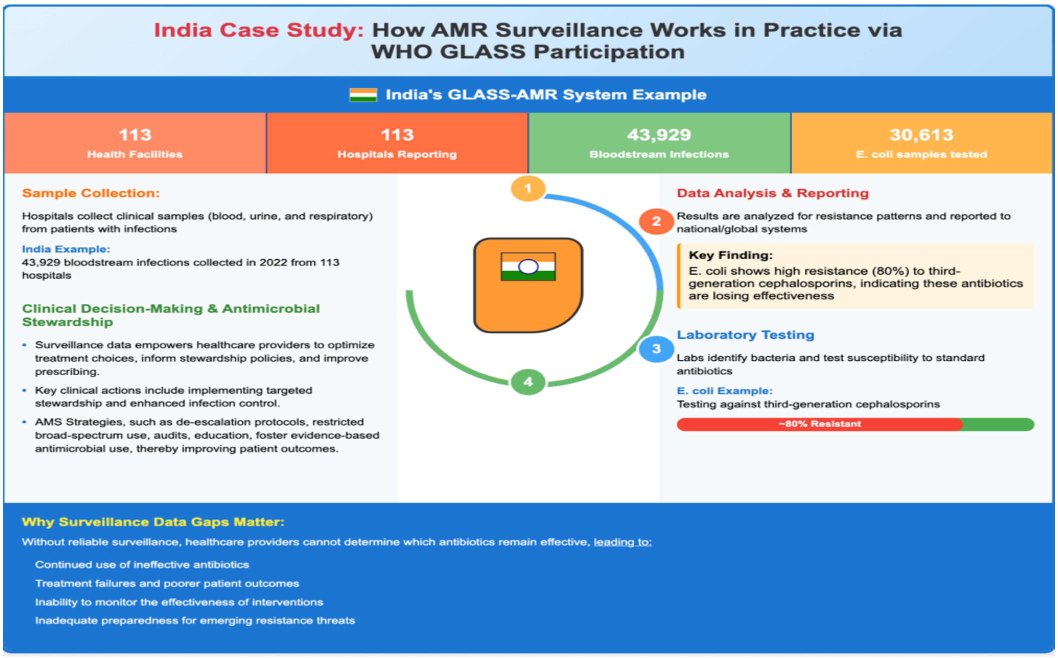

Figure 2. The 55 South Centre Member States Represented by National Flags from Africa, Asia, Latin America, and the Caribbean

1.5. Addressing Global and Regional Challenges of AMR

Antimicrobial resistance represents one of the most significant threats to global public health, food security, and development in the twenty-first century. The ability of microorganisms—bacteria, viruses, fungi, and parasites, to develop resistance to the medications designed to eliminate them compromises our capacity to treat even common infections, leading to prolonged illness, disability, and death. The WHO has declared AMR among the top ten global public health threats facing humanity, with particular urgency in the realm of bacterial resistance to antibiotics.

The magnitude of the AMR crisis is reflected in alarming global statistics. According to the landmark Global Research on Antimicrobial Resistance (GRAM) report, published in *The Lancet*, bacterial antimicrobial resistance was directly responsible for an estimated 1.27 million deaths worldwide in 2019, with an additional 4.95 million deaths associated with drug-resistant infections. These figures exceed the combined global mortality from HIV/AIDS and malaria, positioning AMR as a leading cause of death globally. Projections suggest that without effective interventions, AMR-related deaths could reach 10 million annually by 2050, surpassing cancer as a cause of mortality.

The burden of AMR is not distributed equally across regions. LMICs in sub-Saharan Africa, South Asia, and parts of Latin America experience disproportionately higher rates of AMR-related morbidity and mortality. In these regions, resistant infections affect individuals across all age groups, with particularly devastating impacts on neonatal and paediatric populations.

The WHO African Region reports resistance rates exceeding 80 percent for some common pathogens against several first-line antibiotics, severely limiting treatment options in settings already constrained by resource limitations.

Beyond its direct health impacts, AMR imposes substantial economic costs on health systems and national economies. The World Bank estimates that AMR could cause global economic damage comparable to the 2008 financial crisis, with the potential to reduce global GDP by up to 3.8 percent by 2050 and push an additional 28.3 million people into extreme poverty. For health systems, AMR increases expenditure through prolonged hospitalizations, requirements for more expensive second- and third-line antibiotics, additional diagnostic testing, and intensified infection control measures.

In LMICs, these economic consequences are particularly severe. Limited health budgets become further strained by the costs of managing resistant infections, diverting resources from other critical health priorities. At the household level, families face catastrophic health expenditures related to treating resistant infections, often coupled with loss of productivity and income when breadwinners fall ill. The economic burden of AMR extends to the agricultural sector, where resistant infections in livestock reduce productivity and threaten food security, creating a cycle of economic vulnerability and health challenges.[19]

Multiple factors drive the emergence and spread of AMR in LMICs, requiring comprehensive and context-sensitive interventions. One major contributor is the inappropriate use of antimicrobials, which includes over-prescription by healthcare providers, self-medication without guidance, incomplete treatment courses, and the widespread availability of antibiotics without prescription.

These practices are often enabled by weak regulatory practices. Studies estimate that 20–65 percent of antimicrobials in LMICs are obtained without professional oversight.

At the same time, critical underuse is a growing concern: only 6.9 percent of patients with drug-resistant infections in a study of eight LMICs received appropriate antibiotics in 2019.[20] This under-treatment is often due to limited access to effective antibiotics, high costs of newer agents, and disrupted supply chains.

Additionally, weak diagnostic infrastructure results in empirical prescribing rather than targeted treatment based on microbiological evidence.

Figure 3 illustrates this "Antimicrobial Access Paradox," highlighting the dual challenges of inappropriate overuse and critical underuse of antibiotics in LMICs.

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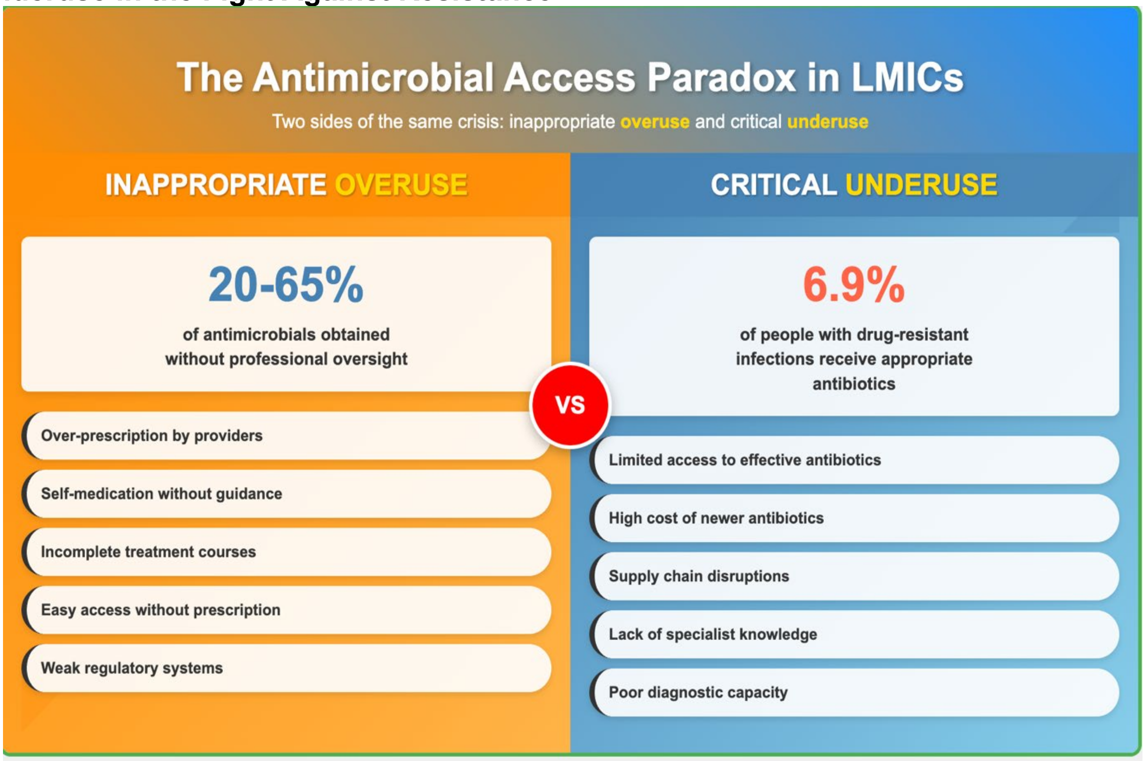
[19] 20. Gandra S, Alvarez-Uria G, Turner P, Joshi J, Limmathurotsakul D, van Doorn HR. Antimicrobial Resistance Surveillance in Low- and Middle-Income Countries: Progress and Challenges in Eight South Asian and Southeast Asian Countries. Clinical Microbiology Reviews. 2020 Jun 10;33(3).

[20] Pierre G. GARDP [Internet]. GARDP. 2025 [cited 2025 Sep 13]. Available from: https://gardp.org/gardp-research-reveals-that-people-with-multidrug-resistant-infections-in-low-and-middle-income-countries-dont-have-access-to-appropriate-treatment.

It underscores how both misuse and lack of access contribute to AMR, driven by systemic issues such as weak health governance, limited specialist capacity, and inadequate diagnostic resources.[21,22]

Figure 3. The Antimicrobial Access Paradox in LMICs: Balancing Overuse and Underuse in the Fight Against Resistance[23]



Inadequate infection prevention and control measures in healthcare facilities and communities facilitate the transmission of resistant pathogens. Limited access to clean water, sanitation, and hygiene infrastructure creates environments where resistant bacteria can spread rapidly between individuals and communities.[24]

[21] AWaRe Classification W. The selection and use of essential medicines, 2025: WHO AWaRe (Access, Watch, Reserve) classification of antibiotics for evaluation and monitoring of use [Internet]. Who.int. World Health Organization; 2025 [cited 2025 Sep 13]. Available from: https://www.who.int/publications/i/item/B09489.

[22] Balasegaram M, Muñoz Tellez V. Achieving sustainable access to antibiotics is more than just a last mile challenge. Nature Reviews Microbiology. 2024 Sep 13;22(10):593–4.

[23] AMR Centre. The cost of antimicrobial resistance in LMICs: challenges and future implications [Internet]. LSHTM. 2023. Available from: https://www.lshtm.ac.uk/research/centres/amr/news/377771/cost-antimicrobial-resistance-lmics-challenges-and-future-implications.

[24] WHO. People-centred approach to addressing antimicrobial resistance in human health [Internet]. www.who.int. 2023. Available from: https://www.who.int/publications/i/item/9789240082496.

2. DATA GAPS IN AMR SURVEILLANCE IN SOUTH CENTRE MEMBER STATES

2.1. The Current Landscape of Surveillance Gaps

Effective AMR surveillance underpins evidence-based stewardship and public health interventions, yet significant blind spots persist across the 55 South Centre Member States. As detailed in the Annex 1, our mapping draws on WHO GLASS enrolment data and supplementary national reports, while acknowledging key limitations: countries may be formally enrolled but face challenges in consistently collecting and reporting high-quality data, whereas others not enrolled in GLASS may operate robust national surveillance systems that are not captured within the global platform.

The mapping conducted for the 55 South Centre Member States has shown the following:

1. **Limited national participation & reporting**: Only 60 percent of the countries have national AMR surveillance systems and a mere 33 percent regularly submit data to WHO GLASS, reflecting systemic weaknesses in their health systems.
2. **Inadequate AMU monitoring**: Fewer than 40 percent can track antimicrobial use effectively, and monitoring is typically confined to major hospitals, neglecting community clinics, and healthcare facilities.
3. **Narrow pathogen focus**: Surveillance focuses on a small number of priority pathogens, failing to capture emerging threats, such as drug-resistant gonorrhoea or tuberculosis.
4. **Lack of demographic details**: Data rarely includes variables such as age, sex, or geographic location, limiting analysis of inequities among subpopulations.
5. **Geographic gaps & rural exclusion**: Surveillance remains largely hospital-centred and urban-biased, leaving rural and remote areas unmonitored.
6. **Weak One Health integration**: Surveillance in animal, food, and environmental settings is sparse; cross-sectoral data sharing is rarely implemented.
7. **Laboratory and diagnostic constraints**: Many regions lack accredited microbiology laboratories outside tertiary hospitals, resulting in inconsistent susceptibility testing, poor laboratory quality assurance, and limited genome-based resistance monitoring.
8. **Environmental surveillance and methodology gaps**: Resistance gene monitoring in wastewater, surface water, soil, or agricultural runoff is infrequent, and few guidelines exist for detecting environmental drivers, such as heavy metals and biocides.
9. **Cross-resistance and antimicrobial misuse**: Poor capacity to detect cross-resistance results in the misuse of antibiotics to fuel resistance to last-resort drugs.
10. **Delays in reporting & data sharing**: Slow or manual reporting systems hinder early detection of emerging resistance (e.g., ceftriaxone-resistant *N. gonorrhoeae*).
11. **Absence of standardized protocols**: Lack of harmonised standard operating procedures (SOPs) for sampling, antimicrobial susceptibility testing (AST), sequencing, and data exchange prevents comparability across sectors and borders.
12. **Limited digital & AI use**: Despite the promise of digital platforms and AI for pattern detection and real-time alerts, adoption in LMICs remains very limited. To close these critical gaps, the WHO, GLASS, and global experts advocate a set of coordinated actions. First, AMU and AMC monitoring should be extended beyond hospitals to include rural clinics, private providers, and veterinary and agricultural sectors, where large volumes of antimicrobials are used but often go unrecorded. Laboratory capacity must be enhanced, particularly in under-resourced and rural settings, through strengthened accreditation schemes, quality assurance systems, and standardised antimicrobial susceptibility testing (AST) protocols. Integrated One Health data

systems are also essential, enabling coordinated surveillance across human, animal, and environmental health domains. Environmental surveillance should be scaled up to monitor resistance genes in waterways, soils, and wastewater, as well as the role of pollutants such as heavy metals and biocides in selecting for resistance.[25,26]

Furthermore, digital technologies and artificial intelligence should be leveraged for real-time data capture, predictive analytics, and automated early warning systems. These are underutilised in many low- and middle-income settings. Finally, harmonised protocols including standard operating procedures for sampling, AST, sequencing, and interoperable data-sharing platforms, must be established to ensure data consistency, quality, and comparability across sectors and borders.

By addressing these structural, geographic, and methodological shortcomings, South Centre Member States can significantly improve the effectiveness of their AMR surveillance systems, contribute robustly to global datasets, and support timely, evidence-informed interventions to safeguard public health.

2.2. Implications for Policy and Clinical Practice

The consequences of these data gaps extend far beyond technical considerations, directly impacting clinical outcomes and policy effectiveness. Without high-quality, locally relevant surveillance data, national health authorities face significant challenges in developing tailored antimicrobial stewardship policies that address specific resistance patterns and consumption trends in their populations. This information vacuum leads to either policy paralysis or the adoption of guidelines developed for different epidemiological contexts, potentially misaligning interventions with local needs.[27] At the clinical level, the absence of current, facility-specific resistance data compromises **prescribing decisions.** Healthcare providers lacking access to **local antibiograms** may rely on outdated information or broad international guidelines, potentially leading to suboptimal antimicrobial choices. A study across six South Centre Member States found that facilities with functional laboratory surveillance systems demonstrated 23 percent higher concordance between prescribed antibiotics and pathogen susceptibility patterns compared to those without such systems, translating directly to improved patient outcomes.[28]

Without compelling local evidence demonstrating the burden of AMR and the cost-effectiveness of stewardship interventions, policymakers may deprioritize investments in surveillance infrastructure and AMS programs. The absence of economic impact data specific to each country further complicates advocacy efforts, leaving AMR initiatives vulnerable to underfunding.[29]

[25] Otaigbe II, Elikwu CJ. Drivers of Inappropriate Antibiotic Use in Low- and Middle-Income Countries. JAC-Antimicrobial Resistance [Internet]. 2023 May 3;5(3). Available from: https://academic.oup.com/jacamr/article/5/3/dlad062/7187015.

[26] WHO. 1 in 10 medical products in developing countries is substandard or falsified [Internet]. www.who.int. 2017. Available from: https://www.who.int/news/item/28-11-2017-1-in-10-medical-products-in-developing-countries-is-substandard-or-falsified.

[27] Aslam B, Asghar R, Muzammil S, Shafique M, Siddique AB, Khurshid M, et al. AMR and Sustainable Development Goals: at a crossroads. Globalization and Health. 2024 Oct 17;20(1).

[28] Wernli D, Harbarth S, Levrat N, Pittet D. A “Whole of United Nations approach” to tackle antimicrobial resistance? A mapping of the mandate and activities of international organisations. BMJ Global Health. 2022 May;7(5):e008181.

[29] GOV.UK. Confronting antimicrobial resistance 2024 to 2029 [Internet]. GOV.UK. 2024. Available from: https://www.gov.uk/government/publications/uk-5-year-action-plan-for-antimicrobial-resistance-2024-to-2029/confronting-antimicrobial-resistance-2024-to-2029.

2.3. Technical and Infrastructure Limitations

Laboratory capacity remains a fundamental constraint, with significant deficiencies in infrastructure, equipment, reagent supply chains, and quality assurance systems. A 2022 assessment found that only 27 percent of district-level laboratories across sampled South Centre Member States had the capacity to perform culture and antimicrobial susceptibility testing
according to international standards.

Even when testing is available, methodological inconsistencies and limited participation in external quality assessment programs raise concerns about data reliability and comparability.[30]

Digital infrastructure limitations further compound these challenges. Electronic laboratory information management systems remain unavailable in approximately 70 percent of public health laboratories across South Centre Member States, necessitating manual data collection processes that increase error risks and reporting delays. Where digital systems exist, they often operate as standalone solutions, limiting interoperability with hospital information systems, pharmacy databases, and national health information architectures.

Workforce capacity constraints represent another critical barrier, with significant shortages of trained microbiologists, laboratory technologists, and informatics specialists. The specialized training required for proper specimen collection, processing, and data management often exceeds available educational resources. Furthermore, high staff turnover in resource-limited settings creates challenges in maintaining consistent surveillance practices.[31]

2.4. The Cycle of Poor Data and Ineffective Stewardship

The relationship between surveillance gaps and antimicrobial stewardship deficiencies creates a self-reinforcing cycle. Without reliable surveillance data, stewardship programs lack the evidence base needed to identify priorities, design targeted interventions, and measure outcomes. The resulting stewardship gaps lead to continued inappropriate antimicrobial use, thereby accelerating the development of resistance. This increasing resistance remains inadequately documented due to surveillance limitations, further obscuring the magnitude of the problem.[32]

In the absence of reliable resistance data, prescribers often resort to unnecessarily broad-spectrum agents or newer antimicrobials, which drives up costs and potentially accelerates resistance to these crucial drugs. Conversely, patients may receive ineffective narrow-spectrum antibiotics for resistant infections when local resistance patterns remain unknown, leading to treatment failures.[33] Breaking the cycle of poor data and ineffective antimicrobial stewardship requires coordinated investment in both surveillance capacity and stewardship implementation.

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[30] South Centre. The South Centre | South Centre WAAW 2024 Webinar Report, February 2025 [Internet]. Southcentre.int. 2024 [cited 2025 Apr 29]. Available from: https://www.southcentre.int/south-centre-waaw-2024-webinar-report-february-2025/

[31] Akkari Y, Dobin S, Best RG, Leung ML. Exploring Current Challenges in the Technologist Workforce of Clinical Genomics Laboratories in the United States. Genetics in Medicine Open. 2023 Mar;100806.

[32] Gulumbe BH, Haruna UA, Almazan J, Ibrahim IH, Faggo AA, Bazata AY. Combating the menace of antimicrobial resistance in Africa: a review on stewardship, surveillance and diagnostic strategies. Biological Procedures Online. 2022 Nov 23;24(1).

[33] 34. Cox JA, Vlieghe E, Mendelson M, Wertheim H, Ndegwa L, Villegas MV, et al. Antibiotic stewardship in low- and middle-income countries: the same but different? Clinical Microbiology and Infection. 2017 Nov;23(11):812–8.

3. WHO GLASS SURVEILLANCE: AMR AND AMU

3.1. Evolution and Development of the WHO GLASS Platform

The World Health Organization's Global Antimicrobial Resistance and Use Surveillance System (WHO GLASS) represents a landmark initiative in the global response to AMR. Established in 2015 following the adoption of the Global Action Plan on Antimicrobial Resistance, GLASS emerged as the first unified attempt to create a standardized, international AMR surveillance framework. The system's development marked a critical shift from fragmented national approaches toward coordinated global monitoring, enabling comprehensive assessment of AMR trends across geographical boundaries and diverse healthcare contexts. GLASS has evolved through distinct implementation phases, each expanding the platform's scope and capabilities.

The initial phase (2015-2019) focused on establishing core surveillance infrastructure and methodologies for monitoring priority bacterial pathogens in human clinical samples. The second phase (2020-2022) broadened the surveillance scope to include antimicrobial consumption and use (AMU) monitoring, recognizing the critical relationship between antimicrobial usage patterns and resistance emergence. The current third phase (2023-present) has further expanded to incorporate One Health surveillance components, acknowledging the interconnected nature of resistance across human, animal, and environmental domains.

This phased approach has enabled GLASS to progressively strengthen its technical framework while accommodating varying capacities among participating countries. From an initial enrolment of 22 nations in 2016, GLASS participation has expanded to 109 countries as of 2023, representing approximately 56 percent of WHO Member States. This growth reflects increasing global recognition of AMR as a priority health threat requiring coordinated surveillance and response mechanisms.[34]

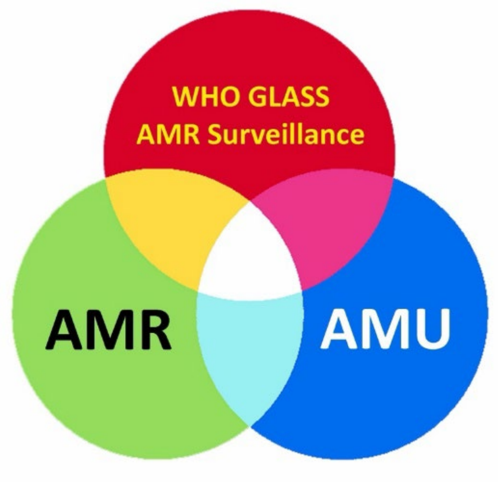
3.2. Surveillance Components: Integrating Resistance and Usage Monitoring

GLASS operates through complementary surveillance modules that collectively provide a comprehensive picture of antimicrobial resistance dynamics and drivers. The AMR surveillance component focuses on monitoring resistance patterns in eight priority pathogens, including *Escherichia coli*, *Klebsiella pneumoniae*, *Acinetobacter baumannii*, *Staphylococcus aureus*, *Streptococcus pneumoniae*, *Salmonella* spp., *Shigella* spp., and *Neisseria gonorrhoeae*. This pathogen selection reflects major public health threats while balancing the practical constraints faced by laboratories in resource-limited settings. The antimicrobial consumption and use surveillance component, introduced in 2019, monitors antimicrobial consumption at national levels and usage patterns in healthcare facilities. This dual approach enables correlation between prescribing practices and resistance trends, providing crucial insights for stewardship interventions. The AMU module collects standardized metrics, including Defined Daily Doses (DDDs) per 1,000 population and Days of Therapy (DOT), allowing for meaningful cross-country comparisons of antimicrobial utilization. The integrated nature of these surveillance components represents a key strength of the GLASS platform. By simultaneously tracking resistance patterns and antimicrobial usage, the system creates a comprehensive surveillance ecosystem that supports evidence-based policy development.[11]

[34] Peaper DR, Doern CD, Sharp S. Proceedings of the Clinical Microbiology Open 2022—assessing clinical laboratory and industry responses to COVID-19 pandemic testing capacity challenges (part 1). Journal of clinical microbiology. 2024 Feb 20;62(3):e00941-23.

This integration is particularly valuable for LMICs, where understanding the relationship between access, use, and resistance is essential for developing contextually appropriate interventions (Figure 4).

Figure 4
Integration of AMR and AMU Surveillance under the WHO GLASS Framework



3.3. Standards, Methodologies, and Reporting Frameworks

GLASS has established standardized methodologies and data collection protocols to ensure consistency and comparability across participating countries. These standards address all aspects of the surveillance process, from specimen collection and laboratory testing to data analysis and reporting. For AMR surveillance, GLASS recommends specific approaches to antimicrobial susceptibility testing, including disk diffusion, determination of minimum inhibitory concentration (MIC), and molecular detection methods for resistance mechanisms of critical importance.

The platform employs a sentinel site surveillance approach, enabling countries with limited resources to generate high-quality data from selected healthcare facilities rather than attempting comprehensive national coverage. This approach strikes a balance between the need for representative data and practical implementation constraints. GLASS provides detailed guidance on sentinel site selection to ensure appropriate geographical and demographic representation within national surveillance networks. The GLASS reporting framework utilizes standardized case definitions, data elements, and quality indicators to maintain consistency across diverse settings. Countries submit aggregated surveillance data through a secure web-based platform, with options for both manual data entry and automated uploads from compatible electronic systems. This flexibility accommodates varying levels of digital infrastructure while maintaining essential standardization of core data elements.

3.4. Integration with National Surveillance Systems

A key design principle of GLASS is its capacity to complement and strengthen existing national surveillance initiatives rather than creating parallel structures. The system supports progressive integration with country-level monitoring systems through flexible implementation approaches and dedicated technical assistance. For countries with established AMR surveillance programs, GLASS provides mechanisms for harmonizing existing methodologies with international standards while preserving valuable historical data. For nations developing new surveillance capabilities, GLASS offers standardized protocols and implementation guidance to build systems aligned with global best practices from inception.

This integration approach is particularly relevant for South Centre Member States, where limited resources necessitate the efficient utilization of existing surveillance infrastructure. GLASS supports countries in mapping current systems, identifying adaptation requirements, and developing phased implementation plans that build on established capacities. Technical assistance encompasses laboratory strengthening, training for surveillance personnel, and guidance on establishing governance frameworks for coordinated AMR monitoring.

However, despite its strengths, GLASS still faces limitations, particularly concerning the comparability of data across countries. Variations in laboratory capacity, diagnostic practices, sampling methodologies, and case definitions can hinder standardisation. Many countries submit aggregated data using different formats, antimicrobial susceptibility testing standards (e.g., CLSI vs. EUCAST), or incomplete pathogen panels, which complicates global benchmarking and trend analysis. Without further harmonisation in data collection, quality assurance, and reporting protocols, disparities in data completeness and representativeness may continue to affect the reliability of cross-country comparisons and the ability to assess regional or global AMR trends with confidence.

3.5. The GLASS Digital Dashboard: Enhancing Data Visualization and Utilization

The GLASS digital dashboard, launched in 2021, represents a significant advancement in making surveillance data accessible and actionable for stakeholders at national and global levels. This interactive, web-based platform transforms complex surveillance datasets into visual representations that facilitate rapid identification of trends, patterns, and emerging threats. The dashboard features customizable visualization tools that allow users to explore resistance rates by pathogen, antimicrobial agent, geographical region, and time period, enabling multidimensional analysis of AMR dynamics.

For policymakers and program managers in South Centre nations, the dashboard provides unprecedented access to contextualized AMR data, supporting evidence-based decision-making and resource allocation. The platform features benchmarking capabilities that enable countries to compare their resistance profiles with regional averages and global patterns, identifying areas that require targeted intervention. Additionally, the dashboard incorporates data quality indicators that help users interpret findings appropriately, recognizing limitations in coverage and representativeness. The WHO GLASS dashboard's functionality extends beyond visualization to include knowledge translation tools that connect surveillance findings with practical guidance for clinical practice and public health response. These features are particularly valuable for resource-limited settings, where translating surveillance data into actionable interventions presents significant challenges. By linking resistance trends with stewardship recommendations, the dashboard helps bridge the gap between monitoring and response.

However, despite these strengths, the current dashboard also has notable limitations. Its utility is constrained by the variability and completeness of data submitted by different countries. Disparities in laboratory capacity, antimicrobial susceptibility testing standards, and reporting formats affect the granularity and comparability of data visualised. Additionally, the platform currently lacks integration with real-time or subnational data streams, limiting its use for localised outbreak detection or rapid response. Enhancing dashboard functionality will require further investments in data standardisation, interoperability, and linkage with clinical and prescribing data systems to fully support decision-making across all levels of health systems.

3.6. Benefits of GLASS Participation for National Health Systems

Participation in GLASS offers multiple benefits for countries beyond the immediate objective of AMR monitoring. The system provides a structured framework for strengthening national laboratory capacity, improving diagnostic quality, and enhancing data management capabilities—developments that benefit health systems beyond AMR surveillance. The standardized protocols and quality assurance mechanisms promoted by GLASS elevate overall laboratory performance, contributing to broader diagnostic capacity for infectious disease management. For countries with limited surveillance experience, GLASS offers a pathway to rapidly develop functional monitoring systems by adopting internationally validated methodologies rather than developing approaches from first principles. This accelerated capability development is particularly valuable given the urgency of the AMR threat. The system's emphasis on data quality and representativeness helps countries generate reliable evidence for policy development, program evaluation, and resource advocacy.

Perhaps most significantly, GLASS participation connects countries to a global community of practice, facilitating knowledge exchange, technical collaboration, and mutual support. This network effect multiplies the value of individual country investments in surveillance infrastructure by creating opportunities for shared learning and collaborative problem-solving.

As digital innovations increasingly transform surveillance capabilities, GLASS provides a platform for rapid dissemination of emerging technologies and methodologies across participating countries, helping to close the technological divide in global health monitoring.

4. Pattern in Participation in AMR WHO GLASS Surveillance

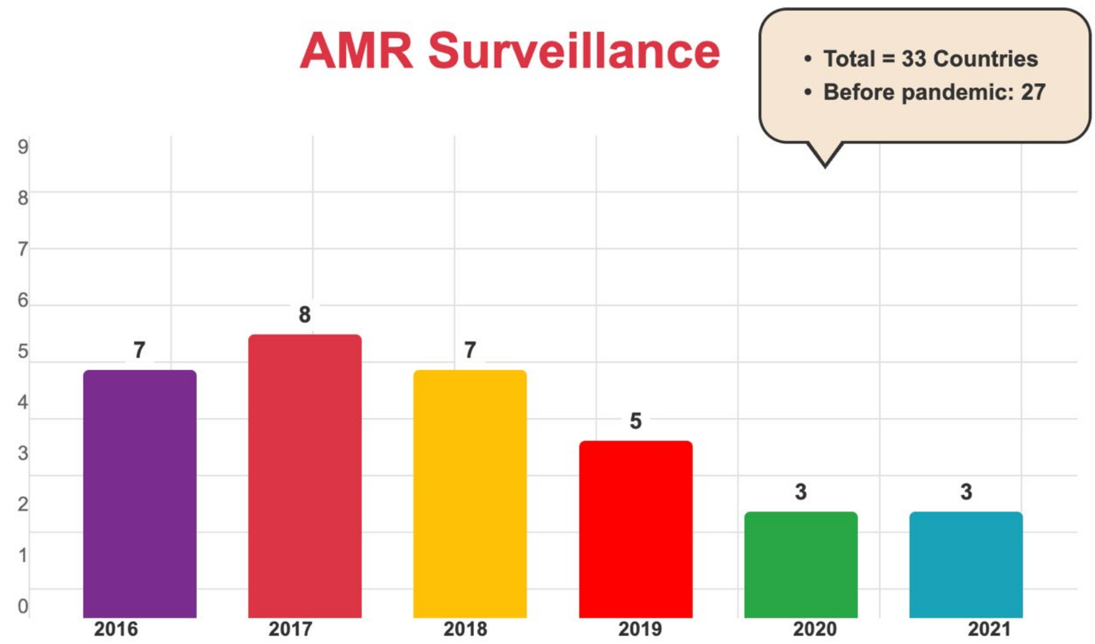
4.1. Trends in South Centre Member States' Participation (2016-2021)

Analysis of WHO GLASS AMR surveillance data reveals distinct patterns in the participation of South Centre Member States from 2016 to 2021. The enrolment trajectory showed robust initial engagement followed by a significant decline coinciding with the COVID-19 pandemic.

As illustrated in Figure 5, seven countries (Cambodia, Egypt, Iran, the Philippines, South Africa, Uganda, and Zimbabwe) joined the GLASS platform in 2016, establishing a foundation for regional engagement.

This momentum accelerated in 2017, with the rate of participation peaking as eight additional countries (Brazil, India, Iraq, Jordan, Malawi, Mozambique, Nigeria, and Pakistan) joined the network, representing the highest annual enrolment across the six years.

Figure 5
Annual Participation of South Centre Member States in AMR Surveillance (2016–2021)



The positive trend continued in 2018, with seven more countries (Democratic People's Republic of Korea, Liberia, Malaysia, Mali, Mauritius, Sri Lanka, and Sudan) enrolling in the surveillance initiative. In 2019, five new countries (Côte d'Ivoire, Gabon, Ghana, Indonesia, and the United Republic of Tanzania) joined the program. During the COVID-19 pandemic, only three new countries joined per year in both 2020 (Benin, Namibia, and Burundi) and 2021 (Colombia, Sierra Leone, and Viet Nam).

By the end of 2021, cumulative participation reached 33 out of 55 South Centre Member States (60 percent), demonstrating meaningful but incomplete engagement across the membership. The bar chart clearly visualizes this evolving pattern, with the height of each column depicting annual enrolment numbers declining progressively from 2017 through 2021, illustrating the pandemic's disruptive impact on AMR surveillance expansion.

4.2. Pre-Pandemic Versus Post-Pandemic Enrolment

The data distinctly illustrates two contrasting phases in GLASS participation patterns. Of the 33 South Centre Member States enrolled by 2021, 27 (81.8 percent) joined before the pandemic's full impact, while only 6 (18.2 percent) enrolled during the pandemic years (2020-2021). This represents a dramatic 77 percent reduction in new enrolments compared to the pre-pandemic period, underscoring the profound impact of COVID-19 on health system priorities and AMR surveillance capacity.

The pre-pandemic period (2016-2019) saw consistent engagement, with an average of 6.75 new countries joining annually. By contrast, the pandemic period (2020-2021) averaged only 3 new countries per year. This sharp decline occurred precisely when antimicrobial usage patterns were changing dramatically due to COVID-19 treatment protocols, creating a dangerous surveillance gap at a critical moment for AMR monitoring.

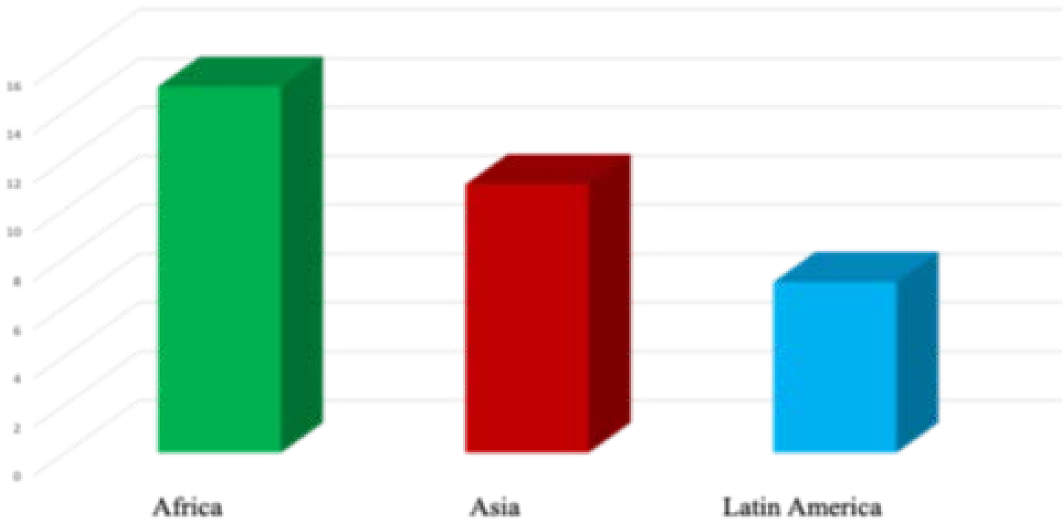
The annotation in Figure 5 highlighting "Total = 33 Countries" and "Before pandemic: 27" effectively quantifies this disparity, emphasizing how the pandemic disrupted what had been a promising trajectory of GLASS adoption among South Centre members. This stark pre/post-pandemic contrast raises concerns about the resilience of surveillance systems during health emergencies and highlights the need for strategies that can maintain essential monitoring activities even during crisis periods.

4.3. Regional Disparities in Participation

Examining the country-level data reveals significant geographical patterns in GLASS participation across South Centre membership. Analysis of the enrolment data by region shows that African nations constitute a significant proportion of participants, with 15 countries enrolled by 2021, representing approximately 45 percent of total South Centre participation. Asian members account for 11 enrolled countries (33 percent), while Latin American and Caribbean nations contributed seven countries (21 percent) to the total.

The timing of enrolment also shows notable regional variations. Several Asian countries demonstrated strong early engagement, with Cambodia, Iran, and the Philippines joining in the initial implementation year (2016). African nations showed more distributed participation across all years, including during the pandemic period, with Benin, Burundi, and Namibia joining in 2020, and Sierra Leone in 2021. Latin American participation was more limited, with Brazil enrolling early (2017), while other countries like Colombia joined only during the pandemic period (2021). These regional patterns suggest differences in priority-setting, capacity, and regional support mechanisms that influenced countries' ability and willingness to engage with GLASS, particularly during the challenging pandemic period. The more sustained African participation during the pandemic merits further investigation into potential regional support structures that enabled continued engagement despite global disruptions (Figure 6).

Figure 6
GLASS Regional Participation Analysis: Trends in South Centre Member State Engagement by WHO Region



4.4. Factors Influencing Participation in AMR Surveillance

Multiple factors appear to influence the participation of South Centre Member States in the WHO GLASS AMR surveillance. While the dataset does not provide specific indicators on health system strength, several patterns suggest underlying determinants of participation. Countries with stronger existing health infrastructure, established laboratory capacity, and previous engagement in international health initiatives generally enrolled earlier in the GLASS program.

The marked decline in participation during 2020-2021 clearly demonstrates how external health crises can dramatically impact surveillance priorities and capacity. Resources previously allocated for AMR surveillance infrastructure development were likely diverted to meet immediate pandemic response needs, thereby postponing plans for GLASS enrolment and implementation. This suggests that countries with greater overall health system resilience and flexibility were better positioned to maintain broader health priorities during the crisis.

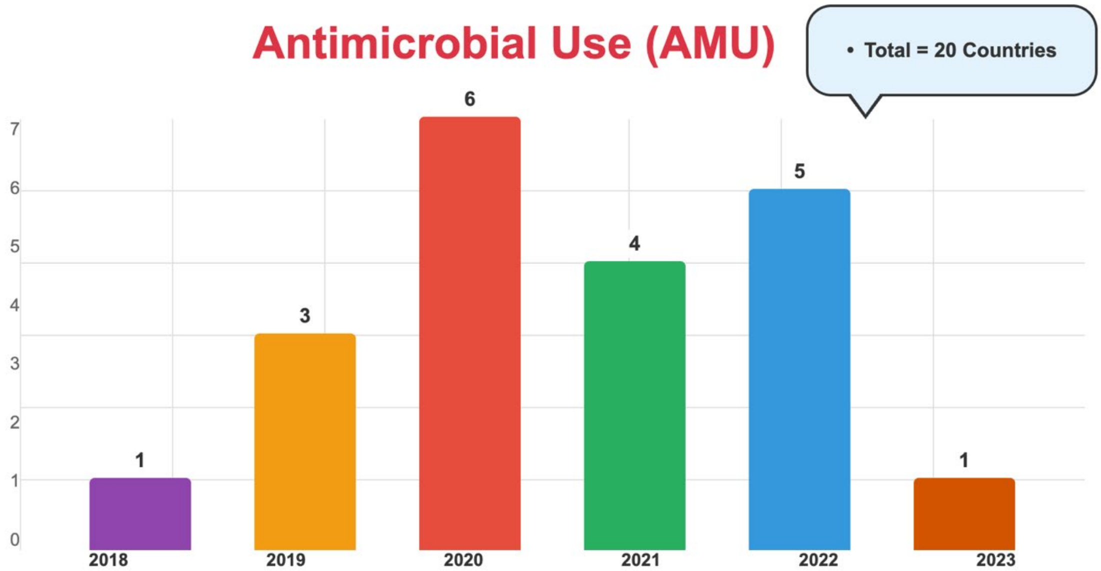
Geographic proximity to regional health organizations and technical support mechanisms also appears to influence participation patterns. Regional clusters of enrolment are visible in the data, suggesting that knowledge sharing, technical support, and peer examples within regions may facilitate GLASS adoption. These patterns highlight the potential value of regional approaches to capacity building and enrolment support.

5. TRENDS IN PARTICIPATION IN AMU WHO GLASS SURVEILLANCE

5.1. Analysis of AMU Surveillance Participation (2020-2023)

The data on South Centre Member States' participation in WHO GLASS-AMU surveillance reveals distinct engagement patterns that differ significantly from those seen in GLASS-AMR enrolment. AMU surveillance involves the standardised collection of data on the quantity and patterns of antimicrobial consumption at national and subnational levels, typically using defined daily doses (DDDs) per 1,000 inhabitants per day to enable international comparability. This information is essential for monitoring trends in antibiotic use, identifying inappropriate prescribing practices, and guiding stewardship interventions. As illustrated in Figure 7, AMU surveillance among South Centre members commenced in 2018, with Gabon being the first to submit data to GLASS (see Appendix 1).

Figure 7
Annual Enrolment of South Centre Member States' in WHO GLASS Antimicrobial Use (AMU) Surveillance (2020–2023)



The most significant period of growth in GLASS-AMU surveillance participation occurred in 2020, when six countries, Egypt, Indonesia, Iran, Jordan, Morocco, and the United Republic of Tanzania, formally enrolled in the platform and submitted AMU data for the first time. This peak in 2020 is particularly noteworthy, as it coincided with the first year of the COVID-19 pandemic, in contrast to the simultaneous decline observed in new country enrolments for AMR surveillance during the same period. Post-2020 data shows continued moderate engagement, with four countries (Benin, Colombia, Sierra Leone, and Uganda) joining in 2021, followed by five countries (Burundi, Pakistan, South Africa, Sudan, and Viet Nam) in 2022. In contrast, 2023 marked a significant decrease, with only Malaysia enrolling, suggesting a potential waning of momentum or the emergence of new barriers to implementation (Appendix 1). By the end of 2023, a cumulative total of 20 South Centre Member States had enrolled in AMU surveillance, representing 38 percent of the 55 member states.

5.2. Comparison Between AMR and AMU Surveillance Enrolment

A comparative analysis of enrolment in AMR versus AMU surveillance reveals significant disparities in both the magnitude and patterns of engagement. While 33 South Centre Member States (60 percent) had enrolled in AMR surveillance by 2021, only 20 countries (38 percent) had joined AMU surveillance by 2023, despite having an additional two years of potential enrolment opportunity. This difference highlights the greater complexity and resource requirements associated with implementing consumption monitoring compared to resistance surveillance.[35]

The temporal trends in surveillance participation reveal a notable divergence between AMR and AMU reporting. AMR surveillance saw robust early adoption between 2016 and 2018, followed by a plateau and slight decline during the COVID-19 pandemic. In contrast, AMU surveillance, which began later in 2018, showed limited initial uptake but experienced its most significant expansion between 2020 and 2022. While this inverse relationship may partially reflect increased awareness of antibiotic consumption during the pandemic, it more likely highlights the relative complexity and underreporting challenges of AMU surveillance. Unlike AMR, which is derived from microbiological sampling, AMU requires comprehensive data on defined daily doses (DDDs) from varied healthcare settings—data that are often incomplete, especially in LMICs with limited digital infrastructure and variable reporting from hospitals and private providers (Appendix 1).

Another notable difference is the composition of participating countries. Among the 20 countries enrolled in AMU surveillance, 15 had previously established AMR surveillance systems, suggesting that many countries build AMU monitoring upon existing AMR surveillance infrastructure. However, 18 countries with established AMR surveillance have not yet implemented AMU monitoring, highlighting the distinct challenges associated with collecting consumption data, even when basic surveillance capacity exists (Appendix 1).

5.3. Challenges Specific to AMU Monitoring

The lower rates of participation in AMU surveillance compared to AMR surveillance reflect distinct conceptual and practical challenges. While AMR surveillance focuses on laboratory-based monitoring of resistance patterns in clinical isolates, AMU surveillance involves quantifying the amount of antimicrobials used—typically expressed in DDD per population. This distinction is important: **use** refers to the act of prescribing or administering antimicrobials, whereas **consumption** captures the actual volume of antimicrobials dispensed or taken, often sourced from pharmacy sales or supply chain data. Tracking antimicrobial consumption requires standardised metrics and reliable data systems across diverse healthcare settings, which are often lacking or fragmented in many South Centre Member States, thereby contributing to lower engagement in AMU surveillance initiatives.[36]

AMU surveillance requires several foundational components beyond just digital infrastructure. At a basic level, it necessitates trained personnel to collect, interpret, and record data on antimicrobial prescribing and consumption patterns, as well as systems to routinely capture information from hospitals, pharmacies, and supply chains. These include capacities for prescription tracking, pharmacy dispensing logs, and records of hospital antimicrobial administration. Only after these human and operational capacities are in place can digital data

[35] Sine K, Appaneal H, Dosa D, LaPlante KL. Antimicrobial Prescribing in the Telehealth Setting: Framework for stewardship during a period of rapid acceleration within primary care. Clinical Infectious Diseases. 2022 Jul 30;ciac598.
[36] Sujeewa Ariyawansa, Gunawardana KN, Hapudeniya MM, Manelgamage NJ, Karunarathne CR, Madalagama RP, et al. One Health Surveillance of Antimicrobial Use and Resistance: Challenges and Successes of Implementing Surveillance Programs in Sri Lanka. Antibiotics. 2023 Feb 23;12(3):446–6.

systems be effectively leveraged to standardise, analyse, and report antimicrobial use metrics across facilities. The limited enrolment in AMU surveillance among South Centre Member States likely reflects these layered infrastructure and workforce constraints.[37]

Additionally, AMU monitoring often necessitates coordination across multiple sectors, including hospitals, community pharmacies, and pharmaceutical supply chains, creating complex governance challenges. The coordination requirements for comprehensive consumption data collection exceed those for laboratory-based resistance surveillance, which can often be established within existing microbiology infrastructure. The data patterns suggest that countries with more integrated health information systems and stronger pharmaceutical governance structures were better positioned to implement AMU surveillance. Many South Centre Member States face significant challenges with pharmaceutical sector fragmentation, unregulated dispensing practices, and limited electronic prescription systems, all of which complicate systematic consumption monitoring.[38]

5.4. Importance of Consumption Data for Stewardship

Despite these challenges, the growth in AMU surveillance participation—particularly during the pandemic period—reflects an increasing recognition of the critical importance of consumption data for effective antimicrobial stewardship. Understanding usage patterns provides the essential context for interpreting resistance data and designing targeted interventions to address inappropriate prescribing and consumption. The data shows that several countries prioritized establishing AMU surveillance even amid the pandemic's disruptions, suggesting strategic recognition that consumption monitoring offers direct actionable insights for clinical practice and policy. This prioritization likely reflects growing awareness that effective stewardship programs fundamentally depend on understanding current usage patterns to identify intervention priorities and measure progress.[39]

For South Centre Member States with limited resources, AMU data enables more efficient targeting of stewardship activities toward settings, prescriber groups, or antimicrobial classes that show the highest usage rates or most concerning prescription patterns. The increased enrolment during 2020-2022 suggests growing recognition of these benefits, despite the implementation challenges.

[37] 38. Patel S, Jhass A, Hopkins S, Shallcross L. Enhancing antimicrobial surveillance in hospitals in England: a RAND-modified Delphi. JAC-Antimicrobial Resistance. 2022 Sep 5;4(5).

[38] Chua AQ, Verma M, Hsu LY, Legido-Quigley H. An analysis of national action plans on antimicrobial resistance in Southeast Asia using a governance framework approach. The Lancet Regional Health - Western Pacific. 2021 Feb;7:100084.

[39] Kiran Sunder Bajracharya, Luu S, Cheah R, KC S, Mushtaq A, Elijah M, et al. Mentorship advances antimicrobial use surveillance systems in low- and middle-income countries. JAC-Antimicrobial Resistance [Internet]. 2024 Dec 26 [cited 2025 Jun 17];7(1). Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC11670778/.

6. Comparative Analysis of AMR and AMU Surveillance Enrolment Among South Centre Member States

An analysis of the data reveals distinct patterns in how South Centre Member States have engaged with the two complementary components of the WHO GLASS platform: AMR and AMU surveillance.

By the end of 2023, 33 of 55 South Centre Member States (60 percent) had enrolled in AMR surveillance, while 20 countries (38 percent) had joined AMU surveillance. This enrolment gap of 12 countries highlights the greater implementation challenges associated with consumption monitoring compared to resistance tracking. Only 15 countries have enrolled in both surveillance components, representing 27 percent of the South Centre's membership.

The COVID-19 pandemic had a mixed effect on surveillance enrolment. AMR participation declined significantly during the pandemic, with only six countries joining after 2020 compared to 27 before. Conversely, AMU surveillance saw its most significant growth during the pandemic period, with 16 of 21 participating countries joining from 2020 onward.

Countries adopting both surveillance components generally followed a sequential pattern, with AMR surveillance typically implemented before AMU monitoring. However, a few exceptions exist, notably Gabon, which established AMU surveillance in 2018 and subsequently added AMR monitoring in 2019. Regional enrolment patterns are also evident, with African members showing stronger participation in proportion to their representation within the South Centre. The data suggests that while establishing basic AMR surveillance infrastructure remains the priority for many countries, there is growing recognition of the complementary value that AMU data brings to comprehensive antimicrobial stewardship efforts.

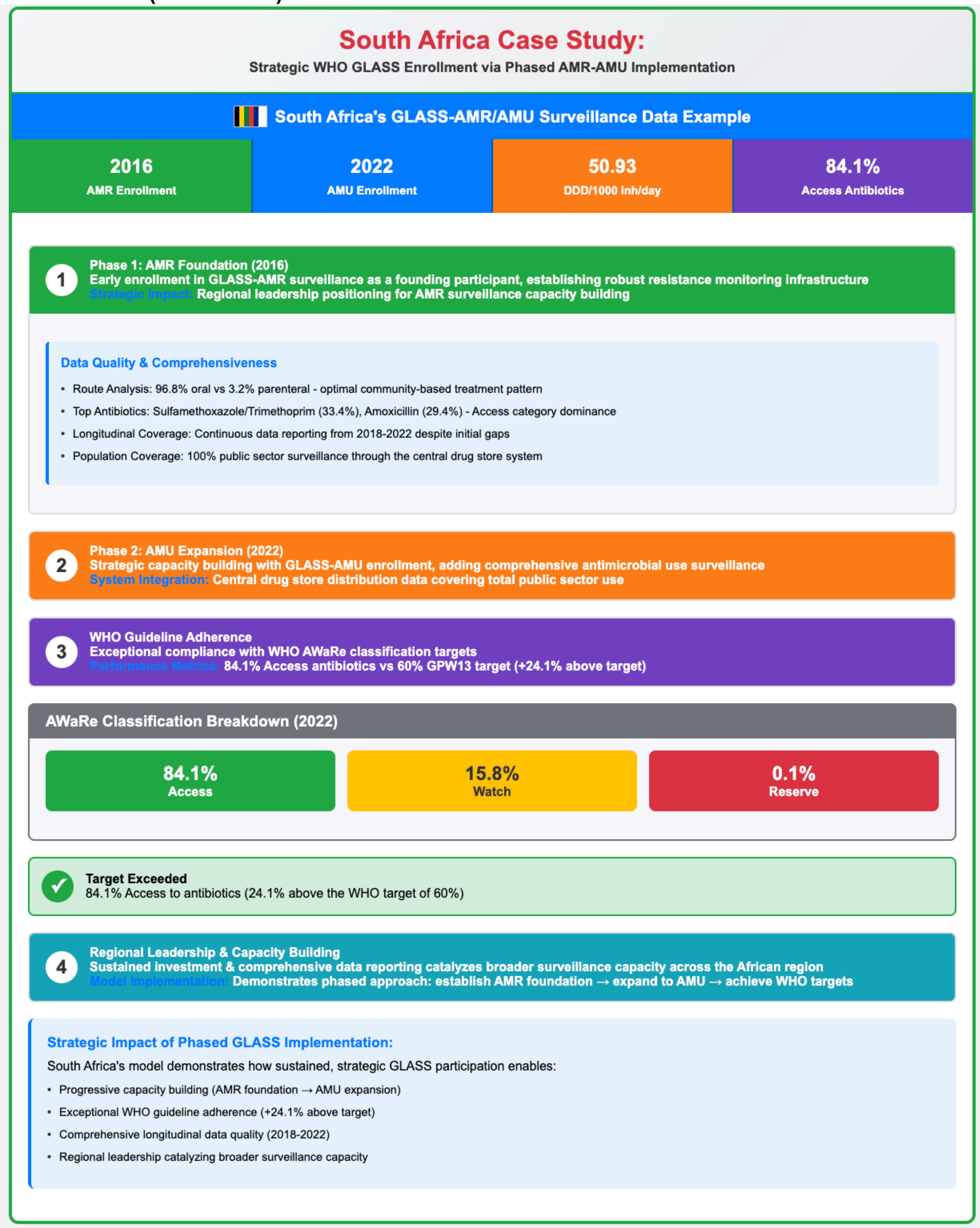
6.1. Case Study Examples of Country Engagement with GLASS

Understanding country engagement with the WHO Global Antimicrobial Resistance and Use Surveillance System (GLASS) requires more than simply noting enrolment dates. Participation involves the submission of surveillance data on priority pathogens from defined specimen types (e.g., blood, urine) collected from sentinel sites such as hospitals. However, the extent and quality of data contributed vary significantly. Some countries report only a limited number of pathogens or data from a small subset of healthcare facilities, often tertiary care or intensive care units (ICUs), which can introduce sampling bias and limit the representativeness of national-level AMR trends. For data to meaningfully inform clinical and public health decision-making, broader sampling across geographic regions, facility types, and population demographics is essential.

South Africa exemplifies the impact of early and sustained GLASS participation, having enrolled in GLASS-AMR surveillance in 2016 as one of the founding participants, followed by GLASS-AMU enrolment in 2022. This phased approach demonstrates strategic capacity building, with the country first establishing robust antimicrobial resistance monitoring before expanding to comprehensive surveillance of antimicrobial use. By 2022, South Africa was reporting detailed antimicrobial consumption data covering 50.93 DDD per 1,000 inhabitants per day, with particularly strong adherence to WHO guidelines showing 84.1 percent Access to antibiotics usage against the 60 percent GPW13 target. The country's comprehensive data spans multiple antibiotic classes, with detailed breakdowns by route of administration (96.8 percent oral, 3.2 percent parenteral) and specific substance monitoring, including the top-used antibiotics like Sulfamethoxazole and trimethoprim (33.4 percent) and Amoxicillin (29.4

percent). This longitudinal data contribution from 2018-2022, despite initial data gaps in 2016-2017, illustrates how sustained investment and regional leadership can catalyze broader surveillance capacity while maintaining data quality and comprehensiveness over time (Figure 8).

Figure 8
South Africa Case Study: Strategic Phased Implementation of WHO GLASS-AMR/AMU Surveillance (2016–2022)



India, which joined GLASS in 2017, offers a compelling case of scale and institutional commitment. In 2022 alone, India reported 43,929 bloodstream infection samples from 113 hospitals, alongside 30,613 *E. coli* isolates tested (see Figure 1). These contributions represent significant engagement, but also highlight common challenges: most data originate from large urban hospitals, often intensive care units (ICUs), which may not fully reflect the broader community burden. For instance, E. coli resistance to third-generation cephalosporins exceeded 80 percent, but without data from community and rural settings, this may not present a complete national picture.

These country experiences highlight the importance of assessing not only whether a country participates in GLASS but also the scope, quality, and representativeness of their data. To reduce bias, GLASS encourages expansion of sentinel sites beyond ICUs, diversification of specimen types, and disaggregated reporting by patient demographics. Strengthening data completeness and geographical coverage is critical to ensuring surveillance findings are accurate and applicable to broader clinical and public health contexts. Looking ahead, tailored technical support and regional collaboration will be key to strengthening GLASS engagement across South Centre Member States and mitigating disruptions from future health emergencies.

7. KEY CONSIDERATIONS AND FUTURE TRENDS IN STRENGTHENING AMR SURVEILLANCE AND STEWARDSHIP

7.1. Closing the Data Gap: Strategies and Priorities

The persistent data gap in AMR surveillance and AMU monitoring remains one of the most critical challenges facing South Centre Member States. As evidenced by the enrolment patterns in WHO GLASS, with only 60 percent of countries participating in AMR surveillance and 38 percent in AMU monitoring, substantial work remains to achieve comprehensive coverage. Bridging this gap requires multifaceted strategies prioritizing both technological solutions and governance frameworks. Strategic prioritization is essential, as countries cannot immediately implement comprehensive surveillance across all healthcare facilities, pathogens, and antimicrobials. A phased approach focusing initially on high-priority pathogens and sentinel sites can generate valuable data while building capacity for expansion. The WHO AWaRe (Access, Watch, Reserve) framework offers a practical structure for prioritizing which antimicrobials to monitor first, enabling countries to focus limited resources on tracking agents with the greatest public health significance.[41]

7.2. Strengthening National Capacity

Building human capacity represents the foundation for sustainable surveillance systems. The current shortage of trained microbiologists, laboratory technicians, infection control specialists, and health informaticians in many South Centre Member States directly limits surveillance capabilities. Long-term solutions must include expanding specialized training programs and creating career pathways that retain skilled personnel within public health systems. Regional Centres of Excellence offer promising models for accelerating capacity building through shared resources and expertise. The successful implementation of regional reference laboratories in East Africa has demonstrated how collaborative approaches can extend specialized microbiology services beyond national capabilities. These centres can provide advanced training, quality assurance, and specialized testing services that would be unfeasible for individual countries to establish independently.[42]

South-South knowledge transfer initiatives have proven particularly effective, as they facilitate sharing of implementation experiences from similar resource contexts. Brazil's mentorship program for Latin American countries and South Africa's technical support for neighbouring nations illustrate how regional leaders can accelerate capacity development through structured knowledge exchange. These approaches often prove more applicable to local conditions than models imported from high-income settings.[43] Importantly, capacity strengthening must extend beyond technical laboratory skills to include data analysis, interpretation, and translation into policy. Surveillance data collected without the capacity to analyze and utilize it remains undervalued. Training programs in data science, health economics, and policy analysis are

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[41] Arieti F, Göpel S, Sibani M, Carrara E, Pezzani MD, Murri R, et al. White Paper: Bridging the gap between surveillance data and antimicrobial stewardship in the outpatient sector—practical guidance from the JPIAMR ARCH and COMBACTE-MAGNET EPI-Net networks. Journal of Antimicrobial Chemotherapy. 2020 Dec;75(Supplement_2):ii42–51.

[42] Bello SA, Oyedele LO, Akinade OO, Bilal M, Davila Delgado JM, Akanbi LA, et al. Cloud computing in construction industry: Use cases, benefits and challenges. Automation in Construction [Internet]. 2020 Dec;122(1):103441. Available from: https://www.sciencedirect.com/science/article/pii/S0926580520310219.

[43] Group WB. South-South Knowledge Exchange Activities with Brazil - Links of Interest [Internet]. World Bank. World Bank Group; 2021 [cited 2025 Jun 17]. Available from: https://www.worldbank.org/en/country/brazil/brief/south-south-knowledge-exchange-activities-with-brazil-links-of-interest.

crucial for converting surveillance information into effective stewardship initiatives and policy reforms.

7.3. Health Systems Integration

The full potential of AMR surveillance can only be realized through integration with broader health information systems and clinical workflows. Standalone surveillance programs operating in isolation from routine healthcare delivery create additional burdens for healthcare workers and generate data that remains disconnected from clinical decision-making.

Successful integration approaches observed in South Centre Member States have leveraged existing health information infrastructure rather than creating parallel systems. Colombia's integration of AMR surveillance with its national notifiable disease reporting system illustrates how shared information architecture can reduce duplication while enhancing sustainability. Similarly, Thailand's incorporation of antimicrobial stewardship indicators into hospital accreditation requirements has embedded surveillance within existing quality improvement frameworks.[44] Integration extends beyond technical systems to include governance structures and funding mechanisms. Countries that have established multisectoral national AMR coordinating committees with clear lines of authority have demonstrated more sustained implementation of surveillance. These governance mechanisms ensure surveillance activities remain aligned with broader health system priorities and maintain political support despite competing health challenges.

7.4. Global Collaboration

Expanding surveillance coverage necessitates the inclusion of all healthcare delivery channels, including private sector providers, who deliver a significant portion of healthcare services in many South Centre Member States. Public-private partnerships (PPPs) can play a critical role in strengthening AMR surveillance by integrating private laboratories, hospitals, and pharmaceutical distributors into national surveillance systems, thereby improving data completeness and representativeness. For example, India’s national AMR surveillance network includes several private hospital groups, allowing for broader monitoring beyond the public sector.[45] However, given that private sector actors may prioritise profit, clear safeguards must underpin such partnerships.

These include robust regulatory oversight, data-sharing agreements aligned with public interest, transparency in reporting, and accountability mechanisms to ensure that surveillance efforts remain driven by public health priorities rather than commercial objectives. Global collaborations strengthen national surveillance systems by providing essential technical support, reference laboratory services, and external quality assessment. Partnerships with international technical agencies that provide specialized support for laboratory strengthening, data management, and quality assurance have facilitated the successful expansion of GLASS participation among South Centre Member States. These collaborations enable knowledge transfer while maintaining national ownership of surveillance programs.[46]

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[44] South Centre. Lessons from COVID-19: Strengthening Antimicrobial Stewardship Prior and During Pandemics [Internet]. Southcentre.int. 2025. Available from: https://www.southcentre.int/policy-brief-136-25-february-2025/.
[45] Derakhshani N, Rezapour R, Azami-Aghdash S, Nafar H, Soleimanpour S, Tahmazi Aghdam E, et al. Factors affecting private sector engagement in achieving universal health coverage: a scoping review. Global Health Action [Internet]. 2024;17(1):2375672. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC11249157/.
[46] Goodman C, Witter S, Hellowell M, Allen L, Srinivasan S, Nixon S, et al. Approaches, enablers and barriers to govern the private sector in health in low- and middle-income countries: a scoping review. BMJ Global Health. 2024 Oct;8(Suppl 5):e015771.

Funding partnerships that align global health security objectives with national health priorities plays a critical role in mobilising resources for AMR surveillance and stewardship. The collaboration between the Fleming Fund and the South Centre, spanning from July 2017 to March 2025 with a budget of £2.19 million, exemplifies how targeted international financing can catalyse capacity development while addressing shared global concerns.[47]

This partnership supports 12 South Centre Member States: Ghana, India, Indonesia, Pakistan, Malawi, Nigeria, Sri Lanka, Sierra Leone, Tanzania, Vietnam, Uganda, and Zimbabwe, by strengthening AMR governance, promoting One Health collaboration, and enabling civil society engagement. A key feature of this collaboration is the support of Civil Society Organisation (CSO)-led AMR advocacy projects, particularly during World AMR Awareness Week (WAAW). In 2024 alone, 27 projects across more than 20 countries reached over 3,000 individuals through direct training, healthcare worker education, school outreach, and AMR youth symposia, with many more engaged via radio, social media, and grassroots activities. These initiatives targeted diverse communities, including pastoralists, students, market vendors, and livestock farmers, empowering them as local AMR champions.[48]

Examples include Tanzania's Daladala Campaign, where minibuses carried AMR messages; Uganda's village health team training on diagnostics and stewardship; Nigeria's multi-state youth-led campaigns, which reached over 7 million people; India's One Health Clubs for youth in tribal regions; and Ghana's diagnostic stewardship workshops for clinicians and lab staff. These community-driven efforts focus on sustainable behaviour change and system-wide engagement, offering a scalable model for AMR awareness, especially in resource-constrained settings. By centring equity, youth engagement, and local ownership, the Fleming Fund–South Centre partnership provides a compelling model for future investments in surveillance and stewardship.

7.5. One Health Approaches to Surveillance

The interconnected nature of AMR across human, animal, environmental, and food domains necessitates surveillance systems that capture this complexity. The current predominance of human healthcare surveillance, with limited integration of veterinary, agricultural, or environmental monitoring, represents a significant limitation in understanding and addressing AMR dynamics.

Emerging One Health surveillance models in LMICs demonstrate practical approaches to cross-sectoral integration. Examples of such initiatives in Kenya have identified previously unrecognised linkages between antimicrobial use in agriculture and resistance patterns in human infections. Digital platforms that enable data sharing across sectoral surveillance systems, while maintaining appropriate governance and privacy protections—are essential for operationalising One Health approaches.

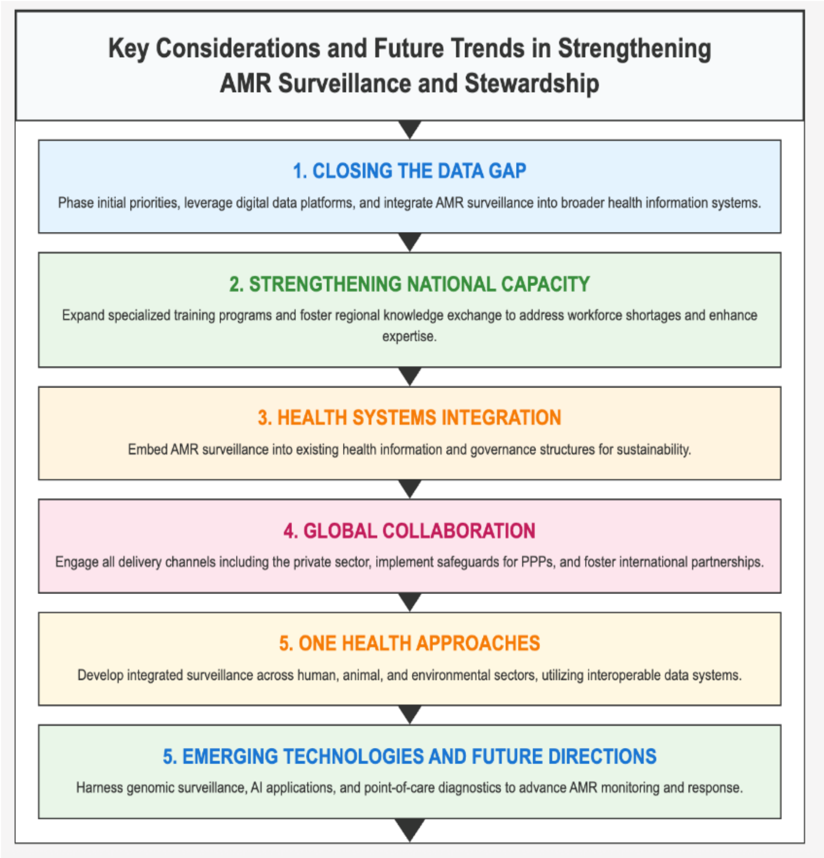
Interoperable databases that allow integrated analysis of human, animal, and environmental data without requiring full system integration represent practical near-term solutions for countries with established sectoral surveillance programs.

Figure 9 presents a flow diagram outlining key considerations and future trends for strengthening AMR surveillance and stewardship. It highlights a phased strategy beginning with closing the data gap through digital platforms, followed by strengthening national capacity, integrating surveillance into health systems, promoting global collaboration, adopting One

[47] The South Centre - Fleming Fund [Internet]. Fleming Fund. 2019 [cited 2025 Jun 17]. Available from: https://www.flemingfund.org/organisations/the-south-centre/.
[48] The South Centre | South Centre Report, March 2025 [Internet]. Southcentre.int. 2025 [cited 2025 Jun 17]. Available from: https://www.southcentre.int/south-centre-report-march-2025/.

Health approaches, and leveraging emerging technologies. These elements collectively support sustainable, data-driven AMR responses aligned with broader health system goals.

Figure 9. Flow Diagram of Key Considerations and Future Trends to Strengthen AMR Surveillance and Stewardship for Closing the Data Gap.



8. CONCLUSION

This research paper on the participation of South Centre Member States in the WHO Global GLASS highlights both progress and persistent gaps in global AMR surveillance efforts. While approximately 60 percent of South Centre Member States are enrolled in GLASS for AMR surveillance, only 38 percent have established AMU monitoring systems. These figures indicate that, despite growing engagement, significant disparities remain in the comprehensiveness of national surveillance capacities, particularly in tracking AMU, a critical component of effective stewardship. This surveillance gap fundamentally limits the ability to design evidence-based interventions to address emerging resistance patterns effectively.

The COVID-19 pandemic created a paradoxical impact on surveillance efforts, disrupting AMR monitoring while simultaneously highlighting its vital importance. The dramatic decline in AMR surveillance enrolment during 2020-2021 exposed the vulnerability of these systems to competing health priorities and resource constraints. However, the parallel increase in AMU surveillance participation during the same period suggests a growing recognition of the value of consumption monitoring, particularly as pandemic-related antimicrobial use raised concerns about accelerated resistance development.

Digital innovations have emerged as transformative enablers for surveillance and stewardship in resource-limited settings. Mobile reporting applications, cloud-based data management systems, and interactive dashboards now allow countries to implement functional surveillance despite infrastructure limitations. These technologies democratize participation in global monitoring networks, enabling facilities with minimal laboratory capacity to contribute meaningful data while enhancing the timeliness and utility of resistance information for clinical decision-making.

The disparities between AMR and AMU surveillance implementation underscore the need for targeted capacity building that addresses the specific technical and governance challenges associated with consumption monitoring. Countries require not only laboratory strengthening but also enhanced pharmaceutical information systems, prescribing oversight mechanisms, and regulatory frameworks governing antimicrobial access. Without these complementary capabilities, the surveillance ecosystem remains incomplete, limiting the actionable insights available to guide stewardship interventions.

For South Centre Member States, several priority actions emerge from this analysis. First, countries should develop integrated national AMR action plans that explicitly connect surveillance capabilities with stewardship implementation, ensuring that data collection directly informs clinical practice improvement. Second, digital infrastructure investments should prioritize interoperable systems that can serve multiple health information needs while accommodating resource constraints. Third, regional collaboration mechanisms should be strengthened to leverage shared expertise, particularly for advanced laboratory services, quality assurance, and workforce development.

The international community must respond with sustained, coordinated support for these efforts. Bilateral and multilateral partners should align technical assistance with national priorities rather than imposing externally driven surveillance models that may not reflect local realities. Financial support should emphasize sustainable system development over project-based interventions that create temporary capabilities without lasting impact. Most importantly, knowledge exchange should be facilitated across South Centre Member States to promote context-appropriate innovations and implementation strategies.

Future research priorities should include implementation science studies examining which surveillance and stewardship models function most effectively in resource-limited settings. Operational research on integrating digital innovations into existing health information ecosystems would provide valuable guidance for countries seeking to modernize their monitoring capabilities. Economic analyses quantifying both the costs of surveillance implementation and the benefits of resistance prevention would strengthen the investment case for these essential systems.

The global challenge of antimicrobial resistance demands collective action across national boundaries and sectors. South Centre Member States, representing a significant proportion of the world's population and a diverse range of health system contexts, have a crucial role in advancing surveillance and stewardship practices adapted to resource-limited settings. By embracing digital innovation, strengthening collaborative networks, and integrating AMR within broader health system priorities, these nations can develop resilient monitoring capabilities that protect both national populations and global health security. Ultimately, our research highlights that effective AMR surveillance and stewardship are not merely technical challenges but fundamental components of equitable global health governance.

Ensuring that all countries—regardless of resource constraints—can participate meaningfully in monitoring and addressing this threat is essential for preserving antimicrobial effectiveness for future generations. The path forward requires sustained commitment, innovative approaches, and genuine partnership between South Centre nations and the broader global health community.

APPENDIX 1

Timeline of AMR and AMU Reporting by South Centre Member States Before and During 2020

		South Centre Countries	Before 2020	During 2020
1		Benin		2020 AMR , 2021 AMU
2		Brazil	2017 - AMR	
3		Burundi		2020, 2022 AMU
4		Cambodia	2016 - AMR	
5		Colombia		2021 AMR - AMU
6		Côte d'Ivoire	2019 - AMR + AMU	
7		Democratic People's Republic of Korea	2018 - AMR	
8		Egypt	2016 - AMR	2020 - AMU
9		Gabon	2018 - AMU - 2019 - AMR	
10		Ghana	2019 - AMR	
11		India	2017 - AMR	
12		Indonesia	2019 - AMR - 2020 - AMU	
13		Iran (Islamic Republic of)	2016 - AMR -	2020 - AMU
14		Iraq	2017 - AMR - 2019 - AMU	
15		Jordan	2017 - AMR	2020 - AMU
16		Liberia	2018 - AMR	
17		Malawi	2017 - AMR	
18		Malaysia	2018 - AMR	2023 - AMU
19		Mali	2018 - AMR - 2019 - AMU	
20		Mauritius	2018 0 AMR	
21		Morocco		2020 - AMR
22		Mozambique	2017 - AMR	
23		Namibia		2020 - AMR
24		Nigeria	2017 - AMR	
25		Pakistan	2017 - AMR	2022 - AMU
26		Philippines	2016 - AMR	
27		Sierra Leone		2021 - AMR - AMU
28		South Africa	2016 - AMR	2022 - AMU
29		Sri Lanka	2018 - AMR	
30		Sudan	2018 - AMR	2022 - AMU
31		Uganda	2016 - AMR	2021 - AMU
32		United Republic of Tanzania	2019 - AMR	2020 - AMU
33		Viet Nam		2021 - AMR - 2022 - AMU
34		Zimbabwe	2016 - AMR	

AMR: Antimicrobial Resistance Surveillance; AMU: Antimicrobial Use Surveillance.

Footnote: Out of 55 South Centre Member States, GLASS reporting data were available for 34 countries at the time of analysis. Countries without entries had not submitted AMR/AMU data to GLASS during the period reviewed

ANNEX 1 - METHODOLOGY

Research Design and Approach

This study employed a cross-sectional descriptive research design to evaluate the participation of South Centre member countries in the WHO Global Antimicrobial Resistance and Use Surveillance System. The research framework was structured around quantitative analysis of surveillance enrolment data, complemented by qualitative assessment of participation patterns and barriers. This mixed-methods approach allowed for both statistical characterization of engagement levels and contextual interpretation of underlying factors influencing participation decisions. The study focused specifically on the 55 member states of the South Centre, examining their representation within global AMR and AMU surveillance frameworks to identify patterns, gaps, and opportunities for enhanced engagement.

Data Collection Methods

Data collection was conducted on November 18, 2024, during World Antimicrobial Awareness Week, providing timely insights aligned with global AMR advocacy efforts. Primary data were extracted from the publicly available WHO GLASS digital dashboard, which serves as the official repository for country participation records and surveillance statistics. The dashboard provided comprehensive information on country enrolment status, year of registration, types of surveillance modules implemented (AMR and/or AMU), and consistency of data submission.[11] For each South Centre member country, we documented:

1. Enrolment status in the GLASS platform (enrolled/not enrolled)
2. Year of initial registration with GLASS
3. Participation in AMR surveillance modules
4. Participation in AMU surveillance modules

This information was systematically organized in a standardized Excel spreadsheet, with individual country profiles created to document the longitudinal history of engagement with GLASS from its inception in 2015 through November 2024 (Appendix 1).

To ensure data accuracy, cross-verification was performed using the WHO GLASS Annual Reports for 2022-2023 and 2023-2024, resolving any discrepancies through reference to official WHO country participation records.

Analytical Framework and Statistical Methods

The analytical framework employed descriptive statistics to characterize patterns of participation across geographical regions, economic development categories, and time periods. Key metrics included:

- Proportion of South Centre Member States enrolled in GLASS
- Temporal trends in enrolment (annual new registrations from 2016-2024)
- Comparative analysis of AMR versus AMU surveillance participation
- Pre-pandemic versus post-pandemic enrolment patterns
- Provide a case study country example of data generated from GLASS

Data visualization was performed using Microsoft Excel and SPSS to generate graphical representations of enrolment trends, geographical distribution of participating countries, and comparative analyses.

Limitations of the Study

Several limitations should be considered when interpreting the findings of this research. First, GLASS enrolment status alone does not necessarily reflect the quality, comprehensiveness, or sustainability of national surveillance activities. Countries may be formally enrolled but experience challenges in consistently collecting and reporting high-quality data. Conversely, nations not enrolled in GLASS may maintain robust national surveillance systems that do not interface with the global platform.

Second, the analysis relies on publicly available data from the WHO GLASS dashboard, which may have experienced reporting lags or updates pending at the time of data collection. The cross-sectional nature of the study also limits longitudinal insights into changing patterns of engagement over extended periods.

Third, the research does not comprehensively assess the multiple technical, financial, and political factors influencing countries' decisions regarding GLASS participation. A more nuanced understanding of these determinants would require dedicated qualitative research involving stakeholder interviews and country case studies, which fell outside the scope of the current analysis.

Finally, the study's focus on formal GLASS participation may not capture alternative regional or sub-regional surveillance networks that contribute to AMR monitoring but operate outside the WHO framework. Despite these limitations, the findings provide valuable insights into current patterns of global surveillance engagement among South Centre nations and establish a baseline for future research and policy development.

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