Article

Not peer-reviewed version

Impact of Antimicrobial Resistance on UN Sustainable Development Goal 3 Targets in Lower-Middle Income Countries: A Scoping Review

Nirmal Malik *

Posted Date: 24 January 2025

doi: 10.20944/preprints202501.1731.v1

Keywords: sustainable developmental goals; antimicrobial resistance; lower-middle income countries; antibiotics

Article

Impact of Antimicrobial Resistance on UN Sustainable Development Goal 3 Targets in Lower-Middle Income Countries: A Scoping Review

Nirmal Malik

Punjab University College of Pharmacy, Faculty of Pharmacy, University of the Punjab, Lahore, 54590, Pakistan; drnirmalmalik9@gmail.com

Abstract: Background: The United Nations Sustainable Development Goals (UN SDGs) are designed to be achieved by the year 2030, however, inadequate policies and lack of proper implementation of practices to control Antimicrobial Resistance (AMR) has led to the failure of these SDG 3 targets. The targets and the control parameters align with each other as both pose the same challenges to the health sector by increasing morbidity and mortality and making sustainable development impossible. The aim of the study is to directly address the scope of literature available on the effect of AMR on UN SDG 3 targets. Methods: Free-access database with advanced search strategy for peer-reviewed literature and official websites are used to include six full-text publications following Cochrane guidelines for scoping review. The searches are conducted in January 2025; and results from 2015 to 2025 are considered. Results are filtered and extracted for relevant data, and was the identification and screening process was charted using a flow diagram. Results: A total of 543 results are identified from PubMed search, 3 from PubMed Advanced Search and 5 from organization websites. These are narrowed down after rigorous screening and filtration to include 6 publications in total, both from peer-reviewed journals and grey literature. The comparison of SDG 3 targets with AMR shows eight targets (3.1, 3.2, 3.3, 3.4, 3.6 ,3.7 ,3.8, and 3.B), are directly or indirectly impacted by AMR. The interface of AMR and SDG 3 targets presents overlapping challenges, calling for improved policies to curb AMR and encourage SDG 3 target related efforts. Conclusion: The scoping review sums up the extent and nature of available data on this aspect. This provides a comprehensive insight into the evidence of the current status of SDG 3 targets in relation to AMR, highlighting the need of further research and policy amendments.

Keywords: sustainable developmental goals; antimicrobial resistance; lower-middle income countries; antibiotics

Introduction:

At the 2015 United Nations World Summit, an agenda was set forth to establish 17 Sustainable Development Goals (SDGs), which officially came into effect on January 1, 2016. Among these, SDG 3, titled "Good Health and Well-being," is subdivided into nine targets and four means of implementation, all of which are strongly supported by the World Health Organization (WHO).(1) A critical challenge to achieving SDG 3 is the growing threat of Antimicrobial Resistance (AMR), particularly in low- and lower-middle-income countries. AMR impedes the attainment of optimal health outcomes due to the increasing scarcity of effective antibiotic treatments. (2)

The SDGs are designed to be achieved by 2030, but current analyses reveal insufficient progress, especially concerning SDG 3 in lower-middle-income countries. Like many other global health goals, SDG 3 faces significant obstacles, with AMR being a prominent one. AMR has severely hindered health outcomes across various sectors, including trauma care, infectious disease management, and maternal health. Without curbing the rise of resistant microbial strains and discovering new antibiotics, achieving SDG 3 remains an uphill battle.(3)

 doi:10.20944/preprints202501.1731.v1

In the context of SDG 3, AMR has a profoundly negative impact on global health, contributing to prolonged hospital stays, increased healthcare costs, failed treatment protocols, and escalating health complications.(4) The misuse of antibiotics has led to a reduction in effective treatment options and a rise in morbidity and mortality rates. According to the literature, AMR is responsible for 4.3 million deaths every year in the Lower-Middle Income Countries.(5) The rapid spread of resistance has worsened outcomes in even the simplest cases, as existing antibiotics become less effective. While higher- and middle-income countries have established comprehensive protocols to combat AMR, lower- and lower-middle-income countries struggle with practical implementation, despite having national action plans. There are staunch policies in place, especially in the hospital sectors in most LMICs, but the remaining sectors including the agricultural, industrial, and research sector, present either no plan of action, or very unmeticulous steps, that make no difference.(6)

Current literature shows that AMR is rapidly undermining sustainable development, driven by both human and non-human sources of antimicrobial misuse. This is not an issue that any single country can address alone. The Global One Health Index for AMR (GOHI-AMR) stands at an alarming 38.45, based on data from 146 countries. This figure poses a significant threat to health sector development and hampers progress toward seven of the SDGs, with AMR having direct or indirect implications for each.(7) In response, the United Nations, in collaboration with the WHO, has developed a set of policies and agendas for implementation across member states to combat AMR and ensure progress toward the SDGs.(8)

A study that focuses on data from high-income countries, specifically European countries suggest the growing rate of AMR related mortality (approximately 500,000 deaths) and financial costs of 100 billion US dollars by the year 2050, if the AMR implications remain uncontrolled.(9) Interestingly, while existing data link AMR to all 17 SDGs, a focused literature review specifically addressing the targets of SDG 3 in relation to AMR has yet to be published. Addressing AMR is particularly crucial in lower-middle-income countries, where the challenges of meeting SDG goals are more pronounced.(10)

The aim of this scoping review is to thoroughly assess the progress made in achieving Sustainable Development Goal 3 (SDG 3) in the context of the escalating issue of Antimicrobial Resistance (AMR) in Lower-Middle Income Countries (LMICs). Ultimately, this review will provide a comprehensive understanding of the urgent need to combat AMR in lower-middle-income countries to achieve the health and well-being targets set by the UN SDGs.

Methodology

Study Design

This study employs a scoping review in accordance with Cochrane Guidelines(11) due to lack of prior comprehensive review on this topic and to provide a broad overview of the available heterogenous data on this critical global health issue. The review maps the existing literature to offer a comprehensive understanding of the challenges related to achieving SDG 3 targets in the context of AMR in LMICs.

Literature Search Strategy

The words (sustainable development goal) and (antimicrobial resistance) are used as the search string to obtain results related to the various targets of SDG 3. The search strings and limits applied are shown in Table 1. The same words were used to find grey literature from official WHO and UN SDGs website.

Table 1. Search strings and limits applied for data search on PubMed.

 doi:10.20944/preprints202501.1731.v1

Search String 1 (PubMed)	Effect of Antimicrobial Resistance on Sustainable Development Goals
Search String 2 for advanced search (PubMed Advanced Search)	(sustainable development goal) AND (antimicrobial resistance)
Limits	Title/Abstract
Filters	Year: 2015 – 2025, Language: English only, Articles: Full-text articles excluding preprints

Inclusion and Exclusion Criteria

Studies are sourced from peer-reviewed open-access journals using a comprehensive search strategy. The databases PubMed and PubMed Advanced Search, are utilized for peer-review literature, and WHO and United Nations SDGs website is used to include research reports and official publications for grey literature, with a focus on publications from 2015 onward. The search targets data relevant to SDG 3, specifically "Good Health and Well-being," in LMICs. Studies not addressing AMR or conducted in high-income or upper-middle-income countries are excluded, and only full-text articles in English are considered to avoid ambiguities due to language barriers. The selection process of the studies is elaborated in Figure 1.

Results

After applying the search strategy, 543 articles were initially identified from PubMed search. On applying the search string in PubMed Advanced Search, 3 articles were identified, and another 5 articles were identified from the official websites of WHO and UN SDGs as grey literature. Following the removal of duplicates and a relevancy screening, a total of 6 articles, i.e., 3 articles (n=3) from PubMed Advanced Search, 2 articles (n = 2) from PubMed search, and 1 other article from grey literature were included in the final analysis. The results comprise of a case study, a research report, reviews, and commentaries, and are published in peer-reviewed journals and on official websites. These articles provide data not only for LMICs, but also in general from all around the world.

 doi:10.20944/preprints202501.1731.v1

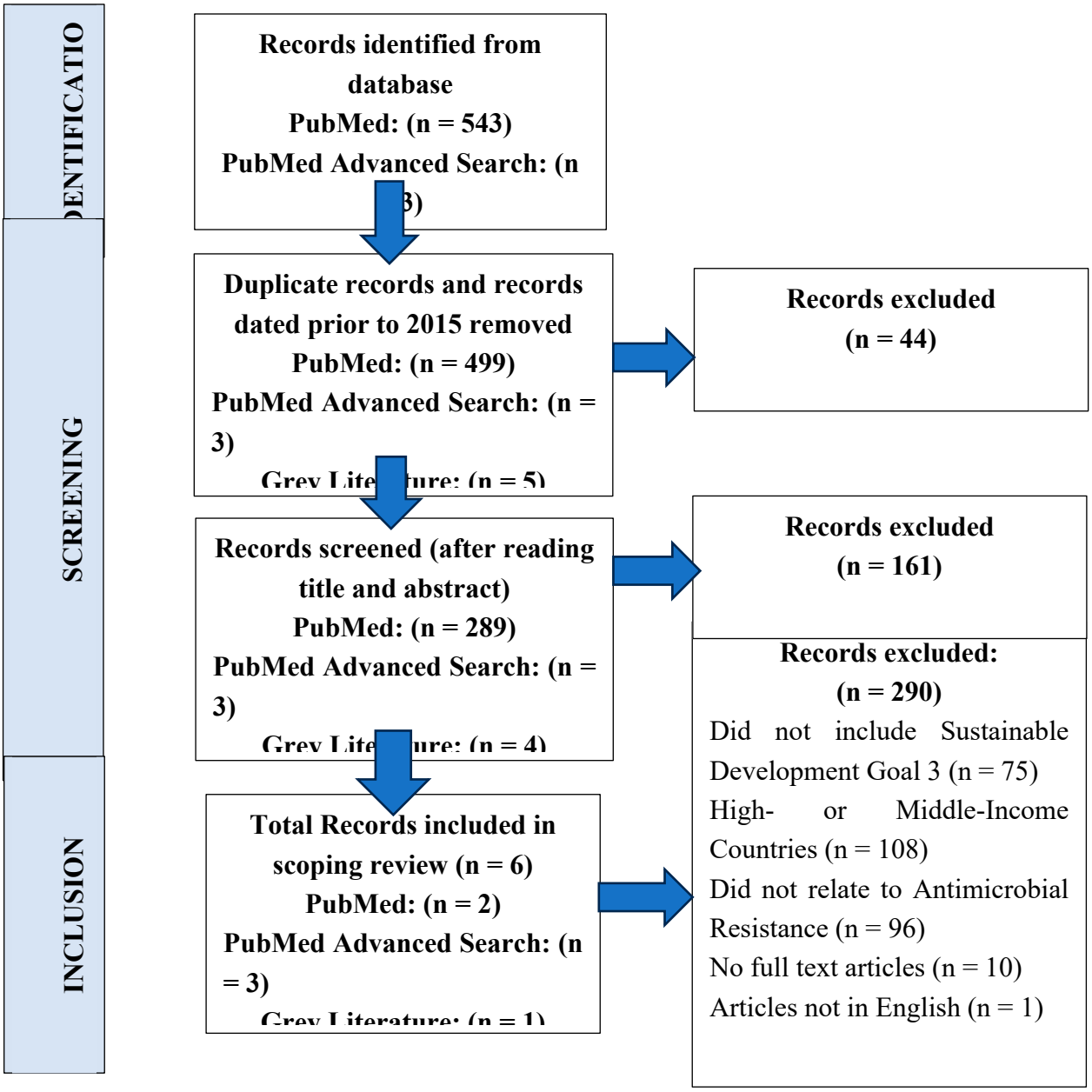

Figure 1. Flow diagram depicting the articles identified, screened and excluded for the scoping review data.

The articles finally considered in the scoping review are utilized to understand the data for the implications of AMR on the progress of Sustainable Development Goal 3. In order to understand the impact, the titles of SDG 3 targets and their relation with AMR are explicitly enlisted in Table 2.

Table 2. Titles of the targets of Sustainable Development Goal 3 that relate with AMR.

No. of SDG 3 Targets	SDG 3 Target Title	Relation with AMR
Target 3.1	Reduce Maternal Mortality	Increases maternal death rates by making infections harder to treat, leading to severe complications and treatment failures.

 doi:10.20944/preprints202501.1731.v1

Target 3.2	End all Preventable Deaths under 5 Years of Age	Makes common childhood infections, like pneumonia and diarrhea, harder to treat, leading to higher mortality rates in young children.
Target 3.3	Fight Communicable Diseases	Reduces the effectiveness of antimicrobial drugs, making it more difficult to manage infections, control outbreaks, and prevent the spread of resistant pathogens.
Target 3.4	Reduce Mortality from Non-Communicable Diseases and Promote Mental Health	Impedes the treatment of Non-Communicable Diseases like organ transplant and cancer during pre- and post-therapy antibiotic administrations.
Target 3.5	Prevent and Treat Substance Abuse	N/A
Target 3.6	Reduce Road Injuries and Deaths	Limiting the effectiveness of antibiotic therapy leading to longer recovery times and higher mortality rates.
Target 3.7	Universal Access to Sexual and Reproductive Care, Family Planning and Education	Increases the incidence of Sexually Transmitted Diseases, perinatal and postnatal infections and deaths.
Target 3.8	Achieve Universal Health Coverage	Increases the complexity and cost of treating infections, straining healthcare systems, and limiting access to effective treatments.
Target 3.9	Reduce Illness and Death from Hazardous Chemicals and Pollution	N/A
Target 3.A	Implement the WHO Framework Convention on Tobacco Control	N/A
Target 3.B	Support Research, Development and Universal Access to Affordable Vaccines and Medicines	Diverts resources and research efforts toward combating resistance, potentially slowing the development of new medicines and vaccines.
Target 3.C	Increase Health Financing and Support Health Workforce in Developing Countries	N/A

Abbreviations: SDG = Sustainable Development Goal, AMR = Antimicrobial Resistance, WHO = World Health Organization, N/A = Not Applicable (Not related to AMR directly or indirectly).

The literature from full-text articles shows a comparison of various SDGs with AMR, however SDG 3: Good Health and Well-being is not assessed individually for its progress under the impact of AMR. Table 3. depicts the characteristics of published findings with the context of all relevant SDGs in relation to AMR that are affected directly or indirectly.

Table 3. Findings from free full-text articles, highlighting the initiatives for AMR across various Sustainable Development Goals.

 doi:10.20944/preprints202501.1731.v1

Study title	Authors (Year)	Study design	SDGs discussed	SDG 3 findings
Antimicrobial Resistance in the Context of the Sustainable Development Goals: A Brief Review	Gajdács, M., Urbán, E., Stájer, A., & Baráth, Z. (2021).	A perspective and a non-systematic review of the peer-reviewed and grey Literature	SDG 1, 2, 3, 6, 8, 10, 12, 13, 17	SDG 3 is only achievable when disadvantageous developments in antimicrobial resistance and related death toll issues are addressed.
AMR and Sustainable Development Goals: at a crossroads	Aslam, B., Asghar, R., Muzammil, S., Shafique, M., Siddique, A. B., Khurshid, M., ... & Baloch, Z. (2024).	A review including peer-reviewed research that addresses pre-formulated research questions	SDG 1, 2, 3, 6, 8, 10, 13, 17	Equitable health service provision and universal access to antimicrobial drugs is vital to achieving SDG 3.
Antimicrobial resistance—a threat to the world's sustainable development	Jasovský, D., Littmann, J., Zorzet, A., & Cars, O. (2016).	A detailed commentary based on peer-reviewed and grey literature	SDG 3, and 1, 2, 6, 8, 12, 17	Emergence of AMR not only poses a threat to universal health coverage, but also to the treatment of maternal and child health, communicable and non-communicable diseases.
Trade is central to achieving the sustainable development goals: a case study of antimicrobial resistance	Hanefeld, J., Khan, M., Tomson, G., & Smith, R. (2017).	A case study and analysis the importance of intelligence and resource trade for achieving SDGs	SDG 3, SDG 11, and SD 16	In the light of SDG 3, access to health goods and medical intellects across the borders is vital to achieving control over AMR.
Tackling antimicrobial resistance by integrating One Health and the Sustainable Development Goals	Ferdinand, A. S., Coppo, M. J., Howden, B. P., & Browning, G. F. (2023).	A detailed commentary on SDGs affected by AMR	SDG 2, 3,6,and 17	Supports One Health nature of AMR programs to incorporate SDG 3 and tackle challenges of these targets equitably around the globe.

 doi:10.20944/preprints202501.1731.v1

Progress and Info - Ensure healthy lives and promote well-being for all at all ages	World Health Organization	A website publication based on research to assess the progress of SDG 3	SDG 3	Assessment of the progress of all targets of SDG 3.
Antimicrobial resistance and the United Nations sustainable development cooperation framework: guidance for United Nations country teams	United Nations SDGs	An advocacy brief with editors from WHO, FAO, OIE, and UNEP	All 17 SDGs	Highlights two main SDG indicators for AMR and pinpoints the dependence of LMICs on out-of-pocket healthcare payments is linked to antimicrobial resistance (AMR).

Abbreviations: SDG = Sustainable Development Goal, AMR = Antimicrobial Resistance, LMIC = Lower-middle Income Countries, WHO = World Health Organization, FAO = Food and Agriculture Organization, OIE = World Organization for Animal Health, UNEP = UN Environment Program.

Discussion

There is not enough literature that shows the impact of AMR on the achievement and progress of SDG 3. Although AMR directly comes under the SDG 3: "Good Health and Well-being" as curbing the growing resistance guarantees the control of health-related morbidities and mortalities, the targets through which this goal must be attained have not yet been discussed in a peer-reviewed paper.(12) However, grey literature from the SDG website gives a comprehensive review on each target achievement and they can be cross-analyzed with the impact of AMR on them.(13)

The studies included in the review not only discuss SDG 3 but also several other SDGs as they relate with AMR. However, the targets of SDG 3 have never been discussed in relation with AMR till date. A study included in the review that assesses antimicrobial resistance in the context of Sustainable Development Goals shows that Self-Medication of Antibiotics (SMA) has a great deal of role in halting the progress of SDG 3 in LMICs. The reason is that LMICs have an SMA range of 7.3-81.3%, which is a maj0or factor in promoting resistance in antimicrobial agents, as compared to an SMA range of 1-66% in High Income Countries (HICs). This explains one of the reasons of slower progress of SDG3 in LMICs.(9) As the health disparities in LMICs are more frequently observed in the Covid and post-covid era, the misuse of antibiotics continues to grow and have substantially contributed to the challenges faced in achieving targets 3.A, 3.3, 3.6, 3.7, 3.8 and 3.B.(14) All these SDG 3 targets are directly affected by AMR, while the few remaining also show an indirect relationship with AMR as depicted in Table 2. The target 3.C of SDG3 specifically focuses on health financing in developing countries, however according to the reviewed study, AMR has a high financial burden in African and South Asian countries accounting for around 4 million to 4.5 million deaths per year and a financial cost of 10 million US dollars.(14, 15) These figures prominently highlight the gravity of the issue of AMR, emancipating why the United Nations had to address a health issue for the fourth time in history. It would not be surprising that the SDG 3 is not achieved if the AMR related mortality rates are not addressed.(16)

Another article explicitly described the implications of SDG 3 with targets 3.1, 3.3, and 3.8 explained in relation to AMR. Antibiotics play a pivotal role in maternal and child health, which is mentioned as a life-saving agent in Every Women Every Child Initiative. Neonatal sepsis and child mortality has been significantly increased with AMR, along with a surge in other communicable

 doi:10.20944/preprints202501.1731.v1

diseases like HIV, hepatitis, STIs, Tuberculosis. Patients suffering from non-communicable diseases are also being equally affected due to resistant strains of bacteria making pre-treatment and post-treatment antibiotic therapies ineffective. Lastly, the Universal Health Coverage is totally unachievable without the control of AMR as resistance to antibiotics stops the management of disease control, prevention, and treatment, and also stops the access to effective medicines.(17)

The use antibiotics is extremely high in both LMICs and HICs, as mentioned in the included articles. However, its use in LMICs, especially Tunisia and Algeria, is reported to be the highest in the year 2015. The use is expected to rise again by the year 2030, where the surge of antibiotic use can become uncontrollable if the stewardship programs are rendered ineffective. The current scenario of AMR in LMICs calls for a complete network to network collaboration in the form of "Next Generation AMR Networks" forming nodes within various regions around the globe. to exchange trained researchers and develop multidisciplinary partnerships.(17) Studies in the current literature support "One Health Approach" to tackle AMR while moving forward with SDGs. Strategic investments in public health sector are the likely solution to counter AMR, especially in LMICs, where the health sector needs utmost attention from the government and global health bodies.(18) Another study shows that trade is central to the explanation of the AMR issue, as it threats the progress of SDG 3. The study supports the trade of healthcare intellect, health goods, services and medicines, which will ultimately create a rotation of trained and well-educated professionals and encourage adoption of better practices to fight against AMR.(19)

The SDG 3 targets 3.1, 3.3 and 3.8 are the most discussed targets in the limited literature published relevant to AMR so far. Fight against communicable and non-communicable diseases, maternal and child health and universal health coverage are the targets most directly linked to AMR.(20) However, there are also other targets that have direct as well as indirect link to AMR which cannot be ignored when assessing the status of SDG 3 achievement, as mentioned in the Table 2. LMICs need a deeper analysis in this context as the sustainable development projects in these countries lack focus on AMR. They have a limited number of resources, health inequity, health services disparities, and inadequate health policies, which have an immense impact on the failure of health policy development and ultimately the failure of SDG 3 progress in these countries.(21) Antimicrobial Stewardship programs and National Action Plans on Infection Control and Prevention are already in place in some LMICs, however there is negligible implementation and follow-up on these policies, making the negative contribution of AMR a significant challenge for SDG 3 targets.(22)

As SDGs are to be achieved by the year 2030, the resistance in microbes is making the antibiotics ineffective, halting the overall progress, especially in the lower-middle income countries. A detailed analysis of each target of SDG 3 under the impact of AMR is important to assess how it is impeding the overall achievement of SDGs. Each of these targets must be analyzed in the high-income countries and the lower-middle income countries separately, as the resources and governmental planning and policies vary widely in the two classes.(23)

Strengths and Limitations

This scoping review has important methodological strengths. The comprehensive search strategy allowed the review to clarify the type of documents available, the extent of the literature, and its nature. Extensive peer-reviewed searches reduced the likelihood of missing any crucial data, while the grey literature searches reduced the risk of publication bias and increased the comprehensiveness of the review. Another strength is that the review brings forth a large research gap as the implications of AMR not only needs to be analyzed on all the targets of SDG 3, but also need a special focus on LMICs separately for better assessment of SDG 3 progress in the near future.

This review does have some methodological shortcomings, such as grey literature searches that focus on reports written in English. Due to lack of literature, the literature revolves around SDGs overall and also highlights the impact of AMR on both lower-middle as well as high income countries. This leaves space for human error in skimming highly selective text for the review. The websites of WHO and UN SDGs are the only hunted websites for in this review, but other websites of

 doi:10.20944/preprints202501.1731.v1

governmental bodies of LMICs and global non-governmental bodies should be considered to obtain better results

The review is more focused on representing the current literature available in the context of the review topic, rather than on the synthesis of the results as the goal is to highlight the need of further research in this aspect. Also, the scope of this review is restricted to the implications of AMR in LMICs only. This can be extended in future research to study challenges, success and failures of SDG 3 targets in LMICs as well as HICs.

Conclusion

The scoping review has put forth important results related to the implications of AMR on SDG 3 and its targets. Only three main targets of SDGs are discussed in the current literature, while the remaining targets require further consideration on how AMR affects them directly or indirectly. AMR has profound effect on SDG 3 and the two form an interface with overlapping challenges and concerns. The literature considered in very less for further review and analysis, especially in LMICs, however this review has fulfilled its aim of gathering the relevant data, and determining the extent of available research in this context. Further research on this topic in LMICs is the gateway to encourage better policy making and sustainable development in the health sector.

Competing Interests: Not applicable

Authors' Contributions: Nirmal Malik: Conceptualization, Data Curation, Formal analysis, Methodology, Writing-the original draft, Writing- review & editing.

Funding: Not applicable

Acknowledgements: I want to dedicate this work to my mentor and my husband, Dr Abrar Ahmad, for his consistent support in completing this manuscript.

Ethics Approval and Consent to Participate: Not applicable

Consent for Publication: Not applicable

Availability of Data and Materials: All data generated or analyzed during this study are included in this published article.

References

1. Alleyne G, Beaglehole R, Bonita RJTL. Quantifying targets for the SDG health goal. 2015;385(9964):208-9.
2. Mantegazza L, De Pascali AM, Munoz O, Manes C, Scagliarini A, Capua IJFiC, et al. Circular Health: exploiting the SDG roadmap to fight AMR. 2023;13:1185673.
3. Kiggundu R, Lusaya E, Seni J, Waswa J, Kakooza F, Tjipura D, et al. Identifying and addressing challenges to antimicrobial use surveillance in the human health sector in low-and middle-income countries: experiences and lessons learned from Tanzania and Uganda. 2023;12(1):9.
4. Pokharel S, Raut S, Adhikari BJBgh. Tackling antimicrobial resistance in low-income and middle-income countries. BMJ Specialist Journals; 2019. p. e002104.
5. Lewnard JA, Charani E, Gleason A, Hsu LY, Khan WA, Karkey A, et al. Burden of bacterial antimicrobial resistance in low-income and middle-income countries avertible by existing interventions: an evidence review and modelling analysis. 2024;403(10442):2439-54.
6. 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. 2023;12(10):1504.
7. Zhou N, Cheng Z, Zhang X, Lv C, Guo C, Liu H, et al. Global antimicrobial resistance: a system-wide comprehensive investigation using the Global One Health Index. 2022;11(1):92.
8. Organization WH. Antimicrobial resistance and the United Nations sustainable development cooperation framework: Guidance for United Nations Country teams: World Health Organization; 2021.

 doi:10.20944/preprints202501.1731.v1

9. Gajdács M, Urbán E, Stájer A, Baráth ZJEJoIiH, Psychology, Education. Antimicrobial resistance in the context of the sustainable development goals: A brief review. 2021;11(1):71-82.
10. Shamas N, Stokle E, Ashiru-Oredope D, Wesangula EJIPiP. Challenges of implementing antimicrobial stewardship tools in Low to Middle Income Countries (LMICs). 2023;5(4):100315.
11. Armstrong R, Hall BJ, Doyle J, Waters EJJoph. 'Scoping the scope'of a cochrane review. 2011;33(1):147-50.
12. Tang KWK, Millar BC, Moore JEJBJoBS. Antimicrobial resistance (AMR). 2023;80:11387.
13. Sdg UJTeprTS. Sustainable development goals. 2019;7:805-14.
14. Mahida N, Winzor G, Wilkinson M, Jumaa P, Gray JJJoHI. Antimicrobial stewardship in the post COVID-19 pandemic era: an opportunity for renewed focus on controlling the threat of antimicrobial resistance. 2022;129:121-3.
15. Stenberg K, Hanssen O, Edejer TT-T, Bertram M, Brindley C, Meshreky A, et al. Financing transformative health systems towards achievement of the health Sustainable Development Goals: a model for projected resource needs in 67 low-income and middle-income countries. 2017;5(9):e875-e87.
16. Humphreys G, Fleck FJWHOBotWHO. United Nations meeting on antimicrobial resistance. 2016;94(9):638.
17. Jasovský D, Littmann J, Zorzet A, Cars OJUjoms. Antimicrobial resistance—a threat to the world's sustainable development. 2016;121(3):159-64.
18. Ferdinand A, Coppo M, Howden B, Browning G. Tackling antimicrobial resistance by integrating one health and the sustainable development goals. BMC Global Public Health. 2023; 1 (1): 11.
19. Hanefeld J, Khan M, Tomson G, Smith R. Trade is central to achieving the Sustainable Development Goals: A case study of antimicrobial resistance. BMJ 358: j3505. 2017.
20. Organization WH. Monitoring and evaluation of the global action plan on antimicrobial resistance: framework and recommended indicators. 2019.
21. Mphande FA. Sustainable Health in Low and Middle Income Countries; Focus on SDG Target 3.3, 3b, 3c and 3d. Sustainable Health in Low and Middle Income Countries: Achieving SDG3 in the (Post) Pandemic World: Springer; 2023. p. 1-12.
22. Joshi MP, Alombah F, Konduri N, Ndiaye A, Kusu N, Kiggundu R, et al. Moving from assessments to implementation: promising practices for strengthening multisectoral antimicrobial resistance containment capacity. 2023;5(1):7.
23. Sulis G, Sayood S, Gandra SJEroa-it. Antimicrobial resistance in low-and middle-income countries: current status and future directions. 2022;20(2):147-60.