Guest Editorial

Can increasing the number and role of community pharmacists in South Africa help address rising antimicrobial resistance rates, and what are the implications?*

TM Maluleke,[1,2] N Schellack,[3] AC Kalungia,[4] IU Rehman,[5] R Moodley,[6] IA Sefah,[7] AG Jelić,[8] A Kurdi,[1,9,10,11] B Godman,[1,9,12] JC Meyer[1,13]

[1] Department of Public Health Pharmacy and Management, School of Pharmacy, Sefako Makgatho Health Sciences University, South Africa.
[2] Saselamani Pharmacy, South Africa
[3] Department of Pharmacology, Faculty of Health Sciences, University of Pretoria, South Africa
[4] Department of Pharmacy, School of Health Sciences, University of Zambia, Zambia
[5] Punjab University College of Pharmacy, Faculty of Pharmacy, University of the Punjab, Pakistan
[6] School of Health Science University of KwaZulu-Natal, South Africa
[7] School of Pharmacy, University of Health and Allied Sciences, Ghana
[8] Department of Pharmacy, Faculty of Medicine, University of Banja Luka, Republic of Srpska, Bosnia & Herzegovina
[9] Strathclyde Institute of Pharmacy and Biomedical Sciences, Strathclyde University, United Kingdom
[10] College of Pharmacy, Hawler Medical University, Iraq
[11] College of Pharmacy, Al-Kitab University, Iraq
[12] Centre for Neonatal and Paediatric Infection, Antibiotic Policy, City St. George's University of London, United Kingdom
[13] South African Vaccination and Immunisation Centre, Sefako Makgatho Health Sciences University, South Africa
***Corresponding author, email:** brian.godman@smu.ac.za

Abstract

Antimicrobial resistance (AMR) is a critical issue globally as well as in South Africa, exacerbated by concerns with inappropriate antibiotic use in primary care. This includes prescribers in South Africa with variable dispensing of antibiotics without a prescription. Where this does occur, this is principally for patients with urinary tract infections (UTIs), including those associated with sexually transmitted infections (STIs), and STIs. There is little dispensing of antibiotics without a prescription for self-limiting conditions including upper respiratory tract infections (URTIs). Community pharmacists in South Africa typically offer symptomatic relief first for patients presenting with URTIs unlike prescribers. In view of this, coupled with the key role that community pharmacists played during the COVID-19 pandemic, and the fact that in a number of countries trained community pharmacists can diagnose and dispensed antibiotics for certain infections including UTIs, we believe it is time for the South African Government and Health Authority to review current legislation and expand the services of community pharmacists. An increased number of community pharmacists can also work with prescribers to improve their antibiotic use, building on examples in South Africa and across developing countries. This paper summarises published evidence to promote an increasing role for community pharmacists in the country to reduce AMR, and the suggested next steps to take this debate forward. We believe this is essential if South Africa is to effectively tackle rising AMR rates.

Keywords: antimicrobial resistance, community pharmacists, national action plan, self-purchasing antibiotics, pharmacist dispensing, South Africa

https://doi.org/10.36303/SAPJ.3898

* As Editor of the ***South African Pharmaceutical Journal*** (SAPJ), I have invited this guest editorial to spotlight an urgent national crisis during World AMR Awareness Week 2025 (18–24 November), themed "*Act Now: Protect Our Present, Secure Our Future*". South Africa's AMR National Strategy Framework (2018–2024) has lapsed without renewal, prompting an open letter from over 70 experts to Minister Dr Aaron Motsoaledi urging reinstatement amid rising AMR threats to NHI and health security, with global projections of 40 million deaths in 25 years. This editorial, co-authored by other scientists, synthesises evidence positioning community pharmacists as underutilised stewards: they already prioritise symptomatic care for self-limiting infections unlike primary care prescribers. It proposes four interlinked reforms: recognise pharmacists as AWaRe-aligned AMS partners in national structures; expand PCDT and scoped prescribing for UTIs/STIs; strengthen pharmacist–prescriber data-driven AMS; and align workforce planning to deploy unemployed pharmacists against AMR while improving access. These actionable steps operationalise WHO Global Action Plan priorities for South Africa.

Introduction

Antimicrobial resistance (AMR) is a critical public health concern across all countries leading to increased morbidity, mortality and costs.[1-7] The associated costs also include the social burden arising from AMR, which has been under-recognised to date.[8] The highest AMR prevalence rates globally are currently seen among low- and middle-income countries (LMICs) including among African countries.[1,9-11] AMR is fuelled by high rates of inappropriate prescribing and dispensing of antibiotics, including antibiotics from the World Health Organization (WHO) Watch and Reserve list with their greater resistance potential.[12-15] For instance in 2022 alone, more than 659,000 children in Africa and more than 752,000 children in Southeast Asia died of AMR-associated complications, with many of these deaths linked to increasing use of Watch and Reserve antibiotics.[16] Utilisation of Watch antibiotics increased by 126%, with similar increases for Reserve antibiotics, in this population between 2019 and 2021, driving up AMR-associated deaths.[16]

A key area of concern among LMICs driving up AMR rates are consistent high levels of dispensing of antibiotics without a prescription, including from the WHO Watch list.[17-20] These high rates have persisted despite ongoing legislation banning such activities.[17,18] High rates are exacerbated by pressure from patients with often limited knowledge of antibiotics and AMR, previous successful experiences with antibiotics including for viral self-limiting conditions including upper respiratory tract infections (URTIs), their infections seen as minor, often long waiting times and costs to see healthcare professionals (HCPs) in primary healthcare clinics (PHCs) as well as the costs of medicines, compared with the convenience of community pharmacies.[17,21-24] South Africa is no exception with high rates AMR, impacting on mortality, alongside high rates of inappropriate antibiotic use across all sectors including primary care (Supplementary Table S1).[25-31] Primary care is critical in this respect as this sector can account for up to 95% of total antibiotic use in humans in LMICs.[32] If not addressed, global mortality from AMR is estimated to reach 1.91 million (1.56–2.26) deaths attributable to AMR by 2050, and 8.22 million (6.85–9.65) deaths associated with AMR by 2050, with up to 4.1 million AMR-related deaths alone in sub-Saharan Africa.[33-34] These projected increases in sub-Saharan Africa have resulted in calls to rapidly instigate multiple activities to urgently address the situation.[35]

There are ongoing Global, Regional and National initiatives to reduce the prevalence and burden of AMR. These include the WHO Global Action Plan (GAP) to reduce AMR in 2015, subsequently developed into National Action Plans (NAPs).[36-39] However, there are ongoing concerns with the implementation of NAPs among LMICs, including among African countries, due to issues with available resources and personnel to instigate agreed activities.[37,38,40-42] South Africa has also developed and launched its NAP.[43,44] However, similar to other LMICs, there are ongoing concerns regarding the implementation of its NAP, which has resulted in approaches to the Ministry of Health to urgently address the situation.[44-46] Recent activities include an open letter from academic researchers, infectious diseases specialists, infection prevention practitioners, microbiologists, pharmacists, pharmacologists, public health experts, and policy experts in the field of AMR to the Minister of Health in June 2025 to prioritise the development and implementation of the NAP.[46] Other WHO initiatives include encouraging greater monitoring of AMR patterns to improve future empiric prescribing through the WHO GLASS initiative.[47,48] In addition, the development of the WHO AWaRe classification and guidance aiming to increase the use of Access antibiotics where antibiotics are necessary with their lower resistance potential.[49-51] Alongside this, encouraging initial non-antibiotic treatments for self-limiting conditions such as URTIs.[50,51] WHO AWaRe guidance is welcomed as there have been concerns with the robustness of a number of antibiotic guidelines produced in LMICs.[52] The initial target was that at least 60% of antibiotic use across sectors should be Access antibiotics.[49,53] However, this has increased to 70% following the United Nations General Assembly (UN GA) high-level meeting on AMR in September 2024.[54,55]

Recent global discussions, including surrounding the recent UN GA high level meeting on AMR, have highlighted that in many LMIC settings strict enforcement of prescription only policies for antibiotics is often not feasible as a result of weak enforcement, workforce shortages, shortages of antibiotics in PHCs, access barriers to see HCPs in PHCs and entrenched informal antibiotic markets.[21,56-58] It is increasingly argued that unregulated access to antibiotics without a prescription should be understood as a symptom of available resources and primary care health system constraints, and that community pharmacists in particular need to be integrated into regulated, algorithm-guided, AWaRe-aligned models of care to improve future antibiotic use, which builds on their skills demonstrated during the COVID-19 pandemic.[59-63] This broader framing is particularly relevant for South Africa, where high AMR rates, gaps in NAP implementation and persistent inequities in access to primary care coexist with under utilised pharmacy capacity.[56,64] Trained community pharmacists can also reduce the extent of substandard and falsified antibiotics within their pharmacies, which is a concern across Africa adding to AMR.[57,65,66] However, to date, this appears to be less of an issue in South Africa compared with other African countries and other LMICs.[57,67,68] The informal sector, which can also add to AMR, is again less of an issue in South Africa compared with other African countries and other LMICs.[57,58]

Antimicrobial stewardship (AMS) activities are urgently needed in South Africa to improve future prescribing and reduce AMR.[46] This includes addressing continued concerns with low levels of knowledge regarding antibiotics and AMR among prescribers in primary care as well as high levels of inappropriate prescribing of antibiotics (Supplementary Table S1).[69-74] There are a growing number of antimicrobial stewardship programs (ASPs) being undertaken among African countries, including South Africa, to try and improve future use given ongoing concerns, and this is likely to continue given rising AMR rates.[21,27,75,76]

There has generally been limited dispensing of antibiotics without a prescription in South Africa compared with other African countries in published studies.[18,77-80] Where this occurs, this has generally been from Independent as opposed to Chain pharmacies, and typically

for patients with urinary tract infections (UTIs) suggestive of sexually transmitted infections (STIs) or for STIs.[79] There has generally been very limited dispensing of antibiotics without a prescription in South Africa for patients with URTIs, with usually symptomatic treatment offered first in accordance with WHO AWaRe guidance, which contrasts with the situation with prescribers (Supplementary Table S1).[50,80-82] This is important given concerns with the overuse of antibiotics to treat URTIs across LMICs where symptomatic treatment should be offered first.[21,50,83-86]

Taken together, this suggests that South African community pharmacists are already acting, to some extent, as de facto stewardship partners in the management of self-limiting infections, even as broader system weaknesses continue to drive inappropriate antibiotic use and AMR. This is encouraging. However, we are aware that there are currently sub-optimal numbers of pharmacists working in the public sector in South Africa providing patient care and guidance to prescribers alongside high levels of unemployment among community pharmacists.[64,87,88] This needs to be urgently addressed to improve future antibiotic use in the country given, as mentioned, high rates of AMR and the implications.[30,46] In view of this, there is a need to document experiences across countries where community pharmacists are allowed to prescribe antibiotics, provide guidance and support to prescribers as well as patients, and assess their impact to reduce inappropriate antibiotic use. This reflects the growing recognition of the value that community pharmacists can bring to improving patient care in LMICs at a time of increasing pressures on available resources.[59,89,90] The findings can provide future direction to all key stakeholders in South Africa given current challenges. This was the aim and objective of this editorial.

Approach

A narrative review approach was undertaken for the content of this editorial to allow for a broader scope of sourced papers as pertinent information contained within identified papers may be part of broader papers. In addition, key documents and information may only be available via the Internet or in Journals not covered by Pub Med or Web of Science; consequently, would typically be excluded from systematic reviews. We are aware this approach may lead to bias. However, the co-authors have considerable experience in this area including providing guidance to all key stakeholder groups across LMICs on ways to appreciably reduce inappropriate antibiotic use.[15,18,21,57,75,84,91-95] We believe this is important given ongoing concerns with AMR in South Africa and the implications, with the principal aim of this editorial to suggest potential ways forward for all key stakeholder groups to enhance the utilisation of community pharmacists to reduce AMR in South Africa.[30,46]

Data from included papers were extracted into summary tables capturing country, year, setting, intervention type and key outcomes, and ordered chronologically where pertinent. The principal authors (TM and BG) synthesised the material thematically, focusing on: (i) pharmacist prescribing for selected infections where this occurs; (ii) community pharmacy-based AMS interventions to reduce unnecessary antibiotic dispensing; and (iii) pharmacist–prescriber partnerships to optimise prescribing, with emphasis on lessons relevant to South Africa (Supplementary Tables 2–4). Key findings were documented by the principal authors (TM and BG) as part of the synthesis, similar to other recent approaches involving these authors.[18,21,57,75]

International evidence and implications for South Africa

International experience demonstrates that community pharmacists can safely manage selected infections including UTIs, reduce unnecessary antibiotic use and contribute to AMS activities when appropriately trained, supported and integrated into primary care systems.

Three main domains emerge from the international literature. These include pharmacists diagnosing and prescribing antibiotics for uncomplicated infections (Supplementary Table S2), AMS oriented interventions to reduce inappropriate dispensing of antibiotics without a prescription among patients (Supplementary Table S3), and pharmacist–prescriber partnerships to optimise antibiotic prescribing in primary care (Supplementary Table S4).

Supplementary Table S2 contains details of programmes across multiple countries, including Canada, New Zealand and the United Kingdom, where community pharmacists have been authorised to treat a range of infectious diseases with antibiotics including UTIs.[96-100] We are also aware in France that community pharmacists are now allowed to dispense antibiotics for patients with UTIs.[101] However, they must belong to a coordinated structure and have previously obtained the agreement of the referring physician, with studies ongoing to assess their impact on subsequent patient care in controlled, cluster-randomised studies.[101]

For such initiatives to succeed in other countries, identified barriers must be addressed.[100,102] These include fostering a favourable socio-political context including developing clear policy pathways and logistics, instigating targeted training courses for community pharmacists to address potential shortcomings in necessary diagnostic and other skills, and raising key stakeholder recognition of the potential role for community pharmacists to be able to prescribe antibiotics in certain situations.[100-102] Alongside this, allocating specific resources and updating infrastructures to improve patient care.[100,102]

Supplementary Table S2 contains details of published studies where community pharmacists have provided advice to patients on the appropriate management of their infectious disease, especially aimed at reducing their requests to dispense antibiotics for essentially self-limiting conditions. As a result, recognising community pharmacists as critical to improve antimicrobial use in primary care across LMICs. ASPs have historically been more difficult to undertake among LMICs due to issues with personnel, available resources, weak infrastructures and inadequate antimicrobial resistance surveillance.[103-105] However, this is changing among LMICs, including among African countries, providing direction for the future.[21,27,75,106-109] Overall, appropriately trained community pharmacists integrated into current health care systems can make an appreciable impact in minimising inappropriate antibiotic use among LMICs (Supplementary Tables S3 and S4).[110,111] This includes working alongside prescribers in LMICs to improve their future antibiotic prescribing through auditing, feedback and other activities.[88,112]

Table I: Proposed inter-related activities for all key stakeholder groups going forward to enhance antibiotic use in primary care in South Africa

Inter-related activity	Rationale and ways forward
Recognising trained community pharmacists as core AMS partners within an AWaRe-aligned national response	• The emerging evidence from South Africa indicates that community pharmacists generally demonstrate comparatively conservative antibiotic use for self limiting infections such as URTIs, often prioritising symptomatic management over antibiotics[79-81,119] • This is in contrast to current prevailing prescribing patterns in primary care in South Africa (Supplementary Table S1), perpetuating ongoing concerns regarding AMR in South Africa • Consequently, rather than positioning community pharmacies primarily as enforcement targets, future policies in South should formally acknowledge their de facto stewardship contribution, including educating patients (Supplementary Table S3), and integrate them into provincial and district AMS structures as well as into any reconstituted national AMR advisory arrangements, e.g. a reinstated Ministerial Advisory Committee on AMR. • This implies using pharmacy generated data in the future to track alignment of antibiotic use with WHO AWaRe Guidance and UN-GA targets,[50,51,54] which could include instigating and monitoring agreed quality indicator targets based on AWaRe[120] • Such activities will necessarily involve community pharmacists in the design and delivery of public and patient education on antibiotic use, and ensure that SAPC pharmacy representatives have a voice in future national AMR planning and monitoring processes building on their skills
Expand antimicrobial-stewardship oriented PCDT and pharmacist prescribing for selected infections in South Africa	• International experience, particularly from Canada, New Zealand and the United Kingdom, demonstrates that suitably trained community pharmacists can safely manage uncomplicated UTIs and similar conditions under protocol, achieving high clinical cure rates, high patient satisfaction, reduced pressure on primary care and emergency care, as well as reduced costs (Supplementary Table S2) • Currently in South Africa, North West University remains the only accredited provider of the PCDT supplementary qualification, and no other institution currently has concrete plans for comparable programmes.[121] This represents a missed opportunity given the country's growing AMR burden and the acknowledged need to shift care for selected infections into community settings to improve patient access • In line with the recent comments, and in collaboration with SAPC, we propose that national stakeholders should prioritise the development, accreditation and piloting of new, AMS focused PCDT and pharmacist prescribing pathways for a constrained set of first line Access antibiotics for clearly defined indications including UTIs and selected STIs (Supplementary Table S2)[56,79,119,122] • SAPC, universities, and professional bodies, should urgently convene a joint working group to specify curricula, competency requirements and supervision arrangements, drawing on WHO AMR competency frameworks, WHO AWaRe guidance, and national and international pharmacy workforce guidance to further develop the PCDT supplementary qualification[50,118,122] • Pilot implementation should be accompanied by rigorous evaluation of clinical outcomes, equity and unintended consequences, with a view to informing wider rollout if results are favourable. This will necessarily involve academic institutions in South Africa working with others
Strengthen pharmacist–prescriber partnerships and data-driven AMS	• Collaboration between pharmacists and prescribers has been shown to improve guideline concordance, increase the proportion of Access antibiotics used and reduce unnecessary antibiotic prescribing for URTIs in primary care settings in South Africa and elsewhere (Supplementary Table S4). • Scaling up such models would move AMS away from ad hoc, individual initiatives in hospitals, towards a more systematic team based practice in primary care where up to 90% or more of antibiotics are used in patients across LMICs, and where there are currently concerns with the use of antibiotics in South Africa (Supplementary Table S1)[30,32] • Priority actions include: (i) expanding pharmacist led audit and feedback sessions alongside academic detailing programmes targeting high volume antibiotic prescribers; (ii) formalising shared care pathways between public sector clinics and community pharmacies for common infections including UTIs and URTIs; and (iii) embedding AMS related indicators into routine performance management for both pharmacy and medical services (Supplementary Table S4) • These activities should be aligned with WHO and FIP recommendations that all healthcare professionals, including pharmacists, acquire core AMR and AMS competencies during pre-service and in-service training.[118,122] This includes enhanced communication skills acknowledging the issues of language where this occurs given ongoing concerns[82,114]
Align AMR workforce planning, access to care and stewardship objectives to achieve NAP goals	• The coexistence of rising AMR, persistently poor access to pharmaceutical care in many public and rural settings, and growing unemployment among community pharmacists and pharmacist's assistants in South Africa, highlights the absence of a current coherent AMR workforce strategy to address rising rates. [30,31,46] • International frameworks emphasise that developing an AMR competent workforce is a central pillar of effective national responses, with pharmacists increasingly recognised as key stewards of antimicrobial use • For South Africa, this implies moving beyond generic calls for "more pharmacists" towards a deliberate, competency based workforce planning that links expanded community pharmacy roles to defined AMR and AMS functions across the healthcare system, e.g. surveillance activities, prescribing, dispensing, patient education and inter professional leadership • The strategic investment in community pharmacy infrastructure and roles, tied to expanded and clearly regulated scopes of practice, AMS responsibilities and sustainable remuneration, could simultaneously improve access to high quality primary care services, reduce inappropriate antibiotic use and absorb part of the growing pool of unemployed pharmacy professionals • Workforce policy should explicitly incorporate WHO AMR competency frameworks and related FIP development goals, ensuring that pre-service curricula, PCDT and other supplementary qualifications, and continuing professional development, are aligned with the knowledge, skills and behaviours required for effective antimicrobial stewardship. Such an approach would also respond to the concerns raised in the open letter regarding the absence of a current national AMR strategy and advisory structure, by signalling that pharmacy workforce reform is part of a broader, system level response to AMR rather than a stand alone professional agenda.

NB: AMR = Antimicrobial Resistance; AWaRe = Access, Watch and Reserve;[49] FIP: International Pharmaceutical Federation; PCDT = Primary Care Drug Therapy; SAPC = South African Pharmacy Council; UN-GA = United Nations General Assembly; URTIs = Upper Respiratory Tract Infections; UTIs = Urinary Tract Infections

Overall, it is important that community pharmacists have appropriate communication skills when talking with patients, including being aware of possible language issues; otherwise, there can be miscommunication potentially adversely affecting antibiotic use.[77,82,113,114] Patient and public engagement is also seen as increasingly important to reduce high levels of requests for antibiotics among patients in LMICs, even for self-limiting infections.[21,115] Community pharmacists can also play a key role in this respect.[21,114] Educational programmes can appreciably improve community pharmacy knowledge regarding antibiotics, AMR and AMS, benefitting all key stakeholder groups going forward.[116]

Recommendations for South African pharmacy stakeholders

South Africa's expired AMR National Strategy Framework, and the recent open letter to the Minister of Health, underscore the urgency of restoring a coherent national response to AMR, including a functioning scientific advisory mechanism.[43,46,56,117,118] Against this backdrop, and in line with the WHO GAP and AWaRe targets, the evidence assembled in this editorial supports a deliberate move away from narrowly punitive, inspection led responses to address the selling of antibiotics without a prescription towards a more enabling, stewardship oriented vision for community pharmacy within a strengthened AMR workforce. This includes the potential for diagnosing and dispensing of antibiotics for agreed conditions to address barriers and shortfalls currently in primary care in South Africa.

Four interrelated sets of actions are proposed for the South African Pharmacy Council (SAPC), the National Department of Health, professional associations, universities and other partners (Table I).

Taken together, these recommendations suggest that South Africa's policy debate should pivot from a narrow focus on enforcing prescription only antibiotic rules towards a more nuanced, system oriented strategy that leverages the full potential of the pharmaceutical workforce within a revitalised national AMR framework.

Conclusion

Community pharmacists in South Africa already contribute meaningfully to AMS activities through conservative dispensing for self limiting infections such as URTIs with typically symptomatic care, and growing engagement in AMS initiatives. However, their potential remains under utilised within the current national AMR policy and service delivery frameworks.

International and local evidence demonstrates that, when appropriately trained, supported and regulated, community pharmacists can safely manage selected infections, reduce unnecessary antibiotic use, and partner effectively with prescribers and patients to optimise their care. At a time when South Africa faces an expired AMR National Strategy Framework, growing AMR rates and the consequences, alongside gaps in access to quality primary care, and increasing pharmacy unemployment, there is a compelling case for repositioning community pharmacists as core AMS partners within a revitalised national AMR response. This supported by an expanded Primary Care Drug Therapy and pharmacist prescribing pathways, structured AMS collaboration with prescribers, and a competency based workforce planning aligned with WHO and FIP guidance.

Ethical considerations

There are no ethical considerations as no patients were involved in this study.

Conflicts of interest

The authors have no relevant conflicts of interest to declare.

Funding

There was no funding for this review paper

ORCID

TM Maluleke https://orcid.org/0000-0001-6437-7198
N Schellack https://orcid.org/0000-0001-9690-6285
AC Kalungia https://orcid.org/0000-0003-2554-1236
IU Rehman https://orcid.org/0009-0000-9577-7282
R Moodley https://orcid.org/0000-0003-0399-0460
IA Sefah https://orcid.org/0000-0001-6963-0519
AG Jelić https://orcid.org/0000-0001-6883-4739
A Kurdi https://orcid.org/0000-0001-5036-1988
B Godman https://orcid.org/0000-0001-6539-6972
JC Meyer https://orcid.org/0000-0003-0462-5713

References

1. Murray CJ, Ikuta KS, Sharara F, et al. Global burden of bacterial antimicrobial resistance in 2019: a systematic analysis. Lancet. 2022;399(10325):629-55. https://doi.org/10.1016/S0140-6736(21)02724-0.
2. WHO. Global antibiotic resistance surveillance report 2025 Available at: https://www.who.

Supplementary file available online at: https://ojs.sabinet.co.za/index.php/sapj/article/view/3898/1908

From the next issue of the SAPJ, and in line with our new DHET accredited status (via SCOPUS), an article publication charge (APC) of R5 800 (excluding VAT) will be levied to support the costs of managing peer review, copyediting, design and layout, and open access hosting of accepted manuscripts; this APC will not apply to authors who are paid up PSSA members. This will apply to all papers that are accepted for publication from the 1st of January 2026.

As this year draws to a close, the SAPJ editorial team extends warm festive greetings to all our readers, authors, reviewers, and partners. May you enjoy a restful holiday period with family and colleagues, and return refreshed for a productive year ahead in 2026 as we continue to grow SAPJ's contribution to pharmacy in South Africa and beyond.

int/publications/i/item/9789240116337. Accessed 20 November 2025.
3. Ho CS, Wong CTH, Aung TT, et al. Antimicrobial resistance: a concise update. Lancet Microbe. 2025;6(1):100947. https://doi.org/10.1016/j.lanmic.2024.07.010.
4. Patra M, Gupta AK, Kumar D, Kumar B. Antimicrobial resistance: A rising global threat to public health. Infect Drug Resist. 2025;18:5419-37. https://doi.org/10.2147/IDR.S530557.
5. Ahmad M, Khan AU. Global economic impact of antibiotic resistance: A review. J Glob Antimicrob Resist. 2019;19:313-6. https://doi.org/10.1016/j.jgar.2019.05.024.
6. Siaba S, Casal B, López-Martínez I. The economics of antibiotic resistance: A systematic review and meta-analysis based on global research. Appl Health Econ Health Policy. 2025 (EPrint). https://doi.org/10.1007/s40258-025-01001-7.
7. Mendelson M, Sharland M, Mpundu M. Antibiotic resistance: calling time on the 'silent pandemic'. JAC Antimicrob Resist. 2022;4(2):dlac016. https://doi.org/10.1093/jacamr/dlac016.
8. Keenan K, Silva Corrêa J, Sringernyuang L, Nagiya S, Chandler CIR. The social burden of antimicrobial resistance: what is it, how can we measure it, and why does it matter? JAC Antimicrob Resist. 2025;7(2):dlae208. https://doi.org/10.1093/jacamr/dlae208.
9. Osena G, Kapoor G, Kalanxhi E, et al. Antimicrobial resistance in Africa: A retrospective analysis of data from 14 countries, 2016-2019. PLoS Med. 2025;22(6):e1004638. https://doi.org/10.1371/journal.pmed.1004638.
10. Antimicrobial Resistance Collaborators. The burden of bacterial antimicrobial resistance in the WHO African region in 2019: a cross-country systematic analysis. Lancet Glob Health. 2024;12(2):e201-e16. https://doi.org/10.1016/S2214-109X(23)00539-9.
11. Lubanga AF, Bwanali AN, Kambiri F, et al. Tackling antimicrobial resistance in sub-Saharan Africa: challenges and opportunities for implementing the new people-centered WHO guidelines. Expert Rev Anti Infect Ther. 2024;22(6):379-86. https://doi.org/10.1080/14787210.2024.2362270.
12. Abejew AA, Wubetu GY, Fenta TG. Relationship between Antibiotic Consumption and Resistance: A Systematic Review. Can J Infect Dis Med Microbiol. 2024;2024:9958678. https://doi.org/10.1155/2024/9958678.
13. Wang L, Chen H, Zhang Y, et al. Global antibiotic consumption and regional antimicrobial resistance, 2010-21: an analysis of pharmaceutical sales and antimicrobial resistance surveillance data. Lancet Glob Health. 2025;13(11):e1880-e91. https://doi.org/10.1016/S2214-109X(25)00308-0.
14. Sulis G, Sayood S, Katukoori S, et al. Exposure to World Health Organization's AWaRe antibiotics and isolation of multidrug resistant bacteria: a systematic review and meta-analysis. Clin Microbiol Infect. 2022;28(9):1193-202. https://doi.org/10.1016/j.cmi.2022.03.014.
15. Godman B, Egwuenu A, Haque M, et al. Strategies to improve antimicrobial utilization with a special focus on developing countries. Life. 2021;11(6). https://doi.org/10.3390/life11060528.
16. ESCMID. Over 3 million children died from antimicrobial resistance-related infections in 2022, major study shows. 2025. Available at: https://a-p-p-a.org/pdf/over-3-million-children-died-from-antimicrobial-resistance-related-infections-in-2022.pdf. Accessed 18 November 2025.
17. Li J, Zhou P, Wang J, et al. Worldwide dispensing of non-prescription antibiotics in community pharmacies and associated factors: a mixed-methods systematic review. Lancet Infect Dis. 2023;23(9):e361-e70. https://doi.org/10.1016/S1473-3099(23)00130-5.
18. Sono TM, Yeika E, Cook A, et al. Current rates of purchasing of antibiotics without a prescription across sub-Saharan Africa; rationale and potential programmes to reduce inappropriate dispensing and resistance. Expert Rev Anti Infect Ther. 2023;21(10):1025-55. https://doi.org/10.1080/14787210.2023.2259106.
19. Al Masud A, Walpola RL, Sarker M, et al. Understanding antibiotic purchasing practices in community pharmacies: A potential driver of emerging antimicrobial resistance. Explor Res Clin Soc Pharm. 2024;15:100485. https://doi.org/10.1016/j.rcsop.2024.100485.
20. Saleem Z, Hassali MA, Godman B, et al. Sale of WHO AWaRe groups antibiotics without a prescription in Pakistan: a simulated client study. J Pharm Policy Pract. 2020;13:26. https://doi.org/10.1186/s40545-020-00233-3.
21. Saleem Z, Moore CE, Kalungia AC, et al. Status and implications of the knowledge, attitudes and practices towards AWaRe antibiotic use, resistance and stewardship among low- and middle-income countries. JAC-Antimicrobial Resistance. 2025;7(2). https://doi.org/10.1093/jacamr/dlaf033.
22. Gashaw T, Yadeta TA, Weldegebreal F, et al. The global prevalence of antibiotic self-medication among the adult population: systematic review and meta-analysis. Syst Rev. 2025;14(1):49. https://doi.org/10.1186/s13643-025-02783-6.
23. Saliya SA, Hailu AG, Sebro SF, Menesho MD. Prevalence and predictors of self-medication practices among adult household members in Hosanna town, Hadiya zone, central Ethiopia. BMC Public Health. 2025;25(1):221. https://doi.org/10.1186/s12889-025-21441-z.
24. Zewdie S, Kassa AA, Bizuneh MM, Tesfaye TC, Yayehrad AT. Antibiotic use without prescription among children aged under 5 years in low- and middle-income countries: a systematic review and meta-analysis. JAC-Antimicrobial Resistance. 2025;7(3). https://doi.org/10.1093/jacamr/dlaf093.
25. Ahmed S, Ahmed R, Adam RZ, Coetzee R. Antimicrobial resistance, antibiotic prescribing practices and antimicrobial stewardship in South Africa: a scoping review. JAC Antimicrob Resist. 2025;7(1):dlaf014. https://doi.org/10.1093/jacamr/dlaf014.
26. Yakobi SH, Nwodo UU. Prevalence of antimicrobial resistance in Klebsiella pneumoniae in the South African populations: A systematic review and meta-analysis of surveillance studies. Microbiologyopen. 2025;14(4):e70037. https://doi.org/10.1002/mbo3.70037.
27. Chigome A, Ramdas N, Skosana P, et al. A narrative review of antibiotic prescribing practices in primary care settings in South Africa and potential ways forward to reduce antimicrobial resistance. Antibiotics. 2023;12(10):1540. https://doi.org/10.3390/antibiotics12101540.
28. Sigudu TT, Oguttu JW, Qekwana DN. Antimicrobial resistance of Staphylococcus spp. from human specimens submitted to diagnostic laboratories in South Africa, 2012-2017. Microorganisms. 2024;12(9). https://doi.org/10.3390/microorganisms12091862.
29. Finlayson H, Chibabhai V, Jeena P, et al. The changing landscape of antimicrobial resistance and use in South Africa: The need for access to new antibiotics: A position paper. S Afr Med J. 2024;114(10):e2348.
30. Department of Health, Republic of South Africa. Surveillance for Antimicrobial Resistance and Consumption of Antibiotics in South Africa 2018-2022. March 2024. Available at: https://www.nicd.ac.za/wp-content/uploads/2024/04/South-African-AMR-Surveillance-Report-2022.pdf. Accessed 19 November 2025.
31. Mendelson M. There's another pandemic we should be focused on: antibiotic-resistant infections - Millions of people are now dying every year because of bad practices and South Africa is one of the worst culprits. 2022 Available at: https://www.groundup.org.za/article/antibiotic-resistance-pandemic-getting-steadily-worse-we-need-fix-it/. Accessed 19 November 2025.
32. Duffy E, Ritchie S, Metcalfe S, Van Bakel B, Thomas MG. Antibacterials dispensed in the community comprise 85%-95% of total human antibacterial consumption. J Clin Pharm Ther. 2018;43(1):59-64. https://doi.org/10.1111/jcpt.12610.
33. GBD 2021 Antimicrobial Resistance Collaborators. Global burden of bacterial antimicrobial resistance 1990-2021: a systematic analysis with forecasts to 2050. Lancet. 2024;404(10459):1199-226. https://doi.org/10.1016/S0140-6736(24)01867-1.
34. Totaro V, Guido G, Cotugno S et al. Antimicrobial resistance in sub-Saharan Africa: A comprehensive landscape review. American Journal of Tropical Medicine and Hygiene. 2025;113(2):253-63. https://doi.org/10.4269/ajtmh.25-0035.
35. Xavier SP. An urgent call to combat antimicrobial resistance in Sub-Saharan Africa through integrated and innovative solutions. Discover Public Health. 2025;22(1):673. https://doi.org/10.1186/s12982-025-01083-7.
36. 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. Lancet Reg Health West Pac. 2021;7:100084. https://doi.org/10.1016/j.lanwpc.2020.100084.
37. Fuller WL, Hamzat OT, Aboderin AO, et al. National action plan on antimicrobial resistance: An evaluation of implementation in the World Health Organization Africa region. J Public Health Afr. 2022;13(2):2000. https://doi.org/10.4081/jphia.2022.2000.
38. Charani E, Mendelson M, Pallett SJC, et al. An analysis of existing national action plans for antimicrobial resistance-gaps and opportunities in strategies optimising antibiotic use in human populations. Lancet Glob Health. 2023;11(3):e466-e74. https://doi.org/10.1016/S2214-109X(23)00019-0.
39. WHO. Global Action Plan on Antimicrobial Resistant. 2015. Available at: https://apps.who.int/iris/bitstream/handle/10665/193736/9789241509763_eng.pdf?sequence=1. Accessed 18 November 2025.
40. Sariola S, Butcher A, Cañada JA, Aïkpé M, Compaore A. Closing the GAP in Antimicrobial Resistance Policy in Benin and Burkina Faso. mSystems. 2022;7(4):e0015022. https://doi.org/10.1128/msystems.00150-22.
41. Godman B, Egwuenu A, Wesangula E, et al. Tackling antimicrobial resistance across sub-Saharan Africa: current challenges and implications for the future. Expert Opin Drug Saf. 2022;21(8):1089-111. https://doi.org/10.1080/14740338.2022.2106368.
42. Saleem Z, Godman B, Azhar F, et al. Progress on the national action plan of Pakistan on antimicrobial resistance (AMR): a narrative review and the implications. Expert Review of Anti-infective Therapy. 2022;20(1):71-93. https://doi.org/10.1080/14787210.2021.1935238.
43. Departments of Health and Agriculture, Forestry and Fisheries for the Republic of South Africa: Antimicrobial Resistance National Strategy Framework 2017 - 2024. Available at: https://www.knowledgehub.org.za/system/files/elibdownloads/2020-03/AMR%20National%20Action%20Plan%202018%20-%202024.pdf. Accessed 19 November 2025.
44. Shabangu K, Essack SY, Duma SE. Barriers to implementing National Action Plans on antimicrobial resistance using a One Health Approach: policymakers' perspectives from South Africa and Eswatini. J Glob Antimicrob Resist. 2023;33:130-6. https://doi.org/10.1016/j.jgar.2023.02.007.
45. Shabangu K, Essack SY, Duma SE. Policy makers' perceptions on implementation of national action plans on antimicrobial resistance in South Africa and Eswatini using Coordination, Accountability, Resourcing, Regulation and Ownership Framework (2018-2019). Antibiotics. 2025;14(7). https://doi.org/10.3390/antibiotics14070696.
46. Mendelson M, van Vuuren M, Govind C, et al. Urgent need to reinstate a National Action Plan and Scientific Advisory Body on Antimicrobial Resistance in South Africa. 19 June 2025. Available at: https://groundup.org.za/media/uploads/documents/open_letter_to_minister_motsoaledi_final-20250619.pdf. Accessed 18 November 2025.
47. Ajulo S, Awosile B. Global antimicrobial resistance and use surveillance system (GLASS 2022): Investigating the relationship between antimicrobial resistance and antimicrobial consumption data across the participating countries. PLoS One. 2024;19(2):e0297921. https://doi.org/10.1371/journal.pone.0297921.
48. WHO. Global Antimicrobial Resistance and Use Surveillance System (GLASS) report Antibiotic use data for 2022. 2025. Available at: https://iris.who.int/bitstream/handle/10665/381094/9789240108127-eng.pdf?sequence=1. Accessed 19 November 2025.
49. Sharland M, Gandra S, Huttner B, et al. Encouraging AWaRe-ness and discouraging inappropriate antibiotic use-the new 2019 Essential Medicines List becomes a global antibiotic stewardship tool. Lancet Infect Dis. 2019;19(12):1278-80. https://doi.org/10.1016/S1473-3099(19)30532-8.
50. Zanichelli V, Sharland M, Cappello B, et al. The WHO AWaRe (Access, Watch, Reserve) antibiotic book and prevention of antimicrobial resistance. Bull World Health Organ. 2023;101(4):290-6. https://doi.org/10.2471/BLT.22.288614.
51. Sharland M, Zanichelli V, Ombajo LA, et al. The WHO essential medicines list AWaRe book:

from a list to a quality improvement system. Clin Microbiol Infect. 2022;28(12):1533-5. https://doi.org/10.1016/j.cmi.2022.08.009.
52. Jamil E, Saleem Z, Godman B, et al. Global variation in antibiotic prescribing guidelines and the implications for decreasing AMR in the future. Frontiers in Pharmacology. 2025;16. https://doi.org/10.3389/fphar.2025.1600787.
53. Klein EY, Milkowska-Shibata M, Tseng KK, et al. Assessment of WHO antibiotic consumption and access targets in 76 countries, 2000-15: an analysis of pharmaceutical sales data. Lancet Infect Dis. 2021;21(1):107-15. https://doi.org/10.1016/S1473-3099(20)30332-7.
54. United Nations. Political Declaration of the High-level Meeting on Antimicrobial Resistance. 9 September 2024 Available at: https://www.un.org/pga/wp-content/uploads/sites/108/2024/09/FINAL-Text-AMR-to-PGA.pdf. Accessed 18 November 2025.
55. Schellack N. Addressing antimicrobial resistance: insights from the 2024 UN General Assembly High-Level Meeting and the role of pharmacists in South Africa. SA Pharmaceutical Journal. 2024;91(5):3-5.
56. Mendelson M, Afari-Asiedu S, Schellack N, et al. Facing up to reality: over-the-counter access to antibiotics in low-income and middle-income countries needs a paradigm shift in thinking. Lancet Glob Health. 2025;13(12):e2175-e9. https://doi.org/10.1016/S2214-109X(25)00394-8.
57. Saleem Z, Mekonnen BA, Orubu ES, et al. Current access, availability and use of antibiotics in primary care among key low- and middle-income countries and the policy implications. Expert Rev Anti Infect Ther. 2025:1-42. https://doi.org/10.1080/14787210.2025.2477198.
58. MalulekeTM, Ur Rehman I, Kurdi A, et al. Challenges regarding the provision of antibiotics via the informal sector across low- and middle-income countries and potential ways forward. Journal of the Medical College for Women and Hospital. Accepted for publication: https://openaccesssgulacuk/id/eprint/118032/.
59. Hedima EW, Okoro RN. Primary health care roles of community pharmacists in low- and middle-income countries: a mixed methods systematic review. BMC Health Serv Res. 2025;25(1):1269. https://doi.org/10.1186/s12913-025-13387-0.
60. Pantasri T. Expanded roles of community pharmacists in COVID-19: A scoping literature review. J Am Pharm Assoc. 2022;62(3):649-57. https://doi.org/10.1016/j.japh.2021.12.013.
61. Cadogan CA, Hughes CM. On the frontline against COVID-19: Community pharmacists' contribution during a public health crisis. Res Social Adm Pharm. 2021;17(1):2032-5. https://doi.org/10.1016/j.sapharm.2020.03.015.
62. Kibuule D, Nambahu L, Sefah IA, et al. Activities in Namibia to limit the prevalence and mortality from COVID-19 including community pharmacy activities and the implications. Sch Acad J Pharm. 2021;5:82-92. https://doi.org/10.36347/sajp.2021.v10i05.001.
63. Opanga S, Rizvi N, Wamaitha A, et al. Availability of medicines in community pharmacy to manage patients with COVID-19 in Kenya; Pilot study and implications. Sch Acad J Pharm. 2021;3:36-42. https://doi.org/10.36347/sajp.2021.v10i03.001.
64. Bateman C. The high cost of having too few pharmacists in SA. 22 November 2024 Available at: https://www.spotlightnsp.co.za/2024/11/22/the-high-cost-of-having-too-few-pharmacists-in-sa/. Accessed 19 November 2025.
65. Jairoun AA, Al Hemyari SS, Abdulla NM, et al. Development and validation of a tool to improve community pharmacists' surveillance role in the safe dispensing of herbal supplements. Frontiers in Pharmacology. 2022;13. https://doi.org/10.3389/fphar.2022.916223.
66. Zabala GA, Bellingham K, Vidhamaly V, et al. Substandard and falsified antibiotics: neglected drivers of antimicrobial resistance? BMJ Glob Health. 2022;7(8). https://doi.org/10.1136/bmjgh-2022-008587.
67. Asrade Mekonnen B, Getie Yizengaw M, Chanie Worku M. Prevalence of substandard, falsified, unlicensed and unregistered medicine and its associated factors in Africa: a systematic review. J Pharm Policy Pract. 2024;17(1):2375267. https://doi.org/10.1080/20523211.2024.2375267.
68. Maluleke TM, Mekonnen BA, Ubaka CM, et al. Potential activities to reduce the extent of substandard and falsified antibiotics across Africa and associated antimicrobial resistance. Frontiers in Tropical Diseases. 2025;6. https://doi.org/10.3389/fitd.2025.1634029.
69. Farley E, Stewart A, Davies MA, et al. Antibiotic use and resistance: Knowledge, attitudes and perceptions among primary care prescribers in South Africa. S Afr Med J. 2018;108(9):763-71. https://doi.org/10.7196/SAMJ.2018.v108i9.12933.
70. Balliram R, Sibanda W, Essack SY. The knowledge, attitudes and practices of doctors, pharmacists and nurses on antimicrobials, antimicrobial resistance and antimicrobial stewardship in South Africa. S Afr J Infect Dis. 2021;36(1):262. https://doi.org/10.4102/sajid.v36i1.262.
71. Alabi ME, Essack SY. Antibiotic prescribing amongst South African general practitioners in private practice: an analysis of a health insurance database. JAC Antimicrob Resist. 2022;4(5):dlac101. https://doi.org/10.1093/jacamr/dlac101.
72. Lagarde M, Blaauw D. Levels and determinants of overprescribing of antibiotics in the public and private primary care sectors in South Africa. BMJ Glob Health. 2023;8(7). https://doi.org/10.1136/bmjgh-2023-012374.
73. Nzayini Z, Dlungele A, Mathibe LJ. Level of self-confidence among nurse practitioners in rural public health facilities regarding antimicrobial stewardship programs. Antimicrob Steward Healthc Epidemiol. 2025;5(1):e208. https://doi.org/10.1017/ash.2025.178.
74. De Vries E, Johnson Y, Willems B, et al. Improving primary care antimicrobial stewardship by implementing a peer audit and feedback intervention in Cape Town community healthcare centres. S Afr Med J. 2022;112(10):812-8. https://doi.org/10.7196/SAMJ.2022.v112i10.16397.
75. Chigome A, Ramdas N, Campbell SM, et al. Potential activities to improve primary care prescribing of antibiotics across Africa. Frontiers in Tropical Diseases. 2025;6. https://doi.org/10.3389/fitd.2025.1634182.
76. Song Q, Li J, Zhou P, et al. Worldwide antibiotic prescription practices in primary care and associated factors: a systematic review and meta-analysis. American Journal of Infection Control. 2025;53(11):1137-1143. https://doi.org/10.1016/j.ajic.2025.08.009.
77. Anstey Watkins J, Wagner F, Xavier Gómez-Olivé F, et al. Rural South African community perceptions of antibiotic access and use: Qualitative evidence from a health and demographic surveillance system site. Am J Trop Med Hyg. 2019;100(6):1378-90. https://doi.org/10.4269/ajtmh.18-0171.
78. Do NTT, Vu HTL, Nguyen CTK, et al. Community-based antibiotic access and use in six low-income and middle-income countries: a mixed-method approach. Lancet Glob Health. 2021;9(5):e610-e9. https://doi.org/10.1016/S2214-109X(21)00024-3.
79. Mokwele RN, Schellack N, Bronkhorst E, Brink AJ, Schweickerdt L, Godman B. Using mystery shoppers to determine practices pertaining to antibiotic dispensing without a prescription among community pharmacies in South Africa-a pilot survey. JAC-Antimicrobial Resistance. 2022;4(1). doi: 10.1093/jacamr/dlab196 https://doi.org/10.1093/jacamr/dlab196
80. Maluleke TM, Maluleke MT, Jelic AG, et al. Estimated extent of purchasing of antibiotics without a prescription from community pharmacies in a rural province in South Africa and the implications. Frontiers in Tropical Diseases. 2025;6. https://doi.org/10.3389/fitd.2025.1637362.
81. Sono TM, Maluleke MT, Ramdas N, et al. Pilot study to evaluate the feasibility of a patient questionnaire for the purpose of investigating the extent of purchasing antibiotics without a prescription in a rural province in South Africa: Rationale and implications. Advances in Human Biology. 2024;14(2):138-47. https://doi.org/10.4103/aihb.aihb_140_23.
82. Sono TM, Mboweni V, Jelić AG, et al. Pilot study to evaluate patients' understanding of key terms and aspects of antimicrobial use in a rural province in South Africa: Findings and implications. Advances in Human Biology. 2025;15(1):108-12. https://doi.org/10.4103/aihb.aihb_119_24.
83. Majeed R, Outhoff K. The role of pharmacists in optimising patient outcomes to reduce the burden of tonsillitis. SA Pharmaceutical Journal. 2025;92(4):16-22. https://doi.org/10.36303/SAPJ.3195.
84. Godman B, Haque M, McKimm J, et al. Ongoing strategies to improve the management of upper respiratory tract infections and reduce inappropriate antibiotic use particularly among lower and middle-income countries: findings and implications for the future. Curr Med Res Opin. 2020;36(2):301-27. https://doi.org/10.1080/03007995.2019.1700947.
85. Dlamini Z, Kupa K, Schellack N. Overview and management of colds and flu. SA Pharm J. 2025;92(2):26-33. https://doi.org/10.36303/SAPJ.2517.
86. Van Schoor J. Colds, flu and coughing: a review of over-the-counter cold and flu medicines. S Afr Pharm J. 2023;90(3):28-30. https://doi.org/10.36303/SAGP.2022.3.3.0133.
87. Rabali T. The plight of unemployed pharmacists and pharmacist'sassistants. S Afr Pharm J. 2024;91(6):5.
88. Van Hecke O, Adegoke Y, Allwood M, et al. Impact of pharmacist-prescriber partnerships to track antibiotic prescribing in publicly funded primary care in the Cape Town metropole, South Africa: An implementation study. South African Medical Journal. 2024;114(12):e1914. https://doi.org/10.7196/SAMJ.2024.v114i12.1914.
89. Essack S, Bell J, Shephard A. Community pharmacists – Leaders for antibiotic stewardship in respiratory tract infection. J Clin Pharm Ther. 2018;43(2):302-7. https://doi.org/10.1111/jcpt.12650.
90. Bishop C, Yacoob Z, Knobloch MJ, Safdar N. Community pharmacy interventions to improve antibiotic stewardship and implications for pharmacy education: A narrative overview. Res Social Adm Pharm. 2019;15(6):627-31. https://doi.org/10.1016/j.sapharm.2018.09.017.
91. Saleem Z, Godman B, Cook A, et al. Ongoing efforts to improve antimicrobial utilization in hospitals among African countries and implications for the future. Antibiotics. 2022;11(12):1824. https://doi.org/10.3390/antibiotics11121824.
92. Robertson J, Iwamoto K, Hoxha I, et al. Antimicrobial medicines consumption in Eastern Europe and Central Asia - An updated cross-national study and assessment of quantitative metrics for policy action. Front Pharmacol. 2018;9:1156. https://doi.org/10.3389/fphar.2018.01156.
93. Ogunleye OO, Basu D, Mueller D, et al. Response to the novel Corona virus (COVID-19) pandemic across Africa: Successes, challenges, and implications for the future. Front Pharmacol. 2020;11:1205. https://doi.org/10.3389/fphar.2020.01205.
94. Godman B, Fadare J, Kwon HY, et al. Evidence-based public policy making for medicines across countries: findings and implications for the future. J Comp Eff Res. 2021;10(12):1019-52. https://doi.org/10.2217/cer-2020-0273.
95. Mwita JC, Ogunleye OO, Olalekan A, et al. Key issues surrounding appropriate antibiotic use for prevention of surgical site infections in low- and middle-income countries: A narrative review and the implications. Int J Gen Med. 2021;14:515-30. https://doi.org/10.2147/IJGM.S253216.
96. Beahm NP, Smyth DJ, Tsuyuki RT. Outcomes of urinary tract infection management by pharmacists (R(x)OUTMAP): A study of pharmacist prescribing and care in patients with uncomplicated urinary tract infections in the community. Can Pharm J (Ott). 2018;151(5):305-14. https://doi.org/10.1177/1715163518781175.
97. Gauld NJ, Zeng IS, Ikram RB, Thomas MG, Buetow SA. Antibiotic treatment of women with uncomplicated cystitis before and after allowing pharmacist-supply of trimethoprim. Int J Clin Pharm. 2017;39(1):165-72. https://doi.org/10.1007/s11096-016-0415-1.
98. Hind C. NHS Grampian project: treating uncomplicated lower urinary tract infection in community pharmacy. The Pharmaceutical Journal. 2018. Available at: https://pharmaceutical-journal.com/article/research/nhs-grampian-project-treating- uncomplicated-lower-urinary-tract-infection-in-community-pharmacy. Accessed 19 November 2025.
99. Thornley T, Kirkdale CL, Beech E, et al. Evaluation of a community pharmacy-led test-and-treat service for women with uncomplicated lower urinary tract infection in England. JAC

Antimicrob Resist. 2020;2(1):dlaa010. https://doi.org/10.1093/jacamr/dlaa010.
100. Jebara T, Cunningham S, MacLure K, et al. Stakeholders' views and experiences of pharmacist prescribing: a systematic review. Br J Clin Pharmacol. 2018;84(9):1883-905. https://doi.org/10.1111/bcp.13624.
101. Piraux A, Parot-Schinkel E, Hamel JF, et al. Efficacy of a pharmacist care protocol to manage uncomplicated female cystitis in community pharmacies: an open-label, multicenter, randomized, controlled, cluster study: the PharmaCyst' protocol. Trials. 2024;25(1):654. https://doi.org/10.1186/s13063-024-08476-0.
102. Zhou M, Desborough J, Parkinson A, et al. Barriers to pharmacist prescribing: a scoping review comparing the UK, New Zealand, Canadian and Australian experiences. Int J Pharm Pract. 2019;27(6):479-89. https://doi.org/10.1111/ijpp.12557.
103. Cox JA, Vlieghe E, Mendelson M, et al. Antibiotic stewardship in low- and middle-income countries: the same but different? Clin Microbiol Infect. 2017;23(11):812-8. https://doi.org/10.1016/j.cmi.2017.07.010.
104. Graells T, Lambraki IA, Cousins M, et al. Exploring the factors that contribute to the successful implementation of antimicrobial resistance interventions: a comparison of high-income and low-middle-income countries. Front Public Health. 2023;11:1230848. https://doi.org/10.3389/fpubh.2023.1230848.
105. Rony MKK, Sharmi PD, Alamgir HM. Addressing antimicrobial resistance in low and middle-income countries: overcoming challenges and implementing effective strategies. Environ Sci Pollut Res Int. 2023;30(45):101896-902. https://doi.org/10.1007/s11356-023-29434-4.
106. Akpan MR, Isemin NU, Udoh AE, Ashiru-Oredope D. Implementation of antimicrobial stewardship programmes in African countries: a systematic literature review. J Glob Antimicrob Resist. 2020;22:317-24. https://doi.org/10.1016/j.jgar.2020.03.009.
107. Chetty S, Reddy M, Ramsamy Y, Naidoo A, Essack S. Antimicrobial stewardship in South Africa: a scoping review of the published literature. JAC Antimicrob Resist. 2019;1(3):dlz060. https://doi.org/10.1093/jacamr/dlz060.
108. Otieno PA, Campbell S, Maley S, et al. A systematic review of pharmacist-led antimicrobial stewardship programs in ub-Saharan Africa. Int J Clin Pract. 2022;2022:3639943. https://doi.org/10.1155/2022/3639943.
109. Nampoothiri V, Hisham M, Mbamalu O, et al. Evolution of pharmacist roles in antimicrobial stewardship: A 20-year systematic review. Int J Infect Dis. 2025;151:107306. https://doi.org/10.1016/j.ijid.2024.107306.
110. Sakeena MHF, Bennett AA, McLachlan AJ. Enhancing pharmacists' role in developing countries to overcome the challenge of antimicrobial resistance: a narrative review. Antimicrob Resist Infect Control. 2018;7:63. https://doi.org/10.1186/s13756-018-0351-z.
111. Zerbinato F, Cunningham S, Tonna AP. Antimicrobial stewardship interventions involving community pharmacy teams: a scoping review. JAC Antimicrob Resist. 2025;7(5):dlaf156. https://doi.org/10.1093/jacamr/dlaf156.
112. Van Hecke O, Adegoke DY, von Pressentin K, et al. Impact of pharmacist-prescriber partnerships to track antibiotic prescribing in publicly funded primary care in the Cape Town Metropole, South Africa: an implementation study. International Journal of Infectious Diseases. 2025;152:107626. https://doi.org/10.1016/j.ijid.2024.107626.
113. Balea LB, Gulestø RJA, Xu H, Glasdam S. Physicians', pharmacists', and nurses' education of patients about antibiotic use and antimicrobial resistance in primary care settings: a qualitative systematic literature review. Front Antibiot. 2024;3:1507868. https://doi.org/10.3389/frabi.2024.1507868.
114. Sono TM, Schellack N, Godman B. The role of patients with addressing inappropriate dispensing of antibiotics without a prescription especially in developing countries. Advances in Human Biology. 2025;15(1):1-4. https://doi.org/10.4103/aihb.aihb_124_24.
115. Scott-Dearing E, Carter V, Corley M, Mathew P, Darzi A. Patient and public involvement and engagement to improve impact on antimicrobial resistance. Nature Communications. 2025;16(1):1022. https://doi.org/10.1038/s41467-024-55410-8.
116. Mohammed AH, Lim A, Hassan BAR, et al. Implementing a community-based antimicrobial stewardship intervention in Malaysia. J Infect Prev. 2024;25(6):225-35. https://doi.org/10.1177/17571774241251650.
117. Department of Health Republic of South Africa. Antimicrobial Resistance - National Strategy Framework; A ONE HEALTH APPROACH 2018 - 2024. Pretoria Available at: https://cdn.who.int/media/docs/default-source/antimicrobial-resistance/amr-spc-npm/nap-library/south-africa-antimicrobial-resistance-national-action-plan-2018---2024.pdf?sfvrsn=533118b0_1&download=true. Accessed 18 November 2025.
118. WHO. WHO Competency Framework for Health Workers' Education and Training on Antimicrobial Resistance. 20 November 2018 Available at: https://www.who.int/publications/i/item/who-competency-framework-for-health-workers%E2%80%99-education-and-training-on-antimicrobial-resistance. Accessed 19 November 2025.
119. Maluleke TM, Maluleke MT, Jelić AG, et al. Current knowledge and attitudes toward antibiotic use among community pharmacy personnel in a rural province in South Africa and the implications. Frontiers in Tropical Diseases. 2025;6. https://doi.org/10.3389/fitd.2025.1637843.
120. Funiciello E, Lorenzetti G, Cook A, et al. Identifying AWaRe indicators for appropriate antibiotic use: a narrative review. J Antimicrob Chemother. 2024;79(12):3063-77. https://doi.org/10.1093/jac/dkae370.
121. Tromp M, Truter I, du Toit J. Primary care drug therapy pharmacists in South Africa: Practice settings and conditions treated. Explor Res Clin Soc Pharm. 2023;12:100352. https://doi.org/10.1016/j.rcsop.2023.100352.
122. FIP. FIP Development Goals: Antimicrobial Stewardship Available at: https://development-goals.fip.org/dg17/. Accessed 20 November 2025.