BMJ Public Health

Health professional and facility engagement in antimicrobial resistance prevention and containment strategic initiatives at public hospitals in Southern Ethiopia: facility-based cross-sectional study

Mende Mensa Sorato [1,2]

To cite: Sorato MM. Health professional and facility engagement in antimicrobial resistance prevention and containment strategic initiatives at public hospitals in Southern Ethiopia: facility-based cross-sectional study. *BMJ Public Health* 2025;**3**:e002314. doi:10.1136/bmjph-2024-002314

► Additional supplemental material is published online only. To view, please visit the journal online (https://doi.org/10.1136/bmjph-2024-002314).

Received 11 November 2024
Accepted 21 March 2025

Check for updates

© Author(s) (or their employer(s)) 2025. Re-use permitted under CC BY-NC. Published by BMJ Group.

[1]Department of Pharmacy, School of Medicine, Komar University of Science and Technology, Sulaymania, Iraq
[2]Department of Pharmacy, College of Medicine and Health Science, Arba Minch University, Arba Minch, Ethiopia

Correspondence to
Dr Mende Mensa Sorato; mende.mensa@komar.edu.iq

ABSTRACT

Objective Antimicrobial resistance (AMR) threatens millions of lives and poses significant health, economic and development challenges. Policies implemented to prevent and contain AMR should address it through a One Health Approach. This study assessed health professional and facility engagement in Southern Ethiopia's AMR prevention and containment strategic initiatives and associated factors.

Design A hospital-based cross-sectional study was conducted among 634 health professionals.

Settings Five randomly selected public hospitals from three (Gofa, Gamo and South Omo) zones.

Participants Health professionals working in the outpatient department in the randomly selected hospitals.

Outcome measure Health professional and facility engagement in AMR prevention and containment strategies. A binary logistic regression model was used to evaluate the association between the explanatory variables (socio-demographic characteristics, institutional and professional factors) and dependent variables (professional engagement in AMR PCSIs). To avoid many variables and unstable estimates and control possible confounders in the subsequent model, only variables that reached a p value less than 0.25 at binary analysis were used in the multivariate logistic regression analysis to identify factors independently associated with health professional and facility engagement level in AMR prevention and containment strategies.

Result This study included 634 participants (56.5% males). Among these professionals, the vast majority (n=444, 70.0%) were aware of the One Health perspective on AMR. Concerning health facility engagement in AMR PCSIs, about one-third (n=203; 32.0%) of professionals reported full engagement in the facilities. Nearly one-fourth of professionals (n=169; 26.7%) reported including AMR prevention and containment procedures in their facility's annual plan. The overall health professional and facility engagement in AMR PCSIs was 412 (65.0%). Having a history of sharp injury (adjusted odds ratio (AOR)=1.88 (1.19, 2.97; p=0.007)), working in a general hospital (AOR=3.746 (2.657, 5.282; p=0.000)), having good knowledge on healthcare waste management (AOR=1.99 (1.225, 3.258; p=0.006)) and being from a facility that included AMR prevention and containment in the annual plan (AOR=3.796 (2.01, 7.180; p=0.000)) were positively and independently associated with the dependent variable (professional engagement in AMR PCSIs). However, a working experience of 6–10 years (AOR=0.6 (0.32, 0.96, p<0.05)), receiving infection prevention control training (AOR=1.47 (1.02, 2.13, p=0.041)) and lack of adequate knowledge on One Health approach (AOR=0.50 (0.32, 0.79; p=0.003)) were negatively associated with professional and facility engagement in AMR PCSIs.

Conclusion In the study area, professional and facility engagement in AMR PCSIs was low. Providing training on infection prevention and control, healthcare waste handling, One Health approach, antimicrobial stewardship

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Revisiting the One Health approach and improving the health system and professional capacity are critical success factors for antimicrobial resistance (AMR) prevention and containment.
⇒ Countries have national strategic initiatives to improve national AMR prevention and containment.

WHAT THIS STUDY ADDS

⇒ National AMR prevention and containment strategies are not well communicated to lower-level healthcare systems (primary hospitals).
⇒ Without having adequate health professional and facility engagement in nationally agreed initiatives at each facility level, it is not possible to achieve the desired AMR prevention and containment targets.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE, OR POLICY

⇒ Communicating or disseminating national strategic initiatives to the lower-level healthcare system can improve the implementation of AMR prevention and containment actions.

for all and disseminating national strategic initiatives to all levels in the healthcare system are important. Researchers willing to work in similar areas must use mixed-method study designs to evaluate the engagement of all (human, animal and environmental) stakeholders toward AMR PCSIs.

INTRODUCTION

Antimicrobial resistance (AMR) threatens millions of lives and poses major health, economic and development challenges with the highest burden in Sub-Saharan Africa (SSA).[1] AMR increases treatment failure, the transmission of resistant strains, and mortality, productivity loss and healthcare costs due to emerging and re-emerging diseases. In a recent *Lancet* systematic review conducted in 2021, 4.71 million deaths were associated with bacterial AMR, including 1.14 million deaths attributable to bacterial AMR, and the number is projected to be 1.91 million deaths attributable to AMR and 8.22 million deaths associated with AMR in 2050. Through improving care for severe infections, and access to antibiotics, 92.0 million deaths could be averted between 2025 and 2050. Similarly, by improving the drug supply chain to prevent and contain AMR for gram-negative infections, 11.1 million AMR deaths can be averted globally in 2050.[2] In the next decade, AMR could push 24 million more people into extreme poverty,[3] if left un-intervened, AMR will cost US$100 trillion by 2050.[4] In Ethiopia in 2019, there were 21 200 deaths attributable to AMR and 85 300 deaths associated with it.[5] In addition to this, AMR is causing political impact (reduce trust, reduce tourism, restrict movement and security threat).[6 7]

Ethiopia is one of the SSA countries facing a huge burden of infectious diseases. According to the report from *Lancet* in 2019, the leading causes of premature mortality in Ethiopia were mainly from infectious origin including neonatal disorders, diarrhoeal diseases, lower respiratory infections, tuberculosis, stroke, HIV/AIDS, ischaemic heart disease, cirrhosis, congenital defects and diabetes. These conditions are further aggravated by malnutrition, unsafe water and poor sanitation, air pollution, hypertension and alcohol use.[8]

Key challenges for AMR containment and prevention in SSA, including Ethiopia, are lack of expertise and resources, poor collaboration, irrational use of antibiotics, lack of infrastructure and institutional capacities, inefficient infection prevention and control (IPC) practices, inappropriate use of antimicrobials for humans, animal and agricultural purposes, weak medicine regulatory systems and presence of inadequate antibiotics in the pipeline.[9–12] In response to this, five global action strategies to prevent and contain AMR were developed. These are awareness and education; AMR surveillance; IPC; optimum use of antimicrobials in human and animal health and research and development and investment. Ethiopia adapted these strategies to its national AMR prevention and containment strategic initiatives (PCSIs). National initiatives include awareness and education; strengthening knowledge and evidence through surveillance; IPC; Antimicrobial Stewardship Programme (AMSP); establishing partnerships and resource mobilisation.[6 7]

Policies implemented for the prevention and containment of AMR should address it through a One Health (human-animal-environment) approach by taking healthcare professionals as pillars for multi-sectoral collaboration.[6 13] Despite the launching of these initiatives, there is a gap in professional practice to reduce the burden on AMR in Ethiopia. For example, IPC is a quality-of-care indicator and national AMR prevention and control strategy pillar.[14–16] However, only one-half of the healthcare workers had safe IPC practices.[17 18] There is little study about professional and health facility engagement in AMR PCSIs in the study area. Therefore, this study assessed professional and health facility engagement in AMR PCSIs and associated factors in Southern Ethiopia.

METHODS AND MATERIALS

Study area, design and period

The study was conducted among three general and two district hospitals in Southern Ethiopia, namely Gamo, Gofa and South Omo Zones, from 1 February to 30 March 2022. Southern Nations and Nationalities and Peoples Region (SNNPR) is one of the largest regions in Ethiopia, accounting for more than 10% of the country's land area and an estimated population of 20 768 000 (May 2018) almost a fifth of the country's population. Less than a tenth of its population (8.9%) lived in urban areas in the region in 2008. The SNNPR is divided into 12 administrative zones.[19 20] A facility-based cross-sectional study was conducted among health professionals working in five public hospitals (Arba Minch, Sawula and Jinka General Hospitals, and Chencha and Dil Fana primary Hospitals) in three randomly selected Zones.

Population

All healthcare professionals who worked at selected hospitals in Gamo, Gofa and South Omo Zones providing care during the data collection period were included in the study. Randomly selected healthcare professionals working in selected hospitals were the study population.

Inclusion and exclusion criteria

All health professionals (doctors, health officers, midwives, nurses, X-ray technicians, pharmacy and laboratory personnel) with at least 2 months of working experience in selected hospitals during the data collection period were included. However, health professionals who were on leave (annual or sick leave) during the data collection period and were not willing to participate in the study were excluded.

Sample size determination and sampling technique

Sample size determination

The sample size was determined using the single population proportion formula. It was computed by considering

that a previous study was done in Gonder Specialized Hospital that demonstrated 84.7% of the respondents demonstrated good knowledge about AMR resistance,[21] 36.3% demonstrated safe practices towards infection prevention,[22] and good AMR knowledge 51.53%, favourable attitudes and good practices were 63.43% and 48.85%, respectively from a recent systematic review.[23] 95% confidence level, 5% margin of error and design effect of 1.5.

$$n = \frac{(z\alpha/2)2 \times p \times (1-p)}{d^2} = (1.96)^2 \times 0.5153(1-0.5153)/(0.05)^2 = 384$$

- where; *n*: number of samples required.
- α: level of significance (set at 0.05).
- *z*: the standard normal deviates with 95% CI (1.96).
- *p*: expected prevalence (51.53%).
- *d*: degree of precision (0.05).

After adjusting for design effect, 384×1.5=576. By adding a non-response rate of 10% which is =57.6. The final sample size was *634*.

Sampling technique and procedure

By using the simple random sampling method, five public hospitals (three general and two district hospitals) were taken from a total of 13 public hospitals located in selected Zones. Three-fourths of the sample (476) was allocated to general hospitals and one-fourth (158) to primary hospitals. Then the sample was equally distributed to general hospitals and primary hospitals (ie, 160, 158 and 158 professionals from Arba Minch General Hospital, Sawula General Hospital and Jinka General, respectively, and 79 professionals from each primary hospital). The principal investigator (PI) used a registered list for sampling frames from each hospital's human resource administration. A consecutive sampling technique was used until the desired sample size was attained.

Variables

Dependent variables

Professional engagement in AMR PCSIs.

Independent variable

Sociodemographic characteristics (age, sex, educational status, level of education, work experience, working unit). *Institutional factors* (training about infection prevention, availability of infection prevention guidelines, updated treatment guidelines and antimicrobials). *Professional factors* knowledge on AMR PCSIs.

Data collection tools and techniques

Data were collected by using a structured self-administered questionnaire prepared based on a review of different kinds of literature.[21 24] The questionnaire was prepared in English and then translated into Amharic and back-translated to English to check for consistency. Health professionals' knowledge about AMR prevention and containment strategies and the One Health approach for AMR prevention and containment were evaluated by using a questionnaire adapted from national AMR prevention and control strategies, and relevant literature.[12 16] Healthcare-waste management and IPC-related practice were assessed by using questions adapted from similar studies.[25] Professional and facility engagement in AMR PCSIs was labelled as good if the score for these dimensions was mean and above and poor otherwise (online supplemental annexes I–II).[26]

Data quality and management

The quality of data was ensured during data collection time as well as during data entry. One-day training was given to data collectors and supervisors. Data were collected by four diploma nurses under the supervision of one medical doctor working in respective hospitals. Two days of training were given before the actual data collection about principles to follow during data collection and the contents of the data collection format for 1 day by the PI. A pretest was done on 5% (32 healthcare workers) in Arba Minch General Hospital, which was not included in the actual study to check for consistency and was amended based on the findings. Additionally, regular meetings were conducted between the data collectors, supervisors and PI to evaluate the challenges. Besides, the PI manually checked data daily and rechecked and evaluated it before entering it into the software.

Data entry and analysis

The collected data were checked for completeness and consistency by the PI daily on the spot during the data collection time. Then, data entry and analysis were done by using Epi-data V.3.1 software and SPSS V.24.0. Summary descriptive statistics were computed for most variables such as sociodemographic factors, AMR prevention and containment strategies, and professional engagement in AMR PCSIs. A bivariate analysis was done to determine the presence of an association between professional and facility engagement in AMR PCSIs and sociodemographic factors: knowledge of infection prevention and AMR. To avoid many variables and unstable estimates in the subsequent model, only variables that reached a p value less than 0.25 at bivariate analysis were included in multiple logistic regression analysis to describe the functional independent predictors of professional and patient engagement in AMR PCSIs. A point estimate of OR with 95% CI was determined to assess the strength of association between independent and dependent variables. For all statistically significant tests, p value <0.05 was a cut-off point.

Operational definitions

AMR PCSIs

National initiatives include awareness and education; strengthening knowledge and evidence through surveillance; IPC; AMSP; establishing partnerships and resource mobilisation.[6 7]

Professional and facility engagement

This study assessed health facility and professional engagement from five dimensions (professional awareness about the One Health approach and AMR, professional

Table 1 Sociodemographic characteristics of health professionals in randomly selected public hospitals in Gamo, Gofa and South Omo Zones, 2023

Variables	Frequency	Per cent (%)
Level of health facility		
Primary hospital	158	24.9
General hospital	476	75.1
Sex of respondent		
Male	358	56.5
Female	276	43.5
Age		
18–29 years	237	36.9
30–39 years	323	50.3
≥40 years	82	12.8
Marital status		
Single	325	51.3
Married	293	46.2
Divorced	13	2.1
Widowed	3	0.5
Level of qualification		
Medical doctor and specialist	78	12.1
Master's degree	56	8.8
First degree	449	70.8
Diploma	51	8.0
Speciality of respondents		
Nurses (adult, paediatrics, outpatient, dental, surgical)	414	65.3
Anaesthesia	12	1.9
Pharmacy professional	9	1.4
Dentist	6	0.9
Health officer	25	3.9
Laboratory	31	4.9
Medical doctor	69	10.9
Midwifery	56	8.8
Ophthalmologist	12	1.8
Radiographer	8	1.3
Others (surgeon, gynaecologist)	2	0.3
Work experience		
1–5 years	282	44.5
6–10 years	253	39.9
>10 years	99	15.6

knowledge about national AMR PCSIs, healthcare professional knowledge about healthcare waste management, healthcare professional's healthcare waste safe management practice and health facility engagement in AMR strategic initiatives). Professional and facility engagement in AMR PCSIs was labelled as good if the score for these dimensions was mean and above and poor otherwise.[26]

Patient and public involvement

None.

RESULT

Sociodemographic characteristics of respondents

634 (358 (56.5%) male) professionals participated in this study. The mean (±SD) age was 32.02±5.41 years ranging from 22 to 54 years. Concerning educational level, the majority 449 (70.8%) of the respondents had a first degree followed by medical doctors 78 (12.3%). Regarding respondents' profession, about two-thirds 414 (65.3%) were nurses followed by medical doctors 69 (10.9%). More than four out of ten 282 (44.5%), had work experience of 1–5 years followed by 6–10 years 253 (39.9%) with a mean value of 6.82±4.056 years ranging from 1 to 29 years (table 1).

Professional awareness about AMR from a One Health perspective

The overall professional awareness about AMR from the One Health perspective was 444 (70.0%). More than three-fourths, 503 (79.4%) of professionals were aware of human-health-related factors, followed by 481 (76.0%) animal-health-related factors and 347 (54.8%) environmental-health factors. Among the human health-related factors, only 268 (42.3%) of professionals reported that the use of antimicrobials increases the risk of AMR. However, almost nine out of ten 567 (89.4%) reported that misuse of antimicrobials contributes to AMR. This highlights the importance of training to address the unavoidable nature of AMR due to innate resistance and the need for due consideration of broad-spectrum antimicrobial use. Regarding animal health-related factors, more than two-thirds of 436 (68.8%) professionals reported the use of antimicrobials in livestock and inappropriate use of antimicrobials for growth promotion contribution to AMR. The great majority, 563 (88.9%) revealed the poor regulatory structure of veterinary medicines as the main contributor to AMR from an animal health perspective. This problem is further augmented by poor government structure, irrational use of antimicrobials by veterinary clinics, access to non-prescription use of antimicrobials, and poor integration of One Health approach stakeholders for AMR prevention and containment. Concerning environmental-related factors, professionals have little knowledge about the contribution of water source contamination from human waste 236 (37.2%), wastes from livestock farming 312 (49.2%), and soil fertilisation with raw animal manure 243 (38.3%). This indicates a need for better integration of these sectors for knowledge sharing and designing region-specific strategies in alignment with national AMR PCSIs (online supplemental table 1). Regarding professional awareness about national initiatives for AMR prevention and containment, three-fourths 475 (75.0%) of professionals were aware of the initiatives (475.3±68.82, ranging from 374 to 573) (figure 1).

Concerning health professional knowledge about priority pathogens for AMR surveillance, one-half 328 (51.7%) knew the priority bacterial pathogens, and 507 (80.0%) knew that infection prevention is one of the

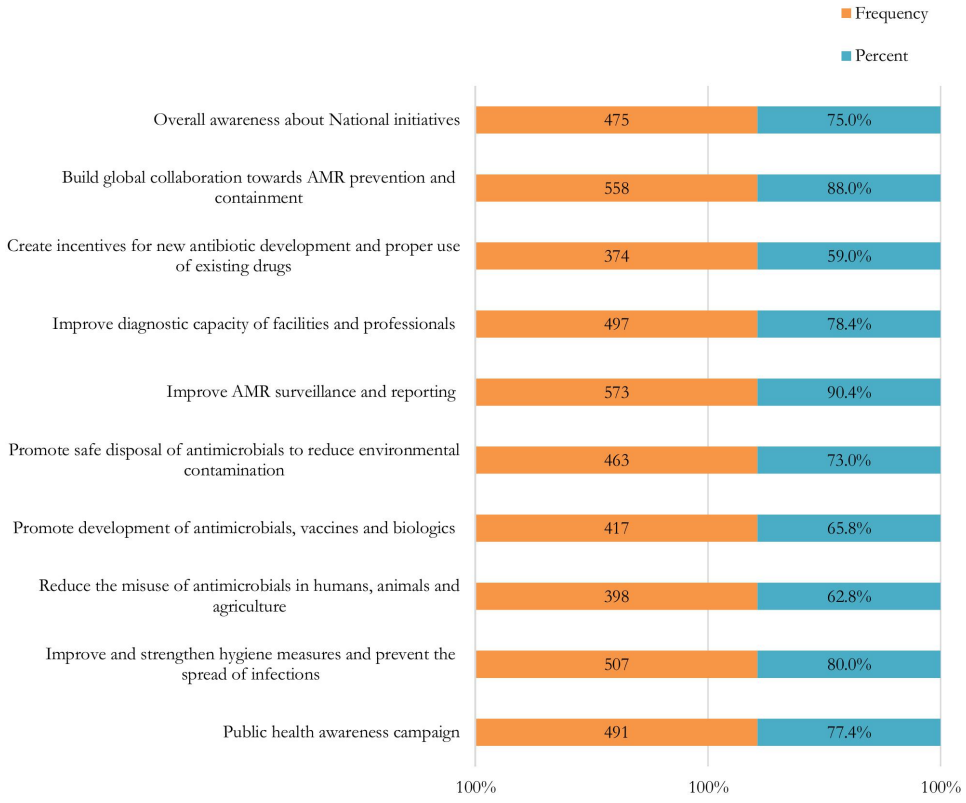

Figure 1 Reported awareness of AMR prevention and containment strategic initiatives at selected public hospitals in Southern Ethiopia. AMR, antimicrobial resistance.

national initiatives for AMR prevention and containment. Regarding healthcare waste management, 410 (64.7%) had good healthcare waste management knowledge. More than three-fourths, 503 (79.4%) of professionals had good knowledge of waste disposal methods, followed by collection time for different wastes 452 (71.2%), storage time 425 (67.1%), and segregation of wastes 259 (40.8%). Concerning AWaRe classification of antimicrobials, more than three-fourths 502 (79.1%) knew about it. More than eight out of ten, 537 (84.7%) professionals correctly identified drugs from the access group, followed by 519 (81.9%) identified reserve group and 449 (70.8%) identified watch group antibiotics (online supplemental table 2). Concerning the healthcare waste management practice, 529 (83.4%) professionals reported good practice with a mean value of 529.4±83.95, ranging from 318 to 604 (figure 2).

Health facility engagement in AMR prevention and containment activities

Concerning health facility engagement in infection prevention and AMR containment initiatives, about one-third, 203 (32.0%) of professionals reported full engagement of facilities. Similarly, 206 (32.5%) and 198 (31.2%) reported the availability of infection prevention guidelines, and waste handling and management guidelines, respectively. About one-fourth, 169 (26.7%) of professionals reported including AMR prevention and containment in their facility annual plan. In summary, the overall health professional and facility engagement in AMR PCSIs was 412 (65.0%) with a median of 428 ranging from 203 to 529. Among the domains included, health professional healthcare waste safe handling practice was the highest at 529 (83.4%) and the lowest was facility engagement in AMR PCSIs at 203 (32.0%) (table 2).

Factors associated with health professional and facility engagement in AMR prevention and containment activities

In bivariate analysis, having a working experience of 6–10 years crude odds ratio (COR)=0.48 (0.29, 0.78; p=0.001) when compared with professionals with more than 10 years' experience, professionals who received infection prevention control training COR=0.759 (0.556, 1.035; p=0.08); not having infection prevention guidelines COR=0.484 (0.331, 0.709; p=0.001), being aware of One Health approach and AMR prevention and containment, COR=0.484 (0.331, 0.709; p=0.000) when compared with their counterparts, history of sharp injury, COR=0.629 (0.461, 0.859; p=0.000); and being from general hospital, COR=0.29 (0.193, 0.420; p=0.035) were associated with professional and facility engagement in AMR PCSIs. Similarly, having good knowledge about healthcare waste management, COR=2.133 (1.314, 3.462; p=0.000); and being from a facility that included AMR prevention and containment in the annual plan, COR=0.26 (0.123, 0.544; p=0.041) were associated with professional and facility engagement in AMR PCSI. In multivariate analysis, professionals with working experience of 6–10 years were 60% (AOR=0.6 (0.32, 0.96; p<0.05)) less likely to engage in AMR PCSI when compared with those who

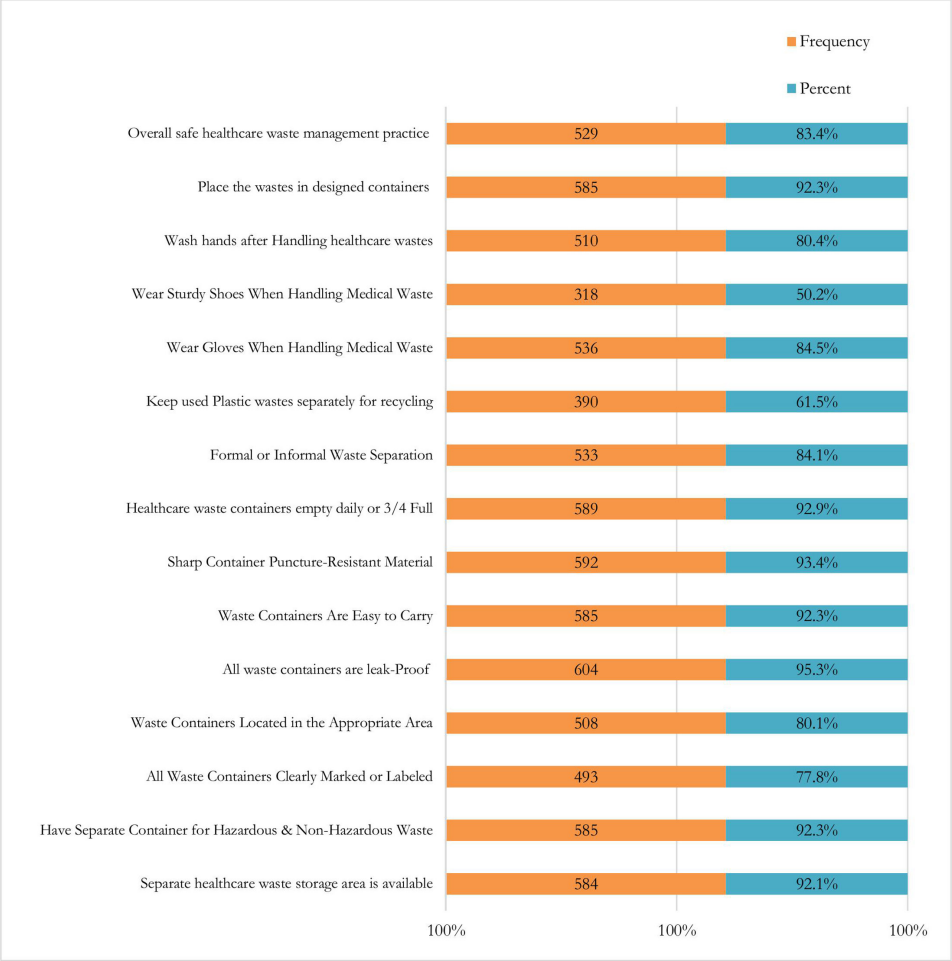

Figure 2 Health professionals healthcare waste safe management practice selected public hospitals in Southern Ethiopia.

Table 2 Health facility engagement in infection prevention and AMR containment activities

Health facility engagement in infection prevention and AMR containment activities	Yes, number (%)
Provided training on infection prevention and waste management in the last 12 months	197 (31.1%)
Availability of infection prevention guidelines and regulations in the facility	206 (32.5%)
Availability of waste handling and management guidelines	198 (31.2%)
Training for newly hired staff	192 (30.3%)
Functional infectious waste management team	289 (45.6%)
Awareness of infectious waste management guidelines	166 (26.2%)
Adequate personal protective equipment	139 (21.9%)
Experienced waste handling injury (last 12 months)	68 (10.7%)
Reported injury to management	80 (12.6%)
Colour-coded healthcare waste bins are available in each working area	369 (58.2%)
Facility segregates waste	371 (58.5%)
Inclusion of AMR prevention and containment in facility annual plans	169 (26.7%)
Availability of antimicrobial prescribing guidelines (AWaRe-classification)	195 (30.8%)
Overall health facility engagement	203 (32.0%)
Overall health professional and facility engagement in AMR initiatives	412 (64.9%)

AMR, antimicrobial resistance.

had more than 10 years' experience. Professionals who received infection prevention control training were 1.5 times (AOR=1.47 (1.02, 2.13; p=0.041)) more likely to engage in AMR PCSI when compared with their counterparts. Similarly, a professional without adequate knowledge about the One Health approach and AMR prevention and containment was 50% (AOR=0.50 (0.32, 0.79; p=0.003)) less likely to engage in AMR PCSI when compared with their counterparts. Health professionals with a history of sharp injury were two times (AOR=1.88 (1.19, 2.97; p=0.007)) more likely to engage in AMR PCSI when compared with professionals with no previous sharp injury. Professionals from the general hospital were 3.7 times (AOR=3.746 (2.657, 5.282; p=0.000)) more likely to engage in AMR PCSI when compared with professionals from primary hospitals. Similarly, professionals having good knowledge about healthcare waste management were 1.9 times (AOR=1.99 (1.225, 3.258; p=0.006)) more likely to engage in AMR PCSI when compared with their counterparts. Finally, professionals from a facility that included AMR prevention and containment in the annual plan were 3.8 times (AOR=3.796 (2.01, 7.180; p=0.000)) more likely to engage in AMR PCSI when compared with professionals from a facility with no AMR annual plan (table 3).

DISCUSSION

This study evaluated health professionals and facility engagement in AMR PCSIs among 634 health professionals in Southern Ethiopia. Overall, health professional and facility engagement in AMR PCSIs was 412 (65.0%) with vitiations among dimensions measured. The dimensions with the highest and the lowest scores were professional knowledge about healthcare waste management and health facility engagement in initiatives 529 (83.4%) and 203 (32.0%), respectively. This variation could be due to a lack of technical capacity and financial resources, a weak regulatory system, and poor policy dissemination from the higher level.[27] It is important to improve the health facility, and the health system engagement in AMR PCSIs at the regional level by using a systems-strengthening approach, optimising the allocation and use of resources, supporting integration and strengthening the capacity of relevant stakeholders like local non-governmental organisations.[28] There are some good national initiatives under implementation to improve antimicrobial stewardship programmes in the country, like prospective audits and feedback for antimicrobials which reduced the time to de-escalation and antimicrobial consumption. Therefore, improving health system managers, and service-delivering facilities (regional and national programme owners) commitment, improving communication between professionals, and assigning dedicated owners to monitor the progress are important.[29 30]

The overall professional awareness about AMR from the One Health perspective was 444 (70.0%). The knowledge about the One Health approach is important to preserve the effectiveness of antimicrobials that are essential for human medicine by reducing their use in animals, improving rational medicine use and reducing the expansion of resistance due to pollution from inadequate treatment of industrial, and farm wastes.[31] These require improved collaboration, knowledge transfer and shared goal development to fight the common enemy for the three (human, animal and environment) sectors. This can be done by including AMR prevention and containment in the facility's short and long-term plans, creating workshops and seminars on AMR-related topics to engage all stakeholders, strengthening surveillance systems, IPC and applying evidence-based policies. In addition, national initiatives should be disseminated to all responsible stakeholders. The policy or strategy that is not communicated well to stakeholders is unlikely to bear the fruit it is intended for. Designing strategies that can improve professional awareness about the One Health approach like updated training for all low-level professionals, improving interprofessional communication and retaining skilled manpower is important.[29]

More than three-fourths, 502 (79.1%) and 195 (30.8%) of professionals knew AWaRe classification of and reported the availability of antimicrobial prescribing guidelines, respectively. A similar revealed that lack of awareness about the WHO AWaRe framework, limited capacity, inadequate access to good-quality antibiotics; and lack of political commitment as challenges for AWaRe implementation.[32] This low awareness can be explained by the low health system and professional commitment as evidenced by 169 (26.7%) inclusion of AMR prevention and containment in the annual plan. This can influence healthcare professionals' prescribing and dispensing practices (overuse or misuse of antibiotics).[30 33]

Healthcare waste management is one strategic initiative for improving IPC. Regarding healthcare waste management, 410 (64.7%) of professionals had good healthcare waste management knowledge. A similar study from the Amhara region showed that 278 (72.2%) of participants were knowledgeable about AMR and its prevention and containment.[34] This is also comparable with findings from the study conducted in Zambia, which showed that 75% of the healthcare workers had good knowledge.[35] Further improvement in IPC knowledge and practice reduces the risk of patients' and professionals' exposure to drug-resistant organisms. This is supported by a similar study that revealed the contribution of hospital wastes as potential sources of multi-drug-resistant extended spectrum beta-lactamase (ESBL)-producing bacteria in Ethiopia. From samples collected from hospitals, bacteria were isolated in 87% of samples (*E. coli*, *Klebsiella* spp, *Providencia* spp and *Proteus* spp). Nearly one-half (49.2%) of the isolated bacteria were ESBL producers.[36] Improving healthcare waste management knowledge and practice through job training, and providing equipment and supplies needed for waste segregation, collection,

Table 3 Table showing associated factors of infection prevention practice among health professionals in randomly selected public hospitals in Gamo, Gofa and South Omo Zones, 2023

Good engagement in AMR prevention and containment initiatives*	Professional and facility engagement in AMR initiatives				
	Poor (222)	Good (412)			
	Frequency (%)	Frequency (%)	COR (95% CI)	AOR (95% CI)	P value
Experience					
1–5 years	124 (44.1%)	158 (54.9%)	0.75 (0.44, 1.26)	1.19 (0.65, 2.18)	0.643
6–10 years	102 (40.1%)	151 (59.9%)	0.48 (0.29, 0.78)	0.6 (0.32, 0.96)	**<0.05**
>10 years	16 (16.2%)	83 (83.8%)	1	1	
Received infection prevention training					
No	234 (53.0%)	208 (47.0%)	1	1	
Yes	91 (47.3%)	101 (52.7%)	0.759 (0.556, 1.035)	1.47 (1.02, 2.13)	**0.041**
Have national infection prevention guidelines					
No	164 (38.2%)	264 (61.8%)	1		
Yes	112 (54.1%)	94 (45.9%)	1.847 (1.273, 2.680)	1.41 (0.98, 2.02)	0.061
Aware of the One Health approach					
No	111 (58.4%)	79 (41.6%)	0.484 (0.331, 0.709)	0.50 (0.32, 0.79)	**0.003**
Yes	145 (32.7%)	299 (76.3%)	1	1	
History of sharp injury in the last year					
No	314 (55.5%)	252 (44.5%)	1	1	
Yes	31 (45.1%)	37 (54.9%)	0.629 (0.461, 0.859)	1.88 (1.19, 2.97)	**0.007**
Type of health facility					
Primary hospital	100 (63.3%)	58 (36.7%)	1	1	
General Hospital	289 (60.7%)	187 (39.3%)	0.29 (0.193, 0.420)	3.746 (2.66, 5.3)	**0.000**
Knowledge about healthcare waste management					
Poor	76 (33.7%)	148 (66.3%)	1		
Good	217 (52.8%)	193 (47.2%)	2.133 (1.314, 3.462)	1.99 (1.23, 3.26)	**0.006**
AMR prevention and containment included in the annual plan					
Yes	83 (49.1%)	86 (50.9%)	0.26 (0.123, 0.544)	3.796 (2.01, 7.18)	**0.000**
No	254 (54.6%)	211 (45.4%)	1	1	

Values in bold are statistically significant.
*The reference category is: poor.
AMR, antimicrobial resistance; AOR, adjusted odds ratio.

storage and disposal is critical for reducing AMR and improving population health.

Factors associated with engagement in AMR PCSIs

In this study, health professionals with working experience of 6–10 years were 60% (AOR=0.6 (0.32, 0.96; p<0.05)) less likely to engage in AMR PCSI when compared with those who had more than 10 years of experience. This suggested better engagement of seniors or professionals with long working experience. It can be explained by better awareness of seniors about antimicrobials and the impact of resistance that could serve as a reinforcing factor to engage in strategic initiatives. This better knowledge can promote surveillance systems, stewardship programmes, engagement in research and development activities, public awareness creation, and enhance collaboration for combating AMR and preserving antibiotics for future generations.[37]

Having a history of sharp injury was two times (AOR=1.88 (1.19, 2.97; p=0.007)) more likely to engage in AMR PCSI when compared with professionals with

no previous sharp injury. A study on the role of IPC on AMR showed that IPC interventions can achieve a significant reduction (35%–70%) in the rates of healthcare-associated infections, irrespective of the income level of a country.[38] The negative memory created from previous injury could motivate the professional to undertake risk reduction interventions, including training on IPC, providing public awareness education and participating in operational (antimicrobial use evaluations) and basic (new drug design and development) research. As evidenced by the findings of this study, professionals who received infection prevention training were 1.5 times (AOR=1.47 (1.017, 2.13; p=0.041)) more likely to engage in AMR-PCSIs than their counterparts. These professionals will have better knowledge about healthcare waste management practices. Professionals with good knowledge about healthcare waste management were 1.9 times (AOR=1.99 (1.225, 3.258; p=0.006)) more likely to engage in AMR PCSI when compared with their counterparts. The finding is similar to the study conducted at Hawassa Comprehensive Specialized Hospital[14] and a study conducted at University Hospital in Qassim, Saudi Arabia.[39] Improving infection prevention training either through on-the-job training or inclusion of the module in undergraduate programmes and providing infection prevention guidelines is important.[40]

Similarly, professionals with poor knowledge about the One Health approach were 50% (AOR=0.50 (0.32, 0.79; p=0.003)) less likely to engage in AMR PCSI when compared with their counterparts. This is because knowledge of the One Health approach enhances the system-level thinking of AMR prevention and containment. Experts with accurate knowledge of zoonotic disease, and antimicrobial use in animals, environmental contamination from animal excretion of antibiotics to the environment; knowledge of rational use of antimicrobials in the human population enables professionals to collaborate and network with stakeholders for improving AMR prevention and containment.[41] Poor professional knowledge about the One Health approach negatively affects the networking and collaboration among stakeholders from human, animal and environmental sectors of AMR prevention and containment.[42]

Professionals from the general hospital were 3.7 times (AOR=3.746 (2.657, 5.282; p=0.000)) more likely to engage in AMR-PCSIs when compared with professionals from primary hospitals. This could be due to differences in the level of expertise available in the hospitals. General hospitals have better expertise, including infectious disease specialists, microbiologists and clinical pharmacy specialists who are the backbone of AMR prevention activities like antimicrobial stewardship programmes and infection prevention. Therefore, improving the level of expertise and professional mix can reduce the difference between primary hospitals and general hospitals.[43] This is critical because system-level resilient (not fragmented) action is critical for the successful implementation of AMR PCSIs. In addition, primary hospitals are in remote areas, and limited access to evidence-based guidelines and technologies including the internet could contribute to this difference.

Health professionals from a facility that included AMR prevention and containment in the annual plan were 3.8 times (AOR=3.796 (2.01, 7.180; p=0.000)) more likely to engage in AMR PCSI when compared with professionals from a facility with no AMR annual plan. The inclusion of AMR prevention and containment in the facility's annual plan indicates the management's level of commitment to reducing the current burden of AMR. For example, an annual plan for AMR prevention and containment could include IPC, health worker education and training, community awareness creation, actions to promote hygiene measures, empirical and definitive treatment recommendations, actions against nosocomial infections, antimicrobial use evaluation and surveillance systems.[44]

LIMITATIONS

This study addressed the entire components of national AMR prevention and containment strategies making it comprehensive. However, being a cross-sectional study, it is not possible to identify a causal relationship between dependent and independent variables. The data was collected from health professionals working for human health, and the engagement of animal health professionals and agricultural sector professionals is equally important.

CONCLUSION

Professional and facility engagement in AMR PCSIs was low in the study area. Receiving infection prevention control training, having a history of sharp injury, being from a general hospital, having good knowledge about healthcare waste management and being from a facility with AMR included in the annual plan were factors positively associated with professional and facility engagement in AMR PCSIs. However, low work experience and lack of adequate knowledge about the One Health approach and AMR prevention and containment were negatively associated with AMR PCSIs. Without having adequate health professional and facility engagement in nationally agreed initiatives at each facility level, it is not possible to achieve desired AMR prevention and containment targets. Therefore, providing training on IPC, healthcare waste handling, the One Health approach, antimicrobial stewardship for all professionals, and disseminating national strategic initiatives to all levels of the healthcare system by involving all stakeholders are key success factors. For researchers who are willing to work in similar areas, it is imperative to evaluate the engagement of all (human, animal and environmental) stakeholders towards AMR PCSIs by using mixed-method study designs.

X Mende Mensa Sorato @MS

Acknowledgements I would like to thank the local government offices of Gofa Zone Health Department, Gamo Zone Health Department and South Omo Zone Health Department for their invaluable support in facilitating the research data collection process. I extend my gratitude to all study participants for their important insights and contributions in providing information in this research process.

Contributors The corresponding author approved the manuscript. MMS conceived the research, framed the format design and conducted data analysis. MMS conducted data analysis, reviewed the manuscript write-up process, polished the manuscript and developed the manuscript for publication and guarantor of the study. The guarantor of the study is (MMS); accepts full responsibility for the finished work and/or the conduct of the study, has access to the data and controls the decision to publish.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval This study involves human participants. Ethical clearance was obtained from the Institutional Review Board of Arba Minch University College of Medicine and Health Sciences with Reference number: IRB/TH1/02/2014. Permission letters to conduct the study were obtained from Gamo, Gofa and South Omo Zones, the health department, and respective hospital administrations. The interview was carried out only with the full consent of the patient being interviewed. Participation was voluntary and written/verbal informed consent was obtained from each participant. Code numbers were used in place of identifiers to maintain the confidentiality of participants' information.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request. All the data reported in the manuscript are publicly available upon the official request of the corresponding author upon acceptance of the manuscript.

Supplemental material This content has been supplied by the author(s). It has not been vetted by BMJ Publishing Group Limited (BMJ) and may not have been peer-reviewed. Any opinions or recommendations discussed are solely those of the author(s) and are not endorsed by BMJ. BMJ disclaims all liability and responsibility arising from any reliance placed on the content. Where the content includes any translated material, BMJ does not warrant the accuracy and reliability of the translations (including but not limited to local regulations, clinical guidelines, terminology, drug names and drug dosages), and is not responsible for any error and/or omissions arising from translation and adaptation or otherwise.

Open access This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: http://creativecommons.org/licenses/by-nc/4.0/.

ORCID iD

Mende Mensa Sorato http://orcid.org/0000-0002-6342-0980

REFERENCES

1 Rogers Van Katwyk S, Hoffman SJ, Mendelson M, *et al*. Strengthening the science of addressing antimicrobial resistance: a framework for planning, conducting and disseminating antimicrobial resistance intervention research. *Health Res Policy Syst* 2020;18:60.
2 Naghavi M, Vollset SE, Ikuta KS, *et al*. Global burden ofbacterial antimicrobial resistance 1990–2021: a systematic analysiswith forecasts to 2050. *The Lancet 2024* 2021;404:1199–226.
3 Gajdács M, Urbán E, Stájer A, *et al*. Antimicrobial Resistance in the Context of the Sustainable Development Goals: A Brief Review. *Eur J Investig Health Psychol Educ* 2021;11:71–82.
4 Majumder MAA, Rahman S, Cohall D, *et al*. Antimicrobial Stewardship: Fighting Antimicrobial Resistance and Protecting Global Public Health. *Infect Drug Resist* 2020;13:4713–38.
5 Regassa BT, Tosisa W, Eshetu D, *et al*. Antimicrobial resistance profiles of bacterial isolates from clinical specimens referred to Ethiopian Public Health Institute: analysis of 5-year data. *BMC Infect Dis* 2023;23:798.
6 Mudenda S, Chabalenge B, Daka V, *et al*. Global Strategies to Combat Antimicrobial Resistance: A One Health Perspective. *PP* 2023;14:271–328.
7 da Silva Jr. JB, Espinal M, Ramón-Pardo P. Antimicrobial resistance: time for action. *Revista Panamericana de Salud Pública* 2020;44:1.
8 Misganaw A, Naghavi M, Walker A, *et al*. Progress in health amongregions of Ethiopia, 1990–2019: a subnational country analysis forthe Global Burden of Disease Study. *The Lancet 2022* 2019;399:1322–35.
9 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;21:1089–111.
10 Moyo P, Moyo E, Mangoya D, *et al*. Prevention of antimicrobial resistance in sub-Saharan Africa: What has worked? What still needs to be done? *J Infect Public Health* 2023;16:632–9.
11 Organization WH. Global shortage of innovative antibiotics fuels emergence and spread of drug-resistance. 2021
12 Velazquez-Meza ME, Galarde-López M, Carrillo-Quiróz B, *et al*. Antimicrobial resistance: One Health approach. *Vet World* 2022;15:743–9.
13 Aslam B, Khurshid M, Arshad MI, *et al*. Antibiotic Resistance: One Health One World Outlook. *Front Cell Infect Microbiol* 2021;11:771510.
14 Bekele T, Ashenaf T, Ermias A, *et al*. Compliance with standard safety precautions and associated factors among health care workers in Hawassa University comprehensive, specialized hospital, Southern Ethiopia. *PLoS One* 2020;15:e0239744.
15 Aghdassi SJS, Hansen S, Bischoff P, *et al*. A national survey on the implementation of key infection prevention and control structures in German hospitals: results from 736 hospitals conducting the WHO Infection Prevention and Control Assessment Framework (IPCAF). *Antimicrob Resist Infect Control* 2019;8:1–8.
16 Health mo: antimicrobial resistance prevention and containment strategic plan the one health approach. In Addis Ababa; 2021.
17 Sahiledengle B, Tekalegn Y, Woldeyohannes D. The critical role of infection prevention overlooked in Ethiopia, only one-half of health-care workers had safe practice: A systematic review and meta-analysis. *PLoS One* 2021;16:e0245469.
18 Jain M, Dogra V, Mishra B, *et al*. Knowledge and attitude of doctors and nurses regarding indication for catheterization and prevention of catheter-associated urinary tract infection in a tertiary care hospital. *Indian J Crit Care Med* 2015;19:76.
19 FEWSNET U. Disaster prevention and preparedness commission (DPPC), the government of ethiopia: southern nations, nationalities, and peoples region (SNNPR LIVELIHOOD PROFILE), regional overview. 2005.
20 ICF CSACEa. Ethiopia demographic and health survey 2016: key indicators report. addis ababa, ethiopia, and rockville, maryland, USA. CSA and ICF. 2016.
21 Simegn W, Dagnew B, Weldegerima B, *et al*. Knowledge of Antimicrobial Resistance and Associated Factors Among Health Professionals at the University of Gondar Specialized Hospital: Institution-Based Cross-Sectional Study. *Front Public Health* 2022;10:790892.
22 Geberemariyam BS, Donka GM, Wordofa B. Assessment of knowledge and practices of healthcare workers towards infection prevention and associated factors in healthcare facilities of West Arsi District, Southeast Ethiopia: a facility-based cross-sectional study. *Arch Public Health* 2018;76:1.
23 Woldegeorgis BZ, Kerbo AA, Obsa MS, *et al*. A systematic review and meta-analysis of antimicrobial resistance knowledge, attitudes, and practices: Current evidence to build a strong national antimicrobial drug resistance narrative in Ethiopia. *PLoS ONE* 2023;18:e0287042.
24 Storr J, Twyman A, Zingg W, *et al*. Core components for effective infection prevention and control programmes: new WHO evidence-based recommendations. *Antimicrob Resist Infect Control* 2017;6:1–18.
25 Masia MD, Dettori M. Antimicrobial Resistance, Healthcare-Associated Infections, and Environmental Microbial Contamination. *Healthcare (Basel)* 2022;10.
26 Bayleyegn B, Mehari A, Damtie D, *et al*. Knowledge, Attitude and Practice on Hospital-Acquired Infection Prevention and Associated Factors Among Healthcare Workers at University of Gondar Comprehensive Specialized Hospital, Northwest Ethiopia. *Infect Drug Resist* 2021;14:259–66.
27 Sihombing B, Bhatia R, Srivastava R, *et al*. Response to antimicrobial resistance in South-East Asia Region. *Lancet Reg Health Southeast Asia* 2023;18.

28 Kiggundu R, Waswa JP, Konduri N, *et al*. A One Health approach to fight antimicrobial resistance in Uganda: Implementation experience, results, and lessons learned. *Biosaf Health* 2024;6:125–32.
29 Gebretekle GB, Haile Mariam D, Abebe W, *et al*. Opportunities and barriers to implementing antibiotic stewardship in low and middle-income countries: Lessons from a mixed-methods study in a tertiary care hospital in Ethiopia. *PLoS One* 2018;13:e0208447.
30 Cella E, Giovanetti M, Benedetti F, *et al*. Joining Forces against Antibiotic Resistance: The One Health Solution. *Pathogens* 2023;12.
31 McEwen SA, Collignon PJ. Antimicrobial Resistance: a One Health Perspective. *Microbiol Spectr* 2018;6.
32 Mudenda S, Daka V, Matafwali SK. World Health Organization AWaRe framework for antibiotic stewardship: Where are we now and where do we need to go? An expert viewpoint. *Antimicrob Steward Healthc Epidemiol* 2023;3:e84.
33 Al-Shami HA, Abubakar U, Hussein MSE, *et al*. Awareness, practices and perceptions of community pharmacists towards antimicrobial resistance and antimicrobial stewardship in Libya: a cross-sectional study. *J Pharm Policy Pract* 2023;16:46.
34 Abera B, Kibret M, Mulu W. Knowledge and beliefs on antimicrobial resistance among physicians and nurses in hospitals in Amhara Region, Ethiopia. *BMC Pharmacol Toxicol* 2014;15:26.
35 Mudenda S, Chabalenge B, Daka V, *et al*. Knowledge, awareness and practices of healthcare workers regarding antimicrobial use, resistance and stewardship in Zambia: a multi-facility cross-sectional study. *JAC Antimicrob Resist* 2024;6:dlae076.
36 Gashaw M, Gudina EK, Tadesse W, *et al*. Hospital Wastes as Potential Sources for Multi-Drug-Resistant ESBL-Producing Bacteria at a Tertiary Hospital in Ethiopia. *Antibiotics (Basel)* 2024;13.
37 Ahmed SK, Hussein S, Qurbani K, *et al*. Antimicrobial resistance: Impacts, challenges, and future prospects. J Med Surg Public Health 2024;2:100081.
38 Bernatchez SF. Reducing antimicrobial resistance by practicing better infection prevention and control. *Am J Infect Control* 2023;51:1063–6.
39 Abalkhail A, Al Imam MH, Elmosaad YM, *et al*. Knowledge, Attitude and Practice of Standard Infection Control Precautions among Health-Care Workers in a University Hospital in Qassim, Saudi Arabia: A Cross-Sectional Survey. *Int J Environ Res Public Health* 2021;18:11831.
40 Moghnieh R, Al-Maani AS, Berro J, *et al*. Mapping of infection prevention and control education and training in some countries of the World Health Organization's Eastern Mediterranean Region: current situation and future needs. *Antimicrob Resist Infect Control* 2023;12:90.
41 Steele SG, Toribio J-A, Booy R, *et al*. What makes an effective One Health clinical practitioner? Opinions of Australian One Health experts. *One Health* 2019;8:100108.
42 Khan MS, Rothman-Ostrow P, Spencer J, *et al*. The growth and strategic functioning of One Health networks: a systematic analysis. *Lancet Planet Health* 2018;2:e264–73.
43 Amponsah OKO, Owusu-Ofori A, Ayisi-Boateng NK, *et al*. Antimicrobial stewardship capacity and infection prevention and control assessment of three health facilities in the Ashanti Region of Ghana. *JAC Antimicrob Resist* 2022;4:dlac034.
44 Puro V, Coppola N, Frasca A, *et al*. Pillars for prevention and control of healthcare-associated infections: an Italian expert opinion statement. *Antimicrob Resist Infect Control* 2022;11:87.