

Antimicrobial resistance and primary health care

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Acknowledgements

"Antimicrobial resistance and primary health care" forms part of a series of thematic papers produced under the overall direction of Shannon Barkley and Ed Kelley in the Department of Service Delivery and Safety, World Health Organization headquarters, Geneva, Switzerland.

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We also thank the following international experts for providing advice and comments: Palitha Abeykoon (Sri Lanka Medical Association, Sri Lanka), Alexandre Costa (UNICEF headquarters, New York), David Sanders (School of Public Health, University of the Western Cape, South Africa) and Paul Rutter (UNICEF, South Asia).

Useful comments and suggestions were made by WHO staff, in particular Nima Asgari, Klara Tisocki, Lluis Vinyals and Sirenda Vong from the South-East Asia Regional Office, and Benedetta Allegranzi, Raniero Guerra, Francis Moussy, Carmen Pessoa da Silva, Marc Sprenger and Lizzie Madden (consultant) from WHO headquarters.

The views expressed in this document do not necessarily represent the opinions of the individuals mentioned here or their affiliated institutions.

WHO/HIS/SDS/2018.56

Contents

Introduction	1
Scale and nature of the problem of antimicrobial resistance	5
Antimicrobial resistance is an increasingly severe threat to health worldwide	5
Increasing antimicrobial resistance will force people into poverty	5
The burden of disease has shifted but antibiotics remain essential	6
The antibiotic consumption conundrum: essential to care but a driver of resistance	6
Antibiotic overuse hastens the emergence of resistance	6
Inappropriate use of antibiotics contributes to antibiotic resistance and fails patients	7
Health care workers may not understand the issue or have sufficient resources	9
Unsafe water and poor sanitation increase antimicrobial resistance	10
Changing context of health and health care	12
Primary care for ageing populations requires antibiotics	12
People are moving to cities and creating new health needs	13
Commercial health care increases patients' costs and antibiotic use	13
Technology is reshaping primary care	13
The Internet improves access to good-quality primary care but also spreads misinformation	15
Growing populations need to be fed	15
Role of primary health care in an effective response to antimicrobial resistance	16
Community-based actions are needed	16
Community engagement and empowerment can raise awareness and change behaviour	16
Antimicrobial resistance must also be addressed in the food chain	17

Primary	care can reduce antimicrobial resistance	19
P	rimary care facilities should set the example for community hygiene	19
N	Maintaining access to antibiotics requires good supply chain management	19
T	raining health workers is essential to rational antibiotic use	21
S	imple diagnostic tests and other technologies help control antimicrobial resistance	21
	ring antimicrobial effectiveness should be part of an integrated approach to care	22
Ir	ntegrated programmes can effectively tackle antimicrobial resistance	23
Ir	mmunization reduces infection, transmission and antibiotic use	23
Policies,	regulations and monitoring are needed to control antimicrobial resistance	24
Ir	mproving access to primary care should not mean overuse of antibiotics	24
S	everal policies can help reduce inappropriate prescribing in primary care	26
V	Vithout maps of resistance and consumption, prescribers are lost	26
Multised	ctoral action on antimicrobial resistance should be emphasized at the local level	28
А	antibiotic use in agriculture must be addressed	28
Е	nvironmental contamination is a concern	29
А	action on antimicrobial resistance must involve all sectors	30
G	Global and national action plans emphasize education	30
Concluding the	oughts and next steps	33
References		34
Appendix		43



The promotion and protection of the health of the people is essential to sustained economic and social development and contributes to a better quality of life and to world peace.

Declaration of Alma-Ata, 1978 (1)

The time may come when penicillin can be bought by anyone in the shops. Then there is the danger that the ignorant man may easily underdose himself and by exposing his microbes to non-lethal quantities of the drug make them resistant.

Sir Alexander Fleming, Nobel lecture, 1945 (2)

The global move towards universal health coverage, and within that journey the urgent need to develop and implement feasible models of primary care for the billions of people who still lack access, are central themes in the health and development dialogue. Meanwhile, the declining effectiveness of antibiotics in treating common bacterial pathogens because of antimicrobial resistance (AMR) is an increasing concern and a major threat to global health.

The relationship between AMR and primary health care is bidirectional. Good-quality primary care, which includes vaccination, the rational use of medicines and the availability of effective antibiotics, is one way to reduce the inappropriate use of antibiotics. At the same time, preserving the effectiveness of antibiotics through improved stewardship is central to providing primary care. In this paper, we consider the bidirectional linkages between AMR and primary care and explore how the problems of AMR and lack of access to primary care can be addressed synergistically.





Introduction

Forty years ago, the Declaration of Alma-Ata enshrined primary health care as the basic approach to addressing health needs (1). The social, economic and demographic context of health care has since changed, with huge reductions in poverty, dramatic population growth, a changing age structure of populations, mass population displacement because of migration and natural disasters, and a shift from infectious to noncommunicable diseases as the major cause of disease burden. Life expectancy has risen in low- and middle-income countries and is now converging with that in high-income countries. Medical insurance has become commonplace, and new technologies have redefined what health care can offer. However, health inequities within some countries exceed those between countries, and despite efforts to improve the quality of health care, unregulated fee-for-service providers continue to be the primary source of care in many low- and middleincome countries (3).

The 2018 Declaration of Astana builds on the 1978 Declaration of Alma-Ata, which called for health for all. The new declaration enjoins a renewed commitment to primary health care to achieve universal health coverage and the Sustainable Development Goals (SDGs). It urges better primary care, identifies essential public health functions, and emphasizes disease prevention and health promotion.¹

This reaffirmation of the importance of primary care is timely, given the growing threat of antimicrobial resistance (AMR). AMR describes the situation where infections caused by microbes no longer respond to treatment. The emergence and spread of drug resistance poses a serious threat to modern medicine (4). World Bank research suggests that AMR could cost low-income countries more than 5% of their gross domestic product and push 28 million people, mostly in the developing world, into poverty by 2050 (4). Rising incomes, high background rates of infectious diseases and easy, over-the-counter access to antibiotics, driven in part by lack of access to good-quality primary care, are exacerbating the problem of resistance in low- and middle-income countries. Low-income countries are particularly vulnerable because the second-line antibiotics needed to combat the most resistant infections are often unaffordable (4).

¹ The World Health Organization differentiates primary health care, a whole-of-society approach to health to maximize the level and distribution of health and well-being by acting simultaneously on three components: 1) primary care and essential public health functions as the core of integrated health services, 2) multisectoral policy and action, and 3) empowering people and communities, from primary care, health services that are first-contact, continuous, comprehensive, and coordinated.

Just as access to effective antimicrobials — alongside poverty reduction, greater agricultural productivity, water and sanitation infrastructure, perinatal and maternal care, HIV/AIDS and malaria treatment, and community health and vaccination programmes — underpinned progress towards the UN Millennium Development Goals (Appendix, Box A1) (5), continued access to antimicrobials will be essential to achieving the SDGs. The poorest are hardest hit by resistant infections, and increasing health care costs have the potential to push people back into poverty, reversing the gains of the past 40 years (4). Thus, the rise of AMR poses a challenge to societal development.

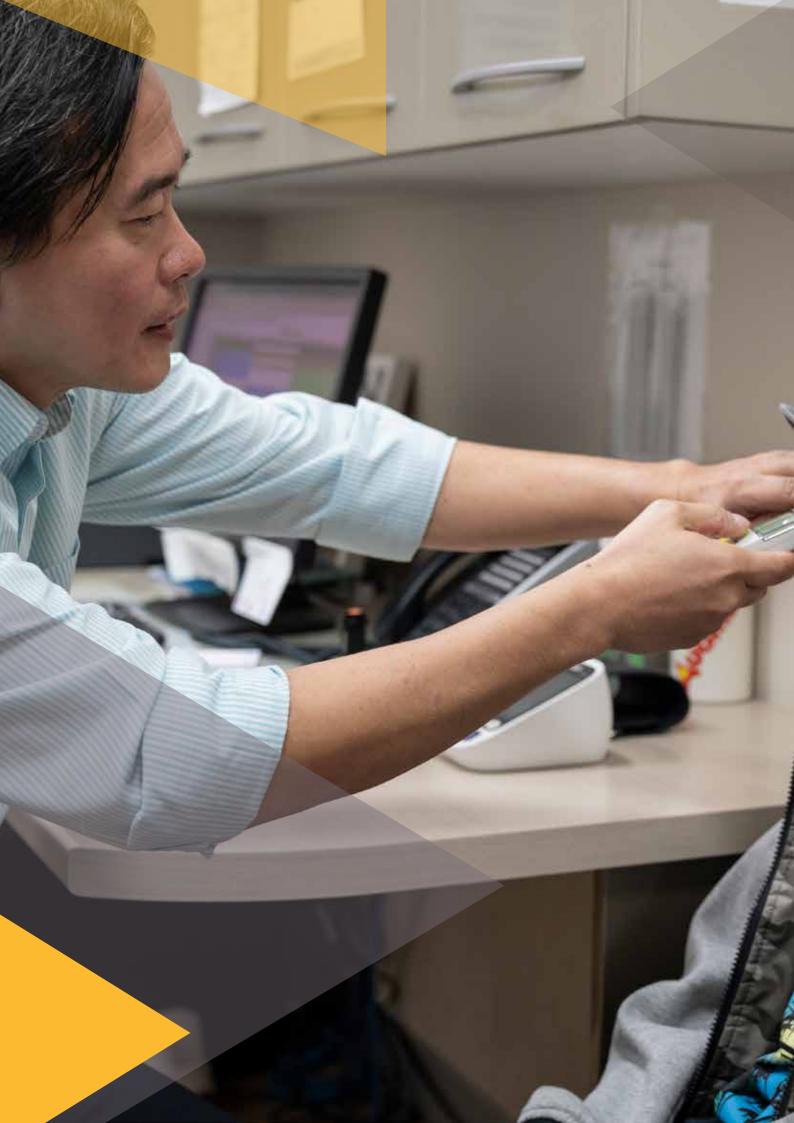
Antibiotics are often used as a substitute for basic public health. When formal primary care is missing, patients obtain antibiotics from pharmacists or lay providers (6,7). In poor regions with ineffective infection prevention and control and limited access to clean water and sanitation, health care has come to depend on cheap antibiotics (8). Increasing resistance undermines the quality of care and services. Conversely, primary health care can dramatically reduce AMR through simple, cost-effective interventions.

To date, the response to AMR has focused on infection prevention and control in tertiary care, alongside antimicrobial stewardship and better surveillance, including detection of resistant strains. Yet the elements essential to combat AMR are the basic components of a well-functioning primary health care system that improves cost-effectiveness, efficiency, health outcomes and patient satisfaction (9).

These align with the three pillars of primary health care: primary care and essential public health functions as the core of integrated health services, engaged and empowered people, and multisectoral policy and action to improve health (10).









Primary care and essential public health functions as the core of integrated health services

An effective AMR response requires access to clean, safe primary care facilities, supported by essential public health functions, with effective infection prevention and control procedures, adequate water and sanitation, and well-resourced, trained health care workers. Patients' first contact with the health system should involve comprehensive, continuous, coordinated and patient-centred care. To ensure rational prescribing, this primary care must be integrated with systems that monitor antibiotic use and emergent resistance at the community level. Prescribing can then be based on accurate diagnosis and local resistance patterns.

The five elements of essential public health functions in primary health care are: health protection, health promotion, disease prevention (service delivery), surveillance and preparedness (intelligence). These functions are key to effective prevention and management of infection as well as more appropriate use of antibiotics, which underpins AMR control.

Engaged and empowered people

People and communities should be the "owners" of their own health, advocates of policies that promote and protect health, and architects of the services that contribute to health. If engaged and empowered, people will use antibiotics more appropriately, demand reductions in antibiotic use in food animals, practice infection control measures, such as hygienic food preparation and handwashing, and promote toilet use and construction of sanitation infrastructure.

Multisectoral action on health

All policies with health ramifications should be coordinated. AMR is a threat to livestock production as well as human health, and it is driven by inappropriate antimicrobial use in agriculture and food production as well as in human health care. Globally, more antibiotics are used in livestock production than in human health. A coherent, coordinated response by government agencies at both national and local levels is needed to strengthen the regulation of medicines and prevent and manage infection across human, animal and environmental sectors.



Scale and nature of the problem of antimicrobial resistance

Antimicrobial resistance is an increasingly severe threat to health worldwide

Studies of drug resistance are often conducted in hospitals, but resistance is commonly found in community settings (11,12). In a recent study of serious, community-acquired infections in young children in South-East Asia, 17% of blood culture isolates were not susceptible to penicillin, ampicillin, gentamicin, or a combination of these drugs (13). Drug resistance in syphilis, gonorrhoea and chlamydia is an emerging threat (14). Gonorrhoea, with 106 million new cases worldwide each year (15), has recently made headlines for being resistant to multiple antibiotics (16).

Drug resistance makes infections more difficult and expensive to treat and reduces the likelihood of treatment success. Treatment for drug-susceptible tuberculosis (TB) costs US\$ 40 per patient, lasts six months, and has a success rate of at least 85%. In contrast, treatment for multidrug-resistant TB costs more than US\$ 1000 per patient and lasts nine to 12 months, and has a success rate of 54% (17).

Increasing antimicrobial resistance will force people into poverty

The effects of AMR extend beyond health into poverty. In countries that have lessened the gaps in health care coverage and inequality, emerging resistance threatens to widen them (4). Despite the shift in the global burden of disease to noncommunicable diseases, infectious diseases disproportionately affect those living in poverty. An additional 28 million people could face extreme poverty by 2030 because of AMR, and most of this burden will afflict low- and middle-income countries (4). Health systems in the developing world rely on the availability of cheap antibiotics and are not equipped to cope with the increasing burden of resistant infections. The high treatment costs associated with resistant infections, in addition to worse health outcomes, have severe consequences in developing countries, where the proportion of health care expenses paid out of pocket can be high — for example, 67% in both India and Nepal (17,18). The number of people pushed into poverty each year by out-of-pocket health expenditure is not known; in India alone the estimates range from 46 million households (19) to 57 million people (18). Out-of-pocket expenditure is predominantly — perhaps 80% in India — for medicines, including antibiotics and other drugs, mainly in outpatient care (18). This is the case in other countries as well; in Nepal, 77.1% of out-of-pocket payments are for medicines, and in Timor-Leste, 70% (18). In low- and middle-income countries, an increase of 10% in out-of-pocket health care expenditure has been associated with a 3.1% increase in resistant isolates, apparently because co-payments in the public health sector drive patients to the private market, where financial incentives increase inappropriate prescribing, and drug quality is poorly regulated (20).

Universal health coverage has the potential to bring people out of poverty by enabling adults to work and children to attend school (21). Containment of AMR would augment this benefit: access to effective antibiotics would reduce disease burden, rapid diagnostics would promote appropriate prescribing, and patients could afford to pay for their prescribed courses of antibiotics.

The burden of disease has shifted but antibiotics remain essential

From 2000 to 2016, the percentage of deaths worldwide caused by communicable diseases and maternal, perinatal and nutritional conditions dropped from 31% to 20% (22), in part because of access to antibiotics, whereas deaths attributable to noncommunicable diseases increased. Communicable and noncommunicable diseases are interrelated and cannot be dealt with in isolation. Multiple conditions may occur in the same patient, and one disease may increase susceptibility to another, making patients vulnerable to secondary infections. Lung cancer, diabetes and chronic obstructive pulmonary disease are among the leading causes of death worldwide (23). Both cancer chemotherapy and surgery require prophylactic antibiotics (24), and patients with chronic obstructive pulmonary disease may also require regular antibiotic treatment (25). In addition, many diseases linked to diabetes, such as TB, are alleviated by antibiotics, as are infections in patients with undiagnosed diabetes (26).

The antibiotic consumption conundrum: essential to care but a driver of resistance

Expanded access to health care in recent decades has increased both appropriate and inappropriate use of antibiotics (27). The 65% increase in antibiotic consumption worldwide between 2000 and 2015 (28) is associated with mounting resistance. Antibiotic consumption has increased by 114% in low- and middle-income countries (28), but more children still die from a lack of access to antibiotics than from resistant infections (29). Paradoxically, progress towards universal health coverage risks undermining the efficacy of antibiotics. Universal coverage aims to ensure access to good-quality antimicrobials when needed, but this must be balanced with more robust systems to prevent inappropriate use.

Antibiotic overuse hastens the emergence of resistance

Overprescribing by health care professionals is one driver of AMR. In South-East Asia, antibiotics are available over the counter without a prescription in all countries except Bhutan. Furthermore, two-thirds of antibiotics in this region are consumed without a prescription (30), even though the practice is prohibited everywhere except Thailand and Timor-Leste (31). Public awareness of AMR is often low; community studies have found that many people cannot correctly define "antibiotic" (12,32). Ease of access has resulted in rates of self-medication as high as 42.5% in Jordan (33) and 73% in some parts of India (34). Often, self-prescribers have limited knowledge of when antibiotics are indicated and how they should be used (32). Online pharmacies have increased inappropriate access to antibiotics. One study found 36.2% of 138 online vendors sold antibiotics without a prescription. These vendors were also most likely to sell quantities in excess of a single course, and antibiotics often took more than seven days to reach the customer, giving the infection an opportunity to progress (35).

In rural areas, medical professionals may be expensive, clinics may be long distances away, or patients may doubt clinicians' medical ability. In rural India, 50% of people go directly to a pharmacy for antibiotics as a first choice (32). Doctors may fear losing business if they do not meet patients' expectations by prescribing antibiotics (36). In some health systems, doctors receive commissions from medicine sales and thus have incentives to overprescribe (37).

Inappropriate use of antibiotics contributes to antibiotic resistance and fails patients

According to a 2014 study, 81.3% of medical and pharmacy students in Malaysia incorrectly believed that antibiotics could treat influenza and 81.3% believed dispensing antibiotics to meet patient demand and prescribing antibiotics over the telephone constituted good patient care (38). Even when antibiotics are appropriately prescribed, failures in supply, particularly in the developing world, frequently lead to missed doses or incomplete antibiotic courses (39). Antibiotic choices may be governed by practical limitations, such as what drugs are available or not yet expired (40). Improvements to the entire health system and medicine supply chain are necessary to tackle these problems (41).

Antibiotics are often administered to treat diarrhoea and acute respiratory infections, although in many cases these conditions are viral and do not need antibiotics. For children in low- and middle-income countries, inappropriate antibiotic prescribing has increased from 42% before 1990 to 72% in 2006–2009 for viral upper respiratory tract infections (42). In these countries, diagnostic tests are often not affordable, accessible, or reliable, and human resources and laboratory infrastructure may not be available (37). Microbial samples take time to culture whereas first-line antibiotics are cheap; where resources are limited, it can seem more cost-efficient to test for resistance empirically by administering treatment. Although 4.1% of new cases and 19% of previously treated cases of TB worldwide are multidrug resistant, 61% of individuals with a confirmed diagnosis for TB are not tested for resistant strains, and only 22% of those with multidrug-resistant TB receive treatment (43).





Health care workers may not understand the issue or have sufficient resources

Some health care workers consider AMR a national or international problem but not something that affects their day-to-day practice (44–47). In the United States, 92% of medical students agreed that knowledge of antimicrobials was extremely important for all medical practitioners, but only a third felt adequately aware of the principles of antimicrobial use, and 90% said they needed more education on appropriate use (48). In some settings nurse practitioners receive minimal education about AMR and appropriate antibiotic prescribing (49), and may prescribe antibiotics inappropriately (50).

Even with high awareness of AMR, health care workers operating in settings with limited resources have to strike a difficult balance in practice (37). They know that antibiotic prescriptions should not be written indiscriminately, but the risk of infection may be high because of limited infection prevention and control or poor hygiene and sanitation. They may also lack information about local resistance patterns, be unable to provide follow-up care to patients, or not have the time or the diagnostic tests to determine the cause of an ailment (37). Human resource shortages are common in primary care, particularly in low- and middle-income countries. In West Bengal, India, some outpatient clinics have only one doctor yet have as many as 800 patients needing attention in a single day (37). Thailand has 0.5 doctors per 1 000 population, in contrast to 2.6 per 1 000 in the United States (51); with so few doctors limiting antibiotic access to prescription only in many LMICs is not feasible. Shortages of trained health care professionals, particularly in rural areas, have created an opportunity for alternative medicine and unregistered medical practitioners. In developing countries, up to 80% of the population may turn to such providers (52), who often tie into the culture of the community and may be more available or more trusted. Traditional medicine may offer a useful alternative to antibiotics, particularly for viral illnesses, such as influenza; however, unlicensed medical providers, including traditional medicine healers, use antibiotics even though they lack appropriate training (32).



Unsafe water and poor sanitation increase antimicrobial resistance

Inadequate water, sanitation and hygiene (WASH) in the developing world contributes to the spread of infectious disease and antibiotic use. In least developed countries, only 32% of people have access to basic sanitation, and only 27% have access to hand-washing facilities with soap and water (53). In the least-developed countries, as classified by the UN, 20% of people still defecate in the open (22). Inadequate WASH causes more than half of diarrhoeal disease; this burden could be reduced by an estimated 47% to 50% through access to safe water and by 69% to 72% through improved sanitation (54). Although only 15% of diarrhoea cases are bacterial in origin and treatable with antibiotics, in the developing world 40% to 80% of cases are given antibiotics. Improved WASH services could mean 590 million fewer cases of diarrhoea treated with antibiotics in India alone by 2030 (54), thereby reducing the spread of resistant infections (Box 1).

Box 1. A movement to improve sanitation in India

Swachh Bharat Abhiyan (the "Clean India Mission") is an initiative of the Government of India to end open defecation, achieve universal sanitation coverage, promote village cleanliness, and improve access to clean drinking water by October 2019. More than 77 million toilets have been built since the mission was conceived in 2014 (55). The programme could avert up to 30 000 deaths from diarrhoea and malnutrition if complete sanitation coverage is achieved (56). Deficiencies in sanitation coverage caused 199 million cases of diarrhoea annually before the initiative began, but if the programme meets targets, it could avoid the loss of up to 14 million disability-adjusted life years between 2014 and 2019 (56). Swachh Bharat is reducing the spread of antimicrobial resistance in India (57) by creating open defecation—free zones and promoting hygienic practices in communities. This will lower the disease burden and reduce both appropriate and inappropriate antibiotic consumption (58).



Poor-quality services contribute to AMR. Many primary care facilities do not follow the basic sanitation measures of aseptic technique, hand-washing and use of personal protective equipment, such as gloves and masks (59). In low- and middle-income countries, 38% of facilities lack onsite water, 19% lack improved sanitation and 35% lack soap for hand-washing (60). Only 58% of sampled facilities across 24 countries had adequate systems to safely dispose of health care waste, which may contain both antibiotics and resistant bacteria. South-East Asia was the region with the lowest levels of safe health waste disposal, at 44% (60). Both antibiotics and resistant bacteria may be present in untreated hospital waste. Inadequate health waste disposal mechanisms put staff and patients at risk of infection and contribute to AMR. Contamination of the water supply promotes the spread of both susceptible and resistant infections and thus has implications for antibiotic effectiveness (61).



Primary care for ageing populations requires antibiotics

By 2050, about a quarter of the world's people will be 60 years or older in all WHO regions except Africa (62). Ageing populations present specific challenges to primary health care. Older people are more commonly affected by chronic illnesses — diabetes, stroke, heart disease, arthritis, dementia and cancer — which may cause disability and reduce mobility (63). Elderly patients often have implants, catheter infections, joint replacement surgeries and chemotherapy whose associated acute ailments may require antibiotic treatment. Older people may be prescribed long-term antibiotics to prevent recurring infections (64), such as chronic urinary tract infections in some elderly women (65). Furthermore, elderly patients may take multiple medications, leading to low adherence to drug schedules (66). In addition to the cumulative effects of long-term alcohol and tobacco use, low levels of exercise and poor diet make elderly people more vulnerable to infection. The resulting high levels of antibiotic use can increase selection for resistance in this population (67).

People are moving to cities and creating new health needs

More than half of the world's population lives in an urban environment (22). Between 2018 and 2050, India alone will add 416 million urban dwellers (68). Dense populations, combined with higher antibiotic consumption in urban areas, are correlated with increased resistance (69). For example, increasing population density has been associated with a rise in AMR in the Chao Phraya River basin in Thailand (70). Waste management and WASH can be challenging in large cities, and urban areas have been associated with many outbreaks of infectious diseases, particularly those transmitted by the faecal-oral route. High population density also increases exposure to airborne infectious diseases, such as influenza, measles and TB (71).

Primary care must adapt to tackle the growing challenges of urban life. As just one example, urban residents can choose among many health care providers, and the increased competition may pressure providers to keep their clients satisfied by unnecessarily prescribing antibiotics (72). Strong regulation is needed to prevent such effects and their consequences for AMR.

Commercial health care increases patients' costs and antibiotic use

In many low- and middle-income countries, health care is privately financed: out-of-pocket payments dropped just 5% between 2000 (49%) and 2015 (44%) (22). In India, 70% of disease episodes are treated in the private sector, and in Sri Lanka, more than 40% of out-of-pocket payments are fees for private medical practitioners (18). Seventy years ago, the Indian health system was 8% private; today, 80% to 85% of the licensed physicians, 93% of the hospitals and 80% of the outpatient clinics operate at least in part in the for-profit private sector (73). Services at private facilities often fall short of those at public facilities (42), which are less likely to prescribe antibiotics inappropriately (74).

Technology is reshaping primary care

The 1978 Alma-Ata Declaration describes primary health care as essential care based on "practical, scientifically sound and socially acceptable methods and technology" (75). The Astana Declaration has now reinforced the role of technology as an essential tool in good-quality primary care services (10). Technological innovations are improving surveillance, prescribing patterns and public awareness. Rapid diagnostic tests would enable physicians to prescribe specific antibiotics rather than broad-spectrum antibiotics (76) and to distinguish between viral and bacterial infections. Machine learning has made it possible to track and classify antibiotic resistance genes from different sources (77) and to understand patterns in consumption. This ability to track the origin and spread of antimicrobial resistance genes will facilitate the development of AMR control strategies (77).

Even in remote regions, mobile applications can address a range of health needs. BugWise, an application rolled out in South Africa in late 2017, gives patients information on their diagnosis, the appropriate use of antimicrobials and infection prevention; doctors can enter a patient's characteristics and symptoms to obtain guidance on their diagnosis and the local prevalence of resistance (78).



The Internet improves access to good-quality primary care but also spreads misinformation

Across the world, educational attainment has risen (22), and increasing numbers of people with Internet access are educating themselves to manage their own health (79). Health care workers now have opportunities to promote health messages, appropriate antibiotic use and hygiene practices at the community level (80). In 2017 there were 2.46 billion social media users worldwide, and the number is projected to increase to 3.01 billion by 2021 (81). Online social networks can help extend public health awareness (82) but may also promote misinformation on health issues, such as use of antibiotics to treat colds and influenza (83) and the supposed danger of vaccines (84). In France, a seasonal public health campaign to spread public awareness of viral respiratory infections and antibiotic resistance led to a 27% reduction in antibiotic use over five years (85). Public health messaging through mass media campaigns (82) has also been successful in reducing the spread of infections by raising public awareness about sexual health and increasing condom use.

Growing populations need to be fed

As populations become richer, so do their diets. Growing demand for animal protein is causing a shift from traditional mixed farms to large, industrial-scale farms, which tend to administer antibiotics extensively both for livestock growth promotion and as prophylaxis (86). Antimicrobial use in pig and poultry production is predicted to double in line with increasing global meat consumption (87). Already the majority of antibiotic use occurs in the farming sector (88). Antibiotic use in livestock has been linked to the emergence of resistance (89,90), and the transfer of resistant bacteria has been seen among farm workers, animals and the environment at poultry and pig farms in Ethiopia and Denmark (91,92). Even low concentrations of antibiotics can select for resistant bacteria of animal origin, which then spread to humans through the environment, food products and agricultural workers (93).

Population growth has put pressure on food resources and malnutrition is still a problem in the developing world. Undernourished people have compromised immune systems and hence are more vulnerable to infection; conversely, infection can also cause malnutrition by impairing nutrient absorption (94). Bacterial infections, including those that cause diarrhoea and pneumonia, circulate in malnourished populations, increasing the burden of resistant and susceptible disease alike (94). Food scarcity can lead people to pay less attention to food safety, and the resulting infections from contaminated food can both increase antibiotic consumption and facilitate the spread of AMR. The high prevalence of bacterial infections in underfed populations also increases antibiotic consumption. In short, access to adequate nutrition would reduce antibiotic use.



Role of primary health care in an effective response to antimicrobial resistance

Community-based actions are needed

Community engagement and empowerment can raise awareness and change behaviour

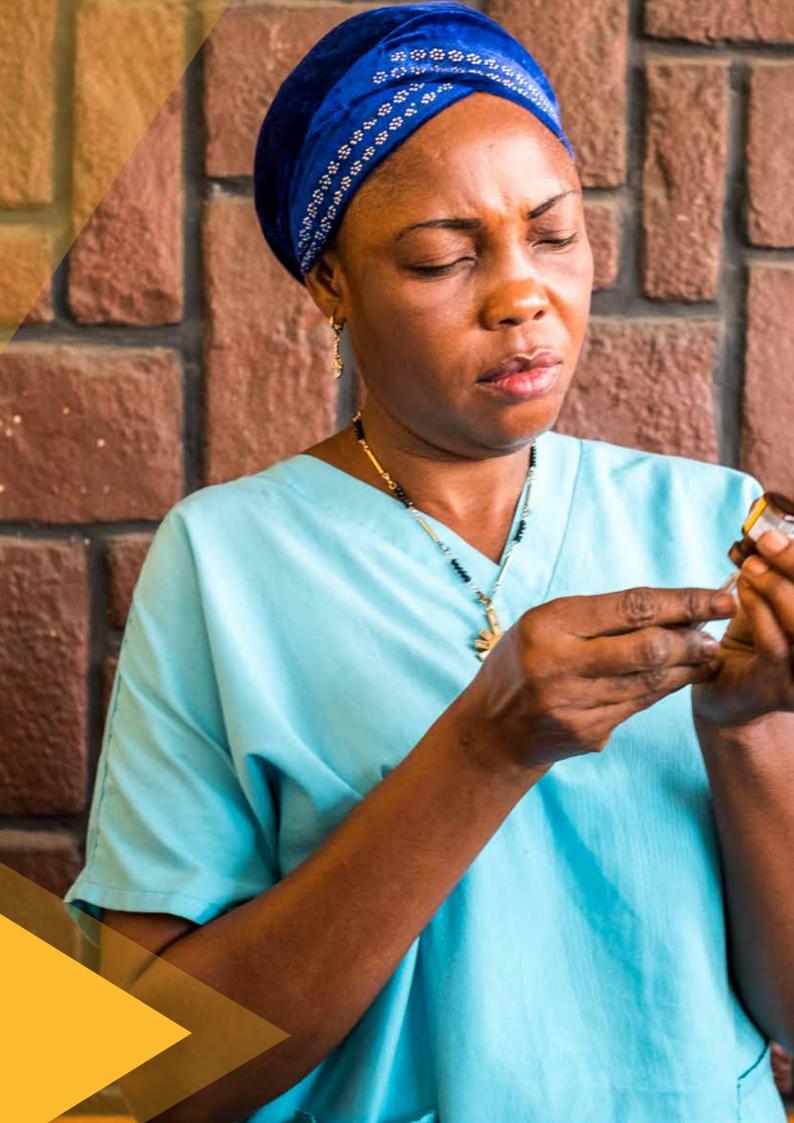
Community-based approaches, which view people and communities as owners and advocates of their own health, can be an effective tool to reduce antibiotic use and improve hygiene practices. In Laos, for example, a campaign to promote hygiene distributed educational materials through families considered to be leaders in the community (95). Changes to the labelling of antibiotic medicines can also raise public awareness (96) and indicate that antibiotics are protected drugs. In India, the "redline campaign" labelled antibiotic packaging with a red line, in an effort to increase public awareness of antibiotic resistance and to decrease inappropriate use.



Online sales are a problem for regulators because the Internet is a prohibitively large space to regulate, and sellers work across borders more easily than do the regulators charged with protecting the public from antibiotic misuse and counterfeit and falsified medications (97–99). Consumers and primary care prescribers should be made aware of the risks of using uncertified retailers and encouraged to buy from certified online pharmacies (100).

Antimicrobial resistance must also be addressed in the food chain

Reducing antibiotic use in animal husbandry has financial consequences for farmers, particularly where hygiene and nutrition for animals are poor. Nevertheless, primary care providers should be informed about agricultural use of antimicrobials through specific training or educational materials. Raising public awareness of the risks of AMR has already driven change in antibiotic use where consumers have expressed their preference for a sustainable and safe food supply (101). Awareness of the role of farming and agriculture in the emergence of AMR can also prompt better hygiene and reduced antibiotic use on farms, thereby reducing the potential for transfer of resistant infections between farm and community.





Primary care can reduce antimicrobial resistance

Primary care facilities should set the example for community hygiene

Without basic water, sanitation and hygiene, primary care facilities become points of exposure to infection, for both patients and staff. Such facilities can act as the starting point for AMR transmission in the community and elsewhere, and may lead staff to lose confidence in their practice. Hand hygiene stations, sanitary toilets and water treatment not only improve the quality of care but also increase the uptake of health care services, encourage mothers to give birth in facilities, improve staff morale and become the model for WASH practices in the community (60). Both infrastructure and awareness are needed. Primary care facilities need adequate water and sanitation, a built environment that allows thorough cleaning and hygiene practices, and a staff culture of consistent safe hygiene. Health workers must be trained in infection prevention and control and supported with adequate resources, policies and systems that entrench good hand-washing practice, wearing of gloves where appropriate, use of sterile equipment, safe waste disposal and cleaning of contaminated laundry (102). Standards for and monitoring of the disposal of unused antibiotics, effluent and solid waste are also needed (60).

Maintaining access to antibiotics requires good supply chain management

Antibiotic supply chains are complex. For some antibiotics, the number of suppliers has increased, which has made effective management, regulation and quality assurance more difficult (103). For example, in some African countries, more than 200 amoxicillin products are registered. In other cases, low prices have reduced the number of manufacturers and wholesalers of other essential medicines, creating vulnerabilities in the supply chain. For example, benzathine penicillin, usually the first treatment for syphilis, has been in short supply in 39 countries, including Germany, India and the United States, since 2015 (103).



Antibiotic shortages are particularly common in low- and middle-income countries, where supply chains may be weak, pharmaceutical management capacity poor, procurement systems ineffective and rural facilities isolated. In addition, inadequacies in distribution systems may prevent antibiotic supplies from reaching peripheral facilities and cause stock-outs (104), or drugs may degrade and become less effective because of inadequate storage. A dependence on only one or a few producers can make the global supply of certain antibiotics highly vulnerable to manufacturing process errors and fluctuations in the availability of active ingredients (103).

An estimated 7.2% of antibiotics worldwide are falsified or substandard. Such products may cause as many as 72 430 childhood pneumonia deaths each year (105). Substandard drugs may select for resistance if they provide a subinhibitory dose because the active pharmaceutical ingredient is insufficient or degraded. The Internet has provided opportunities for the sale of substandard and falsified drugs (106). Infections not managed with effective treatment are more likely to be transmitted and spread. Such treatment failures, in the absence of diagnostic tests, may be attributed to resistance and lead to the use of second-line antibiotics that should be conserved for resistant infections (107).

Training health workers is essential to rational antibiotic use

Currently, many health workers receive all their updates and continuing medical education from pharmaceutical representatives, who have incentives to increase drug sales, particularly of more expensive drugs (37). One remedy may be to provide unqualified and unregistered health workers with training courses, as is being done in India (108). More preservice training on AMR, in addition to continuing education modules and prescribing guidelines based on reliable, independent information, would improve adherence to best practices for antibiotic prescribing. Ideally, data on local patterns of antimicrobial use and consumption should be used to optimize use; providing feedback to overprescribers on local prescribing patterns successfully reduced prescribing in the United Kingdom (109). However, even with good information, health workers may prescribe antibiotics unnecessarily if they do not have time to diagnose an illness and provide follow-up care. Restricting antibiotic access without addressing fundamental weaknesses in primary care will not be a long-term solution to the AMR crisis.

Simple diagnostic tests and other technologies help control antimicrobial resistance

Reducing underdiagnosis and overtreatment in primary care through the provision of low-cost rapid diagnostics could reduce resistance rates (8). However, such tests for bacterial infections are still not widely available (110) and would require health care workers to be trained in their use. In the case of malaria, rapid diagnostic tests doubled the diagnosis rate in Africa between 2010 and 2016, and insecticide-treated nets have been shown to reduce malaria mortality rates in children under five by 55% (111). Access to primary care facilities has reduced the frequency of malaria morbidity by up to 66% (112). The most effective means of preventing a mild case of malaria from developing into a severe disease is through prompt diagnosis and treatment (113). The deployment of these simple technologies in primary care is therefore crucial.





Integrated programmes can effectively tackle antimicrobial resistance

Integrated community case management (iCCM) at the community level and integrated management of childhood illness (IMCI) at the facility level have both successfully used an integrated health systems approach to treat children with infections. iCCM provides a simple treatment algorithm for community health workers treating children with fever, diarrhoea, coughing, or breathing difficulties (114). IMCI offers clinical guidelines to health care facilities, as well as training and standardised medical practices for providers (115), such as criteria for referring a child to a health care centre and for prescribing antibiotics (116). The programmes have reduced mortality rates and costs for both families and health systems (117–119).

ICMI has also reduced antibiotic use even where facilities lack adequate diagnostics for infections (120). Health care workers who have completed IMCI modules are more likely to prescribe antimicrobials appropriately, to administer the first dose in the facility, and to give patients information on proper use (115,117,120–123). In many countries, community health workers can dispense amoxicillin for specific acute childhood illnesses; in Pakistan, health care workers with iCCM training who gave oral amoxicillin to children with severe pneumonia had a lower treatment failure than those who referred patients to a health facility, in part because the treatment began sooner (124).

Immunization reduces infection, transmission and antibiotic use

Vaccines prevent 2 million to 3 million deaths from diphtheria, tetanus, pertussis (whooping cough) and measles each year. An additional 1.5 million deaths could be avoided if vaccination coverage were increased (125). Vaccines can reduce AMR by lowering the disease burden and thereby reducing both disease transmission and antibiotic use. Introduction of the first pneumococcal conjugate vaccine reduced resistant invasive pneumococcal disease by 57% in the children vaccinated; it also reduced the disease in adults over 65 years by 49%, even though this population was not vaccinated (126). In Israel, children who had received the pneumococcal conjugate vaccine used antibiotics for 17% fewer days than children who had not received it (127). The inclusion of pneumococcal conjugate vaccine in childhood vaccination schedules could reduce the amount of antibiotics used for pneumonia cases by 47%, the equivalent of 11.4 million antibiotic days globally (28).

Policies, regulations and monitoring are needed to control antimicrobial resistance

Improving access to primary care should not mean overuse of antibiotics

At least half of the world's people still do not have their essential health needs met (128). This lack of access coexists with widespread inappropriate antibiotic use in many health systems, particularly affecting the poorest populations (129). Universal health coverage aims to improve access to primary care, but if this increases inappropriate antibiotic consumption, it could also increase antibiotic resistance, thereby reducing the effectiveness of these essential drugs and burdening health systems with higher costs. In combination with other factors, free provision of essential medicines to all patients has been shown to increase the use of good-quality medicines by as much as 10%. However, studies in China, Indonesia and the United States indicate that antibiotic use rises if insured patients are no longer limited by medicine costs (28). Policy-makers need to regulate which antibiotics are available at different tiers of health service so that increased access does not exacerbate AMR.

One way to balance access and overuse is to promote access to some antibiotics while reserving others for the treatment of resistant infections. In its most recent Model List of Essential Medicines, WHO categorized antibiotics as 1) access antibiotics, which should be widely available and quality-assured, 2) watch antibiotics, which are recommended for a limited set of specific indications, and 3) reserve antibiotics, which should be used only as a last resort (130). Primary care providers would need a reliable supply of good-quality antibiotics from the access group and then limit their use of antibiotics in the watch and reserve groups.



Several policies can help reduce inappropriate prescribing in primary care

Policies on essential medicines have been shown to reduce the use of antibiotics to treat upper respiratory tract infections. After the national policy in the Republic of South Korea was changed to prohibit doctors from dispensing drugs, antibiotic prescribing for patients with viral illness fell from 81% to 73% (131). More generally, WHO essential medicines policies have improved medicine use, especially in low- and middle-income countries. However, evidence for the success of such policies is context specific, and ongoing monitoring and evaluation are needed to ensure that interventions are effective and appropriate to the given context.

Another policy intervention, restrictions on over-the-counter dispensing of medicines without prescription, has been associated with reduced antibiotic consumption in Brazil and Mexico (132). In addition, greater regulation of the private sector can reduce industry incentives to overprescribe and ensure that health services achieve an acceptable standard of care.

Successful interventions in higher-income countries include shared decision-making, test-guided management and point-of-care testing to reduce prescribing for acute respiratory infections in primary care (133). Economic interventions, such as changing the pricing strategy, should also be investigated as ways to improve prescribing. In Nepal, charging fees per medication, rather than per prescription, was associated with lower drug wastage from inappropriate drug prescribing and a greater proportion of prescriptions that adhered to guidelines (134). Encouraging membership in professional organizations is another way of promoting good practices in the private sector.

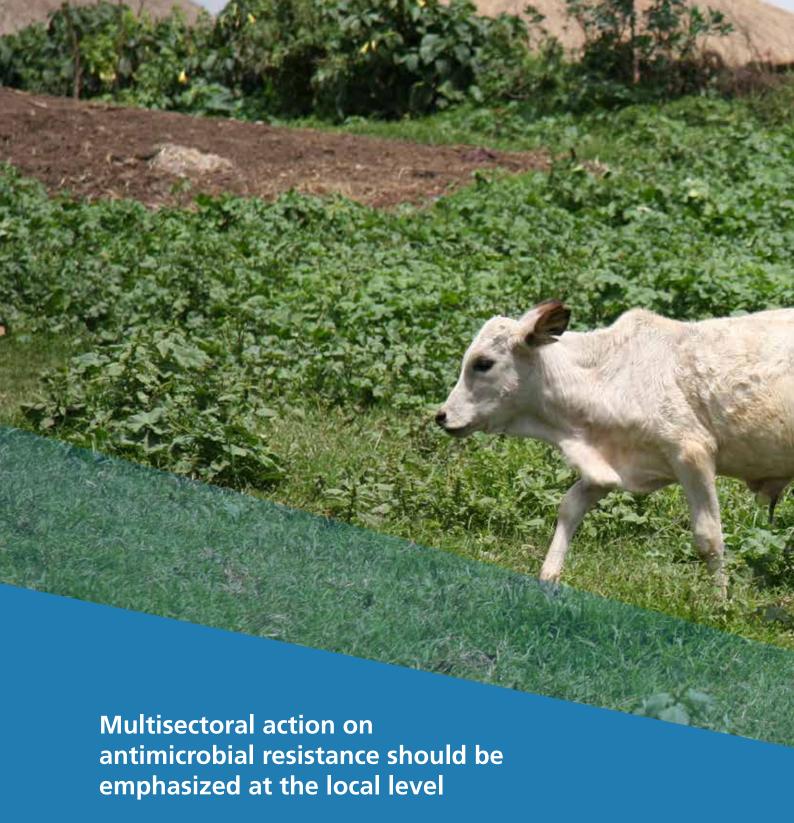
Without maps of resistance and consumption, prescribers are lost

Specific data on resistance and consumption at the community level are needed to monitor resistance, inform treatment guidelines and patient treatment (13), and understand prescribing patterns. Moreover, data are needed on total consumption, the proportion of consultations that result in antibiotics being prescribed and the proportion of antibiotics prescribed that are in the "access" group, which should be the most widely available, as defined in the WHO Model List of Essential Medicines. The data must then be used by trained community health care workers to inform treatment.

The prevalence and patterns of resistance seen in primary care could be different from those seen in tertiary hospitals, where patients are often treated for recurrent infections that are more likely to be drug resistant. In addition, treatment failure is not always a reliable indicator of antibiotic resistance, since the failure may be caused by misdiagnosis or the use of substandard or falsified drugs (107). According to the report of the WHO Global AMR Surveillance System (GLASS)², AMR rates were significantly higher in infections of hospital origin compared with those in community settings (138). These results indicate that there should be caution in basing prescribing in the community on hospital AMR profiles because first-line antibiotics may still be effective in these settings.

² Launched in 2016, GLASS is the first global AMR surveillance system, with 66 countries enrolled as of August 2018. Regional AMR surveillance networks, including CAESAR in central Asia, RELAVRA in Latin America and EARS-NET in Europe, support country participation in GLASS and provide global information on antibiotic use and resistance patterns for human infections (135–137). The system requests that countries provide data from both hospital and community levels; however, data are often obtained at the hospital level or from outpatient clinics supported by clinical laboratories, which have susceptibility testing facilities and traceable drug-ordering systems.





Antibiotic use in agriculture must be addressed

Antibiotics are widely used in food production to promote animal growth and prevent disease in intensive farming. This constant selection pressure heightens the risk that resistance will develop in animals and that the resistant bacteria can be transmitted to humans through food, contact with animals, or environmental contamination. Action to reduce the overuse of antibiotics must therefore extend beyond the human sector.

The global action plan published by WHO and endorsed by the UN Food and Agriculture Organization (FAO) and the World Organisation for Animal Health (OIE) sets out the actions needed in each sector and national action plan (27). Ministries of agriculture, fisheries, environment and others may coordinate their work at the national level; however, collaboration must extend to local levels. Countries are being encouraged to phase out the use of antibiotics as growth promoters and to avoid the widespread use of those antibiotics that are critical to human health. Support from the primary health community and coordination with the agricultural sector will be essential.



Environmental contamination is a concern

When microbes are in contact with antimicrobial agents, resistance can develop. A large proportion of antibiotics' active ingredients is excreted in the urine of humans and animals (93), and environmental contamination with antibiotic residues can occur from pharmaceutical manufacturing or from the effluent of hospitals or farm animal feed lots. Untreated human and animal faeces create opportunities for resistance to develop or be transmitted. Bacterial contamination of drinking water should always be prevented; however, the presence of resistant bacteria heightens the risks posed by contamination.

Action on antimicrobial resistance must involve all sectors

The Global Antibiotic Resistance Partnership (GARP), set up by the Center for Disease Dynamics, Economics & Policy (CDDEP) with the support of the Bill & Melinda Gates Foundation, is an example of the impact working across the one-health spectrum can have. GARP has established multisectoral national level working groups on AMR in 16 low- and middle-income countries. This has fostered momentum and advocacy at a grassroots level which has connected academics directly to policy-makers and enabled interventions to be country specific (139–140).

Global and national action plans emphasize education

WHO's global action plan on AMR calls on countries to develop national action plans to manage their response through health care, food production and the environment (27). The objectives outlined in the global action plan align with the elements of primary care, as defined by the 1978 Alma-Ata Declaration (Table 1). Primary health care, the most common point of contact between health services and the public, provides an opportunity to empower citizens to reduce AMR. Education is the connection between primary health care and AMR: educating doctors and patients that antibiotics are effective only against bacterial infections, educating farmers and veterinarians not to use antibiotics to promote growth in livestock, and educating households in personal hygiene and safe food practices that reduce the transmission of infection. All these messages can be delivered by primary health care workers.

Table 1. Alignment of 1978 Declaration of Alma-Ata and 2018 Declaration of Astana with WHO's global action on antimicrobial resistance

9		
Primary health care elements in 1978 Alma-Ata Declaration (1)	Components of primary health care in 2018 Astana Declaration (10)	WHO global action plan on antimicrobial resistance (27)
Education on prevailing health problems and methods of preventing and controlling them	 Primary care and essential public health functions as core of integrated health services 	1. To improve awareness and understanding of antimicrobial resistance through effective communication, education and training
2. Promotion of adequate food supply and proper nutrition	Multisectoral policy and action	
3. Adequate supply of safe water and basic sanitation	3. Empowered individuals, families and communities	To strengthen knowledge and the evidence base through surveillance and research
4. Maternal and child care		
Immunization against main infectious diseases		To reduce the incidence of infection through effective sanitation, hygiene and infection prevention measures
Prevention and control of locally endemic diseases		
Appropriate treatment of common diseases and injuries		4. To optimize use of antimicrobial medicines in human and animal health
8. Provision of essential drugs		5. To develop economic case for sustainable investment that takes account of needs of all countries and to increase investment in new medicines, diagnostic tools, vaccines and other interventions





The components of the national action plan that include awareness of AMR, rational use of antimicrobials, infection prevention and control, and One Health (encompassing human, environmental and animal sectors) depend on a primary care approach: AMR cannot be effectively tackled through a vertical programme. Successful strategies such as iCCM and IMCI provide useful models for a combined approach. The United Nations Children's Fund (UNICEF) has also noted that AMR poses a real threat to maternal, neonatal and child health, as recognized in UNICEF's 2016–2030 global health strategy, which highlights approaches and actions to respond to this threat (141).

In the 2018/19 WHO FAO OIE survey 129 of 194 WHO member countries reported having a national action plan (142). Countries with national action plans have started by targeting AMR in tertiary care, where infections are diagnosed, but attention to AMR at the community level will be essential for these plans to be effective. Of the 11 countries in South-East Asia, only the Democratic People's Republic of Korea, India, Indonesia and the Maldives explicitly mention primary health care (Appendix, Table A1). Strategies to address AMR in national action plans at the primary care level include raising awareness among the public and health care professionals, establishing surveillance systems, implementing guidelines on antibiotic use, improving infection prevention and control and WASH, as well as training health care professionals.

Approaches to address the growing threat of AMR are shifting from vertical disease programmes to strengthening of health systems and resilience at the community, subnational and national levels. Tackling AMR requires more data and information and better surveillance systems; good procurement and supply chain management; higher-quality services delivered in the home, the community and the health facility, with standard protocols and trained health providers; a regulated private sector for better engagement and alignment; and social and health insurance schemes that both protect patients from financial risk and prohibit the overuse of antibiotics. Addressing AMR is clearly a multisectoral responsibility: it goes beyond the health sector and requires not only WASH services, infection prevention and control and health-seeking behaviours but also food security, agricultural and environmental policies, and community awareness. Multisectoral national action plans should encompass all these dimensions and build on the successful country experiences in evidence-based strategies (e.g., iCCM, IMCI and the Expanded Programme on Immunization). Policies should pay particular attention to poor and marginalised people, including impoverished mothers and children — the people who will be most affected by AMR because they lack accessible, affordable and good-quality medical services.

Concluding thoughts and next steps

The Global Conference on Primary Health Care in Astana in October 2018 provided an opportunity to refocus global attention on the primary health care approach and how it will help achieve universal health coverage — including universal access to effective antibiotics — as part of progress towards the SDGs. Despite the rise in noncommunicable diseases, the burden of infectious disease remains substantial and is a significant proportion of the overall avoidable disease burden. AMR must be tackled in tandem with the continued development of resilient and accountable health systems that deliver high-quality primary care to those in need without imposing financial hardships.

Moving forward, the contribution of primary care and public health services to combatting AMR needs to be better reflected in national action plans on AMR. In low- and middle-income countries, actions to revitalize primary health care need to include stronger systems to prevent and manage infection both in the community and in health facilities. Community engagement and empowerment are the keys to effective behaviour change in preventing and managing common diseases without the unnecessary use of antimicrobials.

Primary care services will be trusted and used if facilities have skilled health workers and reliable supplies of good-quality diagnostics and medicines, including first-line antimicrobials. Nongovernmental organizations and private providers must be engaged in efforts to address AMR, especially by encouraging more appropriate use of antimicrobials. Better community-based monitoring systems are essential for tracking antimicrobial consumption.

Multisectoral action on AMR is essential because the agricultural sector uses antibiotics intensively. Given that farmers' livelihoods are at stake, local community leaders and platforms must be involved. Intersectoral action may be easier at the community level, even if mandated at the national level.

There are many reasons to promote primary health care, from improving people's health to protecting them from financial risk. The threat of AMR only underscores the urgency of good-quality primary care. The twin challenges of increasing access to care — especially for poor and vulnerable people — and reducing AMR can be addressed through effective primary care. If AMR continues unabated, even the best primary health care will become ineffective.



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Appendix

Box A1. Millennium Development Goal gains from antibiotic access

Goal 1: Eradicate extreme poverty and hunger

- Extreme poverty in developing countries has decreased from an average of 47% of the population in 1990 to 14% in 2015 (1). Access to antimicrobials substantially improved over the same period, particularly in low- and middle-income countries (2). People living in poverty may receive ineffective treatment (3) or may not be able to afford a full course of antibiotics, which creates the conditions for drug resistance to emerge. Access to antibiotics helps the poor escape from a vicious circle of illness and poverty.
- The proportion of undernourished people in the developing world dropped from 23% in 1990 to 13% in 2015 (1). Malnutrition is often linked to vaccine-preventable diseases (see MDG 6): not only can HIV/AIDS, TB and malaria cause malnutrition, but malnutrition can also increase susceptibility to these infectious diseases (4). Increasing access to antibiotics helps break this cycle of disease and malnutrition.
- AMR particularly threatens people who cannot afford a full course of treatment or the more expensive drugs for resistant infections (5). People living in poverty often have unsafe water, sanitation and hygiene services, which facilitate the spread of disease transmission and resistance (6).

Goal 4: Reduce child mortality

• The global mortality rate for children under 5 years declined from 90 deaths per 1 000 live births in 1990 to 43 in 2015 (1). Antibiotic treatment is essential for children with severe pneumonia (7), the leading cause of death in this age group (8). Overall, more than half of the decline in child mortality can be attributed to better treatment of pneumonia, diarrhoea, measles and malaria (5). However, growing resistance to drugs for these conditions threatens to roll back the gains and affects the poorest regions most: the under-5 mortality rate in low-income countries (73 deaths per 1 000 live births) is almost 14 times the average rate in high-income countries (5 deaths per 1 000 live births) (9).

Goal 5: Improve maternal health

- The maternal mortality rate declined from 380 deaths per 100 000 live births in 1990 to 210 in 2013 (1). Antibiotics can prevent avoidable maternal deaths caused by sepsis and other infections (10). One important intervention to reduce maternal mortality is emergency obstetric care, which often requires parenteral antibiotics (11). Good-quality care, particularly in conflict zones like Chad, Iraq and the Syrian Arab Republic depends on antibiotics to treat infection.
- Sustaining and further improving maternal health, especially in low- and middle-income countries, requires effective antibiotics, which are a precious resource in light of the emergence of AMR (5).

Goal 6: Combat HIV/AIDS, malaria and other diseases

- The number of new HIV infections dropped from 3.5 million in 2000 to 2.1 million in 2013 (1). Globally, malaria incidence dropped by 37% and the mortality rate by 58% between 2000 and 2015 (1).
- Antibiotics have been essential to the treatment of TB, which is still the leading cause
 of death from a single infectious agent (12). New drugs, such as bedaquiline and
 delaminid, are used to treat drug-resistant TB, but access will need to be balanced
 against preventing the emergence of resistance.
- AMR threatens the sustainability of gains that have been made towards eliminating HIV/ AIDS, malaria and other diseases (5).

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Table A1. Primary health care (PHC) in the national action plans of countries in South-East Asia

Country	PHC provisions
Bangladesh	 Primary care is not explicitly mentioned Commits to making antimicrobials available at all health care facilities and to developing an AMR policy Recognizes the need for enhanced, enforced regulation of antibiotic use and sale Plans to establish an AMR-surveillance system
	Plans to improve IPC programmes
Bhutan	 Primary care is not explicitly mentioned No auditing system for antimicrobial prescription exists Will increase AMR awareness through educational and public campaigns in university curricula, in-service professional training and media-facilitated campaigns Plans to promote rational use of antibiotics at all health care levels through auditing, training and awareness-raising IPC practices will be strengthened by developing guidelines, enhancing coordination with antimicrobial stewardship team, capacity building and training of health professionals on hospital-acquired infections IPC committees have been assigned and numerical targets set
Democratic People's Republic of Korea	 Commits to better AMR in PHC; aligns with Juche philosophy of the State Constitution ensures universal free health care; AMR is a part of preventive care focus Commits to establishing and implementing an AMR surveillance system Has begun disseminating AMR research and information on rational use through a telemedicine system Plans to revise school curricula to make AMR a core component Plans to increase awareness through television broadcasting, AMR awareness week, vaccination posters and flyers and knowledge surveys Aims to reduce infection incidence through effective hygiene and IPC measures and by promoting better behaviours at the community level, as well as improving infection control in health care settings Is implementing awareness campaigns and education curricula, alongside surveillance systems to meet these aims IPC subcommittees have been assigned



Timor-Leste

- · Primary care is not explicitly mentioned
- Has begun regular communications between national agencies (i.e. national hospitals) and other health care facilities to promote rational use
- Taskforce committees (on public awareness and IPC) are outlined
- Has improved WASH and IPC to minimize spread of infection in community, ambulatory services, and animal and food production; vaccines are affirmed as effective form of intervention
- National stewardship, vaccination, sanitation and hygiene, and social mobilization programmes have been established to minimize poor hygiene and sanitation, which contributes to the development of AMR
- IPC committees have been assigned

India

- Will survey public and professional knowledge of and attitudes to AMR periodically; has set a target of a 50% increase in scores after awareness campaigns
- Commits to review AMR curricula for health care professionals
- Will write general terms of reference for multidisciplinary antimicrobial stewardship committees and teams
- National Authority for Containment of AMR will develop a strategy to reduce the effect of AMR through risk assessment and establishment of best practices; it will be disseminated in phases in selected hospitals and PHC centres by the Ministry of Health & Family Welfare
- Identifies the need and guidelines for implementing IPC standards at all levels of health care, not just tertiary care; hospital infection committees will form the leadership for institutional-level IPC programmes that reduce the spread of disease and AMR in animals, food, the community and the environment
- Launched the Antimicrobial Stewardship, Prevention of Infection and Control programme in 2012; surveys indicate programmes in private institutions were better able to deal with AMR and outbreaks of hospital-acquired infection
- Infection prevention through hand hygiene, clean water, sanitation, biosafety on farms will be promoted
- Has started the *swachh bharat abhiyaan*, *kayakalp* and *swachh swasth sarvatra* initiatives
- Will increase awareness of good hygiene and biosafety (krishi vigyan kendras) practices and ensure appropriate immunizations KAP studies and media campaigns to ensure change

Indonesia

- Guidelines, regulations and awareness campaigns for rational use have been enacted; however, analysis showed efforts were not adequately linked to AMR control and lacked multisectoral coordination
- Technical working groups are being formalized for all AMR goals, including education and awareness, prudent use and surveillance (by clinical staff)
- Timelines for initiatives, knowledge assessments and pilot campaigns are being formalized
- Aims to have a national IPC programme implemented in the community and in health care, animal husbandry, fishing and food industries, coupled with improved WASH and hospital-acquired infection surveillance programmes
- Responsible agencies are in place
- Although sanitation, infection prevention and hygiene, including vaccination, are being pursued in the human health sector, little progress has been made in animal health and food production sectors, with the exception of the export-oriented aquaculture industry

Maldives

- Aims to conduct a national KAP study of AMR for health care professionals in 2017–2018, commissioned by the AMR taskforce
- Aims to incorporate AMR and related topics into health care undergraduate and postgraduate curricula between 2020 and 2022
- Responsible agencies and stakeholders are in place
- Activities of infection control committees have been limited to education and training in hand hygiene, and setting and promoting standard precautions (including those related to transmission)
- Technical subcommittee formed for IPC will conduct a KAP survey in professional groups and renew and implement IPC-related courses and undergraduate and postgraduate curricula
- Recognizes IPC in hospitals as especially important

Myanmar

- Primary care is not explicitly mentioned
- National standard treatment guidelines being drafted for rational use
- Notes current treatment guidelines are rarely guided by local AMR surveillance data, with no analysis of hospital-associated infection data, AMR surveillance, or data on antimicrobial use to prevent infections and improve rational use
- IPC committee is in place but with limited activity
- A situation analysis has revealed that many AMR awareness programmes are not formalized and trainings are not provided in many health care facilities
- National awareness campaign will be organized by 2022, with regular monitoring and evaluation
- AMR will be incorporated into undergraduate curricula by 2020– 2022
- Plans to conduct KAP studies to assess national awareness on issues including hygiene and IPC
- National action plan establishes IPC in hospitals as important but suggests better WASH and IPC to minimize the spread of infections in community and ambulatory services, and animal and food production; vaccines are highlighted as an effective form of intervention to improve health and reduce AMR
- National stewardship, vaccination, sanitation and hygiene and social mobilization programmes have been initiated to minimize poor hygiene, sanitation, which contributes to the development of AMR

Nepal

- Primary care is not explicitly mentioned
- Rational use of antimicrobials will be promoted through appropriate media, government organizations and nongovernmental organizations
- Rational use will be incorporated into various levels of education, and continued education programmes will be instituted for health care professionals
- Notes the need for improved IPC in both health care settings and the community.
- Plans to audit current practices and promote sanitation, biosafety, biosecurity and hygiene (including hand-washing) through IPC committees, education, hygiene awareness and demonstration events and campaigns, vaccinations, behavioural guidelines with minimum standards set and tracked, regulation of health care infrastructure, and optimized use of antimicrobials in humans and animals through regulation and national standards



Sri Lanka

- Primary care is not explicitly mentioned
- Outlines two- and five-year plans to strengthen in-service antimicrobial training of hospital staff and then all health care professionals
- Plans to optimize antimicrobial use within two years through better regulation and monitored stewardship in all health care facilities under the Ministry of Health's direction
- Aims to improve prescription legislation within five years
- IPC measures aim at developing standard IPC practices, capacitybuilding for IPC implementation in health care and animal sectors, infection surveillance, assessments of IPC compliance, and public awareness campaigns
- Two- and five-year timelines for implementation have been developed

Thailand

- Primary care is not explicitly mentioned
- Notes current weaknesses of actions to address AMR: discontinuity of AMR policies; lack of direction, shared goals and national coordination; no national policy to specifically address AMR; ineffective law enforcement and health care regulation; and inefficient and fragmented resource databases on AMR
- Aims to equip health care facilities with effective point-of-care systems
- Aims to increase public knowledge on AMR by 20%
- Affirms that limiting antimicrobial access because prescription drugs may not currently be applied in Thailand
- Personnel are being put in place for implementing and monitoring stewardship in health care facilities, pharmacies and the agricultural sector

AMR = antimicrobial resistance, IPC = infection prevention and control, KAP = knowledge, attitudes and practices, WASH = Water, sanitation and hygiene.

Source: World Health Organization Regional Office for South-East Asia. Antimicrobial resistance. Library of national action plans (http://www.searo.who.int/entity/antimicrobial_resistance/national-action-plans/en/, accessed 24 October 2018).

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