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# Exploring community healthcare providers' perceptions on antimicrobial resistance

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ABSTRACT

*Objectives:* Antimicrobial resistance (AMR) is a threat to global health, making previously curable diseases disabling or incurable. Human misuse of antimicrobials exacerbates the issue. As stewards to the public and prescribers of antimicrobials, healthcare providers are vital to reducing AMR, thus their perceptions and experiences around the issue must be explored. This study aimed to understand the perceptions of community nurses and physicians regarding the causes of AMR as well as barriers and facilitators to addressing it.
*Methods:* In-depth, semi-structured interviews were conducted to understand the perceptions of nurses and physicians on these issues.
*Results:* Overall, participants expressed that both environmental and human causes at various levels contribute to AMR. Whilst most themes were discussed by both healthcare practitioner groups, nurses more frequently mentioned patient causes and patient education compared with physicians. Participants also reflected on facilitators to reduce AMR, including guidelines, patient and provider education, and top-down and bottom-up initiatives. Identified barriers included patient demands, physician pressures and fears, and systemic overworking of physicians.
*Conclusion:* This study demonstrated numerous factors underpinning AMR and many barriers to addressing it, hence a multifaceted approach is required. This work also offers insight on how different groups can be utilised or will react to interventions.


## 1. Understanding community healthcare providers' perceptions on antimicrobial resistance

Antimicrobial resistance (AMR) is one of the top threats to global health [1] and stems from overuse of medicines such as antibiotics, antimalarials, antivirals and antifungals. Overuse magnifies evolutionary mechanisms, which cause microbes to become resistant to previously successful control measures [2]. AMR is present globally [3] and the number of resistant organisms is projected to rise steeply [4]. AMR will make eliminating extreme poverty more difficult, and associated losses may amount to over US$100 trillion between 2015 to 2050 [5]. Previously curable diseases are already becoming disabling or incurable [3].

The agricultural sector is working to prevent diseases without increasing the AMR burden [3]. Another issue stems from human misuse of antimicrobials, boosted by consumers and providers [6,7]. Solutions must reflect the multifaceted nature of AMR [2], optimising antimicrobial use, improving education, and strengthening surveillance and policies [2]. As prescribers of antimicrobials, healthcare practitioners (HCPs) are vital for implementing behaviour change in their own practices and as stewards to the public [8–10].

The National Health Service Education for Scotland states that 'a multiprofessional approach to antimicrobial stewardship (AMS) is required involving all healthcare staff who prescribe, administer or monitor antimicrobial treatment' [11], and studies have found that behavioural change interventions should involve all healthcare workers [12]. Thus, we should study HCPs affected by this issue and their role in it. Previous work indicates multiple barriers facing HCPs, including deferral and attrition of responsibility surrounding infection prevention and control practices [13]. Although most

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providers surveyed state that AMR is an issue, few consider it problematic in their own hospitals or communities [6,14] and may not want to participate in interventions [14]. In addition, many HCPs express that they need more education in AMS [6,12]. Current medical students also report substandard levels of knowledge about AMR [15].

Attempts have been made to address physicians' misprescription of antibiotics [16]. Still, it has been noted that physicians have inadequate knowledge and misconceptions about antibiotic prescribing, and even those aware of the limited usefulness of antibiotics still overprescribe them [16]. Indeed, whilst physicians are posited to inform patients about how to reduce AMR, research has shown that often the opposite occurs; physicians, especially those working in busy [17] or outpatient settings [16], yield to patients' demands for inappropriate prescriptions because of complacency or fear [18]. Other factors such as targeted advertising from pharmaceutical companies [18] and time pressures [19] also inflate physicians' prescription rates.

Including nurses can help AMR initiatives succeed [10,11]. Some health systems have begun to give nurses prescription privileges and, as more nurses attain these, they should be studied [20] and educated to dispense antimicrobials responsibly. By including all nurses, even those who do not prescribe, the health system has much to gain. Nurses are 'first responders, central communicators, coordinators of care, as well as 24-h monitors of patient status, safety, and response to antibiotic therapy' [21] and should have access to supporting information [10]. Recently, advocacy to formally include nurses in AMS has grown [22], however the current infrastructure requires improvement [23]. Consistently interacting with patients makes nurses potential educators, yet also agents who can transmit organisms between individuals [19,20]. In addition, extensive work has found that nurse practitioners are comparable with physicians in terms of patient outcomes in various settings and, in fact, have higher patient satisfaction ratings than physicians [24].

Most work on AMR reduction addresses hospital settings [25], and more AMS is needed in other settings [25] because the majority of antibiotics are prescribed in primary care [16]. Effective healthcare interventions must be tailored to the local context [26], thus countries must seek their own answers to combat AMR. Israel ranks in the top third for outpatient antibiotic consumption compared with European countries [27], and reporting of antimicrobial susceptibility tests is poorly implemented [28]. Variations in countrywide use [28] as well as refugee migration [29] also affect resistance rates. To curb AMR and address related issues, the government required the establishment of AMS programmes, best practice guidelines and annual reports filed to the Ministry of Health [30]. This resulted in a 32% reduction in antibiotic use in the hospital setting, however the decrease in the community was only 4% [27]. AMR continues to steadily increase in community settings [30] and there is a continual discrepancy in the decline between antibiotic use in hospitals and outpatient settings [18].

Although currently Israeli nurses do not have prescription privileges, the country has been moving towards increased integration of advanced care practitioners, including nurse practitioners, clinical nurse specialists and advanced practice nurses, into the healthcare system to combat the increasing HCP shortage and have passed official legislature in 2013 to support this move. As this provider shortage is only projected to increase, and as the role of nurses becomes more valuable, it is reasonable to believe that Israel may follow the lead of other countries that have already decided to grant these rights to nurse practitioners [31].

We are unaware of any work done in Israel to understand the knowledge and perceptions of community HCPs regarding AMR; however, it is crucial to determining interventions. The objective of this study was to understand the experiences of two types of central community HCPs (i.e. nurses and physicians) regarding AMR, more specifically its causes, ways to address it and barriers to addressing it.

## 2. Methods

In-depth, semi-structured interviews were conducted with family physicians and community nurses in Jerusalem and the surrounding area. Semi-structured interviews were preferred as participants can respond freely and the interviewer can further explore relevant issues raised by the participants. Furthermore, semi-structured interviews are an effective research method when minimal data is available [32]. As this is the case regarding community HCPs' knowledge and perceptions on AMR, this approach was utilised.

The interview guide included demographic and open-ended questions focusing on participants' perceptions of AMR, its causes, ways to address it and barriers to addressing it. The study's primary investigator, a senior qualitative researcher, provided undergraduate nursing students in their final year of study with in-depth training in qualitative research methods and they then conducted, transcribed and analysed the interviews. Research ethics exemption was obtained from the Research Ethics Board of the students' institution.

### 2.1. Sample selection

A convenience sample of community physicians and nurses was interviewed with a focus on physicians who prescribe antibiotic treatments as well as nurses who may interact more with patients and are active in patient education initiatives. Including both groups enabled us to explore group co-operation and perceptions from both parties.

### 2.2. Data collection and analysis

Interviews were conducted in private, at a time and place convenient for the interviewee. The interviews were conducted until thematic saturation was reached. Interviews were recorded, transcribed, anonymised and thematically analysed. Transcriptions were checked by a second researcher. Field notes written during the interviews were referred to during the analysis. Interviews were first read for content to gain an initial understanding and were then re-read and coded into key themes and subthemes. Each interview was reviewed by at least two investigators independently and was revised as necessary if a dispute was reached. The overall framework was examined with the full project team. Data collection and analysis were overseen by a senior qualitative researcher.

## 3. Results

A total of 24 participants were interviewed (12 community physicians and 12 community nurses), of whom 9 were male and 15 were female. Overall, the mean participant age was 43.2 years (range 25–65 years) and the mean seniority was 15 years (range 1–44 years). At the time of the interview, all participants worked in Jerusalem. Among the 12 physicians, 8 (66.7%) were male and 4 (33.3%) were female and the mean age was 46.9 years (range 32–65 years). Nine physicians (75.0%) practiced family medicine, one (8.3%) internal medicine, one (8.3%) general medicine and one (8.3%) ophthalmology. The mean physician seniority was 17.8 years (range 2–38 years). Of the 12 nurses, 1 (8.3%) was male and 11 (91.7%) were female and the mean age was 38.9 years (range 25–62 years). Ten nurses (83.3%) worked in health maintenance

organisations (HMOs), 1 (8.3%) in a women's clinic and 1 (8.3%) in an oncology clinic. Mean nurse seniority was 11.7 years (range 1–44 years).

### 3.1. Factors facilitating antimicrobial resistance

Participants discussed natural and manmade causes underpinning AMR. Participants reflected on resistance occurring naturally in the biological process of survival of the fittest:

"*There will always be resistance because bacteria are smart. They are smarter than us . . . We are a passing episode in the lives of bacteria*" (MD-2).

However, humans exacerbate resistance through overusing antimicrobials on animals and humans and through poor hygiene, i.e. "*constant use of antibiotics . . . results in the development of resistance*" (MD-22). The more antibiotics are used, the more AMR is going to develop, i.e.:

"*It is possible that I will give antibiotics because I think someone has an infectious pneumonia, but it's actually a virus . . . it obviously does not affect the virus, but it does affect other bacteria in the body*" (MD-14).

Participants' perceptions around the causes of AMR encompassed three levels: patient, provider and the system (Table 1). At the patient level, participants repeatedly mentioned poor treatment compliance or overall antibiotic misuse, including pre-emptive cessation when the patient 'feels better'. Participants also stated that some patients save antibiotics from previous courses of treatment or take leftover medication from others when think they are sick, without physician consult e.g.:

"*They tell me they start to get a throat infection and don't even go to the doctor, but use antibiotics that were left over from the last time*" (RN-9).

Participants commented on a general lack of understanding regarding viral versus bacterial infections and the fundamentals behind antibiotic treatment. Other medical professionals were not left without critique:

"*nurses and medical staff take antibiotics right and left on their own . . . because they have easier access, if they work in a hospital, they go to the [medication] cabinet*" (RN-13).

At the provider level, participants mostly mentioned that AMR is due to antibiotic overuse and inadequate HCP hygiene. Many participants mentioned general unnecessary use of antibiotics, and broad-spectrum antibiotics specifically. In addition, physicians may initially order stronger antibiotics than required, making escalation more difficult for subsequent treatment and increasing the likelihood of resistance. One participant describes "*it could be a bacterial infection, but you don't have to treat it with antibiotics, and you do anyways. Or there's an illness that is not bacterial and is given antibiotics*" (MD-14).

Other physician missteps involve "*a quick hand on the trigger*" (MD-20), i.e. prescribing antibiotics for viral infections and

**Table 1**
Human causes that lead to antimicrobial resistance.

| Level | Theme | Representative quote(s) |
|---|---|---|
| Patient | Poor compliance, do not complete course of treatment | "*The fact that people start taking antibiotics and don't always finish the treatment until the end, and then they still carry the bacteria and need antibiotics again, it's a repetitive and problematic cycle*" (RN-21)<br>"*People who don't finish the (antibiotic) treatment properly until the end*" (MD-22) |
| | Self-diagnosis of a supposed bacterial infection, and starting to take antibiotics before seeing a physician | "*Even when they just start off with a sore throat, they say, 'Okay, I have strep throat, I'm taking', and it's not definite it's strep. True, it looks like what they had before . . . and then they take [antibiotics] on their own*" (RN-3) |
| | Taking antibiotics left over from a previous treatment, or acquiring from a friend or family member | "*Taking antibiotics only with a doctor's prescription, there are those who pass antibiotics from one to another, 'my son had it and I'll give it to my other son, I think they had the same symptoms', and they decide on their own. So only with a doctor's prescription. Many people come to me and tell me that 'I had a sore throat and I already started Cefalexin at home', or 'I had an infection . . . '. It happens, and I tell them, 'I understand that you want to ease the symptoms as quickly as possible, but you are making it difficult for us to diagnose now, to have a swab with antibiotics, and the doctor will have to finish with the antibiotics you started'*" (RN-7) |
| Provider | Unnecessary use of broad-spectrum antibiotics as opposed to a more specified treatment | "*The use of antibiotics, unwisely, not properly focused. Another factor is inadequate treatment, too short, premature cessation of treatment, and the use of antibiotics that are too broad*" (MD-2) |
| | Physicians may initially order antibiotics that are stronger than a patient requires, making escalation more difficult for subsequent treatment | "*There are all kinds of antibiotic groups, sometimes they go immediately for the group that, it's a waste, you can use the group that, let's say, is less strong, but already using the strong group is too bad*" (RN-3)<br>"*Giving antibiotics when they are needed, but wider than necessary, wider than the sensitivity of the bacteria. Which means antibiotics should be given, but not such strong and broad-spectrum antibiotics. If you want to kill some Streptococcus in the throat and I can give a simple penicillin, but instead I give Augmentin (co-amoxiclav) or third-generation cephalosporin, which will kill the bacterium that I want to kill but also lots and lots of other bacteria*" (MD-14) |
| | Easily prescribe antibiotics/lack of confidence | "*The increased use of antibiotics—also because of uncertainty in diagnosis*" (RN-17)<br>"*There is widespread use of antibiotics, not necessarily justified, and a hand that easily prescribes antibiotics*" (RN-19)<br>"*The overuse of antibiotics when there is no indication, that's the main reason*" (MD-16) |
| | Inadequate healthcare provider hygiene | "*There is not enough protection for the patients and the staff, a lot of people and visitors walk around and there is no control over the transmission of infections*" (RN-13) |
| System | Unnecessary hospitalisation leading to increased exposure to microbes, more infections and more antibiotic use | "*In older people, after multiple hospitalisations and receiving intravenous antibiotics, they sometimes develop resistance*" (RN-21)<br>"*Unnecessary hospitalisation is an additional factor that definitely causes provision of unnecessary antibiotics . . . In most cases it will improve alone*" (MD-14) |
| | Inappropriate use of antimicrobials in agriculture sector | "*There is also a connection to the use in sewage and agriculture. Antibiotics are scattered in all areas of life, for example chicken who receive antibiotics*" (RN-7) |

RN, nurse; MD, physician.

providing antibiotics before a definitive diagnosis is reached. Some participants mentioned that HCPs may lack confidence in their diagnosis and easily prescribe antibiotics, i.e. "*there is widespread use of antibiotics, not necessarily justified, and a hand that easily prescribes antibiotics*" (RN-19). Another emergent theme, only mentioned by nurses, concerned inadequate HCP hygiene, e.g. "*I see that even handwashing between patient and patient, they (HCPs) aren't strict*" (RN-19). This can spread superbugs and other organisms, i.e. "*the staff, primarily, are the biggest transmitters of infections*" (RN-5).

Only a few participants acknowledged system-level factors, including unnecessary hospitalisation and agricultural use of antibiotics. Extended hospitalisation leads to increased antibiotic use and microbe exposure, leading to more infections and resistance. A couple of participants also spoke about agricultural sector resistance affecting humans.

**Table 2**
Current and suggested future initiatives to reduce antimicrobial resistance.

| Current/future | Theme | Representative quote(s) |
|---|---|---|
| Current | Patient education (including treatment justification, difference between bacterial and viral infections, importance of compliance and hygiene) | "*Teaching. Only teaching. Explanation to the patient in the community and in the hospital . . . Guidance including updating the patient, explaining hygiene, explaining the body's immune system, reduction of antibiotics, disease prevention, prevention of infection and resistance transmission*" (RN-11) |
| | | "*Teaching the population what a bacterium is and what a virus is, the difference between them, an explanation of antibiotics and its harm to both the patient and their surroundings. If in the first meeting with each family we spend a quarter of an hour giving a good basis and saying our credo, we will make a big difference and awareness will increase*" (MD-20) |
| | | "*I also tell them about the microbiome, because the problem is small, [and] it's not so interesting if people in hospital have resistance, but if it destroys the good bacteria in their child . . . when you can see it [in terms of] your child, it is easier to avoid and they really avoid [antibiotics]*" (MD-24) |
| | Guidelines such as clear prescribing and isolation policies | "*Be strict about procedures—cleaning between patients, handwashing, disinfecting hands with alcohol, cleaning work surfaces, cleaning beds between patients, cleaning rooms—and treatment rooms more often*" (RN-17) |
| | | "*There are guidelines that give instructions to doctors when to give and when not to give, but there is no enforcement or follow-up whether they are being observed, so there may be room to keep track*" (MD-8) |
| | Confidence in medical judgement | "*Do not start treatment without being 100% certain that this is the problem, because sometimes patients begin to take and then they are told to stop because the culture came back negative*" (RN-1) |
| | | "*Professional knowledge—there is no substitute for it. The moment you understand what you are doing then you inspire trust from the patient, are confident in your decision, and treat accordingly*" (MD-6) |
| | Antibiotic stewardship programmes | "*There are nurses dedicated to antibiotics*" (RN-1) |
| | | "*There are antibiotic nurse champions*" (MD-2) |
| | Healthcare provider education | "*In-service courses about hand hygiene that need to be completed every year or two*" (RN-7) |
| | | "*The HMO requires you to take an in-service course once in a while*" (MD-14) |
| | Use of evidence-based findings such as cultures | "*Look whether it's bacterial or viral. Do tests accordingly, and if it is bacterial, examine sensitivity*" (RN-11) |
| | | "*For every suspected infection, try to take cultures to isolate the agent and treat appropriately*" (MD-6) |
| | Relationship with patient | "*The power of community physicians is precisely to tell people—we are together, we will talk today if necessary, we will talk in the evening, we'll talk tomorrow, I'm not leaving you, we're going to make that decision every day*" (MD-14) |
| | | "*When you listen to the patient, it works, from all directions*" (MD-24) |
| | Teamwork | "*It is necessary to consult an infectious disease doctor*" (MD-2) |
| | | "*Another service offered through [name of HMO], and I assume at the other HMOs—there are infectious disease consults. Every time you don't know something, you're not sure . . . you pick up the phone, write to the infectious disease consult through the computer messaging service, they answer within minutes, usually—'it's a non-pathogenic bacterium, does not need to be treated'*" (MD-14) |
| Future | Improved regulations regarding who can receive antibiotics and what type can be prescribed | "*A patient should not get antibiotics straight away but will always be asked to return after two or three days (if possible) and then start antibiotics*" (RN-13) |
| | | "*One of the solutions abroad, that we don't use enough, is the provision of conditional antibiotic prescriptions. Prescribing antibiotics for the patient and saying, 'If after three days this and that happens, take the antibiotics'. It takes a lot of cooperation and a level of intelligence that doesn't always happen, but that's one of the best methods*" (MD-8) |
| | Increased patient education | "*On the radio too, something like, 'when you go to the doctor's—don't think that antibiotics will help you in any situation or that it will solve all the problems . . . television too*" (RN-3) |
| | | "*There may be flyers about recommended treatment for the flu, yes. But there are no flyers, for example, on what not to take and what to watch out for. It is important to add in all the HMOs*" (RN-13) |
| | | "*I think that we also need to provide the information on more effective channels. For example, today teenagers are on Facebook and Instagram—so the information should be disseminated there*" (RN-13) |
| | Decreased hospitalisation | "*Preventing hospitalisations in various institutions may reduce infections*" (RN-17) |
| | | "*I think that more homecare medicine, at end of life and in general, will reduce resistance because the harsh antibiotics are given in hospital*" (MD-24) |

RN, nurse; MD, physician; HMO, health maintenance organisation.

"*The poultry we eat, we give them antibiotics, which causes resistance in us, as well as the development of resistant bacteria in animals that can be transmitted to humans*" (MD-8).

### 3.2. Factors to stem antimicrobial resistance

Participants mentioned existing facilitators and what could be implemented to reduce AMR (Table 2). Of the current facilitators, the majority of participants mentioned patient education,-including treatment justification and instruction, teaching the difference between bacterial and viral infections, and stressing the importance of hygiene, e.g.:

"*mainly teaching the population and instructing them that antibiotics [come at a] price and inform them about the risks at the start of antibiotic treatment*" (RN-21).

Guidelines were also mentioned, including clear and defined prescribing policies, consultations with other specialisations, and isolation policies when necessary.

"*A clear record of every resistant pathogen should be kept in every area of the hospital and in the community and allocated staff members to monitor the amount and source of the pathogens, and attempt to trace how they developed*" (MD-6).

The Choosing Wisely movement, which has spread internationally from the USA, was mentioned as an example of 'do not do' guidelines. In one of the first Israeli lists, "*not giving antibiotics for otitis media, an acute middle ear infection, in children over the age of two who can be monitored clinically*" (MD-14) was stated. Having confidence in one's medical judgement in light of patient demands was another theme mentioned by some participants. Others stressed the importance of existing AMS programmes, teaching AMS to students, continued education, and the appropriate use of evidence-based findings, such as cultures and swabs, to reduce antibiotic overuse. A few participants mentioned teamwork and strong patient–provider relationships as facilitators to reducing AMR. This involves knowing the patients' health status, having the ability and motivation to follow-up with unclear cases and, for example, asking patients to come back later instead of automatically prescribing.

Participants also identified areas for improvement in reducing AMR, mostly building on current initiatives. Some participants mentioned improving regulations regarding receiving and prescribing antibiotics, e.g. "*prevent specialists from giving strong antibiotics immediately when something simpler is enough*" (MD-18). A few participants mentioned patient education, public service announcements, and resource materials for patients and providers as current initiatives are lacking.

"*I don't encounter such things, not in my clinic and not in other clinics. Maybe some short television programs, but they don't reach a sufficient target audience*" (RN-13).

**Table 3**
Barriers to the suggested solutions for reducing antimicrobial resistance.

| Level | Theme | Representative quote(s) |
|---|---|---|
| Patient | Demanding patients and families | "*There are those who go to the doctor for everything and until the doctor gives them antibiotics, they don't relax*" (RN-9)<br>"*Pressure from the patient on the doctor to receive antibiotics, especially in children, as if without this treatment the child or the patient will not recover. And everyone pays the price*" (RN-6) |
| | Patients' blind belief in antibiotics | "*The patients come to me in the triage . . . They decide themselves that they have a throat infection, when the story isn't even consistent with a bacterial throat infection*" (RN-7)<br>"*A matter of the doctor's credo . . . and the 'halo' that antibiotics have in the community*" (MD-20) |
| Provider | Desire to satisfy patients' demands | "*Doctors often give antibiotics even when they don't think they really need to. They simply prescribe antibiotics to soothe the patient*" (RN-9)<br>"*In order for the patients to be satisfied, they sometimes give antibiotics even if it's not needed*" (MD-8) |
| | Lack of time | To sit with patients<br>"*Work pressure—very short time per patient and a shortage of manpower*" (RN-17)<br>"*There is no time to see patients*" (MD-8)<br>"*There are situations where it's a waste of time to argue—there are some people who you can't talk to, and in the end, after all your efforts—they come out with a prescription for antibiotics, with time you learn how not to waste unnecessary energy*" (MD-18)<br>To wait for culture<br>"*They take too much (antibiotics). They don't even wait for the results of the culture and immediately begin treatment*" (RN-1)<br>To see patient for a repeat visit<br>"*There are doctors who are convinced that they don't have time to say, 'come back in two days'. The clinics are crowded and they don't have time to argue or explain*" (RN-13)<br>"*I can see it in my clinic, for example, a paediatrician that says they don't have time to check the child 3–4 times during the illness, so they give antibiotics and say that if the parents see that it isn't working, it's a sign that it's something viral*" (MD-20) |
| | Fear of litigation | "*Lawsuits too, if it really was, 1% it was bacterial and then something happens, to be covered*" (RN-3)<br>"*I think that the doctors themselves shouldn't give antibiotics unnecessarily, many times they give antibiotics to 'cover themselves'*" (RN-21)<br>"*The medical team prefers to cover [themselves] with antibiotics, so that they have peace of mind*" (MD-22) |
| | Lack of appropriate incentives | "*There are doctors who will carry out tests, laboratory tests and cultures, and some doctors will decide only by intuition, and the reason—they don't want people to come back to them, it's the simplest to just start antibiotics*" (RN-13)<br>"*One of the problems is that the correct thing to do is to give antibiotics only after a few days having tried without, but many times that means seeing a patient again after a few days, and doctors aren't compensated for that. The doctor is paid a salary for a period, and if they need to see a patient a few times, they are essentially doing it for free. A doctor isn't interested in seeing a patient again after two or three days, and after many times a doctor is tempted to give antibiotics instead of seeing them in two days*" (MD-8) |
| System | Lack of physicians | "*The lack of staff versus the growth of patients (the population) causes less strict adherence to the rules. Too many patients per nurse . . . But, the more a nurse is in a hurry, the less time they have to keep up with the rules . . . The rules are not adapted to the reality of the workload*" (RN-11)<br>"*A huge lack of doctors*" (MD-24) |

RN, nurse; MD, physician.

A few participants mentioned reducing hospitalisations and "*treat as much as possible in the community*" (MD-8). Developing new antimicrobials was mentioned by a couple of participants.

Participants reflected on who should be responsible for dealing with AMR. Some participants felt the health system at large, including HMOs, the Ministry of Health and hospitals, can design and implement top-down approaches such as guidelines, e.g. "*this should be the issue of the Ministry of Health and the HMO administrations*" (MD-18) and education, e.g.:

> "*The Ministry of Health needs to convene on the topic and widely publicize it . . . even in schools, as part of health promotion and health education . . . if from a young age, this infiltrates into homes, schools and clinics, we may be able to promote change*" (RN-19).

Medical staff also have a roll. Physicians can ensure adherence to prescription guidelines as "*they are the ones who prescribe antibiotics . . . A doctor should be assertive enough in front of the patient even when [he/she] is demanding*" (MD-22). Nurses can participate in patient education and ensure physician accountability, and interdisciplinary teams can engage in consultations: "*responsibility for preventing resistance rests with the whole chain of medical personnel!*" (MD-16). More broadly, patients, public health officials, pharma, government and professional organisations can reduce inappropriate antimicrobial usage.

> "*The short answer is that those who have the responsibility and those who can help, is everyone. The doctors, and the nurses . . . even the pharmacists*" (MD-14).
>
> "*We as a population, as people, as parents of children and as caregivers. Everyone here has responsibilities*" (RN-7).

### 3.3. Barriers to addressing antimicrobial resistance

Participants also identified barriers to the suggested solutions (Table 3). At the patient level, participants mentioned demanding patients and families as well as patients' blind belief in antibiotics. Patients or their families may come with preconceived ideas and pressure their providers. "*Those who go to the doctor for everything and until the doctor gives them antibiotics, they don't relax*" (RN-9). This may be even more prevalent with sick children because of "*hysteria of parents who want antibiotics at any cost*" (MD-18). Patients can also be misinformed or hold false beliefs about antibiotic effectiveness.

> "*The patient believes in antibiotics blindly: 'only antibiotics will get me over this cold, until they give me antibiotics, I won't get better, give me antibiotics, within two days I'm a different person*'" (MD-20).

Physician-level barriers included satisfying patients, a lack of time (to sit with patients, wait for cultures), appropriate incentives, fearing litigation and old habits. Some physicians find saying 'no' or appearing like they cannot help the patient challenging.

> "*There are some people who you can't talk to, and in the end, after all your efforts—they come out with a prescription for antibiotics, with time you learn how not to waste unnecessary energy*" (MD-18).

It is often simpler and faster to give the patient unnecessary antibiotics, i.e.:

> "*The correct thing to do is give antibiotics only after a few days having tried without, but many times that means seeing a patient again after a few days, and doctors aren't compensated for that. The doctor is paid a salary for a period, and if they need to see a patient a few times, they are essentially doing it for free. A doctor isn't interested in seeing a patient again after two or three days, and after many times a doctor is tempted to give antibiotics instead of seeing [the patient] in two days*" (MD-8).

Physicians may also "*prefer to treat with antibiotics, so that they have peace of mind*" (MD-22) or prescribe "*just in case*" because "*there is always a concern not to give treatment*" (MD-18). It is also challenging to break old habits when physicians are accustomed to prescribing antibiotics immediately or habitually prescribe broad-spectrum antibiotics. One nurse shared:

> "*In a certain department, when a patient arrived with some kind of infection that we were not familiar with, instead of waiting for an infectious disease specialist to come and provide instructions, we gave what we knew . . . and in the meantime, the patient is loaded with antibiotics that don't necessarily suit them*" (RN-9).

A few participants mentioned system-level barriers predominantly focusing on the lack of physicians, leading to overwork and potential burnout. Participants stated that there are not enough physicians: "*a huge lack of doctors*" (MD-24) and, besides this, the population has been increasing at a rate that is not paralleled on the provider end. Current physicians are therefore overworked and not necessarily incentivised for timely follow-up. "*Even the conditions in which we work are far from being . . . ideal*" (MD-24).

Although both HCP groups spoke about a variety of factors, some differences were observed between nurses and physicians. Nurses spoke more often about patient factors, both as fuelling AMR and as stakeholders who need better education. Physicians, on the other hand, spoke more about provider factors, such as HCP teamwork and reducing broad-spectrum antibiotic use.

## 4. Discussion

Participants expressed that environmental and human causes at the patient, provider and system level contribute to AMR. They also reflected on factors they felt could reduce AMR if implemented. These included guidelines, patient and provider education, and top-down and bottom-up initiatives. Barriers to resolving the issue were also found. Patient demands, physician pressures and fears, and systemic overworking of physicians were seen as root causes. This is consistent with other work regarding overuse in different areas of the health system [33], and antimicrobials more specifically [34]. Whilst most themes were discussed by both HCP groups, nurses more frequently mentioned patient factors compared with physicians. This may be because they are more involved overall in patient education. Therefore, initiatives to reduce AMR should take this unique role of nurses into account [19].

### 4.1. Study strengths and limitations

This study has several strengths. Both nurse and physician respondents who interact regularly with patients who utilise antimicrobials were included, potentially informing the issue from various perspectives. Another strength is the use of qualitative methodology to capture new ideas and themes. Study limitations included that only participants from the Jerusalem area were recruited and the results may not be generalisable to the broader population. Patients, a vital stakeholder group, were not included as this was beyond the scope of the study, however future work in Israel should study patient perspectives because they are on the receiving end of antimicrobials, and should explore HCPs' perceptions from other areas in Israel, not just Jerusalem.

### 4.2. Relationship to other studies and policy and practice implications

It has been established that global collaboration is necessary in order to prevent AMR, whilst present collaborative efforts have been poorly funded and modest [31]. According to the 5C Framework posited by Årdal et al. [35], countries worldwide need to find common norms, principles and goals; to communicate

about AMR; to co-ordinate decision-making with other health systems; to make decisions collaboratively; and to move toward collective action. The threat of AMR transcends boundaries and, in order to build capacity for global health action, there is a need to examine local issues in a regional and global context. By understanding the realities of HCPs working on the ground in different health systems around the world, we can begin to find contrasts and, more importantly, commonalities in the way that the issue is perceived and acted upon by those who regularly see AMR in their practice. These commonalities can be built upon to finally move towards collective action globally.

On the national scale, Israel has had past successes in reducing AMR that can be built upon. Some descriptive work has tracked prescription patterns in inpatient [36] and outpatient [29] settings within the country. A shift in approach recently occurred following a 2007 *Klebsiella pneumoniae* carbapenemase (KPC) outbreak in Israel. Among these changes was the establishment of an overseeing body for AMS. Five years later, marked improvement was observed in antibiotic use in hospitals [37], however a corollary decrease in community prescription was not studied.

Although participants mentioned a lack of human capital, Israel has one of the higher physician-to-patient ratios globally [38], thus more physicians may not be the solution. In addition, Israel has had prior successes utilising existing physicians. One study managed to decrease antimicrobial prescribing by community physicians through a medical education programme [39]. This approach may be optimal in conjunction with others to make a more significant impact.

Considering that patient satisfaction was raised by numerous participants, one potential intervention is delaying prescribing. Physicians provide an antibiotic prescription, therefore fulfilling their perceived role and assuaging possibly demanding patients, while advising to delay antibiotic use with expectation of symptom resolution. A Cochrane review found no significant difference in patient satisfaction or safety, and patient use of antibiotics decreased compared with immediate prescription [40]. This should be used synergistically with other ideas to build a comprehensive solution.

This study demonstrated that numerous factors underpin AMR and there are many barriers to addressing it, demonstrating the need for a multifaceted approach. One example was implemented in Australia where a successful series of interventions was enacted to reduce prescriptions for upper respiratory tract infections. Interventions targeted HCPs such as nurses, physicians and pharmacists and, in parallel the public, starting with specific populations such as day-care children and seniors. Interventions themselves were as varied as taking a social media pledge to use antibiotics responsibly, face-to-face education, and clinical audit and feedback for providers [41]. Altogether, changes reduced antibiotic dispensing by 14% country-wide and the authors found a likely cumulative effect where each intervention built on previous successes.

AMR is a multifaceted problem requiring complex solutions. Whilst successful hospital AMS programmes exist worldwide [25] and specifically in Israel [36], there is less work at the community level [9,15]. Effective interventions need to bring together stakeholders from all levels, including policy-makers, researchers, HMOs, community clinics, HCPs and the public. Based on the results of this study as well as existing research, these interventions need to be diverse and address all system levels.

## 5. Conclusion

This study opens the area for further study regarding what should be done to reduce or mitigate AMR in the community. This study examined the provider end of the issue. Future work needs to examine the perceptions and experiences of patients who have an immediate stake in the utilisation of antimicrobials as well as citizens who are more removed from the situation but will suffer the repercussions. Furthermore, interventions must be designed, re-designed and implemented successfully to affect change. This study offers insight as to how different groups can be utilised or will react to various interventions.

This work also provides insights from some key stakeholders that can help shape effective interventions in Israel to mitigate AMR. Israel has progressed towards reducing inappropriate prescriptions in specific settings and has had success targeting specific stakeholders. It is likely ready for a more comprehensive, multifaceted approach. Israel's size can be a weakness and strength; whilst resistance can spread quickly throughout the country, the needle can also move more easily in the opposite direction to reach reasonable goals. The involvement of all parties is vital in order to preserve life-saving medicines for the future.

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## Competing interests

None declared.

## Ethical approval

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