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RESEARCH ARTICLE

Health Care Practitioners Level of Awareness on Antimicrobial Resistance in Grenada

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Abstract

Health care practitioners' level of awareness on antimicrobial resistance in Grenada.

Antimicrobial Resistance (AMR) has become a global public health emergency and there is limited evidence of the extent of healthcare practitioners' knowledge and attitude to the issue in Grenada.

A cross-sectional study utilising self-administered surveys was conducted with registered physicians, pharmacists, and pathology laboratory technicians to evaluate health care workers knowledge about antimicrobial resistance in Grenada.

The study found that while most practitioners could correctly define AMR, there was variability in knowledge about the judicious use of antimicrobials. About one in four physicians (26.4%) did not know whether AMR was a significant problem in the institution(s) where they practiced, compared with the majority (61.7%) who said it was not a problem. However, 41.6% of pharmacists felt that AMR was a national problem; although all (100%) laboratory technicians reportedly did not know if AMR was a significant national problem. Three key factors were perceived by more than 50.0% of each health practitioner group to have contributed to AMR: patients demanding antibiotics, unnecessarily prescribing antimicrobials, and insufficient patient advice about antibiotics. The vast majority of physicians (75.5%), pharmacists (83.3%), and all laboratory technicians (100.0%) agreed that the lack of a surveillance system for monitoring patient history of antibiotic use was a key factor contributing to lack of understanding of AMR issues in Grenada.

This study highlights the urgent need for continuing professional development on AMR and the development of accessible policies, guidelines and a robust surveillance system on the safe and judicious use of antimicrobials to improve antimicrobial stewardship in Grenada.

Keywords

Antimicrobial resistance, Antibiotic surveillance, Health Education, Continuing professional development, Grenada

Introduction

Several common pathogens causing infectious diseases have steadily developed resistance to existing antimicrobials, escalating into a global health crisis [1]. Given the heavy burden of infectious diseases in developing countries, this creates challenges to their healthcare systems, with the resultant need to find alternate solutions for the effective management of infections (AMR) [2,3].

The World Health Organization's (WHO) Antimicrobial Resistance - Global Report on Surveillance report highlighted the magnitude of the AMR challenge and its consequential burden on health economics and treatments options. WHO reports major gaps continue to exist in understanding the severity of the problem [4,5]. There are few peer-reviewed reports describing AMR within the Caribbean region nonetheless emerging evidence suggests a notable emergence and spread of AMR pathogenic strains in the Caribbean and Latin American region [3]. AMR surveillance data are not readily available and there are only a few small studies using laboratory data from larger countries including Cuba [6,7], Jamaica [8-11] and Trinidad and Tobago [12-15], providing limited evidence of emerging and

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wide spread resistance to front line drugs by common gastrointestinal, blood stream, urinary and respiratory tract pathogens. Only few of these studies have assessed health practitioners' perspectives on AMR at the country or regional levels.

It has been speculated that one of the causes of the widespread misuse and abuse of antibiotics is the limited time devoted to training of physicians to use antimicrobials. One report postulated that the amount the amount of time devoted to training medical students in microbiology, infectious diseases, and antimicrobial pharmacology is disproportionate to the relative high rate of consultations for infectious diseases [2].

This study was conducted to assess healthcare practitioners understanding of AMR and to identify any knowledge and practice gaps to inform evidence-base policies and professional development programs to address AMR in Grenada and other small island developing states.

Materials and Methods

A cross-sectional survey was carried out with three classes of healthcare practitioners: physicians, pharmacists, and laboratory technicians. Due to the very small population sizes of doctors, lab technicians and pharmacists in Grenada, the researchers agreed to utilize a total population sampling technique a type of purposive sampling technique where you choose to examine the entire population [16]. The self-administered questionnaire was developed using questions based on a review of the literature and were mainly taken from the Survey on Antibiotic Use and Antimicrobial Resistance [17]. The questionnaire was piloted with two health professionals from each group and adjustments were made to ensure their suitability for self-administration. Questions were added or removed to develop modified questionnaires for each of the three different health professional groups. Respondents completed either a paper-based questionnaire or an online version developed with Survey Monkey. Surveys were administered between November 2014 and September 2015.

Questions for each class of healthcare practitioner covered health professionals' opinions on AMR, their level of awareness of and training to deal with AMR, antimicrobial usage practices, possible solutions, and their perspectives on AMR surveillance in Grenada.

Participants were selected from the following health care practitioner group as follows:

- Physicians: All physicians registered with the Grenada Ministry of Health (MOH) in 2013.
- Pharmacists: A senior pharmacist from each pharmacy listed in the 2014 telephone directory.
- Laboratory Technicians: A senior laboratory technician employed in each of the three pathology laboratories.

Data analysis

Quantitative data from the surveys were analyzed using Epi Info 7.0. Proportions were reported with 95% confidence interval. Qualitative data from open ended questions were analyzed using an inductive thematic analysis.

Results

Of 77 registered physicians, 44.2% (34/77) completed a questionnaire, including 38.2% (13/77) who had practiced over 21 years, 23.6% had practiced 11-20 years and 38.2% had practiced 0-10 years. The majority of physicians 64.9% (50/77) worked only in public institutions while 22.1% (17/77) working in private institutions and 13.0% (10/77) worked in a combination of private and public institutions. Of the 16 pharmacies listed in the 2014 telephone directory, 75.0% (12/16) responded. The majority (7/11 or 63.7%) of the pharmacists had practiced for 11-20 years, while 27.3% had practiced over 21 years and the remainder had practiced for 10 years or less. The majority of pharmacists (66.7%, 8/12) worked in private institutions only and 33.3% while the remainder worked in both public and private pharmacies. One technician at each of the three pathology laboratories (100.0%) participated in the study. Among the laboratory technicians two worked in private institutions while the other one worked in both private and public institutions.

Health practitioner's knowledge of AMR

Overall, physicians and pharmacists' views were consistent in agreeing with the statements that 'antibiotics kill bacteria' and that 'antibiotic resistance is increased by patients who do not complete their full course of antibiotics'. There was, however, discordance within and between the groups with regard to other statements. While 76.5% of physicians and 91.6% pharmacists correctly agreed that unnecessary use of antibiotics makes them become ineffective, almost a quarter of physicians (23.5%) either disagreed, were neutral or did not respond. The majority of physicians and pharmacists rightly disagreed with the statement that 'antibiotics are effective against cold and flu. However, 25.0% pharmacists neither agreed nor disagreed; while 20.5% physicians agreed, were neutral or did not respond to the statement. Only 29.4% physicians and 16.6% pharmacists correctly agreed with the statement 'bacterial resistance may persist for up to 12 months after a course of antibiotic'; while more than a third of physicians (38.2%) and half of the pharmacists (50.0%) remained neutral on this statement. The remaining one third of physicians and pharmacists either disagreed or did not respond.

More than quarter (26.4%) of physicians did not know whether AMR was a significant problem in the institution(s) where they practiced, while the majority (61.7%) said it was not a problem. Only a few physicians

(14.7%) felt that AMR was a significant problem nationally, while 41.1% felt that it was not. A similar proportion, 44.1%, either did not know or did not respond. Conversely, nearly half of pharmacists (41.6%) felt that AMR was a national problem. All (100.0%) surveyed laboratory technicians reported that they did not know whether AMR was a national problem.

Awareness of information sources and training on AMR

Most physicians (82.3%) and 100.0% of pharmacists and lab technicians were unaware of any AMR campaigns in Grenada over the past two years. The majority of respondents felt that the level of awareness about AMR among healthcare practitioners was low to average (Table 1).

When asked where healthcare practitioners sourced information on antibiotics, more than half of physicians (52.9%) and pharmacists (58.3%) reported that the internet was their most frequently used source. The majority of physicians (58.8%) and pharmacists (75.0%) reported that they rarely or never used information from the Ministry of Health. Online courses (50.0%, 54.5%), pharmaceutical representatives (47.1%, 45.4%) and academic lectures (50.0%, 58.3%) were occasionally used by physicians and pharmacists respectively. There was no consensus amongst laboratory technicians about the sources of information for continuing education.

Perceptions about antimicrobial usage practices

Three key factors were perceived by more than 50.0% of each practitioner group to have contributed to AMR: patients demanding antibiotics, prescribing antimicrobials unnecessarily, and insufficient patient advice about antibiotics. Over 50.0% of both physicians and pharmacists also reported that patients' failure to adhere to prescribed treatment frequently contributed to AMR. The list of factors perceived by physicians and pharmacists to have contributed to AMR in private and public health institutions are presented in Table 2 and Table 3 respectively.

The perceived factors that influence health practitioners' choice of antibiotics for patients are presented in Table 4. More than half of responding physicians

Table 1: Health practitioners' perspectives on their level of awareness about AMR in Grenada, 2015.

Practitioners Level of Awareness	Physicians %; 95% CI (n)	Pharmacists %; 95% CI (n)	Lab Technicians %; 95% CI (n)
High	8.8; 2.3-24.8 (3)	8.3; 0.4-4.0 (1)	0.0; 0.0-0.0
Average	64.7; 46.5-79.7 (22)	41.7; 0.4-4.0 (5)	33.3; 1.8-87.5 (1)
Low	14.7; 5.6-31.8 (5)	50.0; 22.3-77.7 (6)	66.7; 12.5-98.2 (2)
None	2.9; 0.2-17.1 (1)	0.0; 0.0-0.0	0.0; 0.0-0.0
No response	8.8; 2.3-24.8 (1)	0.0; 0.0-0.0	0.0; 0.0-0.0

Table 2: Factors perceived by physicians (N = 34) to have contributed to AMR in private and public health institutions in Grenada, 2015.

AMR contributing factors	Private Institutions %, 95% CI, (n)			Public Institutions %, 95% CI, (n)		
	Frequent	Occasional	Never	Frequent	Occasional	Never
Patients failing to adhere to treatment	70.6; 52.3-84.3 (4)	11.8; 3.8-28.4 (4)	0.0; 0.0-0.0	70.6; 52.3-84.3 (24)	11.8; 3.8-28.4 (4)	2.9; 0.2-17.1 (1)
Patients demanding antibiotics	61.8; 43.6-77.3 (21)	17.6; 7.4-35.2 (6)	2.9; 0.2-17.1 (1)	50.0; 32.8-67.3 (17)	35.3; 20.3-53.5 (12)	0.0; 0.0 = 0.0
Prescribing antimicrobials when they are not needed	55.9; 38.1-72.4 (19)	26.5; 13.5-44.7 (9)	0.0; 0.0 = 0.0	52.9; 35.4-69.8 (18)	29.4; 15.7-47.7 (10)	2.9; 0.2-17.1 (1)
Lack of proper patient advise about use of antibiotics	55.9; 38.1-72.4 (19)	23.5; 11.4-41.6 (8)	2.9; 0.2-17.1 (1)	52.9; 35.4-69.8 (18)	29.4; 15.7-47.7 (10)	2.9; 0.2-17.1 (1)
Limited use of laboratory services for diagnosis	47.1; 30.2-64.6 (16)	35.3; 20.3-53.5 (12)	0.0; 0.0 = 0.0	47.1; 30.2-64.6 (16)	38.2; 22.7-56.4 (13)	14.7; 5.6-31.8 (5)
Patients are not properly diagnosed	23.5; 11.4-41.6 (8)	58.8; 40.8-74.9 (20)	0.0; 0.0 = 0.0	32.4; 18.0-50.6 (11)	52.9; 35.4-69.8 (18)	0.0; 0.0 = 0.0
Wrong medicine prescribed for patients	23.5; 11.4-41.6 (8)	55.9; 38.1-72.4 (19)	2.9; 0.2-17.1 (1)	14.7; 5.6-31.8 (5)	67.6; 49.4-82.0 (23)	2.9; 0.2-17.1 (1)

Antibiotics available are of questionable quality	17.6; 7.4-35.2 (6)	52.9; 35.4-69.8 (18)	11.8; 3.8-28.4 (4)	20.6; 9.3-38.4 (7)	52.9; 35.4-69.8 (18)	11.8; 3.8-28.4 (4)
There is a shortage of non-antibiotic medicines	17.6; 7.4-35.2 (6)	52.9; 35.4-69.8 (18)	5.9; 1.0-21.1 (2)	26.5; 13.5-44.7 (9)	50.0; 32.8-67.3 (17)	8.8; 2.3-24.8 (3)
Not prescribing antibiotics when they are needed	11.8; 3.8-28.4 (4)	67.6; 49.4-82.0 (23)	2.9; 0.2-17.1 (1)	14.7; 5.6-31.8 (5)	64.7; 46.5-79.7 (22)	5.9; 1.0-21.1 (2)

Table 3: Factors perceived by pharmacists (N = 11) to have contributed to AMR in private and public health institutions in Grenada, 2015.

	Private Institutions %; 95% CI (n)			**Public Institutions %; 95% CI (n)**		
	Frequent	**Occasional**	**Never**	**Frequent**	**Occasional**	**Never**
Patients failing to adhere to treatment (N = 11; 11)	91.0; 57.1-99.5 (10)	9.1; 0.5-42.9 (1)	0.0; 0.0-0.0	81.9; 47.8-96.8 (9)	9.1; 0.5-42.9 (1)	9.1; 0.5-42.9 (1)
Patients demanding antibiotics (N = 10; 9)	70.0; 35.4-91.9 (7)	36.4; 12.4-68.4 (4)	0.0; 0.0-0.0	22.2; 4.0-59.8 (2)	66.7; 30.9-91.0 (6)	11.1; 0.6-49.3 (1)
Prescribing antimicrobials when they are not needed (N = 11; 11)	54.6; 24.6-81.9 (6)	45.5; 18.1-75.4 (5)	0.0; 0.0-0.0	45.5; 18.1-75.4 (5)	54.6; 24.6-81.9 (6)	0.0; 0.0-0.0
Lack of proper patient advise about use of antibiotics (N = 11; 11)	54.6; 24.6-81.9 (6)	45.5; 18.1-75.4 (5)	0.0; 0.0-0.0	72.7; 39.3-92.7 (8)	18.2; 3.2-52.2 (2)	9.1; 0.5-42.9 (1)
Limited use of laboratory services for diagnosis (12; 9)	41.7; 16.5-71.4 (5)	50.0; 22.3-77.7 (6)	8.3; 0.4-40.2 (1)	44.4; 15.3-77.3 (4)	44.4; 15.3-77.3 (4)	11.1; 0.6-49.3 (1)
Patients are not properly diagnosed (N = 12; 10)	8.3; 0.4-40.2 (1)	91.7; 60.0-99.6 (11)	0.0; 0.0-0.0	30.0; 8.1-64.6 (3)	70.0; 35.3-91.9 (7)	0.0; 0.0-0.0
Wrong medicine prescribed for patients (N = 11; 11)	18.2; 3.2-52.2 (2)	81.9; 47.8-96.8 (9)	0.0; 0.0-0.0	18.2; 3.2-52.2 (2)	72.7; 39.3-92.7 (8)	9.1; 0.5-42.9 (1)
Antibiotic medicines are often not available (N = 10; 10)	0.0; 0.0-0.0	80.0; 44.2-96.5 (8)	20.0; 3.5-55.8 (2)	30.0; 8.1-64.6 (3)	50.0; 20.1-79.9 (5)	20.0; 3.5-55.8 (2)
Antibiotics available are of questionable quality (N = 11; 10)	9.1; 0.5-42.9 (1)	54.5; 24.6-81.9 (6)	36.4; 12.4-68.4 (4)	20.0; 3.5-55.8 (2)	50.0; 20.1-79.9 (5)	30.0; 8.1-64.6 (3)
There is a shortage of non-antibiotic medicines (N = 11; 10)	18.2; 3.2-52.2 (2)	54.6; 24.6-81.9 (6)	27.3; 7.3-60.7 (3)	30; 8.1-64.6 (3)	60.0; 27.4-86.3 (6)	10.0; 0.5-45.9 (1)
Not prescribing antibiotics when they are needed (N = 11; 10)	27.3; 7.3-60.7 (3)	45.5; 16.5-71.4 (5)	27.3; 7.3-60.7 (3)	30.0; 8.1-64.6 (3)	50.0; 20.1-79.9 (5)	20.0; 3.5-55.8 (2)

Table 4: Factors perceived by Physician and pharmacists to have influenced their choice of antibiotics for patients in Grenada, 2015.

	Physicians %, 95% CI, (n)			**Pharmacists %, 95% CI, (n)**		
	Frequent	**Occasional**	**Never**	**Frequently**	**Occasionally**	**Never**
Cost to the patient	67.6; 49.4-82.0 (23)	17.6; 7.4-35.2 (6)	0.0; 0.0-0.0	83.3; 50.9-97.1 (10)	16.7; 2.9-44.8 (2)	0.0; 0.0-0.0
Severity of infection	85.3; 68.2-94.5 (29)	0.0; 0.0-0.0	0.0; 0.0-0.0	75.0; 42.3-93.3 (9)	25.0; 6.7-57.2 (3)	0.0; 0.0-0.0
The infecting organism (suspected or confirmed)	79.4; 61.6-90.1 (27)	5.9; 1.0-21.1 (2)	0.0; 0.0-0.0	63.4; 31.6-87.6 (7)	27.3; 7.3-60.7 (3)	9.1; 0.5-42.3 (1)
Cost to the hospital	41.2; 25.1-59.2 (14)	26.5; 13.5-44.7 (9)	17.6; 7.4-35.2 (6)	41.7; 16.5-71.4 (5)	41.7; 16.5-71.4 (5)	16.7; 2.9-44.8 (2)

Effectiveness of antibiotics for patients typically seen	82.4; 64.8-92.6 (28)	2.9; 0.2-17.1 (1)	0.0; 0.0-0.0	58.3; 28.6-83.5 (7)	41.7; 16.5-71.4 (5)	0.0; 0.0-0.0
Results from samples sent to the laboratory	52.9; 35.4-69.8 (18)	29.4; 15.7-47.7 (10)	2.9; 0.2-17.1 (1)	66.7; 35.4-88.7 (8)	33.3; 11.3-64.6 (4)	0.0; 0.0-0.0
Patients demands and expectations	38.2; 22.7-56.4 (13)	44.1; 27.6-61.9 (15)	2.9; 0.2-17.1 (1)	41.7; 16.5-71.4 (5)	50.0; 22.3-77.7 (6)	8.3; 0.4-40.2 (1)
Profit for the clinician	8.8; 2.3-24.8 (3)	35.3; 20.3-53.5 (12)	41.2 (14)	30.0; 8.1-64.6 (3)	40.0; 13.7-72.6 (4)	30.0; 8.1-64.6 (3)
Hospital or Ministry of Health guidelines	23.5; 11.4-41.6 (8)	47.1; 30.2-64.6 (16)	11.8; 3.8-28.4 (4)	33.3; 11.3-64.6 (4)	58.4; 28.6-83.5 (7)	8.3; 0.4-40.2 (1)
Antibiotic stock available	61.8; 43.6-77.3 (21)	17.6; 7.4-35.2 (6)	5.9; 1.0-21.1 (2)	33.3; 11.3-64.6 (4)	58.4; 28.6-83.5 (7)	8.3; 0.4-40.2 (1)
Influence of pharmaceutical sales representatives	8.8; 2.3-24.8 (3)	55.9; 38.1-72.4 (19)	20.6; 9.3-38.4 (7)	41.7; 16.5-71.4 (5)	58.4; 28.6-83.5 (7)	0.0; 0.0-0.0
Advice from colleagues and/or consultants	44.1; 27.6-61.9 (15)	35.3; 20.3-53.5 (12)	2.9; 0.2-17.1 (1)	27.3; 6.7-57.2 (3)	72.3; 39.3-92.7 (8)	0.0; 0.0-0.0

Table 5: Healthcare practitioners' reported awareness of measures taken to improve control of antibiotics use in the past two years in Grenada, 2015.

	Physicians N = 31, %, (n)		**Pharmacists N = 12, %, (n)**	
	Yes	**No**	**Yes**	**No**
Education/training/meetings on antibiotic use	14.7 (5)	76.5 (26)	8.3 (1)	91.7 (11)
Restrict antibiotics to certain patient conditions	14.7 (5)	76.5 (26)	8.3 (1)	91.7 (11)
Control sales representative activities	11.8 (4)	79.4 (27)	0.0 (0)	100 (12)
Introduce or enforce treatment guidelines	11.8 (4)	79.4 (27)	0.0 (0)	100 (12)
Increased use of laboratory to confirm diagnosis	11.8 (4)	79.4 (27)	16.7 (2)	83.3 (10)
Public education or social media campaigns	5.9 (2)	85.3 (29)	8.3 (1)	91.7 (11)
Implement systems for monitoring antibiotic use	2.9 (1)	88.2 (30)	0.0 (0)	100 (12)

and pharmacists reported five key factors that they perceived frequently influenced the healthcare practitioners' choice of antibiotics for patients: cost to the patient; the infecting organism - suspected or confirmed; severity of infection; effectiveness of antibiotics for patients typically seen; and results from samples sent to the laboratory.

Only 38.2% of physicians believed that their colleagues frequently sent samples to the laboratory for culture and sensitivity testing and only 35.2% believed that their colleagues frequently used the reports in the management of patients.

More than half (55.8%) of physicians indicated they were aware of a person, team or committee in charge of infection control either in the Ministry of Health or the institution where they worked. Physicians felt that they were aware of education and restricting antibiotics to certain patients' conditions as the main measures to control the use of antibiotics over the past two years. Pharmacists were generally unaware of any measures taken to control use of antibiotics. Table 5 summarizes measures to control antibiotics reported by physicians and pharmacists.

Perspectives on possible solutions to AMR in Grenada

Physicians and pharmacists identified several ways in which AMR could be addressed in health institutions including: continuous education for healthcare workers; greater public awareness or education campaigns; increased use of culture and sensitivity testing to guide antibiotic therapy; providing education to patients on antibiotic use; physicians encouraged to avoid unnecessary prescribing of antibiotics; stopping pharmacists from dispensing antibiotics without a physician's prescription; better guidelines from the Ministry of Health or protocols for treating infections empirically based on pathogens frequently detected in the Grenadian population; monitor patients for compliance in using antibiotic; and improved enforcement and monitoring.

Awareness of AMR surveillance and response systems

All physicians, laboratory technicians, and nearly all pharmacists (91.6%) reported that they unaware of any national surveillance and response systems for managing AMR in Grenada. The majority of physicians (73.5%)

pharmacists (83.3%) and all laboratory technicians (100.0%) agreed that the lack of a surveillance system to monitoring patient history of antibiotic use was a key factor contributing to healthcare institutions missing cases of AMR. Technicians reported that either there was no mechanism in place for their laboratories to report to the national surveillance system or that reporting was not applicable to them.

Discussion

This is the first study to assess health practitioners' knowledge and practices related to AMR in Grenada. The study found variability amongst health practitioners in their level of knowledge about AMR and self-reported antimicrobial stewardship practices. There was a general consistency among all groups in defining AMR; however, there were inconsistencies in self-reported knowledge and some practices, with an overall limited awareness of systems to provide information about and to monitor AMR. The findings are likely an indication of the lack of updated training and education among health professionals on this very important topical issue. This lack of awareness of AMR as a local issue and one of relevance to individual health professional group practice has been previously reported in a Jamaican study with physicians [18] and may be an indication of a region-wide issue in the Caribbean.

The study identified gaps in health practitioners' knowledge about the causes and factors contributing to AMR. The fact that 25% of pharmacists and 21% of physicians did not correctly identify that "antibiotics (were not) effective against colds and flu", is worrying and leaves one to speculate whether 20-25% of practitioners are inappropriately prescribing and dispensing antibiotics for colds and flu symptoms. Other studies have postulated that the limited time spent training physicians in pharmacology and infectious diseases may have resulted in inadequate training to manage antimicrobials and could be the underpining factor driving the inappropriate prescribing [2]. Amabile-Cuevas, et al. suggested that the solution to the lack of knowledge and inappropriate prescribing lies upon educational efforts, supported by setting up and enforcing of basic rules [2].

Healthcare practitioners reported that patients in both private and public clinics are demanding antibiotics from their healthcare providers. Evidence from other settings indicates that physicians often feel pressured to prescribe antibiotics for patients with colds and flus [19] and some patients agree they expect doctors to prescribe antibiotics for their colds and flu [20]. Evidence suggests that despite consistent and continued education and an associated high level of knowledge around antibiotic resistance, antibiotic prescribing rates for some illnesses such as URTIs remain high in general practice [19]; often associated with patients' expectations for antibiotics against some pathogens [18,21]. Continuing professional development programs that address AMR issues, should therefore consider the need to provide healthcare professionals with the requisite knowledge, communication tools and decision-making skills to ensure that they practice evidence-based decision making and prescribing [21,22]. Health educational and promotional efforts that target both health professionals and patients have proven to effectively decrease antibiotic abuse [23].

It is important to note that until recently, it was widely believed that stopping antibiotic treatment early encourages antibiotic resistance, but this is no longer supported by current evidence [24]. Evidence now suggests that taking antibiotics for longer than necessary is associated with an increased risk of developing resistance [25,26].

In light of these findings, several recommendations can be made. Firstly, there is an urgent need to develop and implement continuing professional development activities for health professionals to address the basic concepts of AMR and the judicious use of antimicrobials. Priority should be given to those involved in the prescribing, dispensing and administration of antibiotics. Secondly, regulatory and statutory organizations such as the Ministries of Health and others involved in the regulation of health professionals should work together to ensure that all healthcare professionals have access to appropriate guidelines and policies to support the appropriate choice and use of antimicrobials and to follow evidence-based practice. Thirdly, a robust antimicrobial stewardship program that includes a comprehensive surveillance system, with adequate diagnostic capacity for routine antibiotic sensitivity testing is needed in Grenada. Finally, ongoing educational efforts must be tailored for both healthcare professionals with greater emphasis on appropriate antimicrobial prescribing, and support for good clinical practice and address patients' myths about the use of antibiotics and enable patients to make informed choices. An expert review of the issue, such as that carried out by multi-disciplinary experts in Singapore [27], may be useful to develop locally relevant strategies for Grenada and the wider Caribbean Region.

This study has attempted to be as inclusive and comprehensive on the perspective of healthcare practitioners throughout Grenada. However, while only 44% of physicians responded to this survey, this is comparable to and higher than other response rates for physician surveys in other countries. The use of self-administered questionnaires may have resulted in the high response rate from the included health professional groups. While the majority of questions were adopted from an interviewer-administered tool, surveys were piloted and then validated to ensure the reliability and consistency of interpretation of questions. While other health professional groups such as nurses and midwives are potentially involved in the use of antimicrobials, due

to limitations in time and resources their views were not sought.

Conclusions

This is the first study that seeks to assess healthcare practitioners' knowledge and practices related to AMR in Grenada. The study has identified significant gaps in healthcare professional's knowledge and practices in Grenada, which may be an indication of a wider issue of a sparsity of continuing education and health promotional efforts to address AMR in this Small Island Developing State. The findings imply an urgent need to develop health promotion and educational programs for health professionals, with an emphasis on behavior change as well as empowering them to communicate effectively with patients. Further studies are needed to ascertain the knowledge and practice of other categories of health, veterinary and environmental practitioners in order to provide a one health approach to training materials on the AMR issue. Ongoing public awareness, accessible policies and guidelines on the safe and judicious use of antimicrobials for health professionals and consumers are necessary to improve antimicrobial stewardship in Grenada.

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