Final Technical Report

for

Research Project

Knowledge, Attitude, and the Practice of Antibiotic Use among the Public in Maldives

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Final Report

Knowledge, Attitude, and the Practice of Antibiotic Resistance and Antibiotic Use among the Public in Maldives

The Maldives National University

In collaboration with the Maldives Food and Drug Authority, Ministry of Health

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Contents

Executive Summary

Antimicrobial resistance (AMR) represents a growing public health challenge globally and poses a significant threat to the effective prevention and treatment of infectious diseases. In response, the Maldives has committed to addressing AMR through the implementation of its National Action Plan on Antimicrobial Resistance. However, evidence on public knowledge, attitudes, and practices related to antibiotic use has been limited. This national Knowledge, Attitudes, and Practices (KAP) survey was conducted to generate baseline evidence to inform policy development, programme prioritisation, and monitoring of progress under the national AMR response.

A cross-sectional survey was conducted between July and October 2025 among 1,713 adults aged 18 years and above across urban and non-urban settings in the Maldives. Data were collected using a structured questionnaire adapted from the World Health Organization's AMR public awareness survey. Composite Knowledge, Attitude, and Practice (KAP) scores were calculated using WHO-aligned methodologies and analysed using descriptive statistics, chi-square tests with Monte Carlo simulation, and correlation analysis.

Antibiotic use was common among respondents, with a substantial proportion reporting antibiotic consumption in the previous year. While most respondents obtained antibiotics through formal healthcare channels and reported receiving professional advice, gaps were identified in adherence-related behaviours, including incomplete courses, uncertainty regarding dosing instructions, and inappropriate responses to missed doses. A small but important proportion of respondents reported self-medication or informal access to antibiotics, indicating persistent challenges in antibiotic regulation and responsible-use practices.

Knowledge related to antibiotics and antimicrobial resistance was predominantly poor to moderate, with approximately one-third of respondents classified as having poor knowledge. Misconceptions were common regarding the effectiveness of antibiotics for viral infections such as colds, flu, and dengue, and understanding of how antimicrobial resistance develops and spreads was limited. In contrast, attitudes toward responsible antibiotic use were generally more favourable, with over half of respondents demonstrating moderate attitudes and a smaller proportion exhibiting highly positive attitudes.

Antibiotic-use practices were the weakest of the three KAP domains. Nearly half of respondents demonstrated poor practices, and only a minority reported consistently appropriate antibiotic-use behaviours. Sociodemographic analyses showed statistically significant but weak associations between KAP scores and education level, income, and place of residence. Education emerged as the most consistent determinant across all three domains, while age showed no meaningful association. Gender differences were observed only for practice scores and were characterised by small effect sizes.

Nationality-based analysis highlighted important equity considerations. Although attitudes toward antimicrobial resistance were broadly similar between Maldivian and foreign national respondents, foreign nationals were more likely to exhibit poor antibiotic-use practices. This suggests that differences in practice are influenced less by beliefs and more by contextual and structural factors, such as language barriers, access to healthcare services, continuity of care, and reliance on pharmacy-based or informal sources of antibiotics.

Correlation analysis demonstrated positive associations between knowledge, attitudes, and practices; however, these relationships were of moderate strength, indicating that improvements in knowledge alone are unlikely to result in substantial or sustained behaviour change. This underscores the importance of addressing system-level factors alongside awareness-raising efforts.

Overall, the findings reveal a clear imbalance between knowledge, attitudes, and practices related to antibiotic use in the Maldives. While awareness and concern about AMR are present, inappropriate antibiotic-use practices remain widespread. Addressing antimicrobial resistance will require integrated, equity-sensitive interventions that combine targeted public education with behaviour-focused stewardship strategies, strengthened healthcare and pharmacy communication, and effective regulatory enforcement. Particular attention should be given to populations with lower educational attainment and to foreign national communities through inclusive, multilingual, and context-appropriate approaches. This survey provides a critical baseline to support the implementation and evaluation of the National Action Plan on Antimicrobial Resistance and to guide future AMR prevention efforts within a One Health framework.

Knowledge, Attitude, and the Practice of Antibiotic Resistance and Antibiotic use among the Public in Maldives

1 Background

The discovery of antibiotics is considered as one of the most important achievements of the 20th century medicine. After many years of successful usage, antibiotics have begun to lose effectiveness due to growing antimicrobial resistance. This has been recognized by World Health Organization (WHO) as one of the most serious threats to public health. A serious warning was issued in April 2014 WHO document "Antimicrobial Resistance: Global Report on surveillance". It indicated that the "post-antibiotic era, in which common infections and minor injuries can kill, is far from being an apocalyptic fantasy but instead a very real possibility for the 21st century" (1).

Antimicrobial resistance (AMR) is a global public health burden. AMR develops when a microorganism (bacteria, fungus, virus or parasite) no longer responds to a drug to which it was originally sensitive. As a result, standard treatments become ineffective, infections persist and may spread to others. Much of the antimicrobial resistance issue stems from the misuse and irrational use of antibiotics. If antibiotics were always prescribed appropriately and only when needed, the treatment correctly followed, responsibly used in agriculture or aquaculture, and if substandard and counterfeit products could be abolished, there would be only limited selective pressure on bacteria to become resistant.

In Maldives there is limited research conducted in this area to determine current situation and the impact of this pressing issue. However, several efforts, at National Level, have been made to tackle this global issue of AMR in Maldives. Maldives Food and Drug Authority (MFDA) has been assigned as the National Focal point for AMR and a National AMR Committee comprising of all relevant sectors has been formulated in 2016. National Action Plan, in line with Global Action Plan, has been developed and endorsed in May 2017. Subcommittees and task force groups were assigned to conduct the activities in the Action Plan as such, operational plans have been developed on five strategic objectives. Updated NAP AMR 2024-2029 was endorsed on December 2024 and is currently being implemented (2).

The AMR containment policy has been endorsed in April 2019, identifying the priorities and coordinated action required to mitigate the development of antimicrobial resistance in the country. Antimicrobial regulation has also been drafted to emphasize more on antibiotic prescription, import, distribution, dispensing and use. Presently antibiotics are regulated under the Medicines regulation R-46/2014. A National Referral Laboratory (NRL) has been identified as the IGMH Laboratory for AMR in December 2017 and work has been ongoing to network other

laboratories to the system. Monitoring the level of knowledge among public regarding antibiotics has been recognised as very important to overcome the issue of antimicrobial resistance.

Studies assessing antibiotic knowledge and attitudes provide a tool for identifying the problem as well as possible solutions associated with antibiotic use (3). A knowledge and attitude study depicts the knowledge of respondents on a topic area as well as how they feel about the topic. Understanding the level of antibiotic knowledge and attitude among the public will enable a more efficient public health education approach on antibiotic use as it will facilitate the generation of data necessary for developing strategies that are tailored to the requirements of the general public and enable behavioral change.

The lack of adequate antibiotic knowledge and positive attitude among the public can result in inappropriate antibiotic usage and ultimately antibiotic resistance. However, population based studies on knowledge and attitudes concerning antibiotics in Maldives is non-existent. Therefore, understanding the level of knowledge, attitude and practices regarding antibiotics among the public in Maldives is essential to facilitate further development of strategies in compliance with the requirements of the general public, thereby contributing to the containment of AMR in Maldives.

1.1 Review of literature

Antimicrobial resistance (AMR) is an increasingly severe threat to human health worldwide (4). The global crisis of antimicrobial resistance has been attributed to the overuse and misuse of these medications, as well as a lack of development of new antimicrobial drugs (5). This has resulted in acceleration of the natural evolutionary processes by which microorganisms become resistant to antimicrobial treatments, thereby leading to the rapid emergence of antibiotic-resistant bacteria, endangering the efficacy of antibiotics which have brought about a revolutionary change in medicine and saved countless lives (6).

In addition to their use in human healthcare, antibiotics are widely used in agriculture, aquaculture, and animal farming, raising increasing concerns about their adverse impacts (7). Industrial agriculture heavily relies on antimicrobials to enhance animal health, welfare, and productivity. Currently, antimicrobials are extensively used in livestock farming for growth promotion, disease prevention, and infection control to mitigate economic losses. The World Organization for Animal Health's list of critically important antibiotics for livestock includes key classes of antibiotics also used in human medicine, highlighting the significant implications for human health (8).

The use of antimicrobials in veterinary medicine can select genetic material encoding bacterial resistance. These resistant pathogens pose public health risks as they can be transmitted to humans through direct contact or indirectly via the food chain (9). Addressing the impact of veterinary antimicrobial use on public health requires targeted actions, including raising awareness among farmers and stakeholders, implementing regulations to control antibiotic use in animals, and establishing surveillance systems to monitor antimicrobial use and resistance in livestock (10).

Human activities resulting from industrialization has extensively increased the presence of antibiotic residues in food and the environment, thereby contributing to the prevalence of resistant bacteria and genes (11). The resulting high incidence of antibiotic-resistant infections adds substantial expenses to the already overburdened health care systems of developing countries. With its public health and economic burden, there is no scope to ignore the massive global issue of antibiotic resistance. Lack of policies, regulation and control regarding the use of antibiotics is evident and needs to be targeted at a global capacity, although developing nations are at the greatest risk (12). Lower prices of antibiotics, ease of availability, lack of regulations regarding use of antibiotics and the unnecessary consumption of antibiotics are causing more burden in developing countries (13). In countries with no universal health coverage for its citizens, the use of antibiotics is relatively uncontrolled (14).

Public knowledge, attitudes, and practices (KAP) regarding antibiotic use play a vital role in shaping AMR trends. Compliance with prescribed antibiotic course is also a concern in developed nations. A study conducted in the United Kingdom revealed that 11.3% of participants failed to complete their last course as prescribed. Among them, 65% cited reasons such as feeling better or forgetting to take medication. (15). In Developing countries, the misuse of antibiotics in treating viral infections is common and the prevalence of self-medication is alarmingly high (16). Studies in Palestine, Jordan, China, India and Trinidad and Tobago revealed that the irrational use of antibiotics among students due to a lack of knowledge, attitude, and practice has contributed to the high incidence of antibiotic resistance (17-22).

In a study conducted to determine the social aspects of antibiotic use among students and general public in the South and East Asian Region (SEAR), it was observed that the knowledge, attitudes and perceptions of antibiotic use were inappropriate among the general public in SEAR (23). Similarly, in a related study in among the general population in Bangladesh, the majority of respondents demonstrated average knowledge (52.29%), moderate attitudes (67.84%), and good practices (50.61%) regarding antibiotic use and AMR. Socioeconomic factors, such as education, media exposure, and urban residence, significantly influenced their knowledge, attitudes, and practices. The findings also highlighted critical knowledge gaps and misconceptions, with 42% of respondents holding incorrect beliefs about antibiotic resistance

and 54.88% showing inadequate awareness of the importance of completing full antibiotic courses (24).

In Maldives, several efforts at National level, have been made to tackle the massive issue of AMR. In support of the global efforts to combat AMR, Maldives has successfully developed and endorsed a National Action Plan (NAP) on AMR for the period of 2017 – 2022, in compliance with the Global Action Plan (GAP) on AMR. However, research on AMR in the Maldives remains limited, with existing studies primarily focused on clinical data (25, 26). While these studies provide insights into hospital-acquired infections, they do not explore public knowledge, attitudes, and practices (KAP) related to AMR. This highlights a significant gap in understanding community-level awareness and behaviors. Consequently, due to the scarcity of comprehensive research, the current state of public awareness about AMR in the Maldives remains unclear. Public knowledge, attitudes, and practices significantly influence AMR trends, and efforts must prioritize education and awareness campaigns targeting misconceptions and inappropriate use. For the Maldives, addressing the research gap in community-level awareness is vital for creating effective AMR mitigation strategies and aligning national efforts with global health objectives.

1.2 Significance of the study

Antimicrobial resistance is an emerging problem in the Maldives. However, there is no in-depth study or research done to determine the current state of public awareness on antibiotic among the Maldivian population. The population-based studies on knowledge and attitudes concerning antibiotics in Maldives are not available. Therefore, there is no conclusive evidence to establish the current state of public awareness on antibiotics.

The expected outcome of this research is that it reveals the knowledge and perception of the general public on the use of antibiotics. Understanding the level of antibiotic knowledge and attitude among the public will enable a more efficient public health education approach on antibiotic use as it will facilitate the generation of data necessary for developing strategies that are tailored to the requirements of the general public.

This study will present a number of important findings in relation to the use of antibiotics within the Maldivian population, which can help shape future public awareness efforts and aid the evaluation of the impact of these efforts. The study will help identify key areas for improvement and potential barriers to effective communication related to AMR. It will also provide a baseline for monitoring and evaluating the effectiveness of AMR interventions over time. The findings of this study can also direct future research on the topic area, thereby contributing to the containment of antimicrobial resistance in Maldives.

1.3 Aims and objectives

The purpose of this study is to determine the current situation of public awareness on Antibiotic Resistance and Antibiotic use among the residents of Maldives. The findings of this study will facilitate a situational analysis and guide the future interventions and the development of National AMR communication strategy and plan.

The main aim of this study is to evaluate the Knowledge, Attitude and Practice (KAP) associated with antibiotic resistance and antibiotic use among the residents of the Maldives. Individual objectives of the study include to:

- Evaluate the current level of knowledge regarding antibiotic resistance and antibiotic use among residents of the Maldives
- Determine public attitudes and factors influencing the use of antibiotics and their perceptions of antibiotic resistance.
- Examine the practices related to antibiotic use that contribute to the development of antibiotic resistance among the population.
- Assess how knowledge, attitudes, and practices (KAP) regarding antibiotic use vary across different demographic groups

2 Method

2.1 Research design

This is a quantitative research that adopts a cross-sectional survey design targeting the whole population of Maldives. This is an appropriate approach as it will provide the baseline information on the topic area considering the lack of prior studies in this topic area in the Maldives.

2.2 Sample size

The target population of the study consists of the resident population of the Maldives who are aged 18 years or older at the time of data collection. The sample is designed to be nationally representative, providing distinct estimates for the entire country as well as for the following regions: the North region (HA, HDh, Sh, N, and R), the South region (L, GA, GDh, Gn, and S), the Central region (B, Lh, K, AA, ADh, V, M, Dh, and Th), and Male' (including Male', Vilin'gili, and Hulhumale'), based on the resident population of the Maldives (27).

The sampling frame for this study includes all administrative islands, categorized into four regions: North, South, Central, and Male', as previously outlined. A total sample size of 1690 has been estimated for the survey, which is intended to produce estimates for each stratum (North region, South region, Central region, and Male'). Sample sizes for respondents were determined using statistical methodology, ensuring a 95% confidence interval and a margin of error of 10%.

The administrative islands are categorized into four strata as follows:

- Stratum 1: North Region (HA, HDh, Sh, N, and R)
- Stratum 2: South Region (L, GA, GDh, Gn and S)
- Stratum 3: Central Region (B, Lh, K, AA, ADh, V, M, Dh, and Th)
- Stratum 4: Male' (Male', Vilin'gili, and Hulhumale')

To ensure representation from all four administrative regions, two rural islands and one urban island were purposively selected from strata 1 to 3 (North, South, and Central). Table 1 provides a detailed breakdown of the sample sizes for each stratum. The Maldivian sample was reallocated to a 1:1 male-to-female ratio. Given the negligible proportion of foreign females in the population, no reallocation is required for foreign group.

Table 1 Detailed Breakdown of Sample Size

Item	Allocation of Sample	Maldivian	Foreign
Stratum 1: Urban - HDh Kulhudhuffushi	216	162	54
Stratum 1: Rural - Sh Funadhoo	48	36	12
Stratum 1: Rural - R Alifushi	40	30	10
Total	**304**	**228**	**76**
Stratum 2: Urban - S Hithadhoo	208	156	52
Stratum 2: Rural - GDh Fares- Maathodaa	14	11	3
Stratum 2: Rural - L Fonadhoo	45	34	11
Total	**264**	**201**	**67**
Stratum 3: Urban - B Eydhafushi	118	88	29
Stratum 3: Rural - K Huraa	75	57	19
Stratum 3: Rural - ADh Maamigili	128	96	32
Total	**321**	**241**	**80**
Stratum 4: Male' (G Male)	349		
Stratum 4: Vilin'gili	20		3
Stratum 4: Hulhumale'	193		36
Total	**798**	**598**	**199**
Grand Total	**1690**	**1268**	**422**

Below is a summary of the sampling strategy that was adopted for the study:

Step 01: Calculation of Sample Size

Calculation of the sample size using the formula and adjustment according to the regional variation and non- response

$$n = \frac{Z^2 \cdot P \cdot (1 - P)}{d^2}$$

n = required sample size

Z = Z-score corresponding to the desired confidence level (e.g., 1.96 for 95% confidence)

P = estimated prevalence (as a proportion, e.g., 0.1 for 10%)

d = desired precision (margin of error, e.g., 0.05 for ±5%)

Step 2: Stratification by Geography

To ensure representation from all four administrative regions, two rural islands and one urban island were purposively selected from each region.

Step 3: Allocation of sample proportionate to the population of first level strata

Samples were allocated proportionately to the population size of each first level stratum (Islands)

Step 5: Re-allocation of sample proportionate to the population of third level strata

Samples were allocated proportionately to the population size of each second level stratum (Gender)

Step 6: Identification of individual study unit

Samples were taken at household level using systematic random sampling. One eligible individual per household was selected randomly.

2.3 Instruments and materials

The survey questionnaire is extracted from ‘’WHO Antibiotic Resistance: Multi-Country Public Awareness Survey’’ (28) tool and has been adapted to include a few questions from other relevant studies in order to make it applicable to the Maldivian population.

The questionnaire is divided into two sections. The first section is focused on the socio-demographic characteristics of the respondents. The second section is further divided into four parts and addresses the following areas:

1- Knowledge of antibiotics
2- Use of Antibiotics
3- Knowledge of antibiotics resistance
4- Attitudes on antibiotics
5- Use of antibiotics in animals and agriculture

The questionnaire was developed in English and translated to the local language Dhivehi. The questionnaire is administered in the local language or mixed language through face-to-face interviews. Expatriate surveys were conducted in English, the local language, or the respondent’s preferred language, by enumerators who were able to converse in that language. Survey questionnaire for the study is attached Appendix 1 of this report and information to participants and consent form is attached to Appendix 2.

2.4 Data collection

Pilot tests of the questionnaire was carried out with a small sample of participants (n=15) representative of that of the target population to refine the instrument ensuring reliability and validity.

Information for participants and ethical consent was taken before starting the survey. The survey was administered in-person by trained enumerators through face-to-face interviews. Non responses and dropouts was handled by recruiting 10% additional respondents. Enumerators was recruited from islands or areas where the survey was conducted and trained accordingly to fill out the questionnaire accurately. Before the survey implementation, enumerators were trained on objectives of the study, enumerator roles and responsibilities, filling out the questionnaire, study protocol, sampling, community engagement and ethics. The data collection process involved deploying trained enumerators to selected households. Through face-to-face interviews using online forms (via Google form), enumerators gathered detailed information using tablets or phones. Each survey took approximately 30 minutes to complete and data was collected over a period from July to October 2025. The survey instrument was optimised by

conducting pilot study and enumerators were trained before data collection to ensure data accuracy during data collection.

2.5 Data analysis and data management

The results of this study will be analyzed using SPSS 21. The questions corresponding to the parameters of knowledge, attitude, and practice will be evaluated using a range of statistical tests. Descriptive statistics and KAP score were employed to analyse the data.

The data collected was stored electronically with access restricted to research team. Beyond ensuring the quality of the questionnaire, enumerator training, and field supervision, time taken to complete the survey was explored for logical inconsistencies.

2.6 Calculation of Knowledge, Attitude and Practice (KAP) scores

Knowledge, attitude, and practice (KAP) scores were calculated using standard methodologies commonly applied in antimicrobial resistance (AMR) surveys. Each domain (knowledge, attitude, and practice) was scored separately by assigning numerical values to individual questionnaire items and aggregating these to generate composite scores for each respondent. Composite scores were subsequently categorised into performance levels to facilitate interpretation.

Knowledge scoring:

Knowledge items were scored dichotomously, with a score of 1 assigned to each correct response and 0 assigned to incorrect or “don’t know” responses. A total of 14 knowledge items were included, resulting in a composite knowledge score ranging from 0 to 14. Knowledge scores were categorised as poor (0–6), moderate (7–10), and good (11–14), corresponding to <50%, 50–74%, and ≥75% of the maximum possible score, respectively.

Attitude scoring:

Attitudes towards antibiotic use and antimicrobial resistance were assessed using Likert-scale statements. Responses were scored from 1 (“strongly disagree”) to 5 (“strongly agree”). Negatively worded statements were reverse-coded so that higher scores consistently reflected more favourable attitudes towards antibiotic stewardship. For attitude items, “don’t know” responses were treated as missing, rather than incorrect, as they reflect uncertainty rather than a negative attitude. A composite attitude score was calculated as the mean of available attitude items, yielding a score range of 1 to 5. Attitude scores were categorised as negative (<3.0), moderate (3.0–3.9), and positive (≥4.0).

Practice scoring:

Practice items were scored dichotomously, with 1 assigned to appropriate antibiotic-use behaviours (e.g. obtaining antibiotics with a prescription, completing the full course, correct interpretation of dosing instructions, and checking expiry dates) and 0 assigned to inappropriate, "don't know", or missing responses. A total of six practice items were included, producing a composite practice score ranging from 0 to 6. Practice scores were categorised as poor (0–2), moderate (3–4), and good (5–6) practice.

For knowledge and practice domains, missing or blank responses were treated as 0, consistent with WHO KAP survey guidance, as they indicate absence of knowledge or desirable behaviour. KAP scores were analysed both as continuous variables and as categorical variables to support descriptive and inferential analyses.

KAP scores were analysed using both continuous-score comparisons (one-way ANOVA) and categorical analyses (chi-square tests with Monte Carlo simulation where appropriate), with consistent findings across analytical approaches.

2.7 Ethical considerations

Ethical approval for the study was obtained from the National Health Research Council (NHRC), Ministry of Health, and the WHO South-East Asia Regional Ethics Review Committee (SEAR ERC). Participation was voluntary, with informed consent obtained after clearly explaining the study procedures and participants' right to withdraw at any time prior to questionnaire submission.

No risks were anticipated, and the survey was conducted in a safe environment with privacy ensured. Participant feedback was monitored to manage any potential issues, with a reporting mechanism in place. All data were collected anonymously, treated with strict confidentiality, and accessible only to the research team. Research records will be securely stored for five years before disposal.

3 Results and Discussion

3.1 Socioeconomic and demographic characteristics

A total of 1,713 participants completed the survey. Table 2 summarises their sociodemographic characteristics. The sample consisted of 52.4% male (n = 898) and 47.6% female (n = 815) respondents and included 1297 Maldivians (75.7%) and 416 expatriate (24.3%) respondents. The mean age of respondents was 34.1 years, with a median age of 32 years (IQR: 25–40). Participant

ages ranged from 18 to 85 years, indicating representation from young adults through older individuals. The sample was predominantly young and of working age, with nearly 60% of respondents below 35 years.

Table 2 Sociodemographic characteristics of the respondents (n=1713)

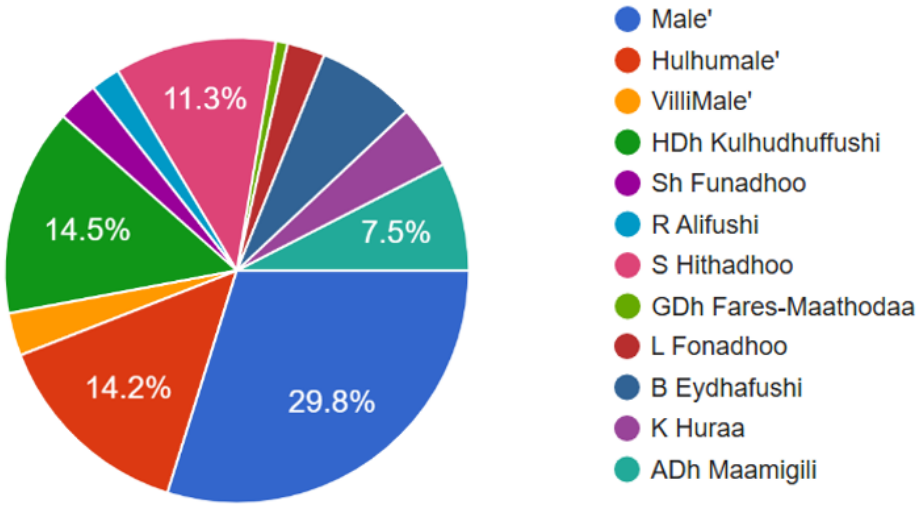
Characteristic	**Number of participants (n)**	**Percentage (%)**
Gender		
Male	898	52.4
Female	815	47.6
Age Group		
18-24	402	23.5%
25-34	605	35.3%
35-44	408	23.8%
45-54	177	10.3%
55-64	84	4.9%
65+	37	2.2%
Education Level		
No formal education	136	7.9%
Primary education	160	9.3%
Secondary education	773	45.1%
Diploma / Certificate	226	13.2%
Bachelor's degree	278	16.2%
Master's degree	137	8.0%
Doctorate / PhD	3	0.2%
Marital Status		
Single	579	33.8%
Married	986	57.6%
Divorced	116	6.8%
Widowed	32	1.9%
Location		
Urban (cities)	1,247	72.0%
Rural (all other islands)	466	28.0%
Sample type		
Local population (Maldivian)	1297	75.7%
Expatriate (Foreign)	416	24.3%

More than half of the respondents (69.6%) had attained at least secondary-level education, indicating a relatively well-educated sample. Higher education included Bachelor's (16.2%), Master's (8.0%), and Doctoral degrees (0.2%), while a smaller proportion reported primary education (9.4%) or no formal education (8.0%). Income distribution varied with majority of the

respondents earned between MVR 5,000–9,999 (26.3%) and MVR 10,000–15,000 (25.1%), with 16.4% unemployed and 9.1% earning below MVR 5,000.

The sample was geographically diverse, representing multiple atolls and urban centres (Figure 1). The largest proportions (72.9%) resided in urban cities including Malé (29.1%), Kulhudhuffushi (14.6%), Hulhumalé (13.9%), Hithadhoo (12.4%) and Villingili (2.9%). Other notable locations from the rural area included Maamigili (7.5%) and Eydhafushi (7.0%). Most respondents were Maldivian (75.7%), while 24.3% were foreign nationals, reflecting a diverse and mixed workforce.

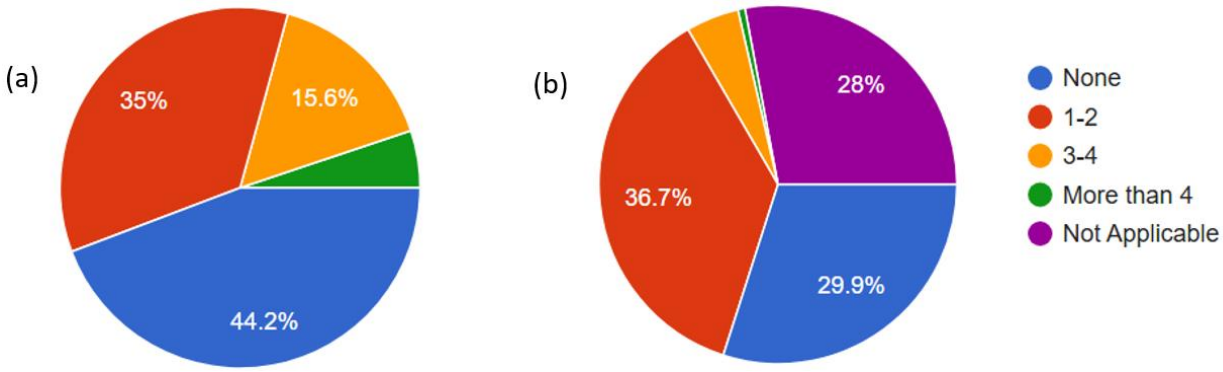
Figure 1 Geographic distribution (atoll/island) of survey respondents



A majority of respondents (57.6%) were married and 34.1% were single Figure 2 presents the distribution of respondents by number of children. A substantial proportion (44.2%) had no children, while most parents reported one to two children (35.0%); smaller proportions had three to four (15.6%) or more than four children (5.1%). Among those with children, the majority (36.7%) had one to two children under 16 years, with very few (5.4%) reporting three or more.

The demographic profile of the respondents indicates a predominantly young, urban, and moderately educated population, broadly reflective of the Maldives' working-age demographic. Most participants were under 35 years and resided in urban centres. This pattern is consistent with national census data showing a youthful population concentrated in urban areas, particularly Malé City (National Bureau of Statistics, 2022).

Figure 2 Number of children of the respondents a) total number of children and b) number of children under 16 years of age

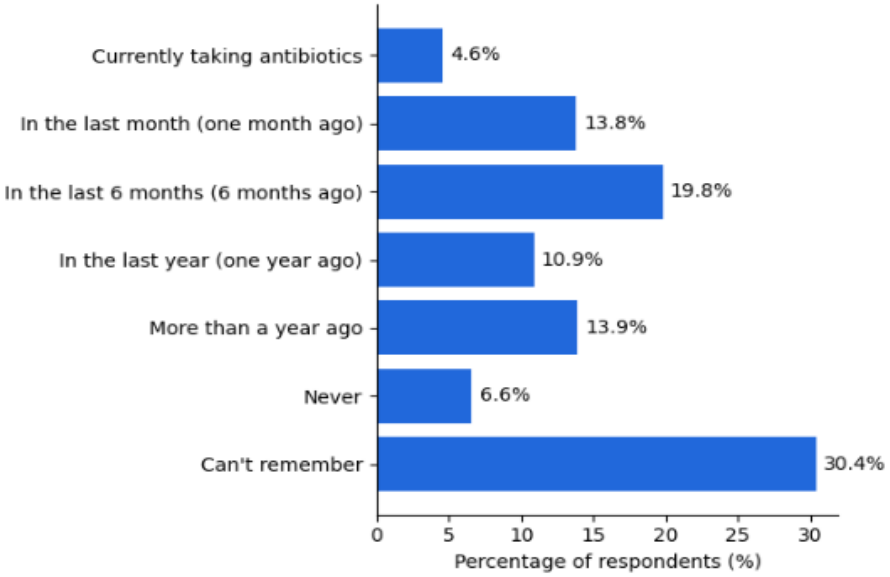


3.2 Use of Antibiotics

As shown in Figure 3, a substantial proportion of respondents (30.4%) reported that they could not recall when they last took antibiotics. Recent use was common, with 19.8% reporting antibiotic use within the past six months and 13.8% within the last month. Smaller proportions reported use within the past year (10.9%) or more than a year ago (13.9%). Only a small fraction were currently taking antibiotics (approximately 4–5%), while 6.6% indicated they had never used antibiotics. Overall, nearly half of respondents reported antibiotic use within the past year, indicating widespread exposure. The high share of respondents unable to recall prior use suggests potential gaps in awareness or recall related to antibiotic consumption.

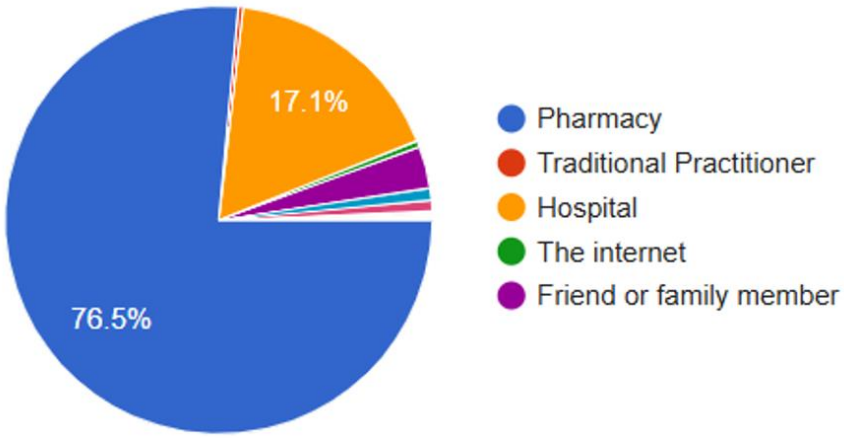
Among those who reported having taken antibiotics (n=1079), a substantial majority (89.3%) obtained them through a prescription from a doctor, demonstrating relatively strong adherence to appropriate prescription practices. However, it is concerning that 9.1% reported taking antibiotics without a prescription, and a small proportion (1.6%) could not recall whether a prescription had been involved. This may contribute to inappropriate use and risk of antimicrobial resistance. Most respondents (88.0%) reported receiving advice from a doctor, nurse, or pharmacist on proper antibiotic use, including dosage, duration and whether to take with food. However, 8.2% received no advice and a small proportion reported limited or unclear instructions. This indicates that although most antibiotic use is medically supervised, a small but important gap remains in communication and understanding of proper antibiotic administration.

Figure 3 Distribution of respondents by time since last antibiotic use



With respect to Figure 4 depicting the source of antibiotics, the majority (76.5%) obtained them from a pharmacy, followed by 17.1% who received them from a hospital. Only a minimal number of respondents acquired antibiotics from informal sources such as traditional practitioners (0.4%), friend or family members (3.2%), or online platforms (0.5%). Although the results indicates the predominance of formal distribution channels, informal access pathways suggest the importance of strengthening regulatory control and promoting public awareness regarding the risks.

Figure 4 Sources from which respondents obtained antibiotics



When inquired whether they completed the full course of antibiotics as prescribed, 68.6% reported doing so, indicating generally good compliance. However, 16.0% reported not completing the course, 9.5% were unable to recall and a small proportion (4.3%) indicated that they followed prescriptions only sometimes (Figure 5). While antibiotic access and prescription

practices are largely guided by professional oversight, these findings highlight persistent gaps in patient compliance and appropriate use practices that may contribute to antimicrobial resistance. The most frequently reported reasons for not completing a course of antibiotics were feeling better or the disappearance of symptoms, followed by forgetfulness or carelessness.

Figure 5 Completion of the course of antibiotics as prescribed

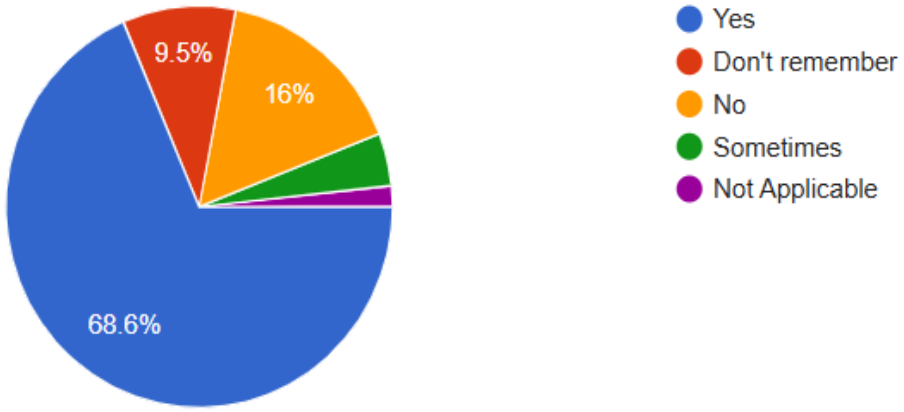
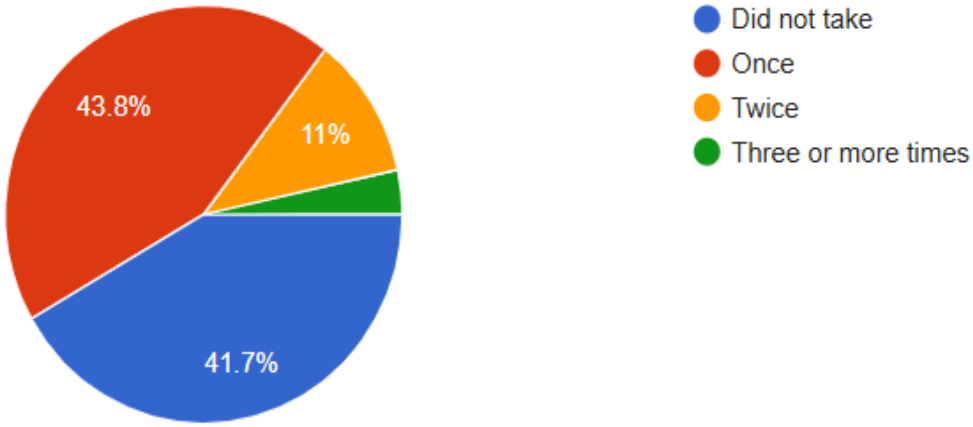


Figure 6 shows that antibiotic use within the last six months varied notably among respondents. Of the individuals reported as having taken antibiotics, 41.7% reported had not taken any antibiotics during this period, while 43.8% indicated that they had taken antibiotics once during the last six months. A smaller proportion (11.0%), indicated taking antibiotics twice, and only 3.4% stated that they had taken antibiotics three or more times within the six-month period. These findings suggest that while a substantial share of the population had recent exposure to antibiotics, repeated use within a short timeframe remains relatively low. Nonetheless, the proportion of respondents who reported using antibiotics at least once (58%) underscores the need for continued public health efforts to promote prudent antibiotic use and to strengthen awareness regarding the risks associated with frequent or unnecessary antibiotic consumption.

Figure 6 Antibiotic use within the last six months



The responses to the question assessing understanding of the instruction **"**three times daily" reveal considerable variation in interpretation among respondents. The majority of respondents (52.5%) correctly understood it as meaning the medication should be taken every eight hours, ensuring even dosing intervals across a 24-hour period. However, 36.5% interpreted it as taking the medicine in the morning, afternoon, and night, which, while partially accurate, may not maintain the intended therapeutic levels if dosing intervals are inconsistent. A smaller proportion (10.4%) believed it referred to taking the medication at any three times during the day, and a few respondents expressed uncertainty or alternative interpretations. These findings highlight gaps in understanding common dosage instructions, emphasizing the need for healthcare providers to clearly explain dosage instructions to improve patient adherence and treatment outcomes.

The responses to the question regarding actions taken after missing an antibiotic dose reveal significant variation in adherence behaviour. The majority (64.7%) reported that they would take the missed dose when they remembered, indicating an understanding of the importance of completing the antibiotic course. However, 16.1% stated that they would stop taking the rest of the antibiotic course, while approximately 10.4% reported taking the missed dose along with the next scheduled one. A smaller proportion (8.8%) indicated alternative or uncertain responses, such as taking the missed dose along with the next scheduled dose, skipping the missed dose, or being unsure of what to do. These findings highlight the need for strengthened patient education and clear communication from health care professionals regarding the correct response to missed doses.

The results also indicate that 59.4% of respondents check the expiry date of antibiotics before use, while 40.6% admitted that they do not check the expiry date. This suggests that although a majority of individuals demonstrate awareness of the importance of verifying medication validity, a considerable proportion still overlook this crucial safety measure. Failure to check expiry dates may increase the risk of reduced drug efficacy or potential adverse effects associated with expired medications.

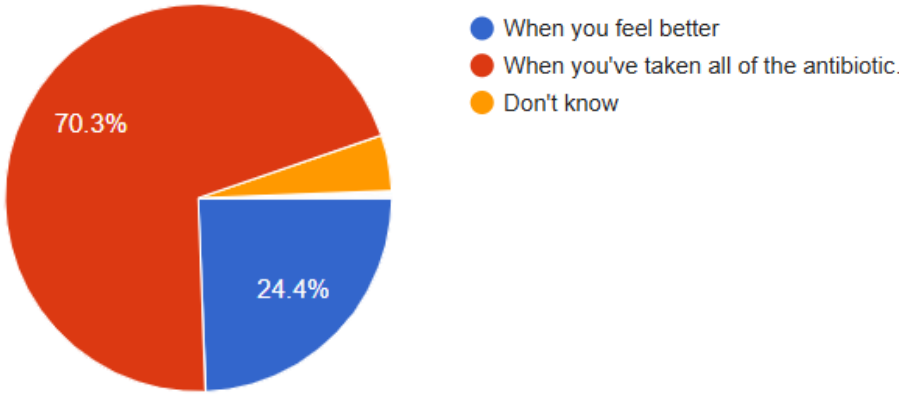
Taken together, the findings indicate that antibiotic use is widespread across the surveyed population, with frequent and recent exposure observed among respondents. While the majority accessed antibiotics through legitimate medical channels and received professional guidance, notable behavioural gaps persist in adherence, dosage comprehension, and verification of medication validity. The presence of self-medication and informal acquisition, though limited, signals vulnerabilities in regulatory enforcement and public awareness. These mixed patterns reflect a population with relatively good access to antibiotics but variable understanding of their proper use. Strengthening patient education, improving provider–patient communication, and reinforcing community-level stewardship and dispensing regulations are therefore essential to

ensure responsible antibiotic practices and to curb the emergence of antimicrobial resistance in the Maldives.

3.3 Knowledge of antibiotics

When asked when they believed antibiotic treatment should be stopped, 70.3% of respondents correctly indicated that antibiotics should be taken until the full course is completed (Figure 7). However, a considerable number (24.4%) stated that they would stop taking antibiotics once they felt better, and 5.1% were uncertain. While the majority demonstrated awareness of appropriate antibiotic use, the notable proportion who would discontinue treatment prematurely suggests the need for further public education on the importance of completing prescribed antibiotic courses.

Figure 7 Respondents' perceptions of when antibiotic treatment should be stopped

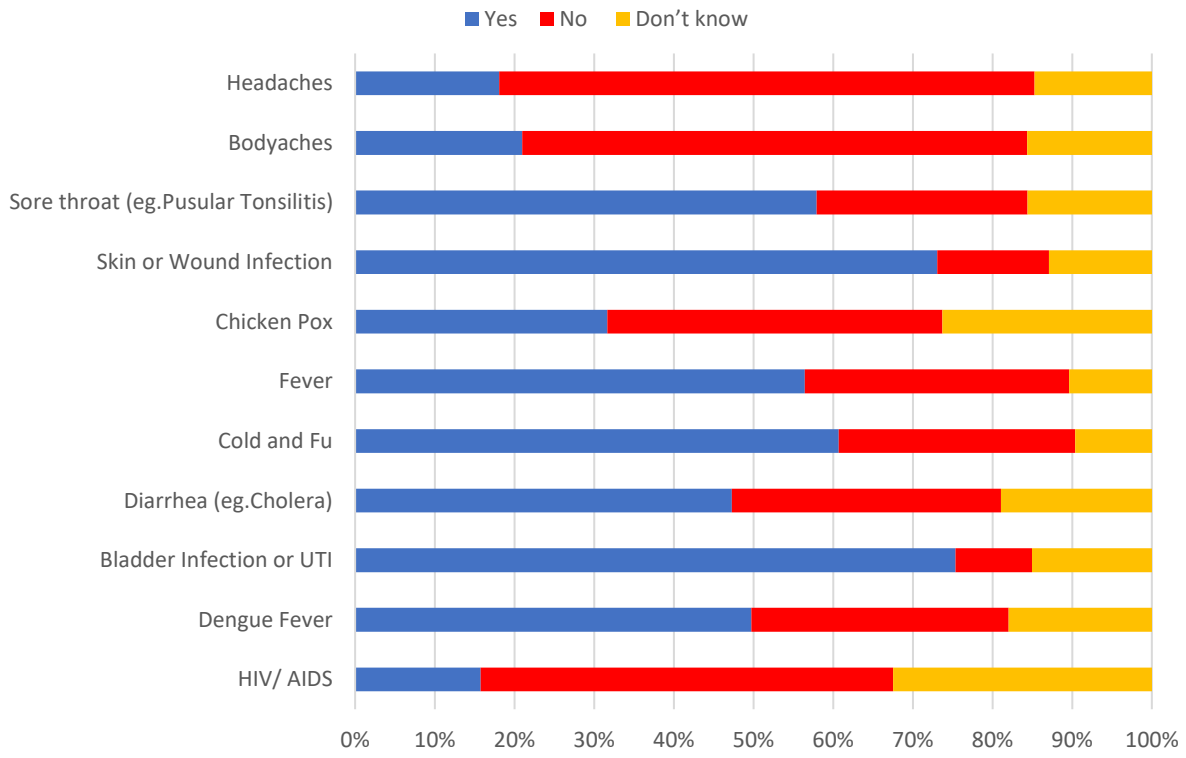


In response to the question whether it is acceptable to use the same antibiotics prescribed to a friend or family member for the same illness, 82.4% of respondents correctly identified this statement as false. This indicates good awareness of the risks associated with sharing antibiotics. However, 11.9% believed it to be true, and 5.7% were uncertain, suggesting that misconceptions about antibiotic sharing persist among a small but significant segment of the population.

Figure 8 illustrates respondents' perceptions regarding the types of illnesses that can be treated with antibiotics. The results reveal mixed levels of understanding regarding the appropriate use of antibiotics. A majority correctly identified Urinary tract infections (UTIs) (75.4%), skin or wound infections (73.1%) and sore throat (57.9%) as conditions that can be treated with antibiotics, indicating relatively good awareness of bacterial infections. However, significant misconceptions persisted for viral and non-bacterial conditions. For instance, a considerable number of respondents incorrectly believed that cold and flu (60.7%), fever (56.5%), and diarrhea (49.7%)

could be treated with antibiotics. Similarly, a notable proportion of participants (44.9%) thought that dengue fever could be treated with antibiotics, and a smaller yet concerning number (15.8%) believed the same for HIV/AIDS. These findings suggest that while awareness of antibiotic use for bacterial infections is relatively high, misconceptions about the role of antibiotics in treating viral infections remain widespread. This indicates a need for targeted public education to reinforce the message that antibiotics are only effective against bacterial infections and should not be used to treat viral diseases.

Figure 8 Perceptions regarding the types of illnesses that can be treated with antibiotics



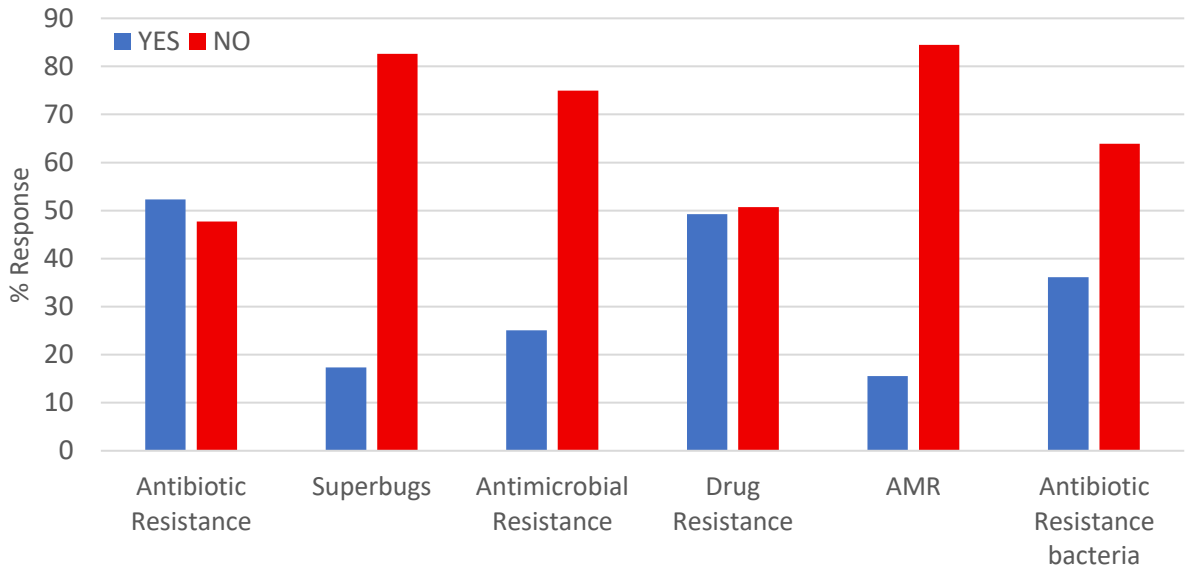
Respondents were asked whether antibiotics are used in agriculture and farming, including in food-producing animals within the country among all participants, 30.1% believed that antibiotics are indeed used in agricultural or livestock production. In contrast, 16.6% stated that antibiotics are not used in farming, while the majority (53.2%) reported that they are unaware of the use of antibiotics in this context. More than half of the respondents were uncertain about the use of antibiotics in agriculture, reflecting limited public understanding of antibiotic applications in the animal production sector. This highlights the need to improve public knowledge of antimicrobial use in the food chain and its potential implications for antimicrobial resistance at both national and global levels.

3.4 Knowledge of antibiotics resistance

The survey explored participants' awareness of key terms related to antimicrobial resistance and the results are shown in Figure 9. Around half of the respondents (52%) had heard the term "Antibiotic Resistance", while awareness was noticeably lower for "Superbugs", "Antimicrobial Resistance (AMR)", and "AMR" as an abbreviation. Awareness of "Drug Resistance" (49%) and "Antibiotic-Resistant Bacteria" (36%) was moderate. The results suggest that while the general concept of resistance is somewhat known, technical or scientific terminology is less familiar to the wider public.

Among those who had heard of these terms, the most common sources of information were media (television, radio, newspapers, and social media) and school or university education, followed by health professionals (doctors, nurses, and pharmacists). A smaller proportion learned about these terms from specific campaigns or family and friends. Notably, a substantial segment of respondents indicated that they could not remember where they had heard the terms. This pattern suggests that both mass media and healthcare interactions play a central role in shaping public understanding of antibiotic resistance. However, the reliance on media as the main source also highlights the importance of ensuring that accurate and consistent information is communicated through these platforms to strengthen public awareness and combat misconceptions.

Figure 9 Awareness of key terms related to antimicrobial resistance



Overall, these findings indicate that while public awareness of antibiotic resistance exists, understanding of broader antimicrobial resistance concepts remains limited. This stresses the importance of targeted awareness campaigns and education programs to enhance knowledge and understanding of AMR terminology and its implications for health and disease prevention.

With reference to awareness regarding causes and consequences of antimicrobial resistance (Figure 10), a large proportion of respondents (72.4%) incorrectly agreed with the statement that "antibiotic resistance occurs when your body becomes resistant to antibiotics and they no longer work as well." This reflects a common misconception, as antibiotic resistance develops in bacteria, not in the human body. Only 9.6% of participants correctly identified the statement as false, while 18% reported uncertainty. These findings highlight a significant knowledge gap in understanding the mechanism of antibiotic resistance and underscore the need for clearer public education on how resistance develops and spreads.

A substantial proportion of respondents (62.2%) agreed that many infections are becoming increasingly resistant to antibiotics, reflecting a broad awareness of the global rise in AMR. However, the 29% who expressed uncertainty highlight that while the concept of resistance is widely recognized, its scale and implications may not be fully understood by all. Most participants (70.1%) correctly identified that if bacteria become resistant to antibiotics, infections can become difficult or impossible to treat. This demonstrates a solid grasp of the clinical consequences of antibiotic resistance, one of the most critical public health messages promoted by WHO and regional AMR action plans. Furthermore, 62.8% of respondents acknowledged that antibiotic resistance could affect themselves or their families. Nevertheless, 16.9% disagreed and 20.3% were uncertain, suggesting that a significant portion of the population still perceives AMR as a distant or indirect threat rather than a pressing local health concern.

Geographical misconceptions were also apparent. Only 17% believed that antibiotic resistance is a problem confined to other countries, while 46% correctly disagreed with this notion, indicating a reasonable understanding that AMR is also a domestic public health issue in the Maldives. However, the remaining 37% who were uncertain suggests that more localized communication and public awareness efforts are necessary to contextualize AMR within the national setting.

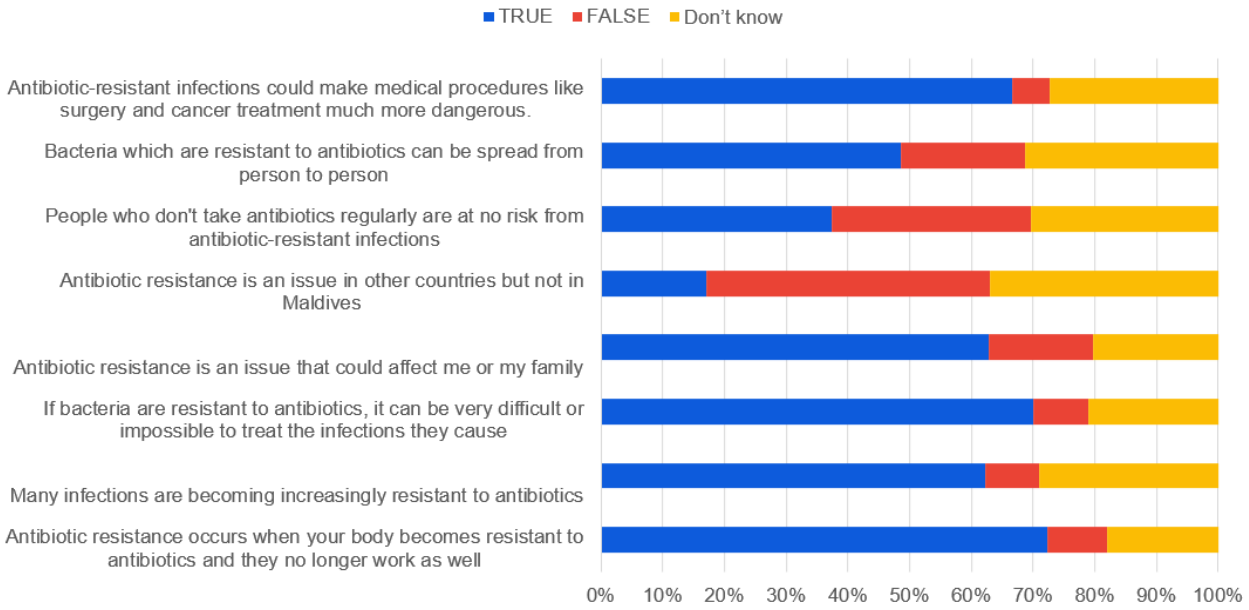
Responses to the statement "People who don't take antibiotics regularly are at no risk from resistant infections" revealed notable confusion: 32.2% correctly disagreed, while 37.5% agreed and another 30.3% were unsure. This indicates limited understanding of the indirect transmission risks of antibiotic-resistant bacteria, which can spread through contaminated food, water, or contact with carriers not just through personal antibiotic misuse. When asked about transmission dynamics, 48.5% correctly recognized that bacteria resistant to antibiotics can spread from person to person, though 20.3% disagreed and 27.4% were uncertain. This further highlights the

need to strengthen public knowledge of AMR as a communicable threat, rather than an individual or isolated problem.

Finally, awareness of the broader implications of AMR was evident, with 66.6% agreeing that antibiotic-resistant infections can make medical procedures like surgery and cancer treatment more dangerous. This understanding aligns with global health messaging that emphasizes the role of effective antibiotics in safeguarding routine and advanced medical care.

Overall, the results show that while the fundamental awareness of AMR exists, there remain critical gaps in understanding its mechanisms, transmission, and local relevance. Educational interventions should therefore move beyond general awareness to focus on clarifying misconceptions particularly that AMR affects everyone, can spread between individuals, and threatens essential healthcare procedures.

Figure 10 Awareness regarding causes and consequences of antimicrobial resistance



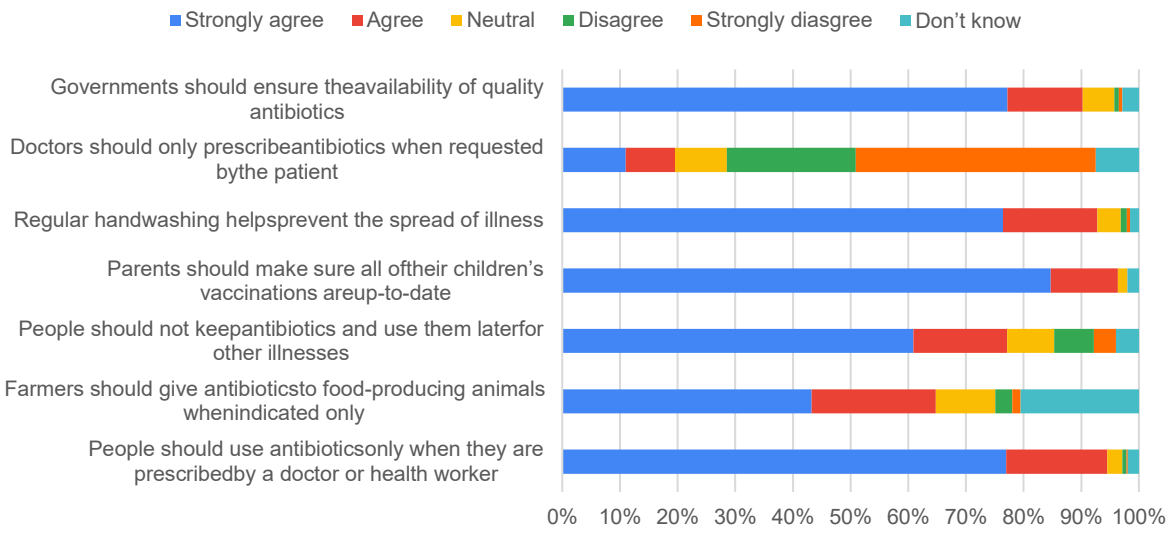
Overall, the results indicate that while the Maldivian public demonstrates a basic understanding of antibiotic use and antimicrobial resistance, significant misconceptions persist across key domains. Most respondents recognised the importance of completing antibiotic courses and avoiding the use of medicines prescribed to others, reflecting good foundational knowledge. However, widespread misunderstanding remains regarding the effectiveness of antibiotics against viral illnesses such as colds, flu, and dengue, as well as limited awareness of their use in food production and agriculture. Although more than half of respondents had heard of antibiotic resistance, understanding of how resistance develops, spreads, and affects local populations was often incomplete. Many continued to view AMR as a problem occurring elsewhere rather than a

national health concern. These findings stress the need for sustained, context-specific education and communication initiatives that clarify appropriate antibiotic use, address persistent myths, and strengthen public understanding of AMR as a shared and immediate threat to health security in the Maldives.

3.5 Attitudes on antibiotics

Respondents were asked to express their level of agreement with a series of statements related to antibiotic use, resistance, and prevention (Figure 11). A large majority (77.2%) strongly agreed that antibiotics should be used only when prescribed by a doctor or health worker, showing widespread understanding of appropriate antibiotic stewardship. Similarly, most respondents (76.4%) strongly agreed that regular handwashing helps prevent the spread of illness and that parents should ensure their children's vaccinations are up to date (85%), reflecting good awareness of preventive health behaviors.

Figure 11 Level of agreement regarding the statements on antibiotic resistance and antibiotic use



Regarding antibiotic use in agriculture, a majority of respondents (64.8%) either strongly agreed or agreed that farmers should administer antibiotics to food-producing animals only when indicated. However, 20.5% of respondents selected "Don't know", suggesting uncertainty or limited understanding of antibiotic use in animal production. Similarly, a large proportion of participants (77.2%) either strongly agreed or agreed that people should not keep leftover antibiotics or use them later for other illnesses, demonstrating awareness of the risks associated with self-medication and misuse. Most respondents correctly disagreed or strongly disagreed (64%) with the statement that doctors should only prescribe antibiotics when requested by the

patient, indicating an appropriate understanding that antibiotic prescriptions should be based on clinical judgment rather than patient demand. However, it is concerning that the considerable number of respondents (36%) agreed or did not know the correct practice.

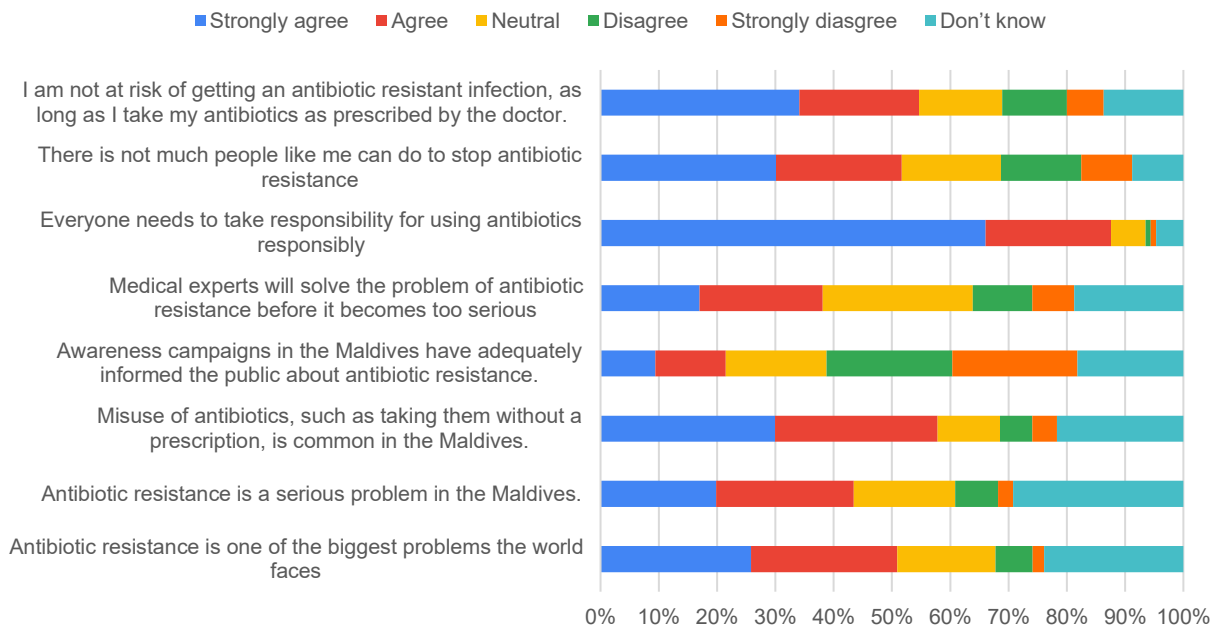
Finally, there was strong consensus (77.2%) that governments should ensure the availability of quality antibiotics, highlighting public expectations for access to safe and effective medicines. Overall, the responses demonstrate encouraging levels of awareness and responsible attitudes toward antibiotic use, though certain misconceptions about prescription autonomy remain. This emphasizes the need for continued public education on antibiotic use in both human and animal health contexts.

Figure 12 demonstrates the level of awareness regarding the global and national significance of antibiotic resistance of the respondents. A majority strongly agreed or agreed that antibiotic resistance is one of the biggest problems the world faces (50.9%) and that it is a serious problem in the Maldives (43.4%), reflecting strong recognition of antibiotic resistance as a major health threat. Similarly, a large portion of respondents (57.9%) agreed that misuse of antibiotics such as taking them without a prescription is common in the Maldives, highlighting public awareness of inappropriate antibiotic practices. In contrast, responses were more divided regarding awareness campaigns on antibiotic resistance. Many respondents (78.5%) selected neutral, disagree, or don't know, suggesting uncertainty about whether existing awareness initiatives have been effective.

While some respondents expressed confidence in medical experts (38.1%) to solve the problem, others were neutral or disagreed, suggesting limited optimism about scientific or medical solutions alone being sufficient to address the problem. A significant majority (87.6%) strongly agreed that everyone needs to take responsibility for using antibiotics responsibly, reflecting broad public understanding that combating antibiotic resistance requires collective action. However, 17% remained neutral and 22.5% of the respondents disagreed with the statement "there is not much people like me can do to stop antibiotic resistance". More than half of the respondents agreed (51.7%), implying that they feel limited in their ability to influence the issue.

Finally, for the statement "I am not at risk of getting an antibiotic-resistant infection as long as I take my antibiotics as prescribed by the doctor," a majority agreed or strongly agreed (54.6%), showing confidence in personal adherence as a protective factor. Nevertheless, this belief also reflects a narrow understanding of antibiotic resistance as an individual rather than a community-level threat. Overall, the results suggest that while awareness of shared responsibility is high, there remains a need to strengthen public understanding of the broader, systemic nature of antibiotic resistance and the importance of coordinated action across both individual and institutional levels.

Figure 12 Level of agreement regarding global and national significance of antibiotic resistance



Overall, the findings indicate generally positive public attitudes toward responsible antibiotic use, preventive health practices, and recognition of antibiotic resistance as a significant public health concern. Most respondents expressed strong support for prescription-based antibiotic use, vaccination, and hygiene measures, reflecting alignment with recommended practices for responsible antibiotic use. However, uncertainty persists regarding antibiotic use in animals, the influence of patient expectations on prescribing, and the extent of national awareness initiatives. Although the majority acknowledged that antimicrobial resistance is a shared global challenge, many continued to underestimate their individual and collective capacity to influence change. Strengthening community engagement, empowering public participation, and promoting the One Health approach through targeted education and communication strategies will be essential to sustain responsible antibiotic practices and mitigate antimicrobial resistance in the Maldives.

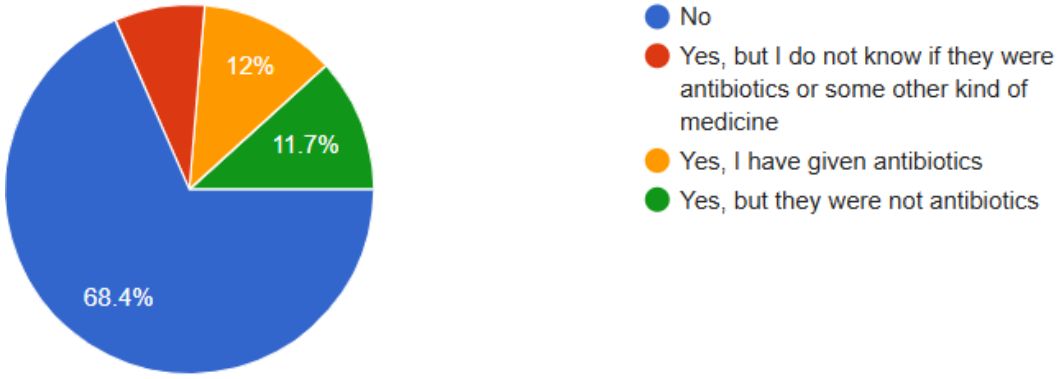
3.6 Use of antibiotics in animals and agriculture

Out of 1,713 respondents, 80.0% reported not owning any animals, while 19.4% indicated that they owned a pet animal. Ownership of other types such as animals for farming, fish, or birds was minimal, with less than 1% of respondents reporting these categories. This suggests that antibiotic use related to household pets or small-scale animal keeping is likely limited among the surveyed population. Among the 342 respondents who reported owning or handling a pet or farm animal, the most commonly owned animals were birds (52.9%), followed by cats (31.6%)

and fish (26.3%). A smaller proportion reported keeping rabbits (1.8%), while ownership of other animals and farm animals was minimal, each accounting for less than 1% of responses.

Out of 342 respondents who reported owning or handling a pet or farm animal, the majority (68.4%) stated that they had never used any medicines or antibiotics on their animals (Figure 13). A smaller proportion (12.0%) indicated that they had given antibiotics to their pets or farm animals, while 11.7% reported using medicines that were not antibiotics. Additionally, 7.9% of respondents said they had used medicines but were unsure whether they were antibiotics or another type of medication. These findings suggest that direct antibiotic use among pet or small-scale animal owners is relatively limited, with most respondents either not administering medicines or being uncertain about their type. The uncertainty expressed by some participants highlights a potential gap in awareness regarding veterinary antibiotic use, emphasizing the need for better education on responsible antibiotic practices in animal care.

Figure 13 Use of medicines or antibiotics on pets and farm animals



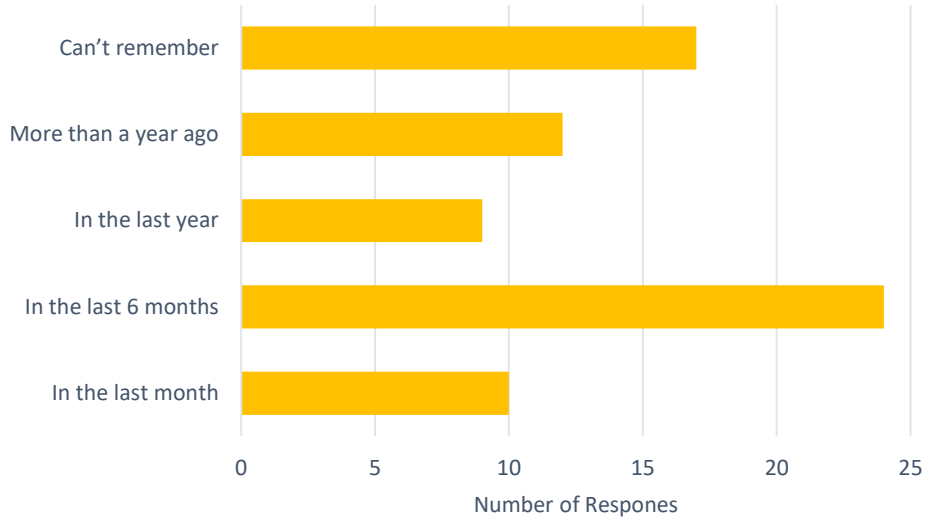
Among the 342 respondents who reported owning or handling a pet, farm animal, or bird, the majority (55.6%) indicated that the question was not applicable, reflecting that many did not administer antibiotics to animals. Of those who had applicable experiences, 31.3% stated that they had never given antibiotics within the past six months, while 8.8% had done so once, and smaller proportions reported giving antibiotics twice (2.9%) or more than twice (1.5%). These findings suggest that antibiotic use among pet or small-scale animal owners is infrequent, with most respondents either not administering antibiotics recently or not engaging in animal care requiring such treatments. The high percentage of “not applicable” responses may indicate that antibiotic use in household and small farm contexts remains relatively uncommon in the Maldives.

Among the six respondents who reported giving antibiotics to their pet, farm animal, or bird more than twice within the last six months, the frequency of administration varied. Two respondents (33.3%) had given antibiotics twice, another two (33.3%) had done so five times, and one

respondent each had administered antibiotics three and four times, respectively. Although the number of respondents in this category is small, these findings indicate that a few individuals engage in relatively frequent antibiotic use for animals. This may reflect repeated illness episodes, preventive antibiotic use, or limited access to veterinary guidance.

When asked about the last time they had given antibiotics to their pet or farm animal, most participants (78.8%) had not administered antibiotics to animals (Figure 14). Among 72 respondents who had, 7.0% reported giving antibiotics within the last six months, 2.6% within the last year, 3.5% more than a year ago, and 5.0% said they could not remember when it was last done. Only a small proportion (2.9%) reported administering antibiotics within the past month.

Figure 14 Most recent antibiotic administration to pets and farm animals



Only a minority of respondents who owned or handled pets or farm animals reported antibiotic use in animals. Of these, 12% followed a veterinarian's advice, while 7.3% administered antibiotics without professional consultation. Antibiotics were mostly obtained from pet shops (7.9%) and pharmacies (4.1%), with fewer respondents sourcing them from veterinarians, friends, or family members, using leftover antibiotics or on the internet. The practice of administering antibiotics without expert supervision points to a need for improved awareness for seeking veterinary consultation. Although animal antibiotic use was relatively limited, the presence of informal and non-prescription access highlights gaps in veterinary oversight and regulation, highlights the need for stronger control of antibiotic sales and increased public awareness on veterinary antibiotic usage.

Among those who reported antibiotic use in animals, 12.3% confirmed that they completed the prescribed antibiotic course, while 2.9% admitted they did not, and 3.2% stated that they could not remember Reasons for not completing the prescribed course included death of animal before completion of treatment (e.g., “bird died,” “the pet died before completion,” “the animal passed away”) or the animal appeared to have recovered, citing statements such as “the animal seemed better” or “followed instructions on the box and stopped when the bird got better.” A few respondents indicated uncertainty or forgetfulness. In addition, only 13.3% reported always checking the expiry date before administering antibiotics to animals, while 6.6% did not check expiry dates. Together, these findings highlight gaps in awareness and safe practices related to animal antibiotic use, emphasizing the need for improved education on completing prescribed antibiotic courses, checking medication expiry and seeking veterinary supervision to ensure effective treatment and reduce risk of antimicrobial resistance.

Overall, the findings indicate that antibiotic use in household pets and small-scale animal keeping in the Maldives is relatively low, reflecting the country’s limited livestock ownership at community level. Where antibiotic use does occur, adherence to veterinary advice and responsible behaviours was reported. However, some degree of unsupervised and informal antibiotic use persists, primarily through pet shops or prior prescriptions. Knowledge gaps regarding the type of medicines used, course completion, and expiry checking point to limited awareness of veterinary antimicrobial use among the general public. These findings emphasizes the need to strengthen public and veterinary education, regulatory oversight of antibiotic sales, and One Health awareness to promote prudent antibiotic use and encourage veterinary consultation, thereby reducing misuse across both human and animal health sectors.

3.7 Composite Knowledge, Attitude and Practice (KAP) Scores and Inferential Analysis

This section presents the composite Knowledge, Attitude, and Practice (KAP) scores derived from the survey responses and examines their associations with sociodemographic characteristics and with each other. Composite scoring was conducted as described in the Methods section, following WHO-aligned KAP methodologies.

3.7.1 Overall distribution of Knowledge, Attitude and Practice scores

Composite KAP scores revealed substantial variation across the three domains. The mean knowledge score among respondents was 7.6 ± 2.9 out of a maximum possible score of 14. Based on predefined thresholds, 34.1% (n = 584) of respondents were classified as having poor knowledge, 50.2% (n = 860) as having moderate knowledge, and 15.7% (n = 269) as having good knowledge regarding antibiotic use and antimicrobial resistance.

Attitude scores were comparatively more favourable. The mean attitude score was 3.25 ± 0.70 on a five-point Likert scale. Overall, 18.6% (n = 318) of respondents demonstrated positive attitudes toward responsible antibiotic use, while 53.2% (n = 912) exhibited moderate attitudes and 25.2% (n = 431) demonstrated negative attitudes.

Practice scores were the lowest among the three domains. The mean practice score was 2.33 ± 2.07 out of a maximum possible score of 6. Only 20.7% (n = 354) of respondents were classified as having good antibiotic-use practices, while 31.6% (n = 542) demonstrated moderate practices and 47.7% (n = 817) exhibited poor practices. A small proportion of respondents (3.0%) had missing scores due to "don't know" responses across all attitude items. Table 3 summarises the distribution of composite KAP scores among respondents.

Table 3 Distribution of Knowledge, Attitude and Practice (KAP) scores among respondents (n = 1,713)

KAP domain	Score range	Mean ± SD	Category	n	%
Knowledge	0–14	7.6 ± 2.9	Poor (0–6)	584	34.1
			Moderate (7–10)	860	50.2
			Good (11–14)	269	15.7
Attitude	1–5 (mean)	3.25 ± 0.70	Negative (<3.0)	431	25.2
			Moderate (3.0–3.9)	912	53.2
			Positive (≥4.0)	318	18.6
Practice			Missing	52	3.0
	0–6	2.33 ± 2.07	Poor (0–2)	817	47.7
			Moderate (3–4)	542	31.6

Note: Knowledge scores were categorised as poor (<50%), moderate (50–74%), and good (≥75%).
Attitude scores were derived as the mean of Likert-scale items (1–5), with negatively worded items reverse-coded.
Practice scores were categorised using standard percentage-based thresholds.

3.7.2 Association between KAP scores and sociodemographic characteristics

Associations between categorical Knowledge, Attitude, and Practice (KAP) scores and selected sociodemographic characteristics are presented in Table 4. Statistical associations were assessed using chi-square tests with Monte Carlo simulation (5,000 replications) due to sparse cell counts in some KAP categories. Effect sizes were estimated using Cramer's V.

Knowledge scores showed a statistically significant association with education level (Monte Carlo χ^2, $p < 0.001$; $V = 0.17$), indicating a weak association, with higher educational attainment associated with greater proportions of respondents demonstrating moderate or good knowledge. Knowledge scores were also significantly associated with place of residence, with

respondents residing in urban areas exhibiting higher knowledge scores than those in non-urban areas (Monte Carlo χ^2, $p < 0.001$; $V = 0.16$).

No statistically significant associations were observed between knowledge scores and age group ($p = 0.17$) or gender ($p > 0.05$), with effect sizes indicating negligible associations.

Attitude scores were significantly associated with education level (Monte Carlo χ^2, $p < 0.001$; $V = 0.18$) and monthly income (Monte Carlo χ^2, $p < 0.001$; $V = 0.17$), both reflecting weak associations. A statistically significant but very weak association was observed between attitude scores and place of residence ($p = 0.011$; $V = 0.07$). Attitude scores did not differ significantly by age group or gender.

Practice scores demonstrated statistically significant associations with education level (Monte Carlo χ^2, $p < 0.001$; $V = 0.17$), monthly income (Monte Carlo χ^2, $p < 0.001$; $V = 0.13$), and place of residence (Monte Carlo χ^2, $p = 0.035$; $V = 0.06$). Although statistically significant, all associations were weak or very weak, indicating limited practical effect sizes. A statistically significant association was also observed between gender and practice scores ($p < 0.001$; $V = 0.13$), though the magnitude of this association was weak and should be interpreted with caution.

Table 4. Association between Knowledge, Attitude and Practice scores and selected sociodemographic characteristics (n = 1,713)

Sociodemographic variable	Knowledge	Attitude	Practice
Gender	χ^2, $p > 0.05$; $V = 0.045$	χ^2, $p > 0.05$; $V = 0.045$	χ^2, $p > 0.05$; $V = 0.045$
Age group	χ^2, $p > 0.05$; $V = 0.072$	χ^2, $p > 0.05$; $V = 0.072$	χ^2, $p > 0.05$; $V = 0.072$
Education level	χ^2, $p < 0.001$; $V = 0.130$	χ^2, $p < 0.001$; $V = 0.130$	χ^2, $p < 0.001$; $V = 0.130$
Monthly income	χ^2, $p = 0.17$; $V = 0.056$	χ^2, $p = 0.17$; $V = 0.056$	χ^2, $p = 0.17$; $V = 0.056$
Urban / non-urban residence	χ^2, $p = 0.16$; $V = 0.053$	χ^2, $p = 0.16$; $V = 0.053$	χ^2, $p = 0.16$; $V = 0.053$

Note: Chi-square tests were conducted using Monte Carlo simulation (5,000 replications) due to sparse cell counts. Effect sizes are reported using Cramer's V and interpreted as very weak (<0.10), weak (0.10–0.19), or weak–moderate (0.20–0.29).

Overall, education level and socioeconomic indicators demonstrated consistent but weak associations with knowledge, attitudes, and practices related to antibiotic use and antimicrobial resistance. Age showed no significant association with any KAP domain, and gender differences were limited to practice scores with small effect sizes. These findings indicate that while sociodemographic factors are statistically associated with KAP outcomes, the magnitude of these associations is modest, underscoring the influence of broader contextual and structural factors beyond individual demographics.

3.7.3 Relationship between Knowledge, Attitude and Practice scores

Correlation analysis using Pearson's correlation coefficients demonstrated statistically significant positive associations between all three KAP domains (Table 5). Knowledge scores were moderately correlated with attitude scores (r = 0.32, p < 0.001) and weakly to moderately correlated with practice scores (r = 0.28, p < 0.001). Attitude scores also showed a moderate positive correlation with practice scores (r = 0.35, p < 0.001).

Although all correlations were statistically significant, the magnitude of the coefficients was moderate, indicating that knowledge and attitudes explain only part of the variability in antibiotic-use practices. This suggests that structural, contextual, and system-level factors beyond individual knowledge and attitudes play an important role in shaping antibiotic-use behaviours.

Table 5. Correlation between Knowledge, Attitude and Practice scores

Variables	Knowledge	Attitude	Practice
Knowledge	1.00		
Attitude	0.32***	1.00	
Practice	0.28***	0.35***	1.00

**p < 0.001

Note: Pearson correlation coefficients indicate statistically significant positive associations between all KAP domains.

3.7.4 Association between KAP scores and nationality

Nationality was examined as a key equity-relevant sociodemographic factor. After reclassifying respondents with nationality data as Maldivian (n =1,297) Maldivians and 416 foreign nationals.

Using chi-square tests with Monte Carlo simulation, nationality was significantly associated with knowledge and practice scores, but not with attitude scores. Maldivian respondents demonstrated higher proportions of moderate and good knowledge compared with foreign nationals (Monte Carlo χ^2, p < 0.05; Cramer's V ≈ 0.10, weak association). A stronger association was observed for practices, with foreign nationals disproportionately represented in the poor practice category and under-represented in the good practice category (Monte Carlo χ^2, p < 0.01; V ≈ 0.12, weak association).

No statistically significant association was observed between nationality and attitude category (p > 0.05), indicating broadly similar attitudes toward antimicrobial resistance and responsible antibiotic use among Maldivians and foreign nationals.

Table 6. Association between Knowledge, Attitude and Practice scores and nationality (n = 1,713)

Nationality	Knowledge	Attitude	Practice
Maldivian (n = 1,283)	χ^2, $p < 0.05$; V ≈ 0.10	χ^2, $p > 0.05$; V ≈ 0.05	χ^2, $p < 0.01$; V ≈ 0.12
Foreign national (n = 427)			

Note: Chi-square tests were conducted using Monte Carlo simulation (5,000 replications) due to sparse cell counts in some KAP categories. Effect sizes are reported using Cramer's V and interpreted as very weak (<0.10) or weak (0.10–0.19).

The composite KAP analysis indicates a clear imbalance between knowledge, attitudes, and practices related to antibiotic use and antimicrobial resistance in the Maldives. While attitudes toward responsible antibiotic use were generally moderate, knowledge levels were predominantly poor to moderate, and appropriate antibiotic-use practices were substantially limited. This pattern highlights a persistent knowledge–practice gap, whereby awareness and concern do not consistently translate into safer antibiotic-use behaviours.

Sociodemographic analyses revealed consistent but weak associations between KAP scores and education level, income, and place of residence, indicating socioeconomic and geographic disparities in AMR-related awareness and behaviour. Education emerged as the most consistent determinant across all three KAP domains, whereas age showed no meaningful association with any domain. Gender differences were observed only for practice scores and were characterised by small effect sizes. Collectively, these findings suggest that structural and contextual factors may exert a stronger influence than basic demographic characteristics in shaping antibiotic-use behaviours.

Nationality-based analyses further underscored important equity considerations. Although attitudes toward antimicrobial resistance were broadly similar between Maldivian and foreign national respondents, foreign nationals were disproportionately represented in the poor practice category, This indicates that gaps in antibiotic-use practices among expatriate populations are unlikely to be driven by differences in beliefs alone, but rather by contextual barriers such as language constraints, access to healthcare services, continuity of care, and reliance on pharmacy-based or informal sources of antibiotics.

Positive correlations between knowledge, attitudes, and practices were observed and are consistent with the conceptual KAP framework, demonstrating that individuals with higher knowledge levels tend to report more favourable attitudes and safer practices. However, the moderate strength of these correlations indicates that improvements in knowledge alone are unlikely to produce substantial or sustained behaviour change. This reinforces evidence from AMR research showing that antibiotic-use behaviour is shaped by a complex interplay of

knowledge, healthcare interactions, regulatory environments, access to services, and social norms.

Overall, the findings highlight the need for integrated, equity-sensitive AMR interventions in the Maldives. Effective responses will require a combination of targeted public education, behaviour-focused stewardship strategies, strengthened healthcare and pharmacy communication, and robust regulatory enforcement. Particular attention should be given to foreign national populations, through multilingual communication and workplace-based outreach. Addressing the gap between awareness and practice will require approaches that move beyond information dissemination and align with World Health Organization recommendations for comprehensive, context-specific antimicrobial stewardship within a One Health framework.

4 Conclusion

This national KAP survey provides the first comprehensive overview of public knowledge, attitudes, and practices related to antibiotic use and antimicrobial resistance (AMR) in the Maldives.

Overall, the findings from the survey reveal that while there is a good level of awareness and generally positive attitudes toward responsible antibiotic use, significant knowledge gaps and misconceptions remain. Most respondents recognized that antibiotics should be taken only when prescribed by a doctor, and a large proportion agreed that antibiotic resistance is a serious global and national issue. However, misconceptions persist regarding the use of antibiotics for viral illnesses and failure to complete treatment courses. Gaps were also evident in adherence, dosage understanding, and medication verification, alongside limited instances of self-medication and informal access.

A considerable proportion of respondents felt that individuals like themselves could do little to prevent resistance, with some believing that medical experts alone can solve the problem. Awareness of antibiotic resistance terminology was moderate, as many respondents were unable to recall hearing key terms or learning about them through formal education or media campaigns.

More than half of the respondents were uncertain about the use of antibiotics in agriculture, highlighting the need to improve public knowledge of antimicrobial use in the food chain and its implications at both national and global levels. Antibiotic use in animals and pets was relatively low, with most respondents reporting that they followed veterinary advice. However, a small minority reported some degree of informal access, mainly through pet shops or leftover prescriptions, administering antibiotics without veterinary consultation or checking expiry dates.

This suggests the need to strengthen community awareness of veterinary antibiotic stewardship and One Health linkages.

Collectively, these results emphasize the need for sustained, targeted public education and awareness programs, particularly those highlighting the risks of misuse, the importance of completing prescribed courses, and the shared responsibility among individuals, healthcare providers, and policymakers in addressing antibiotic resistance. Furthermore, community engagement, stronger regulation, and coordinated multisectoral action will be essential to safeguard antibiotic effectiveness and reduce the spread of antimicrobial resistance in the Maldives.

The composite KAP score analysis reinforces these findings by demonstrating a clear imbalance between knowledge, attitudes, and practices related to antibiotic use and antimicrobial resistance. While attitudes toward antibiotic stewardship were generally moderate to favourable, knowledge scores were predominantly poor to moderate and appropriate practices were limited. Education level and place of residence were consistently associated with KAP performance, highlighting socioeconomic and geographic disparities in AMR awareness and behaviour. These findings indicate that improvements in knowledge alone are unlikely to result in sustained behaviour change and underscore the need for integrated approaches that combine targeted education with behaviour-focused interventions, strengthened regulatory measures, and coordinated multisectoral action to support effective antimicrobial stewardship in the Maldives.

5 Recommendations

Based on the findings of this survey, the following recommendations are proposed to strengthen antibiotic stewardship, public awareness, and responsible use of antibiotics in the Maldives:

1. Strengthen Public Awareness and Education

- Implement targeted, nationwide communication campaigns using KAP findings to prioritise groups with lower knowledge and practices, delivering clear, multilingual, and practical guidance on responsible antibiotic use.
- Implement standardised, brief counselling supported by visual aids to reinforce key messages on responsible antibiotic use such as completing full courses, avoiding self-medication, and seeking medical advice among both Maldivians and foreign nationals.
- Develop tiered communication and behaviour-change strategies aligned with KAP levels, ranging from basic, visual messaging for low-scoring groups to reinforcement and peer-led advocacy for higher-scoring groups.
- Integrate AMR and responsible antibiotic use education into school curricula and community health programs.

2. Improve Veterinary Oversight and One Health Awareness

- Ensure antibiotics for animals are used only under veterinary supervision and according to proper prescriptions.
- Regulate the sale of antibiotics in pet shops and agricultural outlets to prevent informal or unmonitored access.
- Raise public awareness of veterinary antibiotic use and its links to resistance in humans.

3. Strengthen Regulation and Surveillance

- Enforce a prescription-only policy for human and veterinary antibiotics through routine inspection of pharmacies and retail outlets.
- Establish an integrated One Health AMR surveillance system that links AMR data with antimicrobial consumption and AMU data to monitor trends across sectors.
- Conduct periodic national KAP surveys to support adaptive policy implementation and to monitor progress under the National Action Plan on Antimicrobial Resistance.
- Use the findings of this KAP study to initiate a national AMR prevalence survey to provide robust baseline data on resistance patterns in the Maldives.
- Support the development of Standard Treatment Guidelines and National Antimicrobial Stewardship Guidelines that incorporate KAP indicators

- Integrate KAP indicators into national AMR monitoring and evaluation frameworks to track changes in public knowledge, attitudes, and practices over time.

4. Build Professional Capacity and Stewardship

- Provide ongoing training for healthcare providers, pharmacists, and veterinarians on rational prescribing and patient communication.
- Encourage all health professionals to serve as AMR advocates through daily practice and community engagement.
- Include AMR stewardship modules in continuing professional development programs.

5. Promote Behavioral Change and Community Engagement

- Develop locally tailored interventions using community leaders, schools, and media to address misconceptions and promote responsible practices.
- Empower individuals by highlighting the role of collective action in reducing resistance and protecting national health security.

6. Generate Economic Evidence to Support Policy and Resource Mobilisation

- Conduct national studies to estimate the economic burden of antimicrobial resistance, including impacts on healthcare costs, productivity losses, household income, and long-term development outcomes.
- Use economic evidence to support increased domestic investment in AMR containment and to integrate AMR considerations into health-economic planning and national development strategies.
- Use KAP findings to guide resource allocation and programme prioritisation, ensuring limited resources are directed toward populations and regions with the greatest identified need.

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Appendix 1 Survey Questionnaire

See attached separately

Appendix 2 Information Sheet and Consent form

KAP Study on Antibiotic Resistance and Antibiotic Use among the Public in the Maldives

Information Sheet

Antibiotics are medications used to treat bacterial infections. The misuse and overuse of antibiotics in humans, animals and agriculture have resulted in the rise of resistant microorganisms, which makes available treatment options ineffective, resulting in major public health concerns.

This is a survey conducted by The Maldives National University in collaboration with Maldives Food and Drug Authority supported by WHO to assess the knowledge, attitude and practice of antibiotic use and antibiotic resistance among the public in Maldives.

Consent

Participation in this study is purely voluntary. There are no risks anticipated by participating in this study. You may choose not to participate or withdraw at anytime without any consequences. The information given by participants will strictly be used for research purposes only. Personal information such as name, address, contact number and other identifiable information will not be collected or disclosed. Your participation in this study will be valuable in understanding and addressing the antimicrobial resistance situation in Maldives. Ethical clearance was obtained from the National Health Research Council at Ministry of Health and WHO Regional Office for this study.

Your participation in this study will be highly beneficial in addressing the antimicrobial resistance situation in the Maldives.

If you have any additional inquiries, please email research@mnu.edu.mv .