Knowledge and Attitudes of Community Health Care Professionals Towards an Antimicrobial Stewardship Program:

Post-Survey Report

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Abstract

In order to better implement antimicrobial stewardship initiatives in community-based health care settings, the Antimicrobial Stewardship Program in the Regina Qu’Appelle Health Region (RQHR) performed a survey of community health care practitioners to learn more about their knowledge and attitudes towards antimicrobial stewardship.

We surveyed family physicians and nurse practitioners from within the RQHR as well as community pharmacists, dentists, and veterinarians from across Saskatchewan. Surveys were composed of 16-19 questions (depending on the participants’ specialty) and consisted of 5-point Likert scale, sliding bar, and multiple choice type questions. In total, 2575 survey invitations were emailed/faxed to potential participants and we received 333 responses (13%).

Broadly, the results of the survey indicated that education should be the first priority of an antimicrobial stewardship program when engaging with community-based health care. This includes education for the general public to ensure people are aware of antimicrobial resistance and the goals of antimicrobial stewardship. It also includes continuing education for health care professionals to ensure that every member of a health care team understands their role in addressing the problem of antimicrobial resistance, and are aware of the educational tools and resources at their disposal to help educate patients/clients.

This research provides a broad overview of the knowledge and attitudes of community health care professionals from different medical specialties (in both human and animal medicine) towards antimicrobial stewardship. It will aid the Antimicrobial Stewardship Program in designing and executing quality improvement interventions in the community setting and help our province to approach antimicrobial stewardship from a One Health perspective.
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**Introduction**

Rising rates of antimicrobial resistance have been a growing concern for both human and animal health. It is estimated that more than 200,000 Canadians suffer from hospital-acquired infections each year (1). Many of these infections are resistant to antibiotics and they cause more than 8000 deaths annually (1, 2). It is important to remember, though, that this problem does not exist only within hospitals. In fact, up to 80% of antimicrobials used in human health around the world are acquired in the community setting and Saskatchewan is the second highest user of community-dispensed antimicrobials within Canada (3, 4).

One way to combat rising rates of antimicrobial resistance is through the integration of antimicrobial stewardship into medical practice (in both human and veterinary medicine). Upon the launch of the Antimicrobial Stewardship Program in the Regina Qu’Appelle Health Region (RQHR) in June 2016, it was recognized that our position as a ‘regional’ program gave us the unique ability to focus stewardship efforts in the community as well as hospitals. However, because the majority of antimicrobial stewardship programs operate in hospitals, there is a relative paucity of information about effective stewardship strategies in the community setting (see, for example, 5). Even less is known about the knowledge and attitudes towards antimicrobial stewardship for the broad range of community health care professionals, particularly within Canada (see, for example, 6 and 7).

Thus, our first effort was to undertake a survey to determine the knowledge and attitudes of community health care professionals towards antimicrobial stewardship. We also aimed to obtain front-line input on how to best implement stewardship activities in various sectors of human and animal health care. Our final goal was to broaden our approach to include health care professionals not traditionally surveyed in the literature (i.e., nurse practitioners and dentists) as well as connect the human and animal health care sectors by including veterinarians. This was also deemed important for our region as Saskatchewan has a large animal agriculture industry and it is important to approach antimicrobial stewardship as a One Health initiative (i.e., with the understanding that human, animal, and environmental health each affect one another).

The Antimicrobial Stewardship Program would like to thank all respondents for taking the time to fill out the survey and contributing to the growth of our program and guiding our efforts. We would also like to thank the many people involved in both the development and distribution of the survey and completion of this report. We continue to encourage all health care professionals to practice good stewardship with antimicrobials in their area of expertise; it is only through collaboration among all sectors of health care that we can begin to reduce the growing rate of antimicrobial resistance.

If you have any questions about the Antimicrobial Stewardship Program or the results of this survey, please visit our website (www.rqhealth.ca/asp) for more information or contact us directly at antimicrobial.stewardship@rqhealth.ca.
Methods

The research project received RQHR Research Ethics Board approval (REB-16-87) and the survey was reviewed for relevant content by members from each professional specialty (except for dentists; including 2 family physicians, 3 community pharmacists/2 pharmacy managers, 2 nurse practitioners, and several veterinarians from the Saskatchewan Veterinary Medical Association). The survey was composed of a short introduction to the Antimicrobial Stewardship Program and approximately 16-19 questions (depending on the group being surveyed) and was distributed between July and October, 2016. The survey was mainly conducted online, although it was faxed to some community clinics for family physicians without RQHR email addresses. The survey was forwarded to all family physicians and nurse practitioners within the RQHR and all dentists, community pharmacists, and veterinarians throughout Saskatchewan who were registered with their provincial professional association (the College of Dental Surgeons of Saskatchewan, the Saskatchewan College of Pharmacy Professionals, and the Saskatchewan Veterinary Medical Association [SVMA]).

The survey questions consisted mainly of 5-point Likert scale questions (Strongly Agree, Agree, Neutral, Disagree, and Strongly Disagree; with an option for Not Applicable). For analysis, responses were categorized into Agree (Strongly Agree or Agree) and Disagree/Neutral (Neutral, Disagree, or Strongly Disagree). Sliding bar questions were also used and were analyzed using an average of the number chosen along the sliding scale (from 0 to 100) for each specialty group to represent leaning towards one option or the other (or both equally if the value was 50).

Results

Demographics

Unfortunately, each group was below the minimum number of respondents needed to reach a 95% confidence level with a 5% margin of error (calculated with the Raosoft online sample size calculator; http://www.raosoft.com/samplesize.html). Thus, due to the small sample size, caution should be taken when generalizing the survey results to the whole population for each group. Based on percentage, nurse practitioners had the highest response rate (30% or 12/40) while physicians had the lowest (10% or 21/219; Fig. 1). The response rate of pharmacists, dentists, and veterinarians ranged from 12-14% (Fig. 1).

Among physicians and dentists, the majority of the respondents identified as male (57% and 63%, respectively; Fig. 2). The remaining groups (nurse practitioners, pharmacists, and veterinarians) were majority female (92%, 71%, and 72%, respectively; Fig. 2).

The average age among the physicians was 50.4 years (median: 54 years; range: 24-72 years; Fig. 3), making physicians the oldest group on average. Pharmacists averaged the youngest (39.2 years; median: 35.5 years; range: 22-68 years; Fig. 3). Regarding years of experience, physicians were again the highest, averaging 20.9 years of experience (median: 24 years; range: 1-41 years; Fig. 4) and nurse practitioners averaged the least (10.4 years; median: 7 years; range: 2-27 years; Fig. 4).
**Survey Questions**

When asked questions regarding their knowledge of antimicrobial stewardship, veterinarians were most likely to agree with the statement, “I was familiar with antimicrobial stewardship prior to this survey” (99% agreed; Fig. 5A), while 90% or fewer of the human health care professionals agreed with this statement (physicians – 90%, nurse practitioners – 75%, dentists – 65%, and pharmacists – 59%; Fig. 5A). However, >94% of each human health care professional group agreed with the statement, “I believe antimicrobial resistance is an issue of concern” (Fig. 5B). Veterinarians were asked a similar pair of questions, to which 96% agreed with each statement: “I believe antimicrobial resistance is an issue of concern for humans” and “I believe antimicrobial resistance is an issue of concern for animals” (Fig. 5C and 5D, respectively).

When asked questions regarding their knowledge of antimicrobial use, 100% of human health care workers agreed with the statement, “I believe inappropriate use of antimicrobials contributes to antimicrobial resistance” (Fig. 6A). However, only 89% of veterinarians agreed to the statement, “I believe inappropriate use of antimicrobials contributes to antimicrobial resistance in animals” (Fig. 6B). Similarly, >95% of human health care professionals agreed to the statement, “I believe inappropriate use of antimicrobials contributes to patient harm (e.g., through side effects, toxicity, antimicrobial resistant organisms),” while only 85% of veterinarians agreed to the related statement, “I believe inappropriate use of antimicrobials contributes to animal harm (e.g., through side effects, toxicity, antimicrobial resistant organisms)” (Fig 6C and 6D, respectively).

When asked questions regarding antimicrobial stewardship in practice, >85% of prescribers (i.e., pharmacists not included) agreed with the statement, “I feel comfortable consulting with other health care professionals about an antimicrobial prescription (e.g., for indication, dose, duration, route)” (Fig. 7A). Interestingly, only 65% of pharmacists agreed to the statement, “I feel comfortable discussing an antimicrobial prescription with other health care professionals when I suspect a misuse (e.g., dose, duration)” (Fig. 7B). While 19% of veterinarians agreed with the statement, “I believe an antimicrobial stewardship program may interfere with my practicing autonomy,” 11% or less for each human health care prescriber group agreed to the same statement (Fig. 7C).

When asked questions regarding antimicrobial stewardship and patient care, dentists were least likely to agree (75%) with the statement, “I believe inappropriate use of antimicrobials can be significantly reduced through antimicrobial stewardship,” while 89% or more of each other group agreed with the statement (Fig. 8A). The human health care groups agreed at least 94% for each group with the statement, “I believe decreasing inappropriate antimicrobial use will improve patient care” (Fig. 8B). Veterinarians agreed 93% and 92% with the related statements, “I believe decreasing inappropriate antimicrobial use in human patients will improve patient care,” and “I believe decreasing inappropriate antimicrobial use in animals will improve animal care,” respectively (Fig. 8C and 8D, respectively).

When asked questions regarding antimicrobial stewardship and patient education, 90% of physicians, 83% of nurse practitioners, 69% of veterinarians, and 67% of dentists agreed to the statement, “I have been pressured by a patient/patient’s family/client to prescribe antimicrobials even after I advise that the patient/animal’s condition does not require
antimicrobials” (Fig. 9A). At least 92% of each health care practitioner group agreed with the statement, “I believe the public needs more education on the correct use of antimicrobials (e.g., through school curriculums, advertisements, etc.)” (Fig. 9B). Interestingly, only 50-63% of each group agreed with the statement, “I possess or have access to the necessary tools or resources to educate my patients/clients about antimicrobial drugs” (Fig. 9C).

When asked questions regarding antimicrobial stewardship and professional education, 86% of physicians agreed with the statement, “I believe research for new antimicrobial agents should be publicly funded (e.g., government grants),” while only 74% of veterinarians, 68% of dentists, 54% of pharmacists, and 50% of nurse practitioners agreed with the statement (Fig. 10A). At least 80% of each group surveyed agreed to the statement, “I would attend an educational session (e.g., seminar, workshop, online education) that provides further information about antimicrobial stewardship” (Fig. 10B). Interestingly, only 63% of dentists agreed with the statement, “I am willing to promote antimicrobial stewardship initiatives among my colleagues,” while 81% of physicians and pharmacists, 85% of veterinarians, and 100% of nurse practitioners agreed with this statement (Fig. 10C).

Respondents were asked to rate, via a sliding scale, their response to the statement, “I believe inappropriate antimicrobial use in health care is driven mainly by: Health Care Professionals – Patients.” The average response from nurse practitioners leaned the furthest toward health care professionals, while the average response from physicians, pharmacists, and dentists was closer to both patients and health care professionals being equal drivers of inappropriate antimicrobial use (Fig. 11A). The majority of respondents replied to this question, with physicians (86%) having the lowest percentage of responses among individual groups (Fig. 11B). When the same groups were asked to respond to the statement, “I believe the majority of inappropriate antimicrobial use occurs in: Health Care – Agriculture,” the average response from nurse practitioners, pharmacists, and dentists all leaned towards health care, while physicians were much closer to equal inappropriate use between health care and agriculture (Fig. 11C). While 100% of nurse practitioner respondents replied to this question, only 67% of physician respondents, 75% of dentist respondents, and 88% of pharmacist respondents answered (Fig. 11D).

Veterinarians were asked to respond to similar statements to those of the human health care professionals. The average response from veterinarians to the statement, “I believe inappropriate antimicrobial use in animal health care is mainly driven by: Health Care Professionals – Clients,” leaned towards clients (Fig. 12A). For the statement, “I believe the majority of inappropriate antimicrobial use occurs in: Humans (Health Care) – Animals (Agriculture),” the average response from veterinarians leaned towards human health care (Fig. 12A). Respectively, 3% and 11% of veterinarian respondents chose not to answer these questions (Fig. 12B).

Several examples of useful educational tools were suggested and respondents were asked to select which tools they would be interested in for patient/client and/or professional education. For posters/brochures, the majority of each group of respondents (i.e., 57-83%) indicated an interest; for viral prescription pads (for which only prescribers in human health care were surveyed), dentists were least likely to be interested (38%), only 52% of physicians were interested, and 83% of nurse practitioners indicated interest; for an Antimicrobial Stewardship Program website, 70% of veterinarians expressed interest while interest from the
remaining groups ranged between 50-54%; and finally, veterinarians (54%) also had the highest interest in audio/video tools compared to the other groups (8-29%; Fig. 13). A minority (≤8%) of respondents in each group indicated they were not interested in any of the above suggestions and 6-29% of respondents in the different groups provided suggestions for other useful educational tools (Fig. 13). These suggestions included: on-site access to pharmacy professionals; access to RxFiles; public awareness through social media/television/radio/email/blogs/etc.; counselling and education services; face to face patient education; antibiotic guidelines and algorithms; an antibiogram and relevant education about its use; community/school programs; other websites; point of care tests; charts and paper copies (handouts); print material accompanying antibiotics with a layman explanation of the drug, its impact on the body, and the condition for which it has been prescribed; high quality research data (showing the impact of antimicrobial use in animals on AMR in human clients, determining main source of resistance); public speaking events; public service announcement templates; communication of proper information from health care professionals; continuous information about antimicrobial resistance and geographical distribution; workshops (producer seminars/consultations); and to eliminate sales of antimicrobials in lay outlets.

Finally, human and animal health prescribers (i.e., pharmacists excluded) were given several examples of evidence-based clinical aides and were asked if they were interested in using these in their practice. Dentists were least interested in an antibiogram and microbiology expertise (33% and 30%, respectively), while veterinarians (58% and 63%), nurse practitioners (83% and 42%), and physicians (90% and 52%) were more likely to indicate an interest (Fig. 14). At least 51% of each prescriber group indicated interest in pharmacy expertise and among prescribers in human health, dentists were least interested in infectious disease expertise (49%) while physicians and nurse practitioners were most interested (76% and 83%, respectively; Fig. 14). Less than 12% of prescribers in each group indicated no interest in any of the suggested clinical decision aides and up to 21% of respondents in each group provided other suggestions (Fig. 14). These suggestions included: a dedicated app with an updated antibiogram for the region; access to physicians; treatment algorithms; high quality (independent) research data (comparative dose/route/duration/incidence of antimicrobial resistance [Forest Plot], epidemiological studies of techniques reducing human/animal exposure to antibiotic resistant organisms, mechanisms and transfer of resistance); client education about the need for culture and sensitivity profiles (even at extra cost to them as a pet owner); compendiums on culture and sensitivity testing (antibiogram); best practice information/common areas of misuse; improved diagnostics; algorithms for common conditions/clinical presentations/causes; continuing education/seminars (from Health Canada, CDC); field expertise; and independent study of products to provide justification and instructions for use.

Discussion

It comes as no surprise that veterinarians, as a group, were most likely to indicate their prior familiarity with antimicrobial stewardship (Fig. 5A). It has been a component of their continuing education through the SVMA in recent years. Somewhat surprising is that
pharmacists were the least likely to indicate prior familiarity with antimicrobial stewardship (Fig. 5A). Furthermore, only about 2/3 of dentists agreed that they were familiar with antimicrobial stewardship prior to the survey (Fig. 5A); this may be due to having less exposure to prescribing antimicrobials for a broad range of bacterial infections during their training and practice. Despite a relative lack of familiarity with antimicrobial stewardship, it is encouraging to see that the vast majority of respondents agreed that antimicrobial resistance is an issue of concern for both humans and animals (Fig. 5B and 5C).

Similarly, the vast majority of human health care professionals (≥95%), despite being overall less familiar with antimicrobial stewardship, agreed that inappropriate use of antimicrobials contributes to antimicrobial resistance and patient harm (Fig. 6A and 6C). Fewer veterinarians agreed to similar statements indicating their belief that inappropriate use of antimicrobials contributes to antimicrobial resistance (89%) and harm (85%) in animals (Fig. 6B and 6D). It is vital for antimicrobial stewardship programs that health care professionals fully understand the links between antimicrobial use, antimicrobial resistance, and patient harm. This is important for both changing prescribing behaviours and helping to educate the general public.

While ≥85% of each human and animal health prescriber group agreed that they were comfortable consulting another health care professional about an antibiotic prescription, only 65% of pharmacists agreed to a similar statement (Fig. 7A and 7B). This may be due to pharmacists having less information about the indication for a prescription, feeling less knowledgeable about antimicrobial use, or simply feeling intimidated by other practitioners. It is important to remember that pharmacists are a vital part of a health care team and collaboration and discussion around antimicrobial prescriptions should be encouraged among all members of health care teams.

While ≤10% human health care prescribers believe that an antimicrobial stewardship program may interfere with their prescribing autonomy, 19% of veterinarians agreed with this statement (Fig. 7C). The difference here may reflect some of the differences in antimicrobial use between the human and animal health sectors; for example, it may be perceived that antimicrobial stewardship programs might hinder the ability of veterinarians to prescribe antimicrobials off label.

Once again, the vast majority of each respondent group (≥89%) agreed that decreasing inappropriate antimicrobial use will improve patient care in both humans and animals, and, except for dentists, that inappropriate use of antimicrobials can be significantly reduced through antimicrobial stewardship (Fig. 8). Only 75% of dentists agreed with the latter statement, perhaps also due to the lack of previous knowledge of antimicrobial stewardship.

Although only 67% of dentists and 69% of veterinarians indicated they had been pressured by a patient/patient’s family/client to prescribe an antimicrobial when not indicated (compared to 90% and 83% of physicians and nurse practitioners, respectively; Fig. 9A), the majority of each health care professional group (≥92%; Fig. 9B) believe the public needs more education on the correct use of antimicrobials. Alarmingly, only 50-63% of health care professionals in each group believe they possess or have access to the necessary tools to educate their patients/clients about antimicrobials (Fig. 9C). These responses indicate a necessity from antimicrobial stewardship programs to provide and direct both the general
public and community health care professionals towards information and educational tools to increase knowledge and awareness of the proper use of antimicrobials.

There is less agreement that research for new antimicrobials should be publicly funded, garnering, at most, 86% agreement from physicians (Fig. 10A). This may indicate that respondents believe antimicrobial research should be a private venture or perhaps a public-private partnership. Alternatively, it could be that they don’t believe this research is important at all.

At least 80% of each respondent group indicated they would attend an educational session providing further information about antimicrobial stewardship (Fig. 10B). This reinforces the responsibility of an antimicrobial stewardship program to provide this service for community health care professionals. Interestingly, while 100% of nurse practitioners agreed to promote antimicrobial stewardship initiatives among their colleagues, only 63% of dentists shared the same belief (and 81-85% for physicians, pharmacists, and veterinarians; Fig 10C). Perhaps, for dentists, this represents a lack of knowledge (or confidence in their knowledge base) that would prevent them from becoming “champions” (or leaders) of antimicrobial stewardship among their peers. The clinical setting in which these different health care professionals work may also have some impact on their agreement with this statement (e.g., a single dentist in a practice versus multiple physicians in a single practice).

While physicians, pharmacists, and dentists each tended to place equal responsibility on patients and health care professionals for inappropriate antimicrobial use, nurse practitioners leaned much more towards health care professionals (Fig. 11A). It’s unclear why nurse practitioners took a much stronger stance on this question and it should be noted that only 86% of the physician respondents answered this question (Fig. 11B), potentially further reducing the ability to extrapolate the answer to the whole population. Nurse practitioners also took the strongest stance on indicating health care (vs. agriculture) as responsible for the majority of inappropriate antimicrobial use (Fig. 11C). Pharmacists and dentists also leaned towards health care while physicians placed responsibility more equally on both (Fig. 11C). Again, only 67% of physician respondents answered this question, as well as 75% of dentist respondents and 88% of pharmacist respondents (Fig. 11D). Perhaps unfamiliarity with antimicrobial use in agriculture is one reason that respondents were less likely to answer this question.

When veterinarians were asked who they believe drives inappropriate antimicrobial use in animal health care, the average response leaned towards clients (vs. health care professionals; Fig. 12A). When asked where they believe the majority of inappropriate antimicrobial use occurs, the average veterinarian answer leaned towards human health care (vs. agriculture, Fig. 12A). The disparity in responses to these questions between groups of health care professionals underscores the need to continue to develop and enhance surveillance programs surrounding antimicrobial use and resistance in both human and animal medicine. These programs provide the baseline evidence to further understand where problem areas exist and to direct appropriate education to health care professionals and the general public.

There were a number of suggestions regarding the two final questions asking respondents about their interest in educational tools and clinical decision aides. These suggestions should be taken into consideration when designing antimicrobial stewardship initiatives in the community setting. There is one important point to consider regarding
requests for tools which already exist (e.g., an antibiogram, clinical pathways/algorithms, websites, etc.). All of these tools currently exist within the RQHR (at least, for human health care professionals) and this indicates another important role for an antimicrobial stewardship program in ensuring that these tools are shared with our community practitioners.

In summary, this survey has broadly indicated that one of the main roles for an antimicrobial stewardship program in the community is education. Community health care professionals agree it is important to increase public awareness about the problem of antimicrobial resistance and to provide education for both the public and health care professionals about antimicrobial stewardship. We have also learned that it is important to ensure that all sectors of health care (animal and human) are able to provide a consistent message to the public so that we can achieve a culture shift in the way we view and use antimicrobials. The importance of education and a One Health approach to antimicrobial stewardship cannot be stressed enough, so that everyone, including the general public, health care professionals, and policy makers/governments are aware of the problem and are actively engaged in being part of the solution.
Appendix - Figures

Figure 1: Survey Response Rate for Each Respondent Group  The response rate was highest among nurse practitioners (30%) and lowest among physicians (10%). Pharmacists, dentists, and veterinarians had response rates of 12%, 13%, and 14%, respectively. The values in each bar represent the number of respondents out of the total number of survey invitations for each group.
Nurse practitioners had the highest percentage of female respondents (92%) and this was lowest among dentists (37%). Physician, pharmacist, and veterinarian respondents were 43%, 71%, and 72% female, respectively.

Figure 2: Percentage of Respondents Identifying as Male or Female
Figure 3: Respondent Age Demographics  The age range of each health care professional specialty is indicated by the black line. The red and blue dashes indicate the mean and median, respectively. Physicians averaged the oldest (50.4 years) while pharmacists averaged the youngest (39.2 years).
Figure 4: Respondent Work Experience Demographics  The range of years of experience of each health care professional specialty is indicated by the black line. The red and blue dashes indicate the mean and median, respectively. Physicians averaged the most years of work experience (20.9 years) while nurse practitioners averaged the least (10.4 years).
A. I was familiar with antimicrobial stewardship prior to this survey.

<table>
<thead>
<tr>
<th>Health Care Professional Specialty</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Physicians</td>
<td>90%</td>
</tr>
<tr>
<td>Nurse Practitioners</td>
<td>75%</td>
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<tr>
<td>Dentists</td>
<td>65%</td>
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<tr>
<td>Pharmacists</td>
<td>59%</td>
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<tr>
<td>Veterinarians</td>
<td>99%</td>
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B. I believe antimicrobial resistance is an issue of concern.

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<th>Health Care Professional Specialty</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Physicians</td>
<td>100%</td>
</tr>
<tr>
<td>Nurse Practitioners</td>
<td>100%</td>
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<tr>
<td>Pharmacists</td>
<td>99%</td>
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<tr>
<td>Dentists</td>
<td>94%</td>
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I believe antimicrobial resistance is an issue of concern for humans.

I believe antimicrobial resistance is an issue of concern for animals.
Figure 5: Responses to Statements Regarding Knowledge of Antimicrobial Stewardship  

A. Veterinarians were most likely to agree with the statement, “I was familiar with antimicrobial stewardship prior to this survey.” The human health care professions agreed less often: physicians – 90%, nurse practitioners – 75%, dentists – 65%, and pharmacists – 59%. 

B. More than 94% of each human health care profession agreed with the statement, “I believe antimicrobial resistance is an issue of concern.” Similarly, 96% of veterinarians agreed with the statements in C, “I believe antimicrobial resistance is an issue of concern for humans,” and D, “I believe antimicrobial resistance is an issue of concern for animals.”
A

I believe inappropriate use of antimicrobials contributes to antimicrobial resistance.

B

I believe inappropriate use of antimicrobials in animals contributes to antimicrobial resistance in animals.
I believe inappropriate use of antimicrobials contributes to patient harm (e.g., through side effects, toxicity, antimicrobial resistant organisms).

I believe inappropriate use of antimicrobials contributes to animal harm (e.g., through side effects, toxicity, antimicrobial resistant organisms).
Figure 6: Responses to Statements Regarding Knowledge of Antimicrobial Use  
A Human health care professionals agreed 100% with the statement, “I believe inappropriate use of antimicrobials contributes to antimicrobial resistance,” while only 89% of veterinarians agreed with the similar statement B, “I believe inappropriate use of antimicrobials in animals contributes to antimicrobial resistance in animals.”  
C More than 95% of human health care professionals agreed with the statement, “I believe inappropriate use of antimicrobials contributes to patient harm (e.g., through side effects, toxicity, antimicrobial resistant organisms),” while only 85% of veterinarians agreed with the similar statement D, “I believe inappropriate use of antimicrobials contributes to animal harm (e.g., through side effects, toxicity, antimicrobial resistant organisms).”
A

I feel comfortable consulting other health care professionals about an antimicrobial prescription (e.g., for indication, dose, duration, route).

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<th>Health Care Professional Specialty</th>
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<tr>
<td>Physicians</td>
<td>85%</td>
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<tr>
<td>Nurse Practitioners</td>
<td>92%</td>
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<td>Dentists</td>
<td>94%</td>
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<tr>
<td>Veterinarians</td>
<td>87%</td>
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B

I feel comfortable discussing an antimicrobial prescription with other health care professionals when I suspect a misuse (e.g., dose, duration).

<table>
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<tr>
<th>Health Care Professional Specialty</th>
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<tr>
<td>Pharmacists</td>
<td>65%</td>
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Figure 7: Responses to Statements Regarding Antimicrobial Stewardship in Practice  

A At least 85% of prescribers (physicians, nurse practitioners, dentists, and veterinarians) agreed with the statement, “I feel comfortable consulting other health care professionals about an antimicrobial prescription (e.g., for indication, dose, duration, route),” while only 65% of pharmacists agreed with the related statement B, “I feel comfortable discussing an antimicrobial prescription with other health care professionals when I suspect a misuse (e.g., dose, duration).” C Veterinarians were most likely to agree (19%) with the statement, “I believe an antimicrobial stewardship program may interfere with my practicing autonomy,” while 11% or less of human health care prescribers agreed to this statement.
A

I believe inappropriate use of antimicrobials can be significantly reduced through antimicrobial stewardship.

B

I believe decreasing inappropriate antimicrobial use will improve patient care.
C  
I believe decreasing inappropriate antimicrobial use in human patients will improve patient care.

D  
I believe decreasing inappropriate antimicrobial use in animals will improve animal care.
Figure 8: Responses to Statements Regarding Antimicrobial Stewardship and Patient Care
A While only 75% of dentists agreed with the statement, “I believe inappropriate use of antimicrobials can be significantly reduced through antimicrobial stewardship,” at least 89% of each other group agreed with the statement. B 94% or more of each human health care group agreed with the statement, “I believe decreasing inappropriate antimicrobial use will improve patient care.” 93% and 92% of veterinarians agreed with the related statements C, “I believe decreasing inappropriate antimicrobial use in human patients will improve patient care,” and D, “I believe decreasing inappropriate antimicrobial use in animals will improve animal care,” respectively.
A

I have been pressured by a patient/patient's family/client to prescribe antimicrobials even after I advise that the patient/animal's condition does not require antimicrobials.

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<tbody>
<tr>
<td>Physicians</td>
<td>90%</td>
</tr>
<tr>
<td>Nurse Practitioners</td>
<td>83%</td>
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<tr>
<td>Dentists</td>
<td>67%</td>
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<tr>
<td>Veterinarians</td>
<td>69%</td>
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B

I believe the public needs more education on the correct use of antimicrobials (e.g., through school curriculums, advertisements, etc.).

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</tr>
<tr>
<td>Nurse Practitioners</td>
<td>92%</td>
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<tr>
<td>Pharmacists</td>
<td>93%</td>
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<tr>
<td>Dentists</td>
<td>97%</td>
</tr>
<tr>
<td>Veterinarians</td>
<td>93%</td>
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**Figure 9: Responses to Statements Regarding Antimicrobial Stewardship and Patient Education**

A  Physicians (90%) and nurse practitioners (83%) were most likely to agree with the statement, “I have been pressured by a patient/patient’s family/client to prescribe antimicrobials even after I advise that the patient/animal’s condition does not require antimicrobials,” while veterinarians (69%) and dentists (67%) were least likely to agree with the statement.  

B  92% or more of each health care professional group agreed with the statement, “I believe the public needs more education on the correct use of antimicrobials (e.g., through school curriculums, advertisements, etc.).”  

C  Between 50-63% of each health care professional group agreed with the statement, “I possess or have access to the necessary tools or resources to educate my patients/clients about antimicrobial drugs.”
A. I believe research for new antimicrobial agents should be publically funded (e.g., government grants).

B. I would attend an educational session (e.g., seminar, workshop, online education) that provides further information about antimicrobial stewardship.
Figure 10: Responses to Statements Regarding Antimicrobial Stewardship and Professional Education

A Physicians (86%) were most likely to agree with the statement, “I believe research for new antimicrobial agents should be publically funded (e.g., government grants),” while nurse practitioners (50%) were least likely to agree with the statement. B 80% or more of each health care professional group agreed with the statement, “I would attend an educational session (e.g., seminar, workshop, online education) that provides further information about antimicrobial stewardship.” C Dentists (63%) were least likely to agree with the statement, “I am willing to promote antimicrobial stewardship initiatives among my colleagues,” while 100% of nurse practitioners agreed with this statement.
A  Average Response to the Statement "I believe inappropriate antimicrobial use in health care is mainly driven by:"

B  Percent of Responses to the Statement "I believe inappropriate antimicrobial use in health care is mainly driven by: (Health Care Professionals --- Patients)"
Average Response to the Statement "I believe the majority of inappropriate antimicrobial use occurs in:"

D  Percent of Responses to the Statement "I believe the majority of inappropriate antimicrobial use occurs in: (Health Care --- Agriculture)"
The average response (via sliding bar) for nurse practitioners leaned the furthest from center (towards health care professionals) regarding the statement, “I believe inappropriate antimicrobial use in health care is mainly driven by: Health Care Professionals – Patients,” while physicians, pharmacists, and dentists averaged a more equal responsibility for both patients and health care professionals. B 86% of responding physicians answered this question while 97-100% each of the remaining group’s respondents answered. C While the average response from physicians was much closer to equal responsibility for the statement, “I believe the majority of inappropriate antimicrobial use occurs in: Health Care – Agriculture,” the average response for nurse practitioners, pharmacists, and dentists leaned much more towards health care. D For this question, only 67% of physician respondents answered. Responses were also lower in the dentist and pharmacy groups (75% and 88%, respectively), while 100% of nurse practitioner respondents answered.
I believe inappropriate antimicrobial use in animal health care is mainly driven by: (Health Care Professionals --- Clients)

I believe the majority of inappropriate antimicrobial use occurs in: (Human Health Care --- Animal Agriculture)
Figure 12: Veterinarian’s Perception of Inappropriate Antimicrobial Use

A The average response (via sliding bar) leaned towards clients regarding the statement, “I believe inappropriate antimicrobial use in animal health care is mainly driven by: Health Care Professionals – Clients,” and the average response leaned towards human health care regarding the statement, “I believe the majority of inappropriate antimicrobial use occurs in: Humans (Health Care) – Animals (Agriculture).” B 97% and 89% of responding veterinarians answered these questions, respectively.
Respondents’ interest in various educational tools varied among the tools and between providers. An Antimicrobial Stewardship Program website and posters/brochures garnered the most interest among all practitioners while audio-visual tools had the least interest. Among prescribers in human health care, dentists were least interested in viral prescription pads compared to physicians and nurse practitioners.
Human and animal health care prescribers’ interest in various clinical decision aids varied among the tools and between providers. An antibiogram, pharmacy expertise, and infectious disease expertise had the most interest from prescribers in human health, while microbiology expertise garnered less interest. Veterinarians’ interest ranged from 51-63% among the various tools for which they were surveyed.
References


