

## AWARENESS OF ANTIMICROBIAL RESISTANCE FROM ONE HEALTH PERSPECTIVE AND ITS RELATION TO SOCIAL DETERMINANTS IN RESIDENTS OF WAH

Hina Shan, Syed Fawad Mashhadi, Humaira Mahmood\*

Army Medical College/National University of Medical Sciences (NUMS) Rawalpindi Pakistan, \*Karachi Institute of Medical Sciences/CMH Malir Karachi Pakistan

### ABSTRACT

**Objective:** To assess the awareness about antimicrobial resistance (AMR) and the various aspects of AMR from a one health concept in relation to social determinants in residents of Wah.

**Study Design:** Cross sectional-analytical study.

**Place and Duration of Study:** One year from Jan to Dec 2017 in Wah, Pakistan.

**Material and Methods:** A total of 400 participants completed the questionnaire, aged 16 years and older. A probability sampling technique was used and Chi-square test of significance was applied to determine the relationship between social variables with dependent variables,  $p$ -value  $<0.05$  was taken as significant.

**Results:** The phrase 'antibiotic resistance' was known to 52.5%, and 19.8% heard 'antimicrobial resistance'. The term least heard was 'superbugs' (9.5%). The most cited source of information was 'doctor' followed by 'media'. Results showed that 67.3% believed that health of people is connected to the health of animals and environment, 62% agreed that collaborative efforts could achieve the best health of people and environment.

**Conclusion:** The awareness related to the causes and spread of antimicrobial resistance came out to be quite low, and the outcomes were found to be associated with gender, age, education, occupation and socioeconomic status. Participants had many misconceptions about various aspects of antimicrobial resistance. Public awareness of AMR was low in all occupational groups, and the results show that high education level, high socioeconomic status, and healthcare-related occupation marked a higher level of knowledge about AMR awareness.

**Keywords:** AMR, Antibiotic resistance, Antimicrobial resistance, One Health.

This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

### INTRODUCTION

For the last eight decades, antibiotics and other antimicrobials saved millions of lives from common and life threatening infections like pneumonia, post-operative infections, tuberculosis, and many more<sup>1</sup>. These vital medicines contributed in the advancement of modern healthcare, agriculture, and food production, but the emergence of antimicrobial resistance (AMR) has put the substantial gains risk making it the world's biggest concern<sup>1,2</sup>. As stated by the Director-General of WHO, Dr. Tedros Adhanom Ghebreyesus "A world in which the drugs don't work is a threat to global health security<sup>3</sup>." Currently, there are very few new antibiotics in the pipeline, and though the supply is insufficient, the demand for these

medicines is higher than ever<sup>3</sup>.

Antimicrobial resistance is a natural process and has been there since the discovery of first antibiotics, but now it has risen to high levels not only in healthcare settings but also in the wider community<sup>3</sup>. Antimicrobial resistant-microbes are found everywhere be it people, animals, food, and the environment (in water, soil, and air), making the spread easy from person to person and also between people and animals. The magnitude of the problem has been accepted globally and in the report from the 'Review on Antimicrobial Resistance', it is estimated that 10 million lives a year are at risk by 2050<sup>4</sup>. Even today, 700,000 deaths per year occur because of resistant infections with an expected economic output of 100 trillion USD at stake if the timely containment of AMR doesn't take place<sup>5</sup>.

Each year almost two million people become infected with bacteria that are resistant to

**Correspondence:** Dr Hina Shan, Senior Lecturer, HITEC-Institute of Medical Sciences, Taxila Pakistan (Email: [drhinashan@gmail.com](mailto:drhinashan@gmail.com))  
Received: 29 Jan 2018; revised received: 24 Apr 2018; accepted: 23 May 2018

antibiotics, and 23,000 deaths occur in the USA alone as a result of AMR<sup>6</sup>. It is also estimated that by 2050, 4,73,0000 deaths in Asia and 4,15,0000 deaths in Africa will be because of AMR alone<sup>7</sup>. The treatment failures in gonorrhoea to cephalosporin (the 3rd generation of antibiotics) and quinolone antibiotics have been reported in at least twelve countries including the United Kingdom, Canada, and France. A report published by WHO in 2014 rated Pakistan amongst the top five countries with the highest number of neonatal deaths attributable to AMR<sup>8</sup>. The very report also displayed high resistance rates of *E. Coli* third generation Cephalosporins & Fluoroquinolone resistance which came out to be more than 85 percent. Gonococcal AMR to Ciprofloxacin in patients suffering from Gonorrhoea has been reported to be 86% in Karachi, Pakistan<sup>8,9</sup>.

Inadequate infection control, unrestrained use, self-medication, easy access of antibiotics, poor sanitation and hygiene, lack of knowledge and surveillance about AMR have made the matter worse especially in under-resourced countries where there is lack of regulatory bodies and awareness regarding this issue<sup>10</sup>. Antibiotics are used in food-producing animals, aquaculture, and crop culture for prophylaxis as well as growth promotion and are found in human and animal excreta contributing to the big factor of AMR spread<sup>11</sup>. Many environmental studies have confirmed the ubiquitous presence of antibiotics and antibiotic resistance genes in wastewater or run-off from livestock facilities and agricultural farms<sup>4,12</sup>. The extremely high concentration of antibiotics have been reported in rivers and waste waters in Sweden, Colorado (U.S.A), and Lahore (Pakistan)<sup>6,13,14</sup>. In Pakistan overuse of Fluoroquinolones in human and livestock has increased the concentration of this specific antibiotic in water bodies especially Kahutta and Hattar sites posing an ecological threat to spread of AMR<sup>14</sup>.

WHO declared AMR a high priority issue to be tackled across the globe and in May 2015 World Health Assembly endorsed a Global

Action Plan on AMR, including "One Health" approach, according to Dr Tedros Adhanom Ghebreyesus 'WHO must champion a One Health approach' to tackle the global challenge of AMR<sup>15</sup>. The issue of AMR has many aspects related to its etiology requiring a multi-level solution like a 'One Health' approach which recognizes the connection that is shared by animals, humans and the environment and because of this active link the solutions should be addressed with the help of transdisciplinary synergisms<sup>16</sup>. The areas under the One Health umbrella include issues such as emerging and reemerging infectious diseases, antimicrobial resistance, and loss of biodiversity, environmental pollution, food safety and security for better public health outcomes<sup>17</sup>. In December 2017, an agreement was signed between Pakistan Agriculture Research Council (PARC) and The National Institute of Health (NIH) to strengthen public health in Pakistan as the concept of One Health continues to be promoted by Pakistan One Health Alliance (POHA).

Pakistan developed its first national policy on AMR in 2016 and this year in March 2017 Ministry of National Health Services Regulations and Coordination (MoNHSRC) drafted its first National Action Plan (NAP) to overcome the challenges of combating AMR<sup>18,19</sup>. AMR has the potential to impact the achievements of Sustainable Development Goals (SDGs) on a large scale as well as adding to the double burden of disease, as effective antimicrobials are essential to provide successful prevention and treatment for maternal & child health, communicable & noncommunicable disease, and universal health coverage<sup>20,21</sup>. Measures to contain antimicrobial resistance require a behavioral and attitudinal change in people to recognize antimicrobials as a valuable shared resource (maintaining their efficacy to treat infections in animals and humans alike)<sup>22</sup>. Out of the five strategic objectives of the "Global action plan on AMR" the first objective is to raise awareness and improve understanding of AMR, studies have also shown that one of the most critical steps in fighting AMR is increasing

the awareness of the general public about this issue in the community about causes, spread, and implications of AMR<sup>4</sup>. Presently in Pakistan, little is known about a vital issue of AMR, and to the best of our knowledge, this is the first study in Pakistan documenting knowledge about antimicrobial resistance and the concept of One Health. This study will provide a snapshot of the awareness of antimicrobial resistance & its relation to social determinants through a One Health lens providing information which will be used for quantifying and efficiently addressing the concerning areas for further research and data collection. This study will also help bridge knowledge gaps in understanding major health risks, finding new solutions through the innovative paradigm of one health as health plays an integral part in determining social, cultural, and economic outcomes of society.

## **MATERIAL AND METHODS**

An analytical cross-sectional study was conducted from January to December 2017 using two stage cluster random sampling technique in the urban area of Wah which has a literacy rate of 99 percent<sup>23</sup>. To capture the representative sample from the population of Wah Cantt, WHO sample size calculator was used, with following assumptions of awareness regarding antibiotic resistance 57%, Confidence level of 95% and 5% Absolute precision required. Ethical approval was obtained from the ethical review committee of National University of Medical Sciences, Pakistan. The sampling frame was obtained from station headquarters, Wah Cantt after taking appropriate permission from local authorities. Four sectors were randomly chosen out of the total 27 sectors of Wah Cantt. Data were collected systematically from every fifth house from the first person contacted who fulfilled the eligibility criteria. The households which were found locked or no adult was present at the time of survey or he/she refused to participate in the survey were excluded from the sample. Participants were included if they were 16 years old or older, were able to read Urdu or English language, and were mentally and physically

capable of answering. A validated, closed-ended WHO questionnaire was administered both in English and Urdu languages (Urdu translation was evaluated using the standard forward and backward method). The questionnaire was previously used in a multi-country survey by WHO. It was modified to suit the One Health perspective and was tested for face and content validity with people not participating in the main study. Average monthly household income was recorded in Pakistani rupees (PKR) using the five quintiles from poorest (first) to the richest (fifth) wealth quintiles. The total number of participants who completed the questionnaire were 400 and data was entered and analyzed using SPSS-22. Mean and SD were calculated for continuous variable. Categorical variables were presented by frequency and percentage.

Cross-tabulation was done to determine the association between level of knowledge and understanding of causes and spread of AMR from a one health perspective. Chi-square test of significance was applied to determine the relationship of social variables with dependent variables, *p*-value <0.05 was taken as significant.

## **RESULTS**

A sample of adults aged 16 years and older completed the survey with a total of 400 respondents. Of the total 239 (59.8%) were males. Mean age was 37.52 ± 10.09 years. The minimum age was 16 and the maximum age recorded was 72 years as displayed in table.

The awareness of commonly used key terms for AMR was asked in relation its social determinants, and the details are shown in the fig-1. Out of the total 400 participants, the phrase antibiotic resistance was known to 210 (52.5%) of the respondents. Out of the total of 23 doctors, only 12 (52%) have had heard the terms superbugs.

Antibiotic resistance, the phrase with the highest level of awareness 210 (52.5%) was heard by more females 96 (59.6%) and 65 plus-year-olds (85.7%) of awareness as compared to those aged 16-24, 10 (34.5%). The difference in relation

to gender was statistically significant (chi square=5.489,  $p=0.019$ ). The association related to age was also statistically significant ( $\chi^2=0.035$ ,  $p=0.035$ ). In the context of household

5th quintile, 39 (84.7%) were most likely to be familiar with the term as compared to people in the first or lowest quintile 31 (35%).

**Table: Socio-demographic characteristics of study participants (n=400).**

Variable	Number (N)	Percentage (%)
<b>Gender</b>		
Male	239	59.8
Female	161	40.2
<b>Age Groups</b>		
16-24 year old	29	7.2
25-34 year old	145	36.3
35-44 year old	127	31.8
45-54 year old	79	19.8
55-64 year old	13	3.3
65 plus	7	1.8
<b>Household composition</b>		
Single adult only	70	17.5
Single adult and at least one child under 16	11	2.8
Married adults only	71	17.8
Married and at least one child under 16	132	33.0
Multiple adults aged 16 and above	55	13.8
Multiple adults and at least one child under 16	61	15.3
<b>Education</b>		
Primary or Middle	73	18.3
Secondary or Higher secondary	140	35.0
Bachelor's	126	31.5
Master's or equivalent	61	15.3
<b>Occupation</b>		
Government employees	140	35.0
People in business/private employees	109	27.3
Doctors	23	5.8
Other Professionals (teachers, engineers, etc.)	69	17.3
Students	32	8.0
Jobless/retired/housewives	27	6.8
<b>Monthly household income in Pakistani Rupees (PKR)</b>		
First /poorest Quintile (<20000 PKR)	88	22.0
Second Qunatile ( $\geq 20000$ <30000 PKR)	178	44.5
Third Quantile ( $\geq 30000$ <40000 PKR)	48	12.0
Fourth Quintile ( $\geq 40000$ <65000 PKR)	40	10.0
Fifth/richest Quintile ( $\geq 65000$ PKR)	46	11.5

composition, the difference was not statistically significant ( $\chi^2=4.044$ ,  $p=0.543$ ). Only 11 (34.4%) of the students & 12 (44%) of the housewives had heard the term antibiotic resistance. People in the

Awareness about the term 'antimicrobial resistance' within the occupational category showed that 20 (87%) doctors were aware of the term antimicrobial resistance. People in the 5th

quintile, 28 (60.9%) were more familiar with the term as compared to people in the first/lowest quintile 10 (11.4%).

Out of the 210 (52.5%) respondents who were aware of the term antibiotic resistance, 'doctor' was the most cited source of information (fig-2). Regarding socio-demographic relationship more males, 144 (59.6%) heard the term from

information source (antimicrobial resistance) was  $\chi^2=72.390, p<0.001$ . People in 2nd wealth quintile 77 (43.3%) showed media as the highest source of information for the term 'antimicrobial resistance.' Respondents in the 5th wealth quintile 18 (37.5%) had family/friends as highest source of information.

To understand various aspects of AMR & its

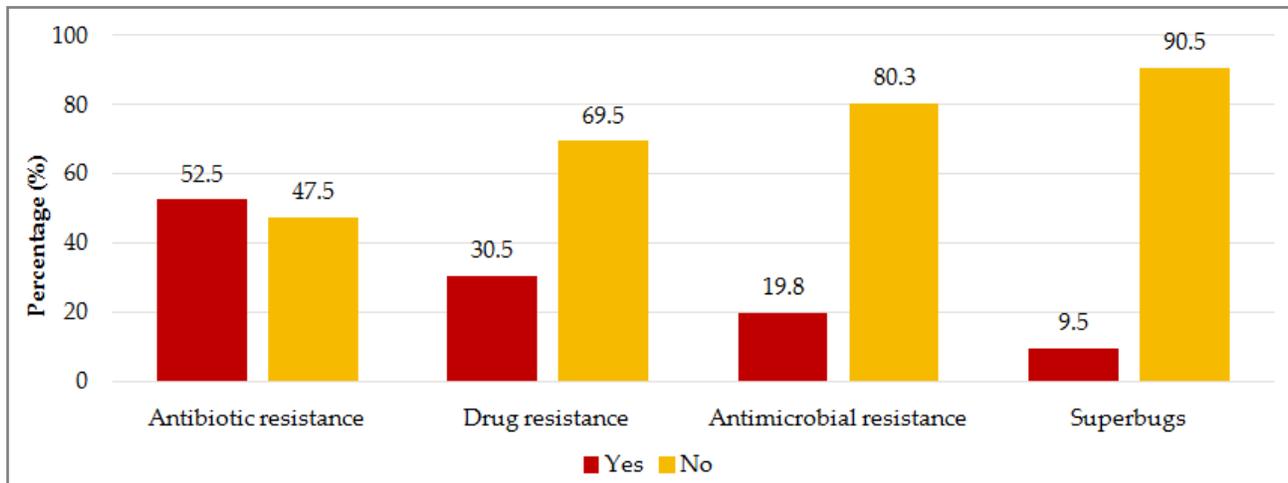


Figure-1: Heard the terminology related to antimicrobial resistance (n=400 for each category).

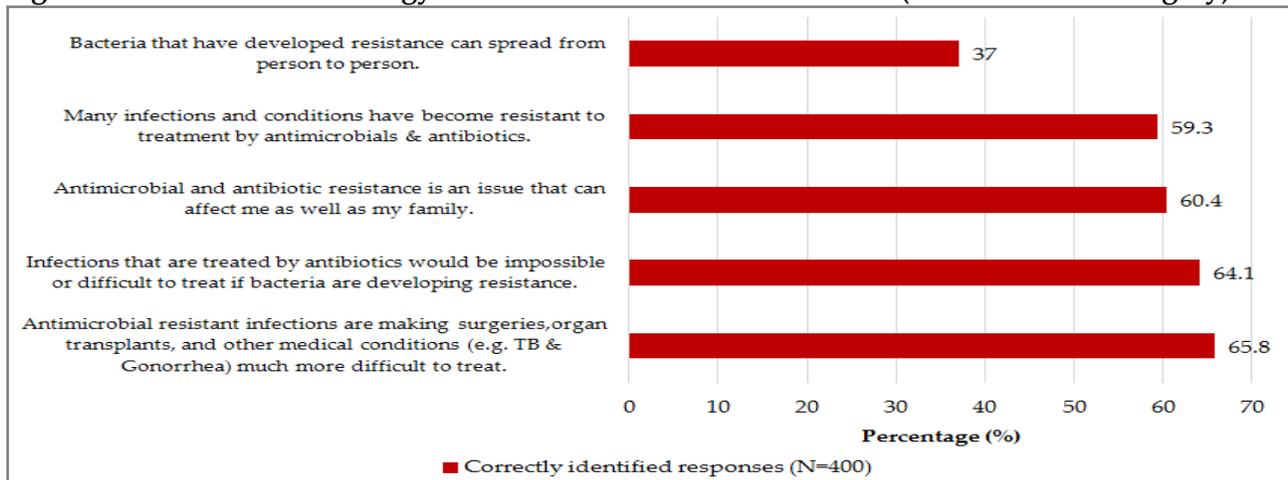


Figure-2: Correctly identified responses of the various aspects of antimicrobial resistance.

doctors as compared to females 66 (40.4%). Government employees, 46 (32.5%) were highest to have heard the term 'antibiotic resistance' from a doctor. People in 2nd wealth quintile 95 (53.3%) showed family/friends as their highest sources of information for the term 'antibiotic resistance'.

The Pearson chi-square value calculated for the association of monthly income with the

social determinants respondents were given five correct statements to be identified as true or false. All the five statements were correct, and their right responses are shown in fig-2.

The statement "Antimicrobial resistant infections are making surgeries, organ transplants, and other medical conditions (e.g., TB & Gonorrhoea), much more difficult to treat",

was rightly answered by 263 (65.8%) of the participants. The association with gender was found to be statistically significant ( $\chi^2=12.029$ ,  $p<0.001$ ). Responses to the statement in relation to the level of education were found to be statistically significant ( $\chi^2=138.615$ ,  $p<0.001$ ).

Participants were presented with three

statements by 319 (79.3%) respondents. When analyzed to find an association with gender, 201 (83.7%) of males gave the wrong answer as compared to females. The association with gender was found to be statistically significant ( $\chi^2=5.685$ ,  $p=0.017$ ) and also with the level of education ( $\chi^2=59.436$ ,  $p<0.001$ ). The youngest group (16-24-year-olds) displayed the highest percentage of 25 (86.2%) in

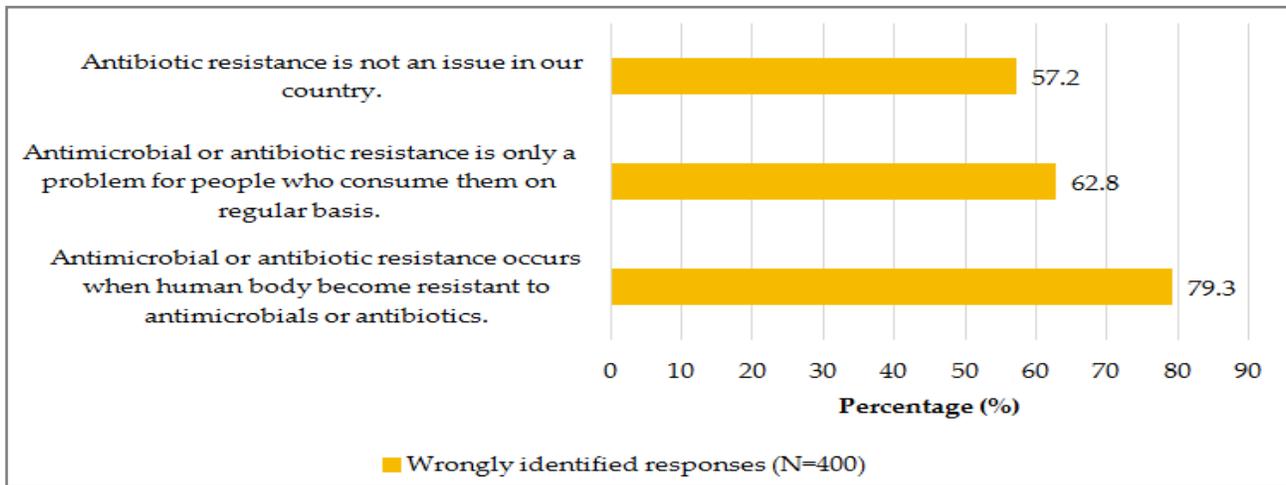


Figure-3: Wrongly identified responses to the various aspects of antimicrobial resistance.

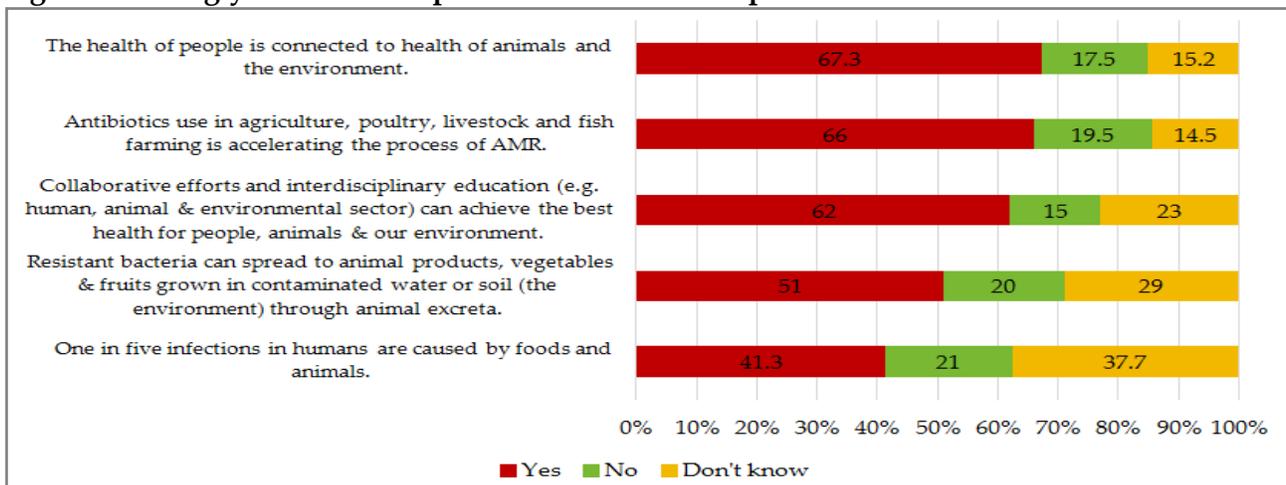


Figure-4: Understanding of antimicrobial resistance from a one health perspective (n=400).

incorrect statements to be identified as true or false to determine the knowledge of various aspects of AMR (fig-3).

The incorrect statement to check the level of understanding about the occurrence of AMR was “Antimicrobial or antibiotic resistance occurs when human body becomes resistant to antimicrobials/antibiotics.” It was considered

wrongly identifying it.

Assessing knowledge of AMR’s inter-relationships in humans, food-producing animals, and the environment (a One Health concept), participants were asked five basic questions relating to One Health concept (fig-4).

Responses analyzing the basic definition of One Health, “the health of people is connected to

the health of animals and the environment" in relation to socio-demographic context was obtained. Out of 269 participants who agreed it to be the right statement, 159 (66.5%) were males (Chi-square=0.212,  $p=0.899$ ). The difference within age groups came out to be statistically significant (Chi-square=21.425,  $p=0.018$ ). The association with level of education was statistically significant ( $\chi^2=43.980$ ,  $p<0.001$ ) with more participants in the bachelor's category agreeing 105 (83.3%) with the statement.

The responses from the statement that collaborative efforts and interdisciplinary education are the solutions to achieve the better results in the health of people, animals and the environment was analyzed in relation to socio-demographic context. Out of the 248 participants who agreed it to be the right statement, more were females 105 (64.6%), Chi-square=1.029,  $p=0.598$ . The difference within age groups came out to be statistically significant (Chi square=27.399,  $p=0.002$ ). People in 45-54 year-olds group agreed the most, 57 (72.2%) with the above statement. The socio-demographic difference was statistically significant in relation to occupation ( $\chi^2=26.186$ ,  $p<0.003$ ).

## DISCUSSION

The genuine fear and concern of public health professionals that era of antibiotics is about to end needs to be addressed on priority as the spread of AMR are reaching crisis levels. Only half of the respondents in our study were aware of the terms 'antibiotic resistance' and 'antibiotic resistant bacteria' this is quite low compared to 89% of the participants aware of the term 'antibiotic resistance' in Mexico<sup>24</sup>. In our study, only 79 (19.8%) respondents were aware of the term 'antimicrobial resistance', 38 (9.5%) were familiar with term 'superbugs.' Surprisingly, Only 12 (52%) of doctors have had heard the term 'superbugs' this highlights the need to educate health workers about "superbugs," strengthening their knowledge through workshops and other campaigns as information plays a big role in behavior change<sup>25</sup>. However, in a similar study

done by WHO, the familiarity was quite high as compared to our results as 44% were aware of the term 'antimicrobial resistance,' 45% with 'superbugs'<sup>24</sup>.

Understanding the various aspects of antimicrobial resistance is very important and encouragingly 65.8% respondents correctly identified that AMR is making medical procedure dangerous, the findings were similar in a survey conducted by WHO<sup>24</sup>. Only half of the respondents (51%) believed that bacteria could spread from person to person the findings were almost near to the findings in another study<sup>24</sup>.

The misconception 'Antimicrobial or antibiotic resistance occurs when human body becomes resistant to antimicrobials or antibiotics, was 317 (79.3%) as compared to 62.8% of the respondents in a study conducted by WHO people<sup>24</sup>. In our study 251 (62.8%) had the wrong idea that Antimicrobial or antibiotic resistance was only a problem for people who consumed them on a regular basis, this misconception was quite low in findings of a study done by WHO<sup>3</sup>.

To assess Knowledge of AMR's inter-relationships in humans, food-producing animals, and the environment (a One Health concept), participants were asked the five questions which are the basics of One Health concept. Encouragingly more than half of the respondents recognized the importance of the connection of health with humans, animals, and the environment. More males and 45-54 year olds agreed with the statement, the higher the level of education the higher was the response. The responses from the statement that collaborative efforts and multidisciplinary approach are the solutions to achieve the better results in the health of people, animals, and the environment was analyzed in relation to socio-demographic context. Out of the 248 (62%) participants who agreed it to be the right statement, females, regarding age (45-54-year-olds), household composition (multiple adults aged 16 and above), education level (bachelor's) agreed the most. The general population

especially of developing countries like Pakistan needs to be educated as AMR costs money, prolonged hospital stays, and morbidity leading to more expensive antimicrobial therapies. Limitations of the study is that it was conducted in only one city of Pakistan that too in the urban region where literacy rate is quite high as compared to the rest of the country making it less generalizable.

## CONCLUSION

The awareness related to the causes and spread of antimicrobial resistance came out to be quite low, and the outcomes were found to be associated with gender, age, education, occupation and socioeconomic status. Participants had many misconceptions about various aspects of antimicrobial resistance. Public awareness of AMR was low in all occupational groups, and the results show that high education level, high socioeconomic status, and healthcare-related occupation marked a higher level of knowledge about AMR awareness.

The findings indicate that young people, low level of education and socioeconomic profile should be the main target of future educational campaigns as they lacked the awareness more than any other group & had many misconceptions about various aspects related to the cause and spread of AMR.

## RECOMMENDATION

The concept of AMR and One Health needs to be promoted to change the behavior and attitude of all the stake holders (general public, veterinary, health care workers, members of food animal industry, policymakers). The implementation of a NAP in Pakistan requires strong political will, financial and technical support to face stewardship challenges as AMR is an unavoidable phenomenon and is considered a silent pandemic requiring a multi-pronged approach to work across SDGs.

## CONFLICT OF INTEREST

This study has no conflict of interest to declare by any author.

## REFERENCES

1. Kahn LH. One Health and the Politics of Antimicrobial Resistance. United States of America: JHU Press 2016; 183p.
2. Gould K. Antibiotics: from prehistory to the present day. *J Antimicrob Chemother* 2016; 71(3): 572-5.
3. Organization WH. Antimicrobial resistance in the Asia Pacific region: A development agenda. Manila: WHO Regional Office for the Western Pacific; 2017.
4. Noyce P. Antimicrobial resistance: More than just overusing antibiotics. *Management* 2017; 12: 17.
5. Houghton F. Antimicrobial resistance (AMR) and the United Nations (UN). *J Infect Public Health* 2017; 10(1): 139-40.
6. Quoc Tuc D, Elodie MG, Pierre L, Fabrice A, Marie-Jeanne T, Martine B, et al. Fate of antibiotics from hospital and domestic sources in a sewage network. *Sci Total Environ* 2017; 575(1): 758-66.
7. Turnidge J. Antimicrobial use and resistance in Australia. *Australian prescriber* 2017; 40(1): 2.
8. Organization WH. Critically important antimicrobials for human medicine: Ranking of antimicrobial agents for risk management of antimicrobial resistance due to non-human use: World Health Organization; 2017.
9. Jabeen K, Bhawan-Mal P, Khan E, Chandio S, Jacobsson S, Unemo M. Antimicrobial resistance and *Neisseria gonorrhoeae* multiantigen sequence typing (NG-MAST) genotypes in *N. gonorrhoeae* during 2012-2014 in Karachi, Pakistan. *BMC Infect Dis* 2016; 16: 353.
10. Núñez-Núñez M, Navarro MD, Gkolia P, Rajendran NB, Del Toro MD, Voss A, et al. Surveillance Systems from Public Health Institutions and Scientific Societies for Antimicrobial Resistance and Healthcare-Associated Infections in Europe (SUSPIRE): Protocol for a systematic review. *BMJ open* 2017; 7(3): e014538.
11. Founou LL, Founou RC, Essack SY. Antibiotic Resistance in the Food Chain: A Developing Country-Perspective. *Front Microbiol* 2016; 7: 1881.
12. Singer AC, Shaw H, Rhodes V, Hart A. Review of antimicrobial resistance in the Environment and Its Relevance to Environmental Regulators. *Front microbiol* 2016; 7: 1728.
13. Khan GA, Berglund B, Khan KM, Lindgren PE, Fick J. Occurrence and abundance of antibiotics and resistance genes in rivers, canal and near drug formulation facilities - A study in Pakistan. *PloS one* 2013; 8(6): e62712.
14. Riaz L, Mahmood T, Kamal A, Shafiqat M, Rashid A. Industrial release of Fluoroquinolones (FQs) in the waste water bodies with their associated ecological risk in Pakistan. *Environ Toxicol Pharmacol* 2017; 52: 14-20.
15. Robinson TP, Bu DP, Carrique-Mas J, Fevre EM, Gilbert M, Grace D, et al. Antibiotic resistance is the quintessential One Health issue. *Trans R Soc Trop Med Hyg* 2016; 110(7): 377-80.
16. Seale AC, Gordon NC, Islam J, Peacock SJ, Scott JAG. AMR Surveillance in low and middle-income settings-A roadmap for participation in the Global Antimicrobial Surveillance System (GLASS). *Wellcome open research* 2017; 2: 92.
17. Van Boeckel TP, Brower C, Gilbert M, Grenfell BT, Levin SA, Robinson TP, et al. Global trends in antimicrobial use in food animals. *Proc Natl Acad Sci U S A* 2015; 112(18): 5649-54.
18. Aslam A, Khatoun S, Mehdi M, Mumtaz S, Murtaza B. Evaluation of rational drug use at teaching hospitals in Punjab, Pakistan. *J Pharmacy Practice Community Medicine* 2016; 2(2): 54-7.

19. Arshad S, Mahmood S, Rasool S, Hayat S, Zafar S, Zehra T. Rational Drug use in Pakistan: A systematic review. *J Pharmacy Practice Community Medicine* 2016; 2(4): 116-22.
  20. Jasovský D, Littmann J, Zorzet A, Cars O. Antimicrobial Resistance. *Development dialogue* 2016; 2.
  21. Sharma S, Govender K, Nagaraju K, Chhetri P, Menze T, Srinivas SC. Antimicrobial Resistance: Identifying the Major Conflicts of Interest and Way Forward. *Indian J Pharmacy Practice* 2017; 10(2): 69.
  22. Doyle M, Acheson D, Newland J, Dwelle T, Flynn W, Scott HM, et al. Enhancing Practitioner Knowledge about Antibiotic Resistance: Connecting Human and Animal Health. *Food Prot Trends* 2016; 36(5): 390-4.
  23. Ramzan M, Ansar A, Nadeem S. Dengue epidemics: Knowledge perhaps is the only key to success. *J Ayub Med Coll Abbottabad* 2015; 27(2): 402-6.
  24. Organization WH. Handle Antibiotics With Care: 2016 Campaign Toolkit. Available at: (Accessed, 2016) WHO, Geneva 2016.
  25. Alpert PT. Superbugs: Antibiotic Resistance Is Becoming a Major Public Health Concern. *Home Health Care Manag Pract* 2016; 29(2): 130-3.
- .....