

# Nurses' Perceptions, Involvement, Confidence and Perceived Barriers Towards Antimicrobial Stewardship Program in Pakistan: Findings from a Multi-Center, Cross-Sectional Study

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**Purpose:** Antimicrobial resistance (AMR) is leading to greater therapeutic cost, length of hospital stays, adverse events, morbidity and mortality. Hospital-based antimicrobial stewardship programs (ASPs) engaging physicians, pharmacists, microbiologists and nurses are considered as effective way to ensure appropriate use of antimicrobial agents. The aims of our study were to assess nurses' perception, involvement, confidence and barriers towards hospital-based ASPs, and use the findings to provide future guidance.

**Methods:** A web-based, cross-sectional study was conducted among the nurses serving at eleven hospitals of Punjab province of Pakistan during a period of two months (December 2021-January 2022). Data were collected using a validated self-administered questionnaire. All data were analyzed using SPSS version 22.

**Results:** A total of 583 nurses participated in the study (response rate = 77.7%). All the participants were female staff nurses and 86% had a minimum of 3 years of working experience. The overall median score on the perception towards ASPs among the nurses was 18 (IQR: 16, 19) on a 0 to 20 scale whereas median score on the involvement in ASPs was 18 (IQR: 15, 37) on a 0 to 64 scale. Median perception and involvement score were statistically significantly differed by age ( $p < 0.001$ ) and years of experience ( $p < 0.001$ ). The overall median score on the confidence to perform ASP activities was 22 (IQR: 14, 24) on a 0 to 28 scale. Lack of knowledge, insufficient support from administration, and heavy workload were found to be the common barriers to perform ASP.

**Conclusion:** Our study concluded that Pakistani nurses have positive perception but limited involvement in ASPs. Moreover, they are confident to perform ASP besides many barriers.

**Keywords:** involvement, confidence, nurses, antimicrobial resistance, antimicrobial stewardship programs, Pakistan

## Introduction

Antimicrobial resistance (AMR) is one of the leading global public health threats facing humanity.<sup>1</sup> AMR is associated with greater health care costs and mortality.<sup>1–3</sup> In 2019, 4.95 million deaths were associated with AMR,<sup>4</sup> with the potential for more than 10 million deaths by 2050 leading to a 3.8% reduction in gross domestic product (GDP) unless addressed.<sup>3</sup> More than 90% of deaths due to AMR occur in low-middle income countries (LMICs), especially in Africa and Asia due to numerous political, economic and sociological factors.<sup>4,5</sup>

Irrational use of antimicrobials is a significant factor in the development of AMR alongside poor infection control measures and a lack of adequate sanitation.<sup>1,2</sup> Pakistan is a LMIC located in South Asia, highly vulnerable to AMR development, including both multi-drug resistant (MDR) and extensively drug resistant (XDR) infections in different areas throughout the country.<sup>6</sup> The key drivers of antibiotics misuse are similar in Pakistan to other LMICs, and include a poor health infrastructure, inadequate awareness among health care providers regarding AMR through poor health education, high cost of consultation among the private sector, lack of proper facilities in public sector hospitals, unrestricted availability of antibiotics as well as customer demand to purchase antibiotics without prescriptions, which includes those from the World Health Organization's Reserve list.<sup>7–10</sup>

In view of increasing AMR concerns and its implications, the World Health Organization (WHO) developed the "global action plan" (GAP) against AMR in 2015 and advised all its member states to produce national plans. The GAP has five objectives including to optimize the use of antimicrobial agents.<sup>11</sup> Pakistan was no exception; however, there have been concerns and challenges with the current implementation of its "national action plan" (NAP) similar to other LMICs.<sup>12,13</sup> Antimicrobial stewardship (AMS) is defined as 'a coordinated programs that promotes appropriate use of antimicrobial, improves patient outcomes, reduces AMR, and decreases the spread of infections caused by multidrug-resistant organisms.'<sup>14</sup> AMS is a proven, collaborative, multisectoral approach engaging all the health care leaders, policy makers, infectious disease specialists, microbiologists, physicians, clinical pharmacists and nurses to improve appropriate prescribing of antibiotics and reduce AMR.<sup>15–17</sup>

ASPs can effectively reduce AMR, mortality, length of hospital stay, hospitals readmission rate and health care expenditure.<sup>18–20</sup> Successful implementation of ASP has saved annual health care cost of \$US 200,000–900,000 in the United States (US).<sup>20–22</sup> An earlier study from Colombia reported a significant decrease in antibiotic consumption due to hospital-based ASPs,<sup>23</sup> with a study from Iran documenting that the expenditure associated with antimicrobial utilization had been reduced by 41.3% due to ASPs.<sup>24</sup> However, there have been concerns with the instigation of ASPs in LMICs in view of knowledge, manpower and other resources issues.<sup>25,26</sup> However, this is starting to be addressed as seen for instance across Africa.<sup>27</sup>

Nurses provide continual care for hospital patients including the administration of antibiotics advised by the physicians.<sup>28</sup> They are also heavily involved in delivering care in primary healthcare clinics under the guidance of physicians given the paucity of physicians working in these clinics in LMICs especially rural areas.<sup>29</sup> Nurses increasingly serve as antibiotic first responders, central communicators, coordinators of care, as well as being aware of the actual condition of the patients on antibiotic therapy.<sup>30</sup> Besides their conventional rolls, their integration in ASPs has been endorsed in many parts of the world due to their ability to perform tasks, which includes assuring culture and sensitivity testing is undertaken before initiation of antibiotics, documenting any antibiotic related allergies, promoting the rationalization of antibiotics doses and duration as well as their indication.<sup>31,32</sup>

According to the Human Resources for Health Vision of the Government of Pakistan 2018, there are 104,046 nurses (including midwives and lady health visitors) in the country.<sup>33</sup> Whilst previous studies have been conducted among health professionals including hospital administrators, medical doctors and pharmacists<sup>34–36</sup> in Pakistan about their awareness and involvement in hospital-based ASPs; we are unaware of any study conducted to date in Pakistan that has explored the perspectives and involvement of nurses in ASPs in either public or private healthcare settings. Consequently, we sought to address this by conducting a multi-center, cross-sectional study among registered nurses currently serving in public sector hospitals of Pakistan. We started with public hospitals as these are the most prolific in Pakistan. The findings can help develop additional educational programmes among nurses if pertinent to improve future antimicrobial prescribing.

## Materials and Methods

### Study Design and Setting

This cross-sectional, web-based survey was conducted among the nurses registered with the Pakistan nursing council, Islamabad, during a period of two months (December 2021-January 2022) using a convenient sampling technique. Nurses serving at eleven public sector hospitals of five divisions (Lahore, Faisalabad, Sargodha, Sahiwal, Multan) of the province Punjab, under the administrative control of Primary & Secondary Healthcare Department (P&SHD), Government of the Punjab. Punjab was selected for this study as it is the largest province of Pakistan. Consequently, should be able to provide sufficient nurses for this study.

### Study Instrument

The study instrument used in our survey was developed from relevant studies conducted among health care professionals.<sup>37–40</sup> Various concurrent activities were subsequently undertaken to ensure internal consistency, validity and robustness of the questionnaire used in the principal study. Firstly, the initial study questionnaire was carefully reviewed by a multidisciplinary team comprising a practicing MSN (Master of Science in nursing) nurse and two academic staff with PhDs in pharmacy to determine the content validity of the questionnaire. Upon their feedback, recommended changes were made to the questionnaire. Subsequently, a pilot study was conducted among 20 registered nurses to optimize the clarity and structure of the questionnaire to enhance its robustness and validity. The findings of our pilot study showed that the study instrument had good internal consistency ([Supplementary Table 1](#)). The final version of the questionnaire following input from the pilot study was used in the principal study. The questionnaire consisted of five sections (Appendix). The five sections were:

- Section I: It collected demographic information of the study participants. This comprised 9 questions including the name of the hospital, the age of the study participants, their gender, marital status, residence, qualification, designation, name of the working department and years of working experience.
- Section II: This section dealt with perceptions towards ASPs and consisted of five items. The study participants were requested to select one option according to their perception about ASPs from the five items using a Likert scale (from strongly agree–strongly disagree).
- Section III: This section consisted of sixteen questions concerning the current involvement of registered nurses in ASPs in their hospital. The study population were asked to choose one option out of five on a Likert scale, with options including always, often, sometimes, seldom, and never as per their involvement in ASPs.
- Section IV: This section comprised seven questions regarding the confidence of registered nurses to perform ASPs. Participants were asked to select one option out of five on a Likert scale including very confident, confident, neutral, unconfident and very unconfident (not at all confident).
- Section V: This section dealt with perceived barriers to perform ASPs in their hospital. This section comprised 8 questions. Registered nurses were asked to choose one option out of five on a Likert Scale, ie, strongly agree, agree, neutral, disagree, strongly disagree.

### Data Collection Procedure

The online version of the questionnaire was shared among registered nurses meeting the inclusion criteria via different social media applications, which included WhatsApp, Facebook, and Gmail, with the request to participate in the study. The link was re-shared after a week to remind non-participants to submit their responses.

### Sample Size

Sample size was computed by using Raosoft<sup>®</sup> sample size calculator. By considering the response rate greater than 50%, a 95% confidence level, 5% margin of error, and a population size of 104,046, the sample size came out as 383.

## Inclusion and Exclusion Criteria

All registered nurses currently serving in the participated eleven public sectors hospitals of pertinent divisions under the control of P & SHD were included in the current survey. All registered nurses working in other divisions of the Punjab, serving in private hospitals and nursing students were excluded from this study.

## Data Analysis

All data were analyzed using SPSS version 22. Data were presented as frequency and percentage unless otherwise specified. The domain specific sum scores were summarized using quartiles [median and inter-quartile range (IQR)]. The summary scores were compared using Mann–Whitney *U*-test or Kruskal–Wallis one-way analysis of variance. A *p*-value (two-side) less than 0.05 indicated statistical significance.

## Ethical Considerations

Ethical approval for this study was obtained from the Human Research Ethics Committee, Department of Pharmacy Practice, Faculty of Pharmacy, The University of Lahore (REC/DPP/FOP/47-A). Approval of the current study was also sought from the institutional ethics committees of the different health settings. Informed consent was also obtained from all the study participants prior to their enrollment in this survey. Participation in this study was anonymous and voluntary, and anyone could leave the survey at any stage without repercussions.

## Results

### Characteristics of the Participants

A total of 583 individuals eventually participated in the study out of 750 invited, giving a response rate of 77.7%. The basic characteristics of the participants are summarized in Table 1. The majority were female staff nurses and 86% had a minimum of 3 years of experience, married and living in urban residences.

### Perception Towards Antimicrobial Stewardship Programs

The overall median score on the perception towards ASPs among the nurses was 18 (IQR: 16, 19) on a 0 to 20 scale, which corresponds to 90 on a 100-point scale. The item specific summary is given in Table 2. The overall median score statistically significantly differed ( $p < 0.001$ ) by age and years of experience (Table 3).

**Table 1** Participant Characteristics (N = 583)

Characteristics	N (%)	
<b>Age class</b>	< 30 years	257 (44.1)
	> 30 years	326 (55.9)
<b>Gender</b>	Female	583 (100)
	Male	0 (0.0)
<b>Designation</b>	Head nurse	15 (2.6)
	Staff nurse	568 (97.4)
<b>Degree</b>	Bachelor	565 (96.9)
	Master degree	18 (3.1)
<b>Marital Status</b>	Single	145 (24.9)
	Married	438 (75.1)
<b>Residence</b>	Rural	215 (37.1)
	Urban	365 (62.9)
<b>Years of Experience</b>	1–2 years	80 (13.7)
	3–5 years	250 (42.9)
	6–10 years	173 (29.7)
	11 or more years	80 (13.7)

**Table 2** Perception of Nurses Towards Antimicrobial Stewardship Programs (ASPs) (N = 583)

Perception Towards ASPs (5 Items)	N (%)				
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. Antimicrobial stewardship programs promote reasonable prescription of antimicrobials	–	–	20 (3.4)	234 (40.1)	329 (56.4)
2. Antimicrobial stewardship programs help control antimicrobial resistance	–	–	15 (2.6)	230 (39.5)	338 (58)
3. Antimicrobial stewardship programs reduce the overuse of antimicrobials	–	–	71 (12.2)	186 (31.9)	326 (55.9)
4. Antimicrobial stewardship programs reduce the cost of treatment.	–	–	62 (10.6)	246 (42.2)	275 (47.2)
5. Antimicrobial stewardship programs Improves medical quality.	–	1 (0.2)	19 (3.3)	228 (39.2)	333 (57.3)

**Table 3** Median (Interquartile Range) Score for Each Domain Score in Overall and by Years of Experience and Age

		Perception Towards ASPs (0–20 Scale)	Involvement in ASPs (0–64 Scale)	Confidence to Perform ASP Activities (0–28 Scale)	Barriers Towards ASP Activities (0–32 Scale)
<b>Overall</b>		18 (16, 19)	18 (15, 37)	22 (14, 24)	19 (17, 24)
<b>Years of Experience</b>					
	1–2 years	18 (17, 19)	17 (13.5, 19)	22 (15, 24)	18 (17, 23)
	3–5 years	18 (17, 19)	18 (15, 37)	23 (21, 24)	18 (17, 23)
	6–10 years	17 (16, 18)	23 (15, 39)	21 (14, 23)	21 (17, 24)
	11 or more years	17 (16, 19)	20 (8, 36.5)	16 (9, 22)	21.5 (17, 24)
	p-value	< 0.001	0.012	< 0.001	0.049
<b>Age class</b>					
	<30 years	18 (17, 19)	17 (15, 28)	23 (21, 24)	18 (17, 22)
	>30 years	17 (16, 19)	20 (15, 39)	21 (12, 23)	21 (17, 24)
	p-value	< 0.001	< 0.001	< 0.001	< 0.001

## Involvement in Antimicrobial Stewardship Programs

The overall median score regarding the involvement in ASPs among the nurses was 18 (IQR: 15, 37) on a 0 to 64 scale, which corresponds to 28.1 on a 100-point scale. The item specific summary is given in Table 4. The study results revealed that nurses' involvement in ASPs was typically limited as half of them had never intervened proactively in problematic prescriptions (50.1%), nor commented on medical orders (56.3%). The majority of surveyed registered nurses had never provided feedback on antimicrobial prescriptions (51.1%), nor participated in decision making regarding antimicrobial therapy for critically ill patients (59.0%). Similarly, the majority of surveyed registered nurses had never participated in AMS committee meetings (63.8%) and had never provided advice to doctors on intravenous to oral conversion (66.7%). The majority of nurses also reported that they have never participated in developing antimicrobial treatment guidelines in their hospital (68.3%). Alongside this, the majority had never participated in evaluating antimicrobial types (59.2%) nor consumption of such therapies in the hospital (60.5%). Moreover, the majority of

**Table 4** Involvement of Nurses Towards Antimicrobial Stewardship Programs (ASPs) (N = 583)

Involvement in ASPs (16 Items)	N (%)				
	Never	Seldom	Sometimes	Often	Always
1. I review prescription of antimicrobials.	52 (8.9)	48 (8.2)	53 (9.1)	145 (24.9)	285 (48.9)
2. I proactively intervene in problematic prescriptions of antimicrobials	292 (50.1)	65 (11.1)	38 (6.5)	100 (17.2)	88 (15.1)
3. I comment on antimicrobial prescriptions and medical orders.	328 (56.3)	51 (8.7)	39 (6.7)	92 (15.8)	73 (12.5)
4. I provide feedback on antimicrobial prescriptions and medical orders	300 (51.5)	69 (11.8)	44 (7.5)	67 (11.5)	103 (17.7)
5. I participate in decision-making of antimicrobial treatment for critically ill patients.	344 (59)	59 (10.1)	32 (5.5)	104 (17.8)	44 (7.5)
6. I participate in antimicrobial stewardship committee meetings and decision making	372 (63.8)	36 (6.2)	53 (9.1)	81 (13.9)	41 (7)
7. I provide advice to doctors regarding the intravenous-to-oral conversion of antimicrobials	389 (66.7)	32 (5.5)	20 (3.4)	97 (16.6)	45 (7.7)
8. I provide advice to doctors about the adverse drug effects of antimicrobials	155 (26.6)	94 (16.1)	197 (33.8)	87 (14.9)	50 (8.6)
9. I provide advice to doctors about drug interactions related to antimicrobials	251 (43.1)	93 (16)	119 (20.4)	78 (13.4)	42 (7.2)
10. I monitor the duration of antimicrobial treatment and recommend appropriate cessation.	148 (25.4)	49 (8.4)	95 (16.3)	145 (24.9)	146 (25)
11. I participate in developing hospital antimicrobial treatment guidelines.	398 (68.3)	21 (3.6)	45 (7.7)	58 (9.9)	61 (10.5)
12. I provide feedback to doctors on bacterial resistance.	141 (24.2)	31 (5.3)	123 (21.1)	161 (27.6)	127 (21.8)
13. I participate in the management and evaluation of antimicrobial types in hospital.	345 (59.2)	20 (3.4)	41 (7)	92 (15.8)	85 (14.6)
14. I monitor and evaluate antimicrobial consumption in hospital.	353 (60.5)	14 (2.4)	32 (5.5)	106 (18.2)	78 (13.4)
15. I communicate with doctors on anti-infective treatment.	352 (60.4)	13 (2.2)	21 (3.6)	106 (18.2)	91 (15.6)
16. I communicate with patients and family members on antimicrobial treatment	97 (16.6)	28 (4.8)	42 (7.2)	216 (37)	200 (34.3)

registered nurses surveyed had never communicated with doctors on anti-infective treatment (60.4%). As shown in Table 3, the overall median score again significantly differed by age ( $p < 0.001$ ) and years of experience ( $p = 0.012$ ).

## Confidence in Performing Antimicrobial Stewardship Programs Activities

The overall median score on the confidence among nurses to perform ASP activities was 22 (IQR: 14, 24) on a 0 to 28 scale, which corresponds to 78.6 on a 100-point scale. The item specific summary is given in Table 5. The results showed that encouragingly nurses typically felt confident and very confident to assess the appropriateness of antimicrobial use, to determine the antimicrobial type required to treat common infections, to adjust antimicrobial doses, to optimize antimicrobial therapy, to advise on the course of antimicrobial treatment, to suggest stopping where necessary and to participate in case discussions on appropriate antimicrobial therapy. As shown in Table 3, the overall median score again significantly differed by age ( $p < 0.001$ ) and years of experience ( $p < 0.001$ ).

## Barriers Towards Antimicrobial Stewardship Programs Activities

The overall median score on the confidence to perform ASP activities among the nurses was 19 (IQR: 17, 24) on a 0 to 32 scale, which corresponds to 59.4 on a 100-point scale. The item specific summary is given in Table 6. Most of the respondents reported that the attention from hospitals towards ASPs is inadequate, they have limited time for participation in ASPs, efficient communication with doctors is lacking, their advice on possible antimicrobials to administer are not widely accepted by the physicians, and training regarding ASPs is insufficient (Table 5). As shown in Table 3, the overall median score again significantly differed by age ( $p < 0.001$ ) and years of experience ( $p = 0.049$ ).

**Table 5** Confidence of Nurses to Perform Antimicrobial Stewardship Program (ASP) (N = 583)

Confidence to Perform ASP Activities (7 Items)	N (%)				
	Very Unconfident	Unconfident	Neutral	Confident	Very Confident
1. To review the appropriateness of antimicrobials use	57 (9.8)	71 (12.2)	35 (6)	172 (29.5)	248 (42.5)
2. To determine the antimicrobial type to treat common infections such as pneumonia, urinary	14 (2.4)	30 (5.1)	85 (14.6)	206 (35.3)	248 (42.5)
3. To adjust the dose and frequency of antimicrobials based on patient and infections	27 (4.6)	60 (10.3)	93 (16)	293 (50.3)	110 (18.9)
4. To optimize antimicrobial treatment based on pharmacodynamic and pharmacokinetic parameters	122 (20.9)	38 (6.5)	157 (26.9)	153 (26.2)	113 (19.4)
5. To provide reasonable advice on the course of antimicrobial treatment	32 (5.5)	54 (9.3)	78 (13.4)	283 (48.6)	135 (23.2)
6. To identify unnecessary antimicrobial treatment and suggest stopping treatment	21 (3.6)	52 (8.9)	100 (17.2)	259 (44.4)	151 (25.9)
7. To participate in consultation and case discussion on antimicrobial treatment	35 (6)	42 (7.2)	88 (15.1)	364 (62.4)	54 (9.3)

**Table 6** Barriers Faced by Nurses Towards ASP Activities (N = 583)

Barriers Towards ASP Activities (8 items)	N (%)				
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. Have limited knowledge of antimicrobial treatment indications, dosage, duration, combination and adverse reactions	221 (37.9)	64 (11)	23 (3.9)	161 (27.6)	114 (19.6)
2. Attention from the hospital administration about ASPs is not enough	21 (3.6)	96 (16.5)	169 (29)	169 (29)	128 (22)
3. Participation in ASPs will make no difference	142 (24.4)	204 (35)	68 (11.7)	131 (22.5)	38 (6.5)
4. Have limited time to participate in ASPs due to other daily work	21 (3.6)	50 (8.6)	53 (9.1)	203 (34.9)	255 (43.8)
5. There is a lack of efficient communication between nurses and doctors	15 (2.6)	63 (10.8)	83 (14.3)	202 (34.8)	218 (37.5)
6. Nurses' advice on antimicrobials has not been widely accepted by doctors	14 (2.4)	43 (7.4)	102 (17.5)	213 (36.5)	211 (36.2)
7. Lack of adequate number of trained nurses	179 (30.7)	144 (24.7)	84 (14.4)	138 (23.7)	38 (6.5)
8. Lack of training about antimicrobial stewardship programs	19 (3.3)	26 (4.5)	21 (3.6)	312 (53.5)	205 (35.2)

## Discussion

We believe that it is one of the first exploratory studies conducted among public sector nurses in Pakistan to evaluate their perception, involvement, confidence and barriers towards involvement in hospital based-ASPs. However, whilst the integration of nurses in hospital-based ASPs is defined, and there is a growing recognition and evidence that nurses can play an active role in optimizing diagnostic stewardship, indications for prescribing, duration of antimicrobial agents and optimizing penicillin allergies,<sup>41,42</sup> our study revealed a number of concerns. This is despite the fact that the majority of participating nurses in our study possessed good perceptions towards ASPs, with the majority of them believing that the appropriate prescribing of antimicrobial agents and infection control measures under the umbrella of ASPs could reduce excessive antimicrobial use and overall costs. These findings are similar to previous studies conducted in the US and Singapore, which reported that the majority of nurses carried similar perceptions about ASPs.<sup>43,44</sup>

A concern is that the majority of the nurses in our study have never been involved in ASPs, with less than a third of the study population currently involved in one of the many aspects of hospital-based ASPs including reviewing antimicrobial prescribing, intervening in problematic prescriptions, commenting on medical orders or suggesting a shift from intravenous to per oral antibiotics. These findings are in contrast to a previous study reported from United

States where most of the study participants were involved or intended to in reviewing prescription and advising intravenous to per oral antibiotic shifts.<sup>45</sup> Other studies in the USA have also highlighted nurses confidence in perform ASPs related tasks to improve antimicrobial prescribing.<sup>46,47</sup> This difference may reflect divergence in the perception of the role of nurses between Pakistan and the USA, with gender differences between nurses and physicians playing a role with nurses currently perceived to have a more submissive role.<sup>48</sup> This needs to change to ensure their value is increasingly recognized as part of any AMS team in the future.<sup>48,49</sup>

Encouragingly, most of the nurses in our study were confident to take part in ASPs related activities to optimize antimicrobial use. They were also willing to review antimicrobial prescriptions, give advice on doses and duration as well as stopping of antibiotics. This is important for the future given ongoing concerns generally across Pakistan with high rates of inappropriate prescribing of antibiotics in hospitals exacerbated by the COVID-19 pandemic.<sup>50–52</sup>

Inadequate attention from hospital administration, workload, lack of enough time, ineffective communication with physicians, and lack of training are major barriers faced by nurses while performing ASP activities in their hospital. These findings are similar to the previous study from UK which demonstrated that heavy workload was one of the main barriers to nurses participating in ASP.<sup>53</sup> These issues, along with improved perception of the role and value of nurses, needs to be addressed going forward given, as mentioned, appreciable concerns with current inappropriate antimicrobial prescribing among public hospitals in Pakistan, and the urgent need to address this given rising AMR rates. We will be exploring this further in future studies.

## Strengths and Limitations

We are aware that there are a number of limitations with our study. Firstly, we conducted this cross-sectional study among nursing staff in only eleven public sector hospitals, therefore we were not able to generalize our result to the whole country. Secondly, we did not include nurses currently serving in private hospitals. Despite these limitations, we believe that the findings of our study are robust given the number of nurses taking part and Punjab is the most populous Province in Pakistan. In view of this, we believe our study will be able to provide useful information to the policy makers to increase ASP activity by including nurses as active members. As a result, reduce ever growing AMR.

## Conclusion and Recommendations

Pakistani nurses do possess positive perceptions and knowledge towards ASPs. However, they currently have only limited involvement in hospital-based ASPs in Pakistan despite their confidence that they can enhance appropriate use of antimicrobial agents in hospitals. This is despite the fact that they are currently facing workload problems and a lack of support from hospital administration to perform ASPs. By providing additional training, nurses can be successfully assigned ASP-related tasks to the benefit of all key stakeholder groups in hospital. Alongside this, perceptions regarding the role of nurses also needs to change among physicians.

## Abbreviations

ASP, antimicrobial stewardship; GAP, global action plan; NAP, national action plan.

## Ethics Approval and Informed Consent

The ethical approval of the current obtained from the Human Research Ethics Committee, Discipline of Pharmacy Practice, Faculty of Pharmacy, The University of Lahore (UOL). Moreover, approval of the current study was sought from the institutional ethics committee of the health settings. An Informed consent was acquired from all the study participant prior to their enrollment in this survey. The participation in this study was anonymous, voluntary and anyone could leave the survey at any stage without repercussions.

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## Disclosure

The authors report no conflicts of interest for this work and declare that they do not have any financial interest or benefit that has resulted from the direct applications of this research study.

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