

A Pilot Test: Doctors, Nurses, and Pharmacists' Knowledge, Attitudes, and Perceptions Towards Antibiotic Prescribing, Antimicrobial Resistance, and Stewardship During the COVID-19 Pandemic in a UK Secondary Care Setting.

Abstract

Antimicrobial resistance (AMR) is a critical global health challenge, projected to cause 10 million deaths annually by 2050. Recognising the seriousness of this issue, the WHO developed a comprehensive global action plan to tackle AMR, highlighting the need for increased awareness and joint efforts. The COVID-19 pandemic has potentially exacerbated AMR due to increased antimicrobial therapy and misuse. This study explores healthcare workers' views towards antibiotic prescribing, AMS, and AMR during the COVID-19 pandemic in a UK secondary care setting. A cross-sectional design was used, employing an online survey targeting doctors, nurses, and pharmacists. Data was collected via Qualtrics XM from 12 June to 13 September 2023. The survey revealed key themes such as inappropriate antibiotic use, increased healthcare-associated infections (HCAIs), and the impact of technology platforms on AMS. These findings underscore the need for clear guidelines and robust communication to support AMS during health crises.

Introduction

Antimicrobial resistance is a critical worldwide health challenge, requiring immediate and collaborative action to mitigate its effects on public health. It is estimated that by 2050, AMR could be responsible for 10 million deaths annually [1]. Recognising the seriousness of this issue, the WHO has developed a comprehensive global action plan to tackle AMR. This plan highlighted the pressing need for increased awareness and joint efforts [2]. The COVID-19 pandemic, caused by SARS-CoV-2, has potentially exacerbated AMR. Evidence suggests that increased antimicrobial therapy during the pandemic could have augmented the incidence of resistant infections [3]. During the pandemic, the misuse of antimicrobials in healthcare and community settings exacerbated the AMR crisis globally. The English Surveillance Programme for Antimicrobial Utilisation and Resistance (ESPAUR) report noted a post-2022 increase in priority pathogens and secondary care antibiotic use, although overall figures were still lower than 2018 levels due to a 11.8% drop in outpatient prescriptions [4]. A study on antibiotic use among 640 patients with respiratory tract infections revealed a rise in "Watch" category antibiotic usage during the pandemic. This emphasises the importance of implementing robust AMS and AWaRe classification in prescriptions to ensure patient safety and combat antibiotic misuse during global health crises [5]. A robust understanding of bacterial resistance to antibiotics is crucial in combatting AMR, as a lack of knowledge can lead to misuse. A comprehensive understanding of bacterial resistance to antibiotics, coupled with informed attitudes and perceptions, is essential for combating AMR. Misconceptions and erroneous attitudes can lead to antibiotic misuse [6].

Antimicrobial stewardship (AMS) employs a systematic approach to ensure appropriate antibiotic use and combat AMR, aligning with evidence-based policies and guidelines such as those of the UK Health Security Agency (UKHSA). This method highlights the importance of informed prescribing practices based on sound knowledge, attitudes, and perceptions, which are pivotal to enhancing AMS and protecting public health in the UK [7,8].

Antibiotic prescribing behaviours, including knowledge, attitude, and perceptions (KAP) towards antibiotic prescribing, AMR and AMS among healthcare professionals (HCPs) are essential areas of exploration, given their role in prescribing antibiotics in acute care settings [9]. In a 2020 study examining doctors' KAP regarding AMS, around 56% were found to recognise or be familiar with the term AMS. However, the study also revealed that over 50% of HCPs were unfamiliar with specific practices or actions within AMS, as well as AMS strategies and interventions [10]. Understanding bacterial resistance is crucial to prevent AMR, as poor knowledge can result in misuse. HCPs' KAP are essential for correct antibiotic prescriptions. Research on HCPs' KAP during COVID-19, especially among nursing students, remains limited [11]. Previous research on HCPs' awareness of AMR has shown mixed results, ranging from limited to satisfactory knowledge. The pandemic's unique challenges may have further diminished their understanding of AMR [12]. Addressing these uncertainties, this study aimed to explore healthcare professionals, including doctors', nurses' and pharmacists' knowledge, attitudes and perceptions concerning antibiotic prescribing and AMS practices during the COVID-19 pandemic, a secondary care setting in the UK.

METHODS

Study design and setting

This study utilised a cross-sectional design, employing a questionnaire survey to explore HCPs' knowledge, attitudes, and perceptions about antibiotic prescribing during the COVID-19 pandemic. The research was conducted via an online survey targeting doctors, nurses, and pharmacists working in a secondary care setting at an NHS Foundation Trust in the East of England region of the UK. Data collection was facilitated using the secure and trusted platform Qualtrics XM. The survey began on June 12, 2023, and was completed on September 13, 2023. The study was reported in accordance with the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) statement.

Sample

To ensure an appropriate and accurate sample size for the survey, data on the total number of healthcare professionals was collected, revealing a total of 7,982 HCPs, comprising 206 pharmacists, 2,140 nurses, and 5,636 doctors. Utilising a 5% margin of error, 95% confidence interval, and an expected response rate of 20%, the pilot sample size was calculated to be 50. Commencing from

Monday, June 12, 2023, to Wednesday, June 30, 2023, the survey was conducted online using an online-based data collection method. Invitations containing a unique barcode and a link to the survey were distributed electronically to the targeted participants.

Participants

Eligibility for participation in this study is determined by inclusion and exclusion. The Inclusion Criteria are as follows: (i) Participants must be HCPs, which includes professionals such as doctors, nurses, and pharmacists; (ii) Participants must be adults, with a minimum age of 25; and (iii) participants must be registered with their respective professional regulatory organisations: doctors with the General Medical Council (GMC), pharmacists with the General Pharmaceutical Council (GPhC), and nurses with the Nursing and Midwifery Council (NMC). All HCPs, regardless of their professional role as doctors, nurses, or pharmacists, are ineligible to participate if they lack work experience at NHS Foundation Trust during the pandemic.

Registration

This study has been officially registered with the ISRCTN registry. The ISRCTN registry is a primary registry acknowledged by the WHO and the International Committee of Medical Journal Editors (ICMJE), accepting all clinical research studies [13]. Moreover, it was registered in Octopus, the global primary research record [14].

Patient and public involvement

The study protocol was submitted to the Citizens Senate, an organisation focused on patient care with a considerable representation of elderly individuals. They provided useful suggestions and comments.

Data collection

A structured questionnaire comprising 12 closed- and open-ended questions was developed. The questionnaire's design was developed based on a literature review on behaviour change and antibiotic prescribing in UK healthcare settings and a behavioural analysis from PHE [15]. The survey, designed to align with the study's objectives, can be found in Supplementary Documents S1 to S3. The survey comprises four sections: Respondent Demographics, Awareness and Knowledge about Antibiotic Prescribing and AMR, Perceptions and Attitudes towards Antibiotic Prescribing and AMS, and AMS Practices.

Statistical methods

The main author collected, extracted and analysed the results. The responses from the participants were provided to the researcher as a completely anonymised set for analysis. A pilot test involving 58% of the sample (140 out of 240 respondents, later excluded from the main survey) evaluated the survey's effectiveness in addressing research questions and established its validity and reliability. This pilot also helped estimate the questionnaire's completion time, roughly 10 minutes. Post-pilot, the questionnaire was refined for clarity and relevance. Validity assessments included face validity by AMS pharmacists at the Trust and content validity by the Royal Pharmaceutical Society (RPS) research team. Reliability was confirmed using Cronbach's Alpha on pilot responses, with excellent, good, and moderate reliability scores across various sections. The average score of 0.80 demonstrates high internal consistency.

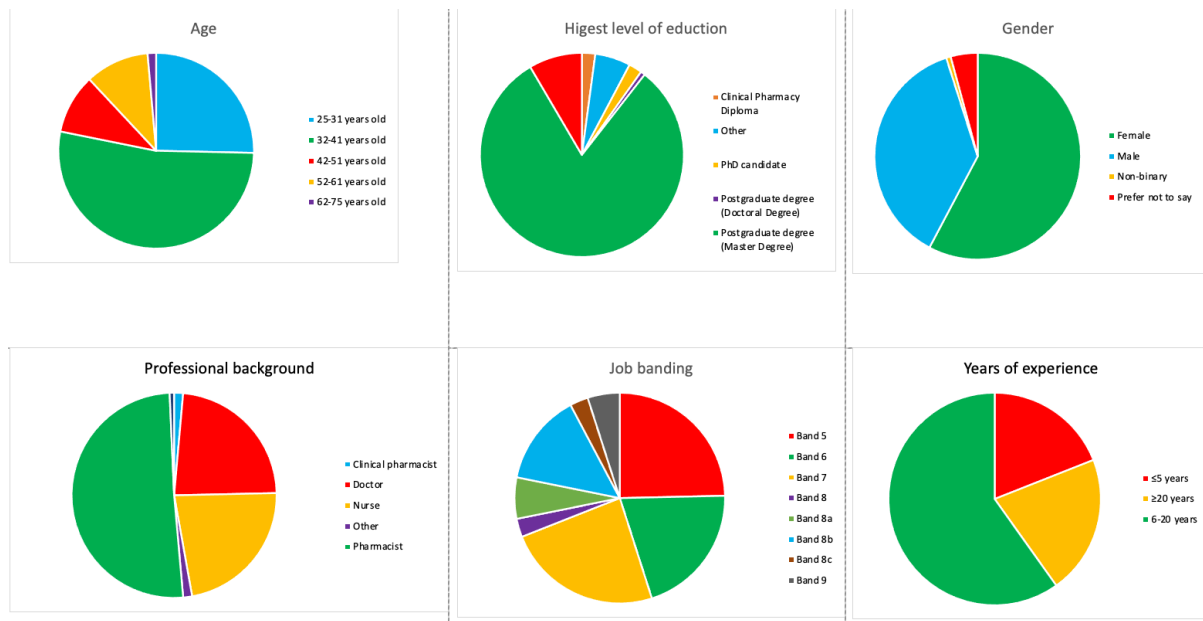
Data analysis

The survey results were analysed using descriptive statistics and IBM SPSS Statistics version 27.0 for Windows. For data analysis, the study also utilised descriptive statistical techniques through Excel 2019 for Windows.

Results

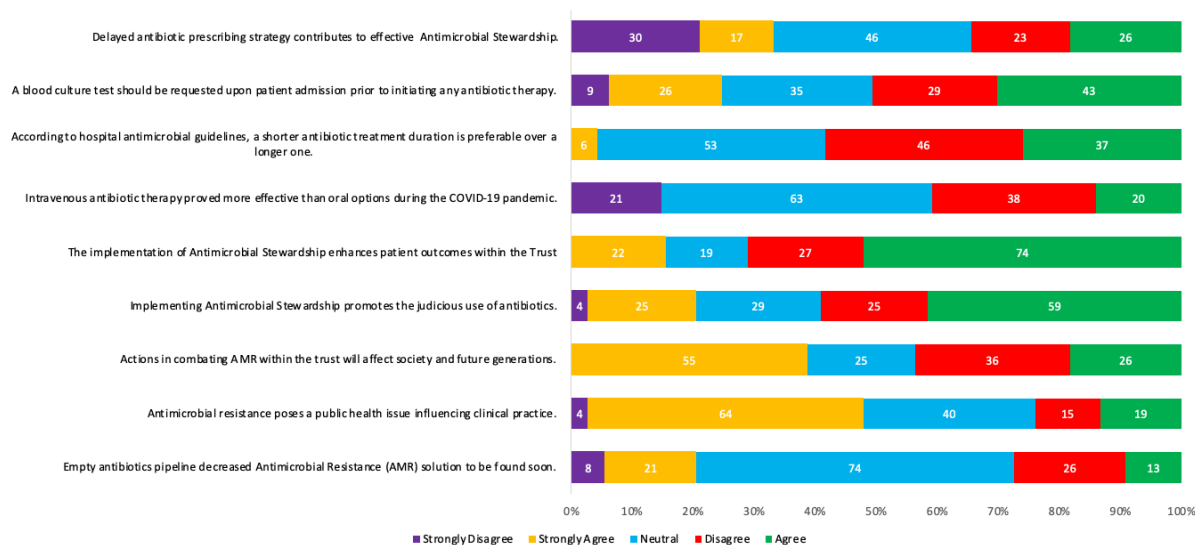
Out of the 7,982 healthcare professionals surveyed, 140 responded to the pilot test. It is important to note that all questions were required, and none were excluded due to incomplete data. The responses, including all completed survey submissions, were recorded online and subsequently analysed for data analysis. Data was exported to an Excel sheet from the secure online platform, 'Qualtrics'. The researcher organised and cleaned the data, providing codes for the 5-point Likert scale responses as follows: 0 for Strongly Disagree; 1 for Disagree; 2 for Neutral; 3 for Agree; and 4 for Strongly Agree.

Figure 1. Demographic and Professional Characteristics of the Participants



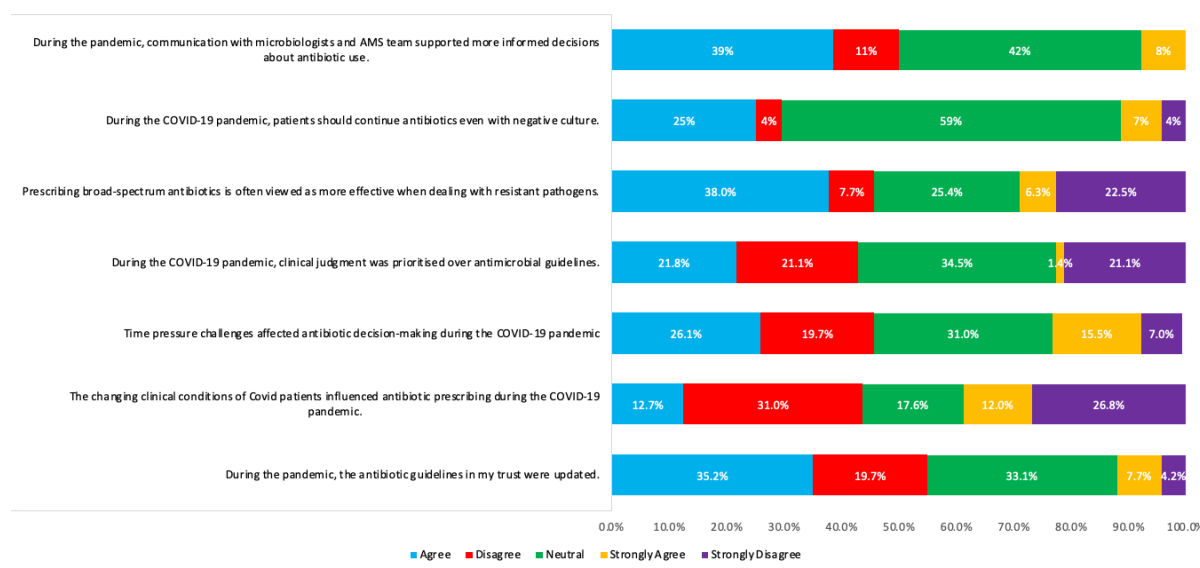
Of 140 participants, a notable 46% (64 participants) expressed strong agreement that antimicrobial resistance profoundly affects public health and clinical decisions. Additionally, 39% (55 participants) strongly agreed that efforts against AMR within the trust have long-term effects on society and future generations. A majority of 52% (74 participants) agreed that AMS implementation leads to improved patient outcomes. 42% (59 participants) agreed that implementing AMS promotes the judicious use of antibiotics. However, 21% (30 participants) strongly disagreed that the approach of delayed antibiotic prescribing effectively contributes to AMS, as shown in Figure 2.

Figure 2: Knowledge and Perspectives of Healthcare Professionals on Antibiotic Prescribing During the COVID-19 Pandemic: Responses to the Questions.



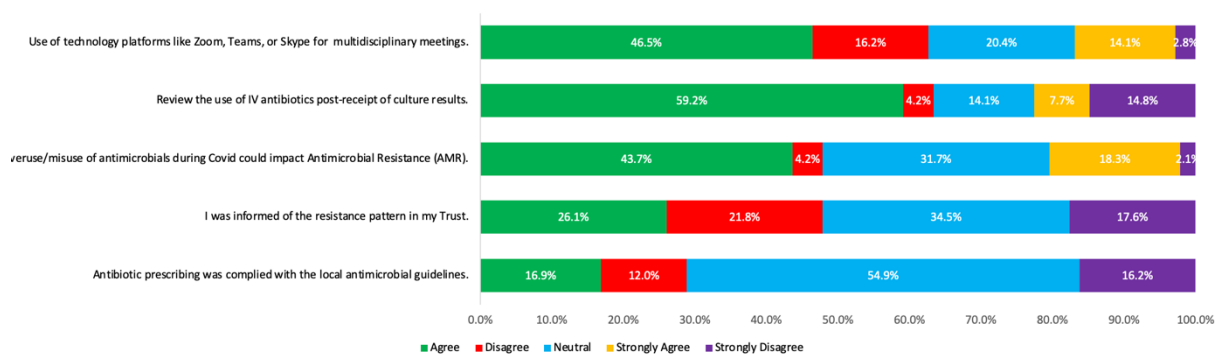
During the COVID-19 pandemic, perceptions of antibiotic guidelines and practices varied widely. Most notably, 39% of participants agreed that communication with microbiologists and the AMS team significantly enhanced informed decisions about antibiotic use. Furthermore, 38% agreed with broad-spectrum antibiotics as more effective when dealing with resistant pathogens. However, 31% disagreed that changing clinical conditions influenced antibiotic prescribing. About 35% agreed with the adaptability and efficiency of updated antibiotic guidelines during the pandemic, and 21.8% prioritised clinical judgment over the guidelines. These findings highlight the pivotal role of clear communication and updated guidelines in crisis healthcare settings, such as the COVID-19 pandemic, as shown in Figure 3.

Figure 3: Attitude and Perception of Healthcare Professionals Regarding Antibiotic Prescribing During the COVID-19 Pandemic.



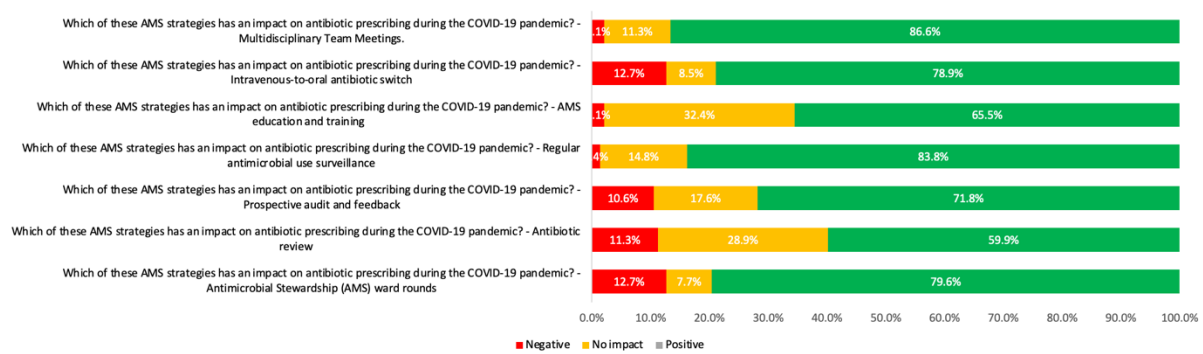
During the COVID-19 pandemic, antibiotic stewardship implementation was met with diverse perceptions. A majority, 59.2%, agreed on the need to review the use of IV antibiotics post-receipt of culture results, highlighting the priority of evidence-based prescribing. Additionally, 46.5% agreed on the importance of utilising technology platforms, such as Zoom, Teams, or Skype for multidisciplinary meetings, reflecting the adaptation to digital tools in healthcare during the pandemic. Notably, 43.7% agreed that the overuse or misuse of antimicrobials during the pandemic could significantly influence Antimicrobial Resistance (AMR). However, there was uncertainty about compliance with local antimicrobial guidelines, with 54.9% remaining neutral, as shown in Figure 4.

Figure 4: Antimicrobial Stewardship Practices During the COVID-19 Pandemic.



During the COVID-19 pandemic, implementing AMS strategies was largely perceived as having a positive impact on antibiotic prescribing. A significant 86.6% believed that Multidisciplinary Team Meetings were beneficial, closely followed by 83.8% for Regular antimicrobial use surveillance. Similarly, 79.6% of participants indicated AMS ward rounds as effective. While Prospective audit and feedback, Antibiotic review, and Intravenous-to-oral antibiotic switch garnered positive feedback from over 70% of participants, AMS education and training were considered impactful by 65.5%. However, nearly one-third felt it had no influence. Overall, the majority recognised the value of AMS interventions during the pandemic, as shown in Figure 5.

Figure 5: Strategies for Antimicrobial Stewardship Interventions During the COVID-19 Pandemic.



DISCUSSION

This survey, conducted within an English NHS Foundation Trust, evaluated HCPs' knowledge, attitudes, and practices related to antibiotic prescribing, AMR, and AMS during the COVID-19 pandemic. The findings suggest a need for enhanced educational interventions that not only improve knowledge but also positively influence attitudes towards AMR and AMS. Traditional education might need to be supplemented with behaviour change interventions that consider organisational, cultural, and professional contexts to be more effective. For instance, a recent study in Saudi Arabia reported a higher median knowledge score of 72.73% among healthcare workers, contrasting with significant knowledge deficits among clinicians in Lahore, Pakistan, highlighting the variability in educational impacts across regions [16]. These findings emphasise the importance of re-evaluating current training methodologies to address not only the cognitive but also the behavioural aspects of AMS to combat AMR effectively.

In Canada, a survey of 1,600 physicians examined their knowledge and counseling practices on antibiotic use and AMR before and after a national awareness campaign. Initially, 336 physicians responded, with 351 participating post-campaign. Findings revealed high knowledge and appropriate counselling practices, with slight improvements in specific areas such as antibiotic disposal and infection prevention post-campaign [17]. In Italy, a 2019 survey segmented healthcare workers into three clusters to evaluate their understanding of antibiotic use and resistance. Allied health professionals prioritised hand hygiene, pharmacists emphasised their advisory role, and doctors showed the deepest knowledge. This diversity underlines the need for tailored educational initiatives for each group [18]. A survey at Near East University in Northern Cyprus involving 314 medical and pharmacy students showed differences in antibiotic knowledge and attitudes. Higher academic levels correlated with proper antibiotic use, while personality traits affected non-prescribed usage. This highlights the importance of educational programs that enhance both knowledge and behaviour in antibiotic stewardship [19]. In Pakistan, a 2019 survey divided healthcare workers into three groups to analyze their antibiotic use and resistance knowledge. Allied health workers focused on hygiene, pharmacists on advising, and doctors had the most comprehensive understanding, highlighting the need for specialized education for each category [20].

In the UK, a survey of 2,404 healthcare workers found most knew antibiotics don't target viruses but less than 80% understood the risks of resistant bacteria. Only 64% felt responsible for managing resistance. Resource limits and time constraints were barriers, with 35% prescribing antibiotics recently due to patient deterioration fears, emphasising the need for robust antibiotic use strategies [21]. The complexity of this challenge suggests that multifaceted educational and policy interventions are crucial to enhance understanding and mitigate the risks associated with antibiotic misuse [22].

Approximately 81% of respondents recognised that efforts to combat antimicrobial resistance (AMR) within their trust could influence broader societal and future outcomes. This aligns with the United Nations' urgent call in "No Time to Wait: Securing the Future from Drug-resistant Infections," and the Royal Pharmaceutical Society's (RPS) recommendations, emphasising swift action to protect antimicrobials and prevent future drug-resistant diseases [2,23]. The study highlights the essential roles of education, awareness, accessibility, and guideline adherence in improving AMS practices. It particularly highlights pharmacists as pivotal leaders in this initiative, as outlined by the RPS, whose leadership is vital in steering healthcare professionals towards strict stewardship adherence to effectively tackle AMR [23].

Critical gaps in antimicrobial stewardship and adherence to antibiotic guidelines call for enhanced, targeted education. An ECDC survey revealed that healthcare workers have considerable knowledge of antibiotic use but lack an understanding of the spread of resistance, highlighting a need for strategic stewardship interventions [24]. Findings from this study prompt consideration of potential barriers to effectively implementing AMS during health crises and highlight the necessity for continual exploration and support in this domain.

A mixed-methods study involving 383 healthcare professionals identified educational and systemic adherence gaps to AMS principles, exacerbated during the pandemic. Findings emphasise the need for targeted training and resources. Notably, HCPs displayed positive attitudes towards enhancing communication for AMS implementation, addressing a critical gap in AMS functionality [25]. The research in Cambodia highlighted that routine habits and insufficient microbiological support drive inappropriate antibiotic use [26]. Despite this, healthcare professionals show a readiness for improved AMS communication, indicating a need for diverse strategies to address AMS challenges across healthcare systems effectively. This suggests the importance of using varied approaches to address AMS barriers among HCPs.

Interestingly, about 46% of respondents strongly agreed that "*Antimicrobial overuse during the COVID-19 pandemic could worsen AMR*". A 2022 study underlined the prevalent over-prescription of antibiotics to COVID-19 patients, with 78% receiving them, mainly cephalosporins and azithromycin. This uncovers a critical demand for stringent antibiotic policies during pandemics to reinforce antimicrobial stewardship and curb rising AMR [27].

Additionally, 74% of participants agreed with the statement, "*Review the use of IV antibiotics post-receipt of culture results*". A 2021 study highlighted the importance of antibiotic review. The AMS

intervention enhanced early antibiotic review and stop rates but necessitated further optimisation, particularly in decision-tool utilisation [28].

Regarding the statement "*Use of technology platforms like Zoom, Teams, or Skype for multidisciplinary meetings*," 49.3% of participants agreed, aligning with a UK study during the pandemic that acknowledged technology as a crucial facilitator for stewardship, e.g., virtual meetings and ward rounds [29]. The pandemic dissolved barriers, enhancing collaboration and necessitating innovative approaches, such as adapting AMS implementation for antibiotic review. The virtual use of technology is proposed as vital for managing future emergencies and AMR [30]. While COVID-19 has influenced clinical judgment and antibiotic selection, adherence to the AMS toolkit from the PHE, "Start Smart, Then Focus," is pivotal, especially during crises, to uphold judicious antibiotic use as far as possible [8]. Furthermore, elevating awareness of antimicrobial guidelines is anticipated to influence AMS and resistance in the long term positively.

STRENGTHS AND LIMITATIONS

This study provides valuable insights into the knowledge, attitudes, and practices of HCPs towards antibiotic prescribing, AMS, and AMR during the COVID-19 pandemic. It uniquely focuses on HCPs in acute care settings, who are often the first responders in emergencies. The findings offer an overview of antibiotic use during the pandemic and suggest how AMS efforts can be adapted for future crises. This could aid in developing educational and training resources aimed at promoting responsible antibiotic use, reducing AMR, and protecting patient health.

This survey's findings, centred on a single NHS Foundation Trust, may not fully represent the UK healthcare landscape. Predominantly drawing from pharmacists, who, unlike doctors and nurses, may not be prescribing but do influence antimicrobial use, could skew the study's applicability. The pandemic's first-wave of roles may differ, impacting data relevance. There's potential bias from the professional make-up of respondents and the study's conductors. Variability in COVID-19's effect on comparable trusts suggests these findings might not be universally applicable. Recall bias could affect the report of practices and attitudes. Additionally, the academic qualifications of pharmacists need clearer definition between undergraduate and postgraduate degrees. A deeper critical review of the data is necessary, taking into account context-specific nuances and potential biases. Comparisons with like-sized and similarly affected organisations may offer broader relevance to the recommendations.

CONCLUSION

This NHS Foundation Trust study, involving 140 primarily pharmacist participants. These findings urgently call for dynamic, quality-focused educational programs that are tailored to various healthcare roles, aiming to enhance the quality of healthcare, patient safety, and antibiotic prescribing practices. The study advocates for the development of specialised training modules and decision-support tools

to bolster AMS, crucial for effectively managing global health crises and AMR. It is essential to re-evaluate current training methodologies to address both the cognitive and behavioural aspects of AMS to combat AMR effectively. Furthermore, the study highlights the pivotal role of pharmacists in leading strict AMS adherence, a critical factor in tackling AMR. Comprehensive educational and policy interventions are necessary to improve understanding and mitigate risks associated with antibiotic misuse, thus enhancing patient safety, preserving healthcare quality, and saving lives globally.

Authors' contributions

All authors, RAE, NU, and ZA, were integral to formulating the research question, designing the study, and executing the study protocol. RAE and ZA were responsible for reviewing the literature and preparing the survey, while RAE also managed its distribution. RAE took the lead on data extraction, formal analysis, investigation, methodology, validation, visualisation, and the drafting of the original manuscript. NU and ZA provided supervision, contributed to the visualisation, and engaged in the review and editing of the manuscript. All authors conducted critical revisions and gave their final approval for the manuscript to be published.

Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Availability of data and materials

The datasets presented in this article are not readily available because this data is restricted and confidential with the institution policy. Requests to access the datasets should be directed to r.a.elshenawy@herts.ac.uk.

Declarations

Ethics approval and consent to participate

This research received ethical clearance from the Health Research Authority (HRA) with the reference number 22/EM/0161, as determined by the Research Ethics Committee (REC). The University of Hertfordshire (UH) ethics committee further approved the study protocol under the reference LMS/PGR/NHS/02975. The authors declare no conflicts of interest in relation to this study. Participants who responded to the survey implicitly gave their informed consent, agreeing to the use of their anonymised data for the purposes outlined in the survey. Data were collected anonymously.

Response to the survey means the participant provides their implied consent to participate in the survey.

Consent for publications

Not applicable.

Competing interests

The authors declare that they have no competing interests

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