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Evaluating antibiotic stewardship in a tertiary care hospital in Kerala, India: a qualitative interview study

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ABSTRACT

Objectives To determine what barriers and facilitators to antibiotic stewardship exist within a healthcare facility.

Setting 1300-bed tertiary care private hospital located in the state of Kerala, India.

Participants 31 semistructured interviews and 4 focus groups with hospital staff ranging from physicians, nurses, pharmacists and a clinical microbiologist.

Results Key facilitators of antibiotic stewardship (AS) at the hospital included a dedicated committee overseeing appropriate inpatient antibiotic use, a prompt microbiology laboratory, a high level of AS understanding among staff, established guidelines for empiric prescribing and an easily accessible antibiogram. We identified the following barriers: limited access to clinical pharmacists, physician immunity to change regarding stewardship policies, infrequent antibiotic de-escalation, high physician workload, an incomplete electronic medical record (EMR), inadequate AS programme (ASP) physical visibility and high antibiotic use in the community.

Conclusions Opportunities for improvement at this institution include increasing accessibility to clinical pharmacists, implementing strategies to overcome physician immunity to change and establishing a more accessible and complete EMR. Our findings are likely to be of use to institutions developing ASPs in lower resource settings.

Strengths and limitations of this study

- ► Our study is the first of its kind to systematically examine the key barriers and facilitators of implementing an antibiotic stewardship programme in a low/middle-income country (LMIC).
- ► We interviewed a variety of healthcare workers: physicians, nurses, clinical pharmacists and a microbiologist.
- ► This was a single-centre study. Thus, transferability of our findings to more resource-limited rural hospitals within India or to other LMIC may not be possible.
- ► We did not conduct direct observations of practice to correlate with self-reporting.

BACKGROUND

The United Nations declared antimicrobial resistance to be 'the greatest and most urgent global risk' in 2016.[1] Antibiotic overuse and misuse drives antimicrobial resistance.[2] In India, rates of infections caused by antibiotic-resistant bacteria are high and increasing.[3–11] Given that the main driver of antibiotic resistance is antibiotic use and misuse, antibiotic stewardship (AS) and AS programmes (ASP) have a critical role in promoting judicious antibiotic use.[12]

In a recent review of AS studies spanning every continent, Davey *et al* found ASPs were effective in decreasing treatment duration and increasing adherence to antibiotic use policy.[13] While the evidence for ASP effectiveness is growing, there is considerable variation among ASPs in size, activities and scope. Newly published consensus of an ASP core elements checklist includes experts from 12 countries on six continents and should be considered by healthcare centres when considering their individual ASP, no matter their economic status.[14] This checklist includes some of the elements we identified as areas of strength in this institution: senior hospital management support, a formal ASP and timely access to laboratory results. Still, we recognise low/middle-income countries (LMIC) face ASP implementation challenges including limited diagnostic laboratory capability, inadequate awareness, limited access to quality antibiotics and high patient census.[15] To date, few studies have explored the challenges facilities in India face carrying out ASPs, such as less available manpower and money dedicated to maintaining a detailed electronic medical record (EMR) compared with higher-income country counterparts.[16–18] EMR systems have been found to be one of the most effective ways of keeping records on patient care and allow for easier discussion and feedback on antibiotic choices.[17] We selected India because, as mentioned, antibiotic resistance rates are high and increasing, and our study

facility had recently implemented an ASP to address this issue. Thus, we undertook a prospective qualitative study in Kerala, India to examine the barriers and facilitators to practising AS in a LMIC healthcare setting and to identify opportunities to improve AS.

METHODS

Location

In January 2018, we conducted a qualitative study to understand the barriers and facilitators to AS at a 1300 bed tertiary care private hospital located in the state of Kerala, India. This urban hospital, which includes 275 intensive care beds, provides free or subsidised advanced care for two-thirds of its patient population. AS activities began in 2015. The hospital's ASP, members of which include internists, surgeons, a microbiologist, critical care physicians, infection control nurses and an administrator, began in 2016. The chief medical officer, the head of both the institution as a whole and the ASP itself, initiated the AS meetings, infectious disease rounds, chart review of patients. Committee members are a mix of junior, mid-level and senior staff and serve for at least 2 years with the option to continue involvement afterwards.

Study population

Physicians, nurses, clinical pharmacists and a microbiologist were identified by the on-site study team by emailing information to staff regarding the project and subsequently approached staff in-person to identify interested participants. We included senior faculty and healthcare professionals working on the critical care medicine and infectious disease teams for interview. Exclusion criteria included non-English speaking staff and staff who were subordinates to any member of the study team.

Data collection

We conducted 31 semistructured interviews and four focus groups with hospital staff involved in AS. Interview guides were developed based on the Systems Engineering Initiative for Patient Safety (SEIPS) framework. This framework evaluates the interactions between the people, organisation, tasks, tools/technology and environment of a given work system, allowing for identification of key areas for improvement or intervention.[19] Interviews were conducted in private rooms at the hospital, and were audio recorded after obtaining verbal consent from the participant. No personal information was recorded, and each interview lasted between 10 and 30 min. The interview guides used have been included for reference (online supplementary appendix A).

Analysis

All interviews were transcribed and analysed deductively using the SEIPS framework. One member from the study team manually coded the interview transcripts. Quotations from transcribed interviews were sorted into the SEIPS categories of person, organisation, tasks, tools/technology and physical environment. After all study team members agreed on the identified themes from the interviews, the most prominent barriers and facilitators to AS were identified in each category based on number of participant responses. We used the Standards for Reporting Qualitative Research guidelines.[20]

Patient and public involvement

The development of our study was informed by many patients' preference to get antibiotics right away, just in case these drugs help. This can influence how healthcare providers deal with prescribing. We did not involve patients with the design or conduct of the study. Results will be disseminated to the involved healthcare workers at staff meetings and electronic communications.

RESULTS

In total, we interviewed 45 hospital faculty and staff. Participants included individual interviews with physicians (27), clinical pharmacists (3) and one microbiologist. We also conducted four focus groups consisting of ASP team members, pharmacists (two groups) and infection control nurses with two to five participants each.

Organisation

The hospital's ASP is the key organisational component of promoting judicious antibiotic use and is in addition to the three clinical pharmacists and one infection control nurse the hospital uses as dedicated, full-time stewardship positions. The ASP team evaluates the list of inpatients receiving antibiotics to evaluate 'The Five R's' of antibiotic prescribing: right drug, right dose, right frequency, right duration and right indication. When the team identifies opportunities for antibiotic de-escalation or reduced duration, a clinical pharmacist member contacts the prescribing physician to issue treatment recommendations, and the prescribing physician decides whether to modify treatment. Typically the hospital sees 30 'higher antibiotic' prescriptions a day; these are the cases the ASP reviews. Usually, the committee has suggestions for five or six cases, most often communicating these with staff via email for recording/tracking purposes. In-person communication during rounds, telephone calls and text messages to the microbiologists in the laboratory are also used as they are more effective methods of quick communication.

According to about half of respondents, hospital administrative leadership champions the ASP by being involved in the meetings, handling difficult conversations with physicians and instilling confidence in all staff that the ASP is working with them to improve patient care. Staff in turn view their institution's ASP as a key facilitator of AS at the hospital (table 1, quotes 1–3). In addition to the ASP itself, 17 interviewees regarded the microbiology laboratory as a key facilitator of AS. Staff praised the 24-hour laboratory's promptness and the rapidity with which laboratory staff uploaded results into the EMR. In

Table 1 Themes identified from SEIPS components with corresponding representative quotations

Theme	Representative quote
Organisation	
Antimicrobial stewardship programme	1. "We audit to make sure the right indication is happening. We check to see the dosage is correct and monitor what's happening here to track our prescriptions." (Pharmacist)
	2. "Every year we do something with the antibiotic prescription program. Along with infection control. Usually a 3 day program for doctors and 1 day is dedicated to antibiotic stewardship. Speakers from all over the country [come] and we take about 30–35 doctors a year and try to teach them about antibiotic stewardship." (Infection control nurse)
	3. "The medical superintendent is a part of our team. I don't think you can get much higher up than that. The management is very supportive." (Pharmacist)
Microbiology laboratory	4. "Our microbiology lab is one of the best in the country. They are very reliable and help us immensely." (Physician)
	5. "Whenever the lab grows something in the culture, could be 6 hours, ten hours, we are called and told. So that does impact our management. If we are thinking about a gram positive illness and we get a culture that's gram negative, which is grown very quickly, we totally change our report. We are informed pretty quickly." (Physician)
Clinical pharmacist availability	6. "[Pharmacists are] not routinely in the ICU. I wish more pharmacists would tell physicians their doses or their drug interactions are wrong, but I don't see them in the cardiac or pediatric ICU." (Physician)
	7. "We have one pharmacist in our ICU, she visits. The problem with her is she's overworked. She's alone. She comes on the rounds only sometimes and comes around and checks the antibiotics dosing is correct. But duration and all others are decided by physicians. If there were more of them it would be much better." (Physician)
	8. "If a clinician is working alone, we may not have much concern about things that pharmacists are more aware of, like drug interactions. Routine medications may have interactions also, so pharmacists' help is needed. That type of information is more with the pharmacists, not the clinicians. They are not always available." (Physician)
Person	
Antibiotic stewardship knowledge	9. "Antibiotic stewardship is a standardized practice with the right treatment at the right time." (Physician)
	10. "To me antibiotic stewardship is to start judicious antibiotics…I won't say to start low antibiotics, I say to start optimum antibiotics." (Physician)
	11. "Most of us here are aware of these ideas. For us, it's about everything that has to do with a prescription. The ultimate aim is judicious use of antibiotics. We need to use the right antibiotics, the right dose." (Physician)
Physician resistance to antibiotic stewardship policies	12. "I think clinicians are empowered to think that they know best. They need to recognize the roles of the microbiologists and the pharmacists and should not feel low that they have asked for help." (Physician)
	13. "Challenges come from navigating human behavior. Sometimes you'll recommend things but people just won't listen to you." (Infection control nurse)
Tasks	
Antibiotic prescribing	14. "We have a high patient load and socioeconomic status is a big deal. Poverty and malnourished children are a reality. We can't wait for cultures. We have protocols to start them on antibiotics according to which ones have been most successful here." (Physician)
	15. "I think it's a problem all over India, because the first antibiotics they prescribe is the carbapenems. And once they prescribe it is never de-escalated or rarely de-escalated. Basically they go, 'let's continue. What the culture says? I don't want to do that. Let's just continue because he's improving.' So it's a major, major, major problem." (Physician)
Workload	16. "Sometimes we are busy and we forget pre admission drugs which are missed because we are more worried about the current problems, and there are so many the patient is already on, that we need to continue." (Physician)

Continued

Table 1 Continued

Theme	Representative quote
	17. "Our work here does affect how long you can spend on individual cases." (Infection control nurse)
Tools and technology	
Antibiogram	18. "It is an annual antibiogram. We divide it into gram positive, gram negative, and yeast. We also have a blood gram positive from blood isolates, negative, and yeast. They are separate. We follow international guidelines so for any isolate that is more than 30, we take them and follow the rules. Every year it is updated. This year they are trying to involve more pharmacists." (Infection control nurse)
Electronic medical record	19. "If I look today at the record, I can only see what they took today. The current medications only. Not what they got yesterday. I can't trace the meropenem. To see all the drugs we have to go to the paper medical record room. It's a very tedious process. We don't know the dose or duration or all the drugs…if the patient returns in a few weeks, we don't know what they were taking and what will be effective." (Pharmacist)
	20. "I see 80 patients a day. So it's not possible for me to spend so much time logging in, recording all this. I don't think it's possible unless I had someone sitting next to me doing just that." (Physician)
Environment	
Posters or signs promoting antibiotic stewardship awareness	21. "It's only in protocols, which we do print out only for doctors. Nurses don't see that." (Physician)
	22. "We have some print-outs on our notice board about colistin and other higher-end antibiotics…but we don't have posters. As for the printouts, they aren't that catchy." (Physician)
High levels of community antibiotic use	23. "Outside the hospital this is a rampant problem in India. There is much abuse and misuse of antibiotics. Anyone can just go to a roadside pharmacy and describe their symptoms and get antibiotics over the counter just like that. They just go to the guy sitting there and get whatever. I think we should make it much harder to get antibiotics." (Physician)

ICU, intensive care unit; SEIPS, Systems Engineering Initiative for Patient Safety.

addition, many physicians relied on the microbiologist's expertise for help identifying micro-organisms in complicated infections (table 1, quotes 4 and 5). As one physician said, "If we are thinking about a gram positive illness and we get a culture that's gram negative, which is grown very quickly, we totally change our report."

Despite having an effective stewardship programme and lab, 16 interviewees identified limited clinical pharmacist availability as a barrier to AS. In India, clinical pharmacists must complete a 6-year doctorate programme from an accredited university to receive licensure, and many physicians recognised clinical pharmacists' knowledge as a critical component of patient care. However, several departments had one clinical pharmacist and many had none at all. Staff worried this lack of pharmacist access may cause clinicians to miss drug interactions or prescribe antibiotics at incorrect dosages (table 1, quotes 6–8).

Person

During our interviews, staff identified AS activities, such as using the correct antibiotic at the correct dose, as a key component of reducing antibiotic resistance. In addition, staff mentioned they often heard about AS at work. This high level of awareness among staff facilitates AS practices (table 1, quotes 9–11).

While most interviewed staff demonstrated AS policy understanding, they revealed many physicians resisted accepting suggestions from the ASP. Moreover, several physicians and pharmacists worried other physicians did not acknowledge pharmacists' contributions to patient care. According to nine interviewees, this immunity to change may impede AS practices and contribute to antibiotic resistance through incorrect antibiotic dosing and duration (table 1, quotes 12 and 13). One clinician described this phenomenon for us by saying, "I think clinicians are empowered to think that they know best. They need to recognize the roles of the microbiologists and the pharmacists and should not feel low that they have asked for help." A nurse we spoke to distilled the issue: "Challenges come from navigating human behavior." Staff immunity to change may present challenges for other LMIC as well; strategies which have been helping this particular facility are publishing easily accessible guidelines and committing to persistent interaction between staff and the ASP. In this way, AS is a priority which is tended to and fostered as an institution-wide value.

Tasks

Staff in 12 interviews felt that clinicians follow established guidelines when prescribing antibiotics when the cause

of illness is not yet known. Following a clinical evaluation, the physician orders a culture and initiates a broad-spectrum antibiotic. Physicians then use this culture result to modify the original antibiotic used. This process, often called de-escalation, involves selecting an antibiotic which has a more specific spectrum or stopping antibiotic treatment if the cultures do not identify a bacterial infection (table 1, quote 14).

As a tertiary care facility, this hospital frequently treats high-risk patients who have acquired resistant infections in the community or at other hospitals. Therefore, physicians at our study institution often feel compelled to empirically prescribe broad-spectrum antibiotics while awaiting culture results. However, physicians often forget or refuse to de-escalate antibiotic use due to workload or fear of losing the patient. In our study, physicians and pharmacists in eight interviews worried this lack of de-escalation may increase the risk of antibiotic-resistant infections (table 1, quote 15) and cited de-escalation as the most important issue regarding antibiotic prescribing. Similarly, nine interviewed staff members feared their high workloads may negatively impact their ability to always judiciously prescribe antibiotics. Physicians noted they are often unable to spend sufficient time evaluating a patient and this, along with uncertainty over what exact drugs the patient has already taken pre-admission, leads to antibiotic over-prescription (table 1, quotes 16 and 17). This happens because if a patient has already taken a certain class of antibiotic and they have not worked, prescribing more is not going to help.

Tools/technology

The hospital microbiologist and clinical pharmacists update the hospital antibiogram annually. The antibiogram, which gives the percent of pathogens susceptible to various antimicrobial agents, is accessible on the hospital intranet and divided into Gram positive, Gram negative and yeast. In 17 interviews, staff members identified this user-friendly tool as a key facilitator in selecting antibiotics based on hospital resistance patterns, a critical component of AS (table 1, quote 18).

In addition to the antibiogram, this hospital also uses an EMR which to save money is built and maintained by the hospital's Information Technology department. The EMR is used to store information on inpatients, a useful addition for identifying immediate drug interactions and thereby reducing harm. However, the EMR does not contain a patient's full scope of antibiotic use, including antibiotic history, duration and dose. This incompleteness often forces physicians and pharmacists to refer to a patient's paper health record, which one pharmacist described as a 'tedious' process (table 1, quote 19). Moreover, physician work flow does not include entering antibiotic data into the EMR. Due to high work volume, physicians depend on the ward secretary, nursing assistants or research assistants to update the EMR. As one physician explained, "I see 80 patients a day. So it's not possible for me to spend so much time logging in, recording all this. I don't think it's possible unless I had someone sitting next to me doing just that" (table 1, quote 20). A dozen interviewed staff members identified this inability to quickly access the full scope of a patient's antibiotic history as a barrier to judiciously prescribing antibiotics.

Environment

Despite having a highly engaged AS team, staff mentioned the hospital did not have signs or posters to increase stewardship awareness which several staff identified as a potentially useful addition. A few interviewees thought AS policies were sometimes printed and posted but did not 'stand out'. These printed antibiotic prescribing protocols were not visible to all staff, and 23 interviewed staff members mentioned this limited visibility may inhibit widespread AS awareness (table 1, quotes 21 and 22).

In addition, staff identified high local antibiotic use as a barrier to stewardship. As patients can purchase antibiotics over the counter or have been recently hospitalised at another facility, many patients enter the hospital already using antibiotics. These high use rates often lead to antibiotic-resistant infections in the community, forcing physicians to prescribe broad-spectrum antibiotics. Furthermore, several staff feared the impact of high antibiotic use in animal husbandry and fisheries on spreading resistance. Seven staff members wished for enhanced antibiotic prescribing regulations and more AS awareness in greater India (table 1, quote 23).

DISCUSSION

Our study is the first of its kind in the English language to systematically examine key barriers and facilitators of implementing ASP in a LMIC tertiary hospital. Using the SEIPS model, we examined the implementation of an ASP at a large tertiary care hospital in order to identify opportunities to improve this programme.

We found that limited access to clinical pharmacists, physician immunity to change resulting in infrequent antibiotic de-escalation, high physician workload, an inadequate EMR, inadequate physical visibility of stewardship activities and high antibiotic use in the community were major barriers to effective ASP implementation. The presence of a prompt microbiology laboratory, high level of understanding of AS among staff, easily accessible antibiogram and established guidelines for empiric prescribing were identified as important facilitators of an effective ASP in this hospital. As Ravi *et al* discovered, we found committed leadership from the administrator was a major factor as well.[18] This could be a main driver of why AS understanding and opinions about the facility's AS efforts were fairly unified among interviewees regardless of if they were involved in the ASP team or not.

Our study found limited access to pharmacists was a barrier for an effective ASP. Multidisciplinary rounds with guideline-based antibiotic recommendations for specific infections have been found to decrease use and duration

of both broad spectrum and high-end, reserve antibiotics.[21] Clinical pharmacists can provide real-time decision support which could significantly improve rates of antibiotic tailoring to culture data.[22] Empowering clinical pharmacists to identify highly misused antibiotics, design guideline-based de-escalation protocols and participate in multidisciplinary rounds may improve the quality of ASP.

Physician resistance to changes in antibiotic use practices was identified as a barrier to an effective ASP. Factors which influence physician antibiotic prescribing habits include anxiety about missing an infection and the antibiotic prescribing behaviour of peers.[23] This is an important active area of research; interventions such as encouraging reflection on practice, the use of audit and feedback, small-group learning with discussions and engagement by senior clinicians, and deploying multidisciplinary teams including clinical pharmacists have been shown to improve prescriber behaviour.[24 25] In LMIC settings, we recommend leadership should actively promote ASP activities and their value. Feedback on antibiotic usage and patterns should be disseminated to improve adherence to local or national guidelines at this facility.

We found that the usability and accessibility of the EMR were another barrier to an effective ASP. Adoption of an EMR can improve ASP by providing a centralised location for microbiology results and other relevant clinical data.[26] However, the expense of acquiring and optimising an EMR system to harness its full potential makes this intervention difficult to implement, particularly in LMIC settings.[27]

Our study identified high and indiscriminate community-based antibiotic use as one reason why AS is such a challenge at our study site. Variably enforced regulations on antibiotic dispensing and the availability of antibiotics without a prescription is a widespread problem in many countries, including India.[28] The broad and unregulated use of antibiotics in animal feed and fisheries compounds this barrier.[29] ASP in healthcare settings can be complemented by AS in the community for all uses of antibiotics, with an inclusive 'One Health' approach to addressing resistance.[30] While not mentioned by any staff, extensive pollution from pharmaceutical production has also been noted as a driver of resistant bacteria, and this too should be addressed in a One Health approach.[31] The state in which our study institution exists, Kerala, is currently the only state in India to have an antibiotic policy. Efforts for federal antibiotic use regulations have some support, but nothing has yet come to fruition.

Our study has limitations. First, this was a single-centre study. Thus, transferability of our findings to more resource-limited rural hospitals within India or to other LMIC may not be possible. Second, we did not conduct direct observations of practice to correlate with self-reporting. Future studies may identify additional barriers and facilitators by implementing direct observation approaches to collect data on stewardship practices. We also asked staff members if they would like to be interviewed, thus introducing the possibility only those who were really invested in AS would agree.

CONCLUSION

The use of the SEIPS model to analyse an ASP in an LMIC identified barriers and facilitators within the healthcare work system. Opportunities for improvement at this institution include increasing accessibility to clinical pharmacists, implementing strategies to overcome physician immunity to change and establishing a more accessible and complete EMR. Interventions which account for and address barriers and strengthen facilitators should be tested in future studies for their effect on antimicrobial usage and resistance.

Contributors KB and CS created the interview guides, wrote the manuscript and conducted on-site data collection. LK assisted with on-site data collection, writing and editing of the manuscript. MVJ assisted with on-site data collection and editing of the manuscript. NS and SKS edited the manuscript and devised the project. DS assisted with writing and editing the manuscript. AS helped with the grant and edited the manuscript. JK edited the manuscript.

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