Article

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Misbah Gashegu [1], Noel Gahamanyi [1,2], François Xavier Ndayambaje [3], Bosco Munyaneza [3], Vedaste Ndahindwa [4], Fredrick Lukwago [5], Lambert Ingabire [5], Fiona Gambanga [6], Pierre Gashema [3,7], Albert Tuyishime [1] , Tafadzwa Dzinamarira [8], Damas Dukundane [5], Thierry Zawadi Muvunyi [5] and Claude Mambo Muvunyi [1,4],*

[1] Rwanda Biomedical Centre, Kigali, Rwanda : misbah.gashegu@rbc.gov.rw, albert.tuyishime@rbc.gov.rw, clmuvunyi@gmail.com

[2] Biology Department, College of Science and Technology, University of Rwanda: gahanoel1984@gmail.com.

[3] Department of Microbiology, School of Medicine and Pharmacy, College of Medicine and Health Sciences, University of Rwanda : nfxr40@gmail.com, munyebos1@gmail.com

[4] School of Public Health, College of Medicine and Health Sciences, University of Rwanda, Kigali, Rwanda: ndahindwa@gmail.com

[5] King Faisal Hospital, Kigali, Rwanda: fredrick.lukwago@gmail.com, damas.dukundane@kfhkigali.com, lambert.ingabire@kfhkigali.com, thierrymuvunyi@gmail.com

[6] Clinton Health Access Initiative Rwanda: fgambanga@clintonhealthaccess.org

[7] Repolicy Research Centre, Kigali, Rwanda: gashemapierre @gmail.com

[8] ICAP, Lusaka, Zambia : anthonydzina@gmail.com

* Correspondence: Claude Mambo Muvunyi, *P.O. Box*7162 Kigali, Rwanda, Email: clmuvunyi@gmail.com

Abstract: Antimicrobial resistance (AMR) is a major public health threat linked to increased morbidity and mortality. It has the potential to return us to the pre-antibiotic era. Antimicrobial stewardship (AMS) programs are recognized as a key intervention to improve antimicrobial use and combat AMR. However, implementation of AMS programs remains limited in Africa, particularly in Rwanda. This qualitative study, conducted at King Faisal Hospital (KFH) in Rwanda, aimed at assessing current prescription practices to identify areas for improvement and promote adherence to AMS principles. The interviews were recorded, transcribed, and thematically analyzed, revealing four emerging themes. First, emerged on AMS activities that were working well which includes availability of microbiology laboratory results, and prescription guidelines as factors influencing antibiotic prescription adjustments. Second, Implementations challenges to AMS which identified the prescription of broad-spectrum antibiotics, limited local data on AMR patterns, stock-outs of essential antibiotics, Thirdly, the importance of adhering to AMR management guidelines at KFH was underscored. Lastly, participant recommendations centered on regular training for healthcare workers, widespread dissemination of AMR findings across departments, and the enforcement of antibiotic restriction policies. These actions can improve prescription behaviors, upholding the highest standards of patient care, and strengthening the nascent AMS program.

Keywords: antimicrobial resistance; antibiotic prescription; healthcare providers; infection prevention; Rwanda

1. Introduction

Antimicrobial resistance (AMR) has emerged as a significant global health threat. This phenomenon renders once-effective antibiotics ineffective, posing a significant challenge to the management of infectious diseases [1]. In response, healthcare facilities have implemented antimicrobial stewardship (AMS) programs as a vital strategy to combat AMR [2], [3]. These programs aim to optimize the use of antimicrobials through a focus on interventions such as

minimizing antimicrobial therapy duration, utilizing rapid diagnostic tests, and implementing clinical decision support tools [2]. AMS programs have been successful in reducing antimicrobial use, and the spread of resistant pathogens [4]. Discouraging empirical treatment by relying on microbiology investigations and restricting the duration of antibiotic prescriptions are crucial components in reducing the burden of AMR pathogens [5].

A review by Davey et al. [6] reported that reducing the prescription of antimicrobials significantly curbs AMR pathogens, improves microbiological and clinical outcomes. While AMS programs are widely recognized as a key strategy to combat AMR, some studies have highlighted a scarcity of robust evidence regarding their overall effectiveness [7]. Furthermore, data on AMS programs in low-and-middle income countries (LMICs) are scanty especially in Africa [8].

To the best of our knowledge and research, there is no published literature on AMS programs in Rwanda. However, two initiatives are being initiated at the University Teaching Hospitals of Kigali (CHUK) and another one at the University Teaching Hospitals of Butare (CHUB). A core strategy in successful AMS programs involves engaging prescribers at the point of prescribing antibiotics to promote informed decision-making [9]. Recognizing the growing threat of AMR, King Faisal Hospital (KFH), a prominent healthcare institution in Rwanda, has taken a commendable step by initiating its own AMS program. We hypothesized that a considerable percentage of prescriptions of antibiotics are not lab-based and AMS principles are not adhered to. This qualitative study aimed at exploring prescription practices to shed light on the experiences, perceptions, and challenges faced by healthcare providers and staff who work at KFH in adhering to AMS principles. The study is expected to allow the identification of gaps in the implementation of the AMS program and inform interventions and way forward both at KFH and other facilities throughout the country.

2. Results

The saturation point was attained following interviews with eight (8) Healthcare workers (HCWs), comprising 4 Medical doctors, 1 pharmacist, 1 Clinical nurse, 1 Infection Prevention and Control (IPC) officer, and 1 Laboratory technician. Additional information about the informants can be found in Table 1. During analysis four main themes were identified and its associated codes, descriptions and summaries of the themes are highlighted below.

Table 1. Key informants details Function and years of experience in the services.

SN	Study Number	Healthcare Workers Function	Period in service
1	KFH/HCW/001	Pharmacist	07 years
2	KFH/HCW/002	Pediatrician Doctor	12 years
3	KFH/HCW/003	Nurse in ICU	15 years
4	KFH/HCW/004	Laboratory technician	12 years
5	KFH/HCW/005	IPC Officer	18 years
6	KFH/HCW/006	ICU Doctor	11 years
7	KFH/HCW/007	Emergency Doctor	08 years
8	KFH/HCW/008	General Practitioner in the emergency Department	14 years

2.1. AMS Activities That Were Working Well

All interviewed participants identified processes and activities within the facility that were working well in terms of AMS. Many excerpts (n=28) showed instances where the AMS program was working well. This was often coded with what is routine in the facility (n=22). The infection prevention and control (IPC) staff interview had most entries on what was working well, followed by the Nurse, and Lab personnel.

When speaking about what was working well, it was generally around the use of Lab tests to determine antibiotic resistance and using those findings to either prescribe or adjust prescription for patients. ICU staff mentioned discussion of IPC and use of antibiotics and protection control in daily

touch points. Fumigation was also listed as being done routinely every 6 months and environmental swabbing every 3 months. All lab equipment including autoclave are serviced every 3 months. Another respondent mentioned that KFH is lucky in that they have a broad range of antibiotics available to choose from. There was also mention of handwashing and general hygiene education at the hospital since COVID-19 broke out in 2020. Also, a reference was made to guidelines, and testing protocols as well as informing the clinicians the lab results so that they can make an informed decision for prescribing antibiotics.

"Most of the time, when the patient comes with fever, we check sensitivity, but when the patient is severely ill, she is put on broad spectrum antibiotic then waits for 2-3 days. Then, adjust antibiotic after getting lab results." -KFH/HCW/003-.

"For us when a patient comes to ICU, we check their diagnosis and if there is a corresponding protocol, especially international, for example, if someone has sepsis, you assess the score then with this you can tell which medicine to give, does he need an antibiotic or not, so we base on the patient's assessment. You can guess which is the likely microbe, if it is resistant or not and then, so you do lab, tests and start antibiotics if you find the pertinent need. Then, you can stop after you get the antibiogram, so I can say that here at King Faisal, there is no problem. I have visited the laboratory, and I didn't find any problem." -KFH/HCW/006-

"Well, here in hospital, there are guidelines regarding how we communicate within the Hospital. When we receive something like a blood culture or a swab, we follow those guidelines. If, for instance, a sample like a blood culture is growing, we have to communicate with the doctor. We inform them that the bacteria that's growing is either gram-negative or gram-positive, and we provide them with a preliminary report. Then, we tell them that after two days, when checking the system, there will be the final result" – KFH/HCW/004-.

All eight 8 respondents described at least one thing that was routinely conducted at the facility with regards to AMS program. In total, 112 excerpts described what is routine in the hospital. Each respondent was clear to a certain extent on how their department routinely handled AMR pathogens. There was a general agreement that with prescription, the prescribing doctor has the final say and makes a decision informed by lab results and patient symptoms as well as their discretion. Clinicians had a good understanding of the general protocol on when certain antibiotics are supposed to be prescribed or not.

"In the pediatric population, our approach to antimicrobial treatment aligns with the guidelines provided by the Ministry of Health or the Rwanda Biomedical Centre. These guidelines outline the use of first, second, and third-line antimicrobials for various conditions. When treating pediatric patients, our strategy for selecting antibiotics follows a similar path. We typically initiate treatment with first-line antimicrobials as empiric prophylactic therapy while awaiting a definitive diagnosis. For instance, in the case of newborns, our current practice recommends starting the initiation of treatment with ampicillin and gentamicin as first-line empiric therapy. However, it is concerning that we are observing high levels of resistance, with rates reportedly reaching up to 80% for these antibiotics. Despite this challenge, our adherence to guidelines mandates the initiation of treatment with ampicillin and gentamicin as the initial approach. If there is no improvement in the patient's condition or if concerns arise regarding resistance, we then consider transitioning to second-line antimicrobials as per the guidelines." -KFH/HCW/002-

2.2. Challenges with AMS

All eight respondents shared challenges with handling AMR issues at the facility. ICU listed the most challenges followed by Lab and emergency.

Major challenges included:

1. Antibiotic abuse

"I feel like sometimes, um, we, the health care personnel, we do abuse antibiotics, because sometimes we may order an antibiotic today, tomorrow we are changing it, another day we are changing it, and we don't follow the protocols, not to start with and not to end with." -KFH/HCW/006-

2. Lack of training, education, and awareness of AMR among staff, resulting in no clarity on how to use AMR data that is available by clinicians

"There's no report, no communication that tells us anything, except for us to take the initiative to ask. At that moment, when we identify a germ that is resistant, we have a tendency to call that we've encountered a patient with resistance to a certain antibiotic that is spreading rapidly, especially to this antibiotic. Then, we communicate that we have identified a germ that is resistant." - KFH/HCW/004-

3. Stockouts of either some antibiotics or supplies needed for testing in the lab

4. Communication breakdowns between personnel and departments resulting in delays in test results being received or read by relevant clinicians

Another key issue highlighted was the fact that KFH is a referral hospital and sometimes patients come, and they are already prescribed a different antibiotic which is not effective or not the appropriate one. The issue of the clinician having final discretion on prescription was also raised as a challenge as it was mentioned that sometimes Doctors do not keep up with guidelines and international recommendations. Sometimes there are disagreements on the best antibiotics to go with even after lab reports, but the doctor (clinician) has the last say. Committees were mentioned but there is not much focus on AMR, the drug and therapeutic committee (DTC). And some respondents mentioned that they were part of the DTC but either had not attended or did not know when the meetings are held.

An AMS committee was referenced but the respondent mentioned that it is still in its infancy stage and not yet very functional. Another challenge was the lack of a specific forum to discuss AMR issues. One respondent estimated that only 30% of antibiotic prescriptions were based on antibiogram. Another respondent said that there is no restriction on antibiotics. Whatever antibiotic he wishes, he prescribes. No pre-authorization for certain antibiotics.

2.3. Use of Guidelines and Standard Protocols for AMR

While conducting the interviews, respondents often brought up and referred to use of guidelines, policies, and protocols. Respondents mentioned different guidelines like International, National, Ministry of Health, the Rwanda Biomedical Centre (RBC) guidelines. However, respondents appeared more familiar with hospital or department-based guidelines/ protocols.

"My understanding is that, if there are available nationally based guidelines, then that can help people to adhere to the local hospital-based guidelines."

Many excerpts (n=26) referenced the use of guidelines in AMR work. A few excerpts (n=4) actively referenced compliance to guidelines standards or protocols when it comes to AMR.

"No! When we conduct testing, we need to adhere to established standards. We adhere to these standards and then send the report. It's up to them to take the initiative to provide the medicine because often, you can see in the treatment that it may need to start. The patient can start the treatment, the patient arrives with symptoms that match the sample taken to the lab, and then they start the antibiotic to save time because microbiology results can take like two to three days. So, these days, the patient needs to start the antibiotic. Therefore, when we conduct testing, we follow established standards." -KFH/HCW/004-

Some respondents also mentioned antimicrobial stewardship (AMS) policy.

"Um, we have a policy on infection surveillance whereby every patient who comes into our hospital is expected to have a blood culture done on them. But because of our insurance, it becomes a little bit difficult. But where we have found it's not very difficult is for our patients who are admitted in ICU. Any patient who is admitted in ICU, they have to do a blood culture sensitivity so that they are able to know what infection the patient has. They came with it from home, or they acquired it from a hospital? And any devices they come with, like the urinary catheters, the IV cannulas, we do remove them from accident and emergency, before they go into the unit. So that we start again and fix ours." -KFH/HCW/006-

2.4. Recommendations for How AMS Program Can Be Improved at KFH

Many respondents (n=7) gave at least one recommendation of what could be done better or differently with regards to AMR. Several excerpts (n=33) included a form of recommendation on AMR stewardship. Recommendations were also coded many times with challenges indicating that respondents were not only able to identify challenges with AMR but propose possible solutions to solving the issue.

"Considering the recent trend of antimicrobial resistance among our patients, for instance, some individuals believe that only certain antibiotics can cure them, leading them to prescribe ceftriaxone yet it would have been more prudent to start with Amoxicillin. I believe it is essential to initiate treatment with first-line or lower-class antibiotics rather than higher classes. Additionally, I would recommend that doctors use antibiograms more frequently to guide their prescribing practices." - KFH/HCW/001-

Many recommendations were about:

1. Need for training and sharing of up to date knowledge on AMR to increase awareness
2. Need for up to date research being conducted at KFH to create an evidence base for AMS
3. Request for regulations and guidelines to inform prescription of antibiotics and a platform to discuss AMR issues
4. Need for an effective system for timely relaying of antibiotic test results to clinicians in the facility. As well, a report-back mechanisms so lab staff know how clinicians are making use of the results

"Yes, of course, Rwanda is ahead in many things there is no reason to limit ourselves. I believe these things of antibiograms, and antibiotics are not complex, you must train people. I remember when we were in Butare we could see lab technicians doing that work and then sharing guidance with clinicians. So, it means that we cannot wait to have specialists everywhere for admitted patients for us to achieve these targets. We all treat patients, and all patients deserve the best care which means no harmful prescriptions. So, I say that I wish that research can be promoted, collaboration of clinicians and researchers in the center like RBC, so we can analyze our own data draw specific conclusions. The problem is that clinicians do not have time for writing grants and they may not have the right skills for that. That is the advice I can give." -KFH/HCW/005-

3. Discussion

This qualitative study revealed several strengths of the AMS program at KFH One positive finding is the understanding of AMR by the healthcare worker sand the role played by the microbiology laboratory to determine effective antibiotics important for adjusting prescriptions. This finding aligns, to some extent, with studies conducted among physicians and nurses in Uganda [13], Gabon [14], Nigeria[15], South Africa [16], and Belgium 18. However, it is important to acknowledge that limited knowledge and awareness of AMS programs and AMR have also been documented in healthcare settings in Saudi Arabia [17]. This disparity in knowledge levels might be partially attributed to the relatively recent introduction of AMS programs in many LMICs [8]. These findings highlight the critical need for regular and ongoing educational programs to bolster healthcare workers' understanding of both AMR and AMS principles.

Interview participants emphasized the importance to rely on microbiology laboratory results while prescribing antibiotics or adjusting them. This concurs with the study conducted in Norway [10]. It has been shown that reliance on microbiology laboratory results discourages empirical treatment and can reduce the duration of antimicrobial therapy which can are crucial in curbing AMR trends [8,18,19]. Morency-Potvin et al. [20] showed that clinical microbiologists are pillars in AMS programs as they produce cumulative antimicrobial susceptibility reports used as evidence of AMR to alert surveillance systems. The nascent AMS program at KFH should strengthen the microbiology laboratory and its staff to provide regular reports and meetings to share findings of pathogens with increased resistance.

The study also revealed that KFH staff demonstrated awareness of the importance of hand hygiene in infection prevention and control (IPC). Improper hygienic practices lead to infections that promote use of antimicrobials known as a driver of AMR [21,22]. Additionally, participants

mentioned other practices such as routine fumigation and environmental swabbing that contribute to maintaining a hygienic hospital environment and mitigating the spread of resistant pathogens. Previous studies highlighted water, sanitation, hygiene and IPC among important weapons to reduce the AMR burden [21,23]. While awareness of these practices is positive, it is essential to go beyond mere knowledge. Regular reinforcement through morning staff meetings and patient education initiatives can promote behavior change and lead to long-term improvements in IPC practices.

The laboratory key informants mentioned that the laboratory staff communicate preliminary results to the clinicians. The laboratory staff highlighted adhering to the set turn-around-time (TAT). KFH also uses an electronic system which significantly improved the reporting period when compared to the old paper-based system. This allows quick access to results immediately after being generated. However, microbiologists should keep the practice of calling the requesting department for critical results. It is also important to think about introducing an alert system that can send a text message to the clinicians. Despite these successes, the interviews also revealed challenges associated with the AMS program. Some participants mentioned instances where patients were initially placed on broad-spectrum antibiotics, with adjustments made only after receiving laboratory results. Additionally, a clinician expressed concern about the lack of restrictions on certain antibiotics. The World Health Organization (WHO) has developed the AWaRe (Access, Watch, Reserve) classification system for antibiotics aiming to promote the judicious use of these medications. This system categorizes antibiotics based on their importance for public health. The goal is to encourage the use of Access category antibiotics for at least 60% of prescriptions, while limiting the use of those in the Watch and Reserve categories [24]. A previous study demonstrated that the adoption of a computerized prescriber authorization system for certain antibiotics led to a decrease in broad-spectrum antibiotic prescriptions and a corresponding increase in narrow-spectrum antibiotic prescriptions [25]. However, the effectiveness of antibiotic restriction policies in reducing AMR remains a topic of ongoing debate. KFH is advised to revise the AMR trend and set a list of antimicrobials that will be placed in the watch and reserve categories. Also, conditions to grant such antimicrobials should be clear and adhered to. Moreover, stockouts of essential antibiotics and laboratory supplies, communication breakdowns, and delays in receiving laboratory reports were identified as impediments to effective AMS implementation. The lack of clarity on utilizing available AMR data and varying antibiotic prescription practices among clinicians further exacerbate the challenge [26]. Similar challenges have been listed to be common in several LMICs [18,27,28]. It is crucial for KFH management to address raised challenges to ensure the sustainability of initiated AMS program. AMS committee should serve as a link between the laboratory and clinicians by ensuring that AMR results from laboratory are regularly reviewed. Also, regular training would help to improve awareness on AMR and AMS of KFH personnel.

4. Materials and Methods

4.1. Study Design

This was an exploratory qualitative study. It involved an in-depth interview with key informant healthcare providers and allied health staff from different departments at King Faisal Hospital (KFH). The study aimed the awareness of antimicrobial resistance (AMR) issues and the role played by the antimicrobial stewardship committee in reducing the burden of AMR. Semi-structured interviews were used to determine factors influencing the antimicrobial prescription at the hospital. The exploratory qualitative study was chosen as it assisted researchers in exploring views from different key informants on a set of predetermined questions to face-to-face interviews.

4.2. Study Site and Selection

The study was conducted at the KFH located in Kigali City, Rwanda. In 2023, KFH was upgraded to the level of being a University Teaching Hospital. KFH was chosen based on the previous study that established baseline data on AMR in Rwanda and the fact that its AMS program is nascent.

4.3. Study Interview Guide Development

The study team developed an interview guide based on the study objectives and literature [11–13]. The study was conducted to assess practices related to AMR and AMS programs at KFH. The guide included open-ended questions on awareness of AMR, communication of laboratory and clinicians, antibiotic prescription, antimicrobial stewardship, IPC, etc. Then, face-to-face interviews were organized and conducted physically at KFH with eight (08) key informants.

4.4. Recruitment of Participants

Participants were purposively selected from each department including (i) emergency, (ii) intensive care unit (ICU), (iii) neonatal intensive care unit (NICU), (iv) the laboratory, (v) pharmacy, vi) pediatrics, (vii) surgical ward, (viii) IPC nurse, and (ix) internal medicine. Key informants were identified through a mapping exercise with the help of the Director of Research at KFH. Participants included an emergency physician, a internal medicine physician also trained on critical care, a consultant neonatal pediatrician, a pediatrician, a critical care nurse, a pharmacist, the laboratory manager and one IPC nurse. Two consultants (internal medicine and surgery) did not get time for the interview.

4.5. Key Informants' Interviews (KIIs)

Face-to-face interviews with key informants were conducted by trained and experienced researchers. NG holds Ph.D in Clinical Microbiology, VD is a Medical doctor with Masters in Public Health, and MG also has holds Masters in Public Health. Interviews took place between 6th to 14th December 2023 and were conducted in a quiet place within KFH premises. Before the interview, verbal consent was sought from the interviewee to record the conversation and participants were informed that the duration of the interview would last between 30-45 min. Interviewers were informed to respond in either English or Kinyarwanda and interviews were recorded. The interview was done in either Kinyarwanda or English or the mix of both languages depending on the choice of the interviewee. All records were translated into English by a qualified interpreter.

4.6. Data Analysis

Data was analyzed using thematic analysis approach. Recorded KIIs were transcribed and translated from Kinyarwanda to English. All transcripts were cross-checked to ensure completeness of data by the interviewers and researchers. All transcripts were read through, and codes were generated by a separate researcher. Dedoose software was used to create codes and analyze the data. Responses with similar codes were re-categorized under a unifying theme. After data was coded in Dedoose, it was then manually organized into themes. Themes were then interpreted for their descriptive meaning. Descriptive quotes representing key themes were identified.

5. Conclusions

Antimicrobial Stewardship programs are critical in combating antimicrobial resistance globally. This study which aimed at assessing prescription practices, delves into the current state of AMS at KFH and highlights key findings regarding its efficacy, challenges, use of guidelines, and recommendations for improvement. It highlights the pros and cons of such practices to be used by our team to develop training materials on AMR and AMS. The findings will also be used by the management of the hospital to design other interventions to improve patients' health outcome.

The study highlights major findings from interviews held with healthcare professionals at KFH in Rwanda. It was found that healthcare workers have the knowledge of the AMR burden, the role of microbiology laboratory results in adjusting antimicrobial prescription, and the importance of AMS programs. These findings underscore the importance of ongoing educational initiatives to strengthen knowledge and promote adherence to AMS principles among healthcare professionals at KFH. Furthermore, strengthening the microbiology laboratory, implementing antibiotic restriction

policies informed by local AMR data, and developing clear guidelines are crucial steps to optimize the AMS program's effectiveness.

6. Patents

Supplementary Materials: Not Applicable (NA)

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