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Development and evaluation of a continuous quality improvement programme for antimicrobial stewardship in six hospitals in Uganda

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ABSTRACT

Background Appropriate antimicrobial use is essential for antimicrobial stewardship (AMS). Ugandan hospitals are making efforts to improve antibiotic use, but improvements have not been sufficiently documented and evaluated.
Methods Six Ugandan hospitals implemented AMS interventions between June 2019 and July 2022. We used the WHO AMS toolkit to set-up hospital AMS programmes and implemented interventions using continuous quality improvement (CQI) techniques and targeting conditions commonly associated with antibiotic misuse, that is, urinary tract infections (UTIs), upper respiratory tract infections (URTIs) and surgical antibiotic prophylaxis (SAP). The interventions included training, mentorship and provision of clinical guidelines to support clinical decision-making. Quarterly antibiotic use surveys were conducted.
Results Data were collected for 7037 patients diagnosed with UTIs. There was an increase in the proportion of patients receiving one antibiotic for the treatment of UTI from 48% during the pre-intervention to 73.2%, p<0.01. There was a 19.2% reduction in the number of antimicrobials per patient treated for UTI p<0.01. There was an increase in use of nitrofurantoin, the first-line drug for the management of UTI. There was an increase in the use of Access antibiotics for managing UTIs from 50.4% to 53.8%. The proportion of patients receiving no antimicrobials for URTI increased from 26.3% at pre-intervention compared with 53.4% at intervention phase, p<0.01. There was a 20.7% reduction in the mean number of antimicrobials per patient for URTI from the pre-intervention to the intervention phase, from 0.8 to 0.6, respectively, p<0.001 and reduction in the number of treatment days, p=0.0163. Among patients undergoing surgery, 49.5% (2212) received SAP during the pre-intervention versus 50.5% (2169) during the intervention.
Conclusions Using CQI approaches to focus on specific causes of inappropriate antibiotic use led to desirable overall reductions in antibiotic use for URTI and UTI.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Antimicrobial resistance (AMR) is a global public health crisis, with appropriate antibiotic use a critical component of global AMR response efforts.

WHAT THIS STUDY ADDS

⇒ This study adds lessons suitable for other resource constrained, low-income countries on how to use continuous quality improvement approaches to improve antibiotic use.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Ministries of health can make recommendations for adopting the approaches used by hospitals involved in this study, for use at a national level and mandate antimicrobial stewardship interventions.

BACKGROUND

Antimicrobial resistance (AMR) has emerged as a major global public threat, leading to more deaths than malaria and HIV in 2019, with the highest burden in the western sub-Saharan African region.[1] Exposure of bacteria to antimicrobials is one of the major drivers of the emergence and spread of AMR.[2] Antimicrobial stewardship (AMS) programmes, including antimicrobial use surveillance, are integral components of global and national efforts to combat the emergence and spread of AMR.[3]

Globally, over 50% of medicines, including antimicrobials, are reportedly used inappropriately,[4 5] a practice that propagates antibiotic misuse, leading to poor patient outcomes, financial hardship and the emergence of AMR, especially in low-income and middle-income countries (LMICs).[6 7]

AMS refers to the practice of supporting the appropriate use of antimicrobials.[8] AMS activities can focus on some or all the various groups contributing to irrational antibiotic use, namely, prescribers, other healthcare workers, patients, leaders in clinical practice settings, policymakers and the public. Prescriber factors contributing to AMR include the lack of treatment guidelines, non-adherence to the guidelines when they are available, pressures on prescribers and other healthcare providers from patients and the drug industry and the lack of hospital infection prevention and control (IPC) programmes. Additionally, specific disease conditions, such as upper respiratory tract infections (URTIs), have been associated with higher or inappropriate use of antimicrobials.[9 10] Although less than 20% of all URTIs are caused by bacteria[11] and evidence suggests that antimicrobials have a limited role in managing URTIs,[9] using antimicrobials to treat URTIs in LMICs is common, with an estimated 71% of patients with a URTI receiving an antibiotic prescription in 2006.[12] Data from Uganda shows that over 50% of children with symptoms of acute respiratory tract infections receive an antibiotic.[13 14] Because of the risk of misuse of antimicrobials in URTIs, the proportion of URTI cases prescribed an antibiotic is a key WHO indicator of appropriate antibiotic use in health facilities.[12] In addition, urinary tract infections (UTIs) are one of the leading causes of outpatient hospital visits and are associated with high antibiotic use and increased risk of AMR.[15] Similar findings have been described in Uganda.[16]

Despite the existence of guidelines for managing UTIs,[17–19] adherence to these remains low in most countries,[20] with inappropriate use characterised by unnecessary prescriptions, excessive duration of therapy and unnecessary use of broad-spectrum antimicrobials reported globally, including Uganda.[10 21] Finally, among inpatients, over 28% of the Global Burden of Disease (life years lost) was estimated to be surgical.[22] Central to the practice of surgery is the use of antimicrobials for infection prophylaxis, that is, surgical antibiotic prophylaxis (SAP), and/or treatment purposes.[23] Hence, the high burden of surgical disease, coupled with the role of antimicrobials in surgery, contributes to antibiotic overuse in the absence of effective AMS. Evidence shows limited capacity to implement antibiotic use guidelines in most LMICs.[24–26] Addressing these common causes of inappropriate antibiotic use is critical to the success of hospital AMS programmes.

To respond to challenges to inappropriate antimicrobial use in hospitals, it is important to implement global best practices in AMS, contextualised to local norms at the level of health facilities. The Global Action Plan on AMR recommends that countries and hospitals establish AMS programmes.[3] Similarly, the WHO benchmarks for International Health Regulations capacities includes recommended actions to support AMS at both national and facility levels within the AMR technical area.[27] Among various approaches that have been applied to address healthcare delivery challenges, systematic capacity building[28] and/or continuous quality improvement (CQI) approaches[29–31] are some of the most widely applied effective interventions that have been implemented in LMICs. In this paper, we describe the implementation and evaluation of CQI approaches for AMS in six hospitals in Uganda.

METHODS

Hospital participation

Since 2019, the medicines, technologies and pharmaceutical services programme (hereafter referred to as the programme) has supported 13 hospitals in Uganda in implementing AMS activities. Of these, six hospitals were purposively selected to receive targeted technical assistance to advance their capacity in AMS (online supplemental table S1). Criteria for the selection of the six hospitals were commitment to AMS and willingness to participate, followed by concurrence by the Uganda Ministry of Health. A gradual approach was used to implement activities from June 2019 to July 2022.

Phase 1: getting started, setting up hospital AMS programmes

This phase consisted of developing a local roadmap for AMS, guided by WHO AMS materials[8] and included assessing current practices, establishing a core team, planning and implementing, identifying outcomes, getting the hospital prepared to implement focused AMS interventions and building a business case for AMS. This phase was implemented from June 2019 to March 2021 and is hereafter referred to as the pre-intervention phase.

Setting up hospital AMS programmes

Following the baseline assessment, efforts focused on establishing the foundation for the hospital AMS programmes, that is, stronger governance and leadership for AMS at the hospitals. The programme provided technical assistance to develop AMS work plans that focused on defining structures, systems and roles within which hospital AMS programmes would operate. The activities included obtaining hospital management buy-in and taking ownership of AMS activities and appointing AMS subcommittees under the medicines and therapeutics committees (MTCs). A system was established for regular meetings of the committees, documenting meeting proceedings and taking actions from the meetings. Hospital-based continuous medical education and continuous professional development initiatives were set-up. In collaboration with the hospitals, we developed a mentorship guide for use during the interventions. The implementation of the AMS core elements was done using CQI approaches and the Plan-Do-Study-Act cycle.[32]

Phase 2: implementing interventions to improve antibiotic use for specific disease conditions

This phase was implemented between April 2021 and June 2022, focusing on improving antibiotic use for the identified conditions while continuing to support the functionality of the AMS teams. This phase is hereafter referred to as the intervention phase.

Prioritisation of interventions

Each hospital undertook training on the CQI plan development process for AMS. This training was guided by the findings from the baseline survey, including antimicrobial use surveillance. The hospital AMS teams were trained in identifying stakeholders for hospital AMS programmes; assessing resource needs; assessing the feasibility of AMS intervention implementation at the health facility (ranking); making AMS interventions specific, that is, choosing specific interventions for prioritised actions; strengths, weaknesses, opportunities and threats analysis for hospital AMS programmes; barriers and mitigation plans for AMS programmes; and developing the CQI plan.

Patient and public involvement

No patients were involved in this study. Only pertinent data for this study were captured with no patient identifiers.

Developing and using CQI approaches

Working with hospital AMS teams, we developed a mentorship and supportive supervision guide to use for systematic capacity building for AMS at health facilities. Additionally, we provided technical assistance to the hospitals, including printing and distributing information, education and communication materials; guidelines; and reminders in the workplace, such as posters. Copies of the WHO toolkit, the Uganda MTC manual[33] and AMS posters developed by WHO were provided to the intervention hospitals. The training focused on the need for prescribers to adhere to the Uganda Clinical Guidelines for URTIs and UTIs.[34] To further the transfer of skills, 2244 health workers received mentorships—1036 (46%) men and 1208 (54%) women—through 90 mentorship visits and 38 health facility education and training activities, including continuous medical education, at the six hospitals throughout implementation of the AMS interventions.

Data collection

Assessing AMS core elements

The WHO toolkit of essential healthcare facility core elements for AMS programmes in LMICs (hereafter referred to as the WHO toolkit)[8] was applied during both the pre-intervention and intervention phases to assess the capacity of hospital AMS programme across six core components as shown in figure 1. Data on the WHO toolkit were collected during an interview with the AMS team or MTC focal person, where applicable.

Antimicrobial use surveillance

We applied the techniques found in *How to Investigate Antimicrobial Use in Hospitals: Selected Indicators*'.[35] Using systematic sampling, 100 prescriptions for patients diagnosed with either a URTI or UTI and those who had caesarian sections were included for analysis each quarter. However, when the number of diagnosed cases was less than 100 for any condition, sampling was not done and all cases were included in the analysis. Data were collected retrospectively at every data collection point. The surveys were done for both pre-intervention and intervention phases. Data on prescriptions for UTIs and URTIs were collected from health management information system form 31 (outpatient register from each of the participating hospitals).[36] The register records detailed information about each of outpatient visit, including the date, name of the outpatient department (OPD) and serial number, patient demographics (age, sex, weight, residence, next of kin), OPD visit status (new, reattending and referral), diagnosis and prescription information (drug, formulation, doses, frequency and days of treatment). The closed OPD registers were retrieved from the records office and the running registers were easily assessed at the OPD premises. Data on prescriptions for SAP were recorded from patient admission charts. Where applicable, charts

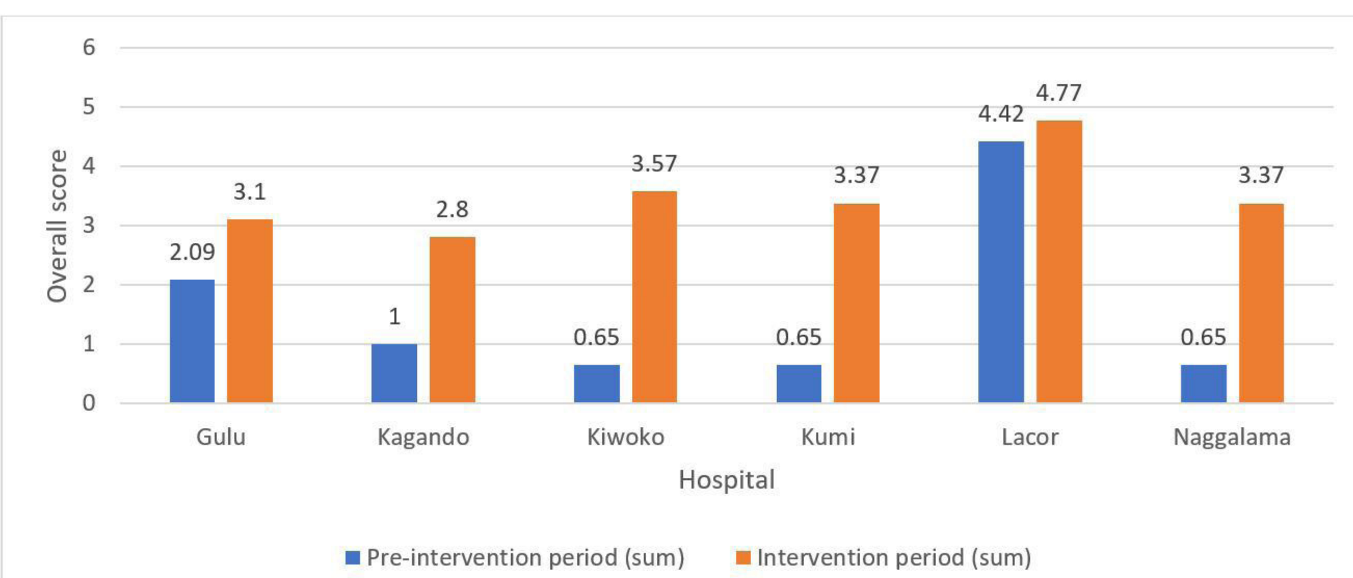

Figure 1 Overall score on antimicrobial stewardship core elements for the six hospitals.

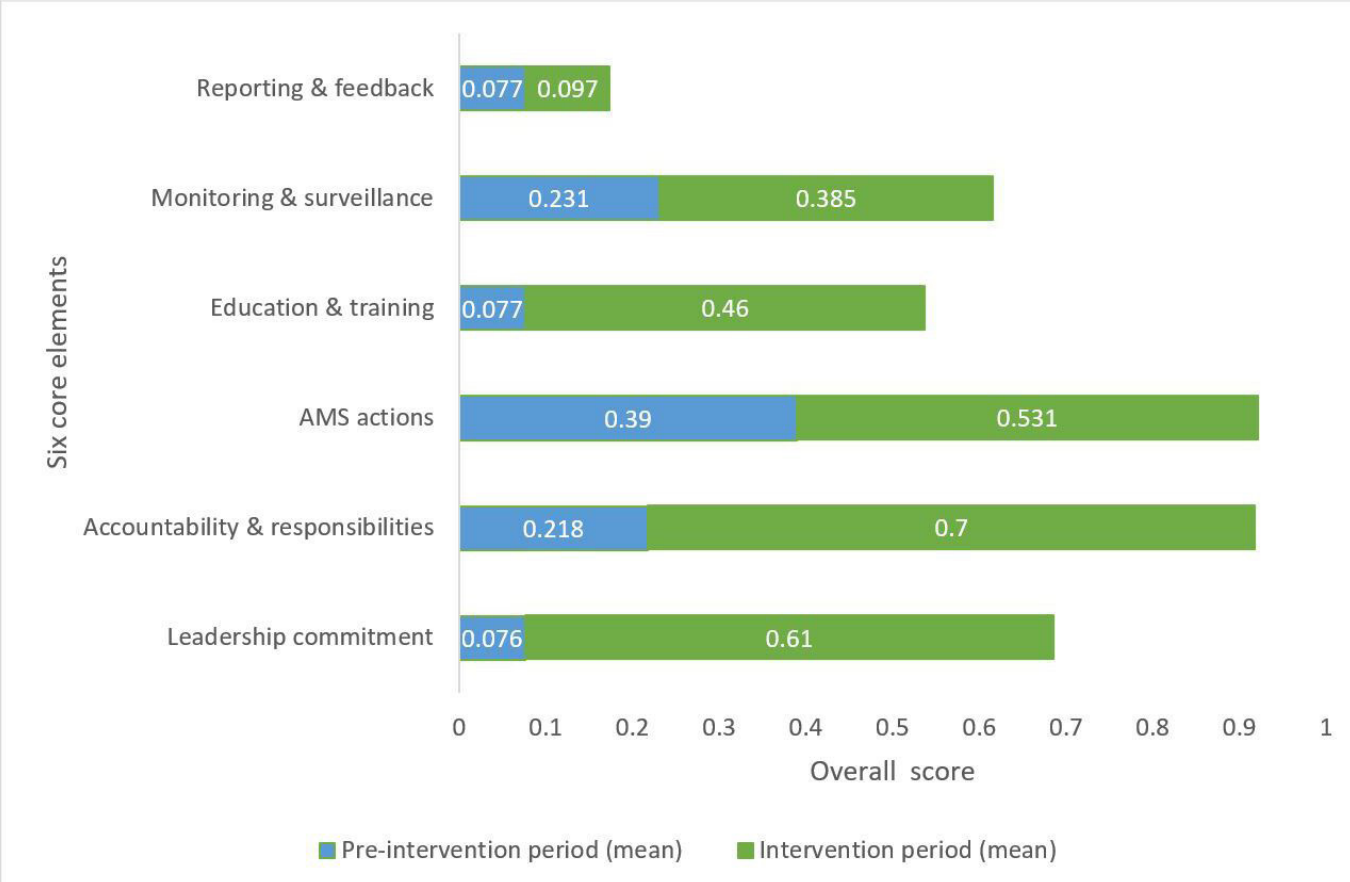

Figure 2 Score across six hospitals by AMS core elements before and during intervention. AMS, antimicrobial stewardship.

were retrieved from the records office and reviewed for prescription information.

Data analysis

Descriptive statistics, that is, means, ranges and SDs where applicable, were used to summarise the antibiotic use measures of interest. Pre-intervention phase—June 2019 to March 2021—versus intervention phase—April 2021 to June 2022—differences in guideline compliance and selected other measures, including presence or absence of core elements of hospital AMS programmes, were analysed. Welch t-tests were calculated to assess changes in selected measures over the pre-intervention and intervention phases. Significance was evaluated at the alpha=0.05 level.

RESULTS

AMS core elements

Figure 1 shows that each of the six hospitals improved their overall AMS core element scores from the pre-intervention to intervention phases on a scale of 6. All but Lacor Hospital experienced substantial improvements in AMS core element scores from the pre-intervention to intervention phase. The mean score for the pre-intervention phase across all six hospitals was 1.57 and 3.50 for the intervention phase. Figure 2 depicts the scores for each of the core elements. There was an improvement from the pre-intervention to the intervention phases for each of the core elements of the WHO toolkit across all the hospitals. At baseline, capacity was lowest for leadership commitment, reporting and feedback and education and training at a score of approximately 7% (0.07/1.0) for each of the capacities, with highest capacity reported for AMS interventions 39% (0.39/1.0). The highest improvement was reported for accountability and responsibilities, followed by leadership commitment and AMS actions.

Antibiotic use

UTIs

Data were collected for 7037 patients diagnosed with UTI, of whom 4427 (63%) were in the pre-intervention and 2610 (37%) in the intervention phase. There was an increase in the proportion of patients who received a single antibiotic for the treatment of UTIs, from 48% during the pre-intervention to 73.2% during the intervention-phase, $p<0.01$. On the contrary, there was a significant reduction in the proportion of patients receiving two and three antimicrobials, from pre-intervention to the intervention phase, with no patient receiving four antimicrobials in the intervention phase, versus 24 patients in the pre-intervention phase. There was a 19.2% overall reduction in the mean number of antimicrobials per patient for UTI from the pre-intervention to the intervention phase from 1.5 to 1.3, respectively, $p<0.01$. The mean number

Table 1 Antimicrobials per patient for UTI and URTI by pre-intervention and intervention phase

	UTI N=7037			URTI N=5424		
	Pre-intervention n=4427	Intervention n=2610	P value	Pre-intervention n=3161	Intervention n=2263	P value
Number of antimicrobials per patient						
0	0 (0%)	0 (0%)	–	832 (26.3%)	1208 (53.4%)	<0.01
1	2125 (48.0%)	1911 (73.2%)	<0.01	2098 (66.4%)	892 (39.4%)	<0.01
2	1689 (38.2%)	661 (25.3%)	<0.01	223 (7.1%)	163 (7.2%)	0.83
3	589 (13.3%)	38 (1.5%)	<0.01	8 (0.2%)	0 (0.0%)	0.005
4	24 (0.5%)	0 (0.0%)	<0.01	0 (0.0%)	0 (0.0%)	–
Mean (SD) and median number of antibiotic treatment days by indication and time						
Mean (SD)	5.93 (2.47)	5.78 (2.11)	0.0060	5.01 (1.32)	4.89 (1.38)	0.01633
Median	5	5	–	5	5	–
Mean (range) number of antimicrobials per patient (by hospital)						
Gulu	2.1 (0–4)	1.6 (1–3)	<0.01	0.9 (0–3)	0.8 (0–2)	0.016
Kagando	1.6 (1–4)	1.4 (0–3)	<0.01	1.0 (0–3)	1.1 (0–2)	0.016
Kumi	1.5 (1–3)	1.4 (1–3)	0.0103	0.8 (0–2)	0.6 (0–2)	<0.01
Lacor	1.4 (1–3)	1.1 (0–2)	<0.01	0.6 (0–3)	0.1 (0–1)	<0.01
Kiwoko	1.3 (1–4)	1.2 (1–2)	<0.01	0.8 (0–2)	0.3 (0–2)	<0.01
Naggalama	1.3 (1–3)	1.3 (0–3)	0.672	0.6 (0–2)	0.6 (0–2)	0.52
Overall	1.5 (0–4)	1.3 (0–3)	<0.01	0.8 (0–3)	0.6 (0–2)	<0.01

URTI, upper respiratory tract infection; UTI, urinary tract infection.

of treatment days for UTI was 5.9 days during the pre-intervention versus 5.8 during the intervention phase, p<0.01 (table 1).

URTIs

Data were collected for 5424 patients diagnosed with URTIs, of whom 3161 (58.3%) were in the pre-intervention and 2263 (41.7%) in the intervention phase. The proportion of patients receiving no antimicrobials for URTI increased from 26.3% at pre-intervention to 53.4% at the intervention phase, p<0.01. Similarly, there was a significant reduction in the proportion of patients receiving one and three antimicrobials from the pre-intervention to the intervention phase, p<0.01. There was a 20.7% overall reduction in the mean number of antimicrobials per patient for URTI from the pre-intervention to the intervention phase, from 0.8 to 0.6, respectively, p<0.001. The mean number of treatment days for URTI was 5.0 during the pre-intervention versus 4.9 in the intervention phase. The mean number of treatment days for URTI slightly reduced in the intervention phase, p=0.0163. The performance of individual hospitals for both UTI and URTI is summarised in table 2, with all hospitals showing overall improvement, except Naggalama Hospital.

Prophylactic antimicrobial use in surgery

Data were collected for 4291 patients undergoing surgery. Among these, 49.5% (2,212) received prophylactic antimicrobials during the pre-intervention versus 50.5% (2169) during the intervention phase. The mean number of days patients received SAP during the pre-intervention phase was 2.93. This increased to 3.23 days during the intervention phase, p<0.01. There was no statistical difference in mean number of SAP doses among hospitals. However, there was a reduction in antibiotic use observed in Lacor Hospital. The number of days for SAP by hospital are shown in table 2. No reduction was observed in the days of use of antibiotics for SAP from the pre-intervention to the intervention phase.

Antimicrobial classes

For UTIs, fluoroquinolones (18.3%) were the most prescribed antimicrobial class during the pre-intervention phase, followed by third-generation cephalosporins (17.2%). During the intervention phase, nitrofurantoin (25.3%) was the most frequently used antibiotic, increasing from sixth position (11.5%) in the pre-intervention. On the contrary, there was a reduction in use of third-generation cephalosporins from second most used (17.2%) at the pre-intervention to fourth most used (14.3%) during the intervention phase. The use of macrolides, metronidazole and tetracycline declined from 12.8%, 13.8% and 10.0%, respectively, during the pre-intervention to 10.0%, 8.6% and 4.0%, respectively, during the intervention-phase (online supplemental table S2).

There was no change in prescribing antimicrobials for URTI cases, with similar ranking in the frequency of use of antimicrobials between the pre-intervention and

Table 2 Mean number of days and doses for SAP per patient by hospital

Patients undergoing surgery, N=4291	Pre-intervention mean (range) n=2122	Intervention mean (range) n=2169	Difference pre-intervention versus intervention (%)	P value
Mean (SD) and median number of antibiotic treatment days by indication and pre-intervention and intervention phase				
Mean (SD)	2.93 (1.23)	3.23 (1.47)	0.3	<0.01
Median	3	3	0	–
Mean (range) number of SAP doses per patient by hospital				
Gulu	2.0 (1–3)	2.2 (0–8)	11.6	<0.01
Kagando	2.0 (1–4)	2.0 (1–4)	0	0.8
Kiwoko	1.9 (1–6)	2.0 (1–5)	4.3	0.023
Kumi	2.0 (1–4)	2.2 (1–4)	9.2	<0.01
Lacor	3.1 (1–8)	2.6 (1–4)	–15.7	<0.01
Naggalama	2.0 (1–3)	2.3 (1–4)	13.9	<0.01
Overall	2.2 (1–8)	2.2 (0–8)	3.9	0.5354

SAP, surgical antibiotic prophylaxis.

intervention phases. Penicillins and macrolides were the most frequently used antimicrobials for URTI during both phases of the programme.

There was no change in the choice of antimicrobials used in surgery, with metronidazole, third-generation cephalosporin and penicillin the most used antimicrobials during both the pre-intervention and intervention phases.

Access antibiotics are antibiotics with a narrow spectrum of activity, generally with less side effects, a lower potential for the selection of AMR and of lower cost. They are recommended for the empiric treatment of most common infections and should be widely available.

Watch antibiotics generally have a higher potential for the selection of AMR and are more commonly used in sicker patients in the hospital facility setting. Their use should be carefully monitored to avoid overuse.

Reserve antibiotics are last-resort antibiotics that should only be used to treat severe infections caused by multidrug-resistant pathogens.

WHO Access, Watch and Reserve category

The WHO Access, Watch and Reserve (AWaRe) categories of antimicrobials, a method to monitor antimicrobial use and support AMS activities is shown in table 3 by indication and pre-intervention and intervention phases. For UTI, the overall proportion of antimicrobials in the Access category increased slightly from 50.4% in the pre-intervention to 53.8% in the intervention phase. The proportion of Access category antimicrobials for URTI decreased from the pre-intervention to the intervention phase, 1305 (67.9%) versus 601 (61.7%), respectively. The SAP Access category antimicrobials slightly increased from 74.3% in the pre-intervention to 75.4% during the intervention phase (online supplemental table S3).

DISCUSSION

CQI is a documented approach to improving quality of healthcare delivery.[32 37] To our knowledge, the findings of this paper are the first documented CQI interventions focused on three common causes of inappropriate antibiotic use in Uganda.

Impact of interventions on AMS core components

The observed improvement on the WHO toolkit measures across all health facilities has not been previously described in Uganda health facilities. The variation in the improvement among health facilities can be explained by the variation in capacity of the hospitals to adopt and implement CQI approaches for AMS. Improvement was observed across all the six AMS core elements of the WHO toolkit measures. The finding of low leadership capacity, low reporting and feedback and lack of training is consistent with findings in other resource-limited settings. The finding of low capacity on governance is not surprising, given similar findings from previous studies, despite earlier efforts to strengthen MTCs.[33 38] The improvement in accountability, leadership and AMS actions is consistent with our CQI approach of setting and supporting structures for AMS teams and supporting them to implement specific AMS actions. The low capacity in reporting is consistent with the support provided with the hospital, where we emphasised facility-based information sharing and less external sharing of findings of the intervention, with little participation of the hospital data teams. Consistent with this finding is the fact that hospital AMS teams do not include personnel with expertise in data analysis. To the best of our knowledge, this is one of the first studies applying the WHO toolkit, supporting its implementation to improve AMS in resource-limited settings. Other available studies from similar settings have

Table 3 AWaRe* category by condition and pre-intervention and intervention phase

	UTI				URTI			
	Access (N=3549)		Watch (N=3319)		Access (N=1906)		Watch (N=991)	
	Pre-intervention (n=2137)	Intervention (n=1412)	Pre-intervention (n=2106)	Intervention (n=1213)	Pre-intervention (n=1305)	Intervention (n=601)	Pre-intervention (n=618)	Intervention (n=373)
Gulu	900 (57.5%)	61 (56.5%)	664 (42.5%)	47 (43.5%)	412 (78.8%)	65 (67.7%)	111 (21.2%)	31 (32.29%)
Kagando	251 (49.0%)	267 (51.5%)	261 (51.0%)	251 (48.5%)	215 (49.1%)	223 (60.6%)	159 (36.3%)	145 (39.40%)
Kiwoko	271 (62.7%)	263 (68.3%)	161 (37.3%)	122 (31.7%)	273 (82.0%)	108 (74.5%)	60 (18.0%)	37 (25.52%)
Kumi	152 (42.3%)	186 (46.4%)	207 (57.7%)	215 (53.6%)	109 (69.4%)	89 (59.7%)	48 (30.6%)	60 (40.27%)
Lacor	450 (59.6%)	399 (66.3%)	305 (40.4%)	203 (33.7%)	204 (58.0%)	43 (69.4%)	148 (42.1%)	19 (30.65%)
Naggalama	113 (18.2%)	236 (38.6%)	508 (81.8%)	375 (61.4%)	92 (50.0%)	73 (47.4%)	92 (50.0%)	81 (52.60%)
Overall	2137 (50.4%)	1412 (53.8%)	2106 (49.6%)	1213 (46.2%)	1305 (67.9%)	601 (61.7%)	618 (32.1%)	373 (38.30%)

Access antibiotics are antibiotics with a narrow spectrum of activity, generally with less side effects, a lower potential for the selection of AMR and of lower cost. They are recommended for the empiric treatment of most common infections and should be widely available.

Watch antibiotics generally have a higher potential for the selection of AMR and are more commonly used in sicker patients in the hospital facility setting. Their use should be carefully monitored to avoid overuse.

Reserve antibiotics are last-resort antibiotics that should only be used to treat severe infections caused by multidrug-resistant pathogens.

*WHO definitions of AWaRe (doi: http://dx.doi.org/10.2471/BLT.22.288614).
AWaRe, Access, Watch and Reserve.

either conducted assessments using the WHO toolkit without supporting its use for quality improvement, or, where quality has been improved, it is based on a toolkit other than the WHO toolkit.[39 40]

Impact of stewardship interventions on antibiotic use

The overall reduction in antibiotic use that was observed was greater for UTIs compared with URTIs, with no significant reduction observed for SAP.

UTIs

We observed reductions in the mean number of days of treatment and mean number of antibiotics prescribed for UTI associated with implementation of the intervention. The observed increase in the proportion of patients receiving a single antibiotic, with reduction in the use of two, three or four antimicrobials for managing UTIs during the intervention, is in line with the Uganda Clinical Guidelines and other international guidelines[19 34 41] that recommend the use of only one antibiotic for managing uncomplicated community acquired UTIs (our study included only patients in the OPD). UTIs are a leading cause of antimicrobial use globally, hence proper stewardship is recommended to inform antibiotic use among patients with UTIs.

URTIs

Reduction in the use of antimicrobials for URTIs was observed as evidenced by reduction in both the mean number of days of treatment and the mean number of antimicrobials prescribed during the pre-intervention and intervention phases. The more than twofold increase in the proportion of patients not receiving an antibiotic in the intervention phase is associated with the implementation of interventions. This has considerable stewardship implications and indicates increasing compliance to both national and global guidelines for managing URTIs, for which antimicrobials are not generally recommended.[34 42 43]

Prophylactic antibiotic use in surgery

Although there was an increase in the mean days of antibiotic use in the intervention phase, there was no statistically significant reduction in the number of SAP doses. The non-increase in the number of doses for SAP, despite the increase in duration of SAP, could be due to changes in the choice of antimicrobials used in surgery to those that require less frequent dosing. It is estimated that over 30% of antimicrobials end up in the surgical pathway in high-income countries, with the figure likely higher for LMICs.[22–24] Major barriers to implementing the SAP intervention are the lack of guidance about SAP in the Uganda Clinical Guidelines and no position on this topic by the Association of Obstetricians and Gynecologists of Uganda. Another common factor cited anecdotally by health workers for low adherence to SAP is poor water, sanitation and hygiene (WASH) and IPC capacities. However, LMICs could invest the savings achieved from AMS programmes to improve IPC/WASH capacities in health facilities.[42 44]

Types of antimicrobials used

The proportional reduction in the use of metronidazole, macrolide, ceftriaxone and tetracycline for UTIs could be associated with better adherence to treatment guidelines as evidenced by increased use of nitrofurantoin. Although nitrofurantoin is the recommended first-line medication for treating uncomplicated UTI in Uganda,[34] its use was low during the pre-intervention phase. By conducting prescriber trainings and encouraging adherence to treatment guidelines, the observed increase in the use of nitrofurantoin could have an impact on the use of other antimicrobials and reduce the emergence of AMR. Additionally, the reduction in the use of macrolide, metronidazole and tetracycline that are usually recommended for managing urethral discharge syndromes could point to better diagnostic stewardship capacity built through prescriber training.

The reduced use of ceftriaxone for managing uncomplicated community acquired UTIs has AMR control implications. Ceftriaxone is a key drug at risk of developing AMR and a WHO priority for monitoring.[45]

Like the URTI intervention, the focus was on a single dose of prophylactic antimicrobials in surgery, rather than on the type of antibiotic used, hence the observed non-difference in the type of antibiotic used during the pre-intervention and intervention phases among surgical patients. However, the heterogeneous use of prophylactic antimicrobials in surgery, with other types of antimicrobials used non-discriminately, has implications for containing AMR. National guidelines or a national policy on SAP, based on WHO guidance, which has been shown to be effective in resource-limited settings, needs to be established and implemented.[46]

AWaRe classification

The observed increase in the use of Access antimicrobials in UTI and surgery patients is a marker of the success of our interventions for AMS in health facilities. However, the observed proportions of antibiotic use for UTIs and URTIs are below the WHO recommendation of 60% or more from the Access category. The observed increase in the use of the Access group of antimicrobials in UTIs is consistent with the recommendations of our intervention, which emphasised the use of nitrofurantoin, an Access category antibiotic.

Limitations

Our study had several limitations. First, our data were not disaggregated by sex and gender because that data is not collected as a variable in the WHO toolkit. Second, the intervention did not follow-up patients to assess treatment outcomes for the choice of antimicrobials used for both the pre-intervention and intervention phases. Third, the cost of the intervention has not been documented. Future research is needed to assess health facility AMS practices, independent of the programme's technical assistance as part of a post-intervention phase. Finally, the lack of a comparison group limits our ability to attribute the observed findings entirely to the CQI intervention. Nevertheless, we believe that the overall approach remains applicable and scalable to other health facilities in Uganda and other LMICs.

CONCLUSION

A strong AMS programme is critical as a foundation for building AMS interventions in health facilities. Although not ideal, AMS programmes can be implemented without microbiology testing in resource-constrained settings. We used locally generated data to ensure ownership of interventions and build capacity for antimicrobial use surveillance. However, more capacity building on antimicrobial use surveillance is needed in Uganda to strengthen AMS programme monitoring and evaluation and to inform future interventions. The lack of microbiology testing should not deter implementation of AMS programmes in resource-limited settings. It is also important that frameworks, like the WHO toolkit, are adopted and their implementation supported at the national level for systematic capacity building on AMS. Lastly, it is feasible to promote appropriate antibiotic use for both UTIs and URTIs in resource-limited settings. The results obtained by having hospital AMS subcommittees and leadership drive change could be used to set-up CQI programmes in other health facilities across Uganda and mandate AMS activities to meet WHO International Health Regulations, capacity 4 for AMS.[27]

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