Inappropriate antibiotic prescribing: a cross-sectional study in Swaziland

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Abstract

Background: A cross-sectional study was performed to determine the one-month prevalence of inappropriate antibiotic prescribing at the outpatient department of Hlatikulu Government Hospital, Swaziland. A survey was also administered to prescribers to determine their knowledge of and attitudes and perceptions towards prescribing for acute respiratory infections (ARIs).

Method: The prevalence of inappropriate antibiotic prescribing for ARIs was estimated by reviewing 410 prescriptions over one month. Ten prescribers participated in the survey conducted to assess their knowledge of and attitudes and perceptions towards prescribing for ARIs.

Results: Overall, a high prevalence of inappropriate antibiotic prescribing for ARIs was found [79%, 95% confidence interval (CI): 75-83)] with regard to doctors, (78%, 95% CI: 73-83) with regard to nurses, and (80%, 95% CI: 74-87) with respect to all age groups. Amoxicillin was the most misused antibiotic (64%). Prescribers were aware of the local treatment guidelines, although not everybody was confident applying them. Nurses in the survey listed antibiotics as their preferred drug of choice for ARIs. Most doctors displayed knowledge of prescribing for ARIs. All prescribers failed to define rational drug use. Forty per cent of the prescribers reported being influenced by patients in their prescribing practices.

Conclusion: Inappropriate antibiotic prescribing for ARIs was rampant. There is a need for strategies to impart knowledge to prescribers, and to translate their knowledge into a change in attitude in order to reduce inappropriate antibiotic prescribing for ARIs.

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Introduction

Prompt antibiotic therapy for an infected patient can make the difference between a cure and death or disability. However, inappropriate antibiotic prescribing reduces the quality of medical care, leading to a waste of resources.[1,2] Most health expenditure in developing countries is on drugs and medical sundries, but the inappropriate use of resources is common.[3] In addition, inappropriate prescribing can give rise to resistant microbial strains, unnecessarily drug adverse reactions and reduced patient confidence. According to the World Health Organization (WHO),[4] a rational prescription must meet certain criteria, such as the appropriate indication, appropriate patient, appropriate antibiotic, dosing and duration, and appropriate information and monitoring.

Acute respiratory infections (ARIs) are the most common ailment with which patients present at primary care facilities.[5] Antibiotic therapy for ARIs is almost always inappropriate because most of these infections have a non- bacterial cause and are self-limiting.[6,7] It was found in a 2005 review that patients with ARIs on antibiotics did not have an advantage over the placebo group in terms of duration in the persistence of symptoms. Rather, there was a significantly greater risk of adverse effects in the antibiotic group [relative risk 3 2.62, 95% confidence interval (CI): 1.32-5.18] in the adult patients.[8] Antibiotics can be considered in cases of chronic coughing (≥ 2 weeks), suspected pneumonia based on fever, infiltrate on a chest radiograph, tachypnoea or a toxic appearance, and suspected pertussis or mycoplasma.[9,10]

The prevalence of inappropriate antibiotic prescribing has been demonstrated in studies performed in several countries,[3,11-13] but such a study has not been carried out in Swaziland. The prevalence of inappropriate antibiotic prescribing in some countries ranges from as low as 6% to as high as 90%.

We set out to measure the prevalence of inappropriate antibiotic prescribing, based on the outpatient prescriptions of patients presenting with ARIs to Hlatikulu Government Hospital, Swaziland, for the month of February 2014. We also held a small survey among outpatient prescribers to gain an idea of their knowledge of and attitudes and perceptions towards prescribing for ARIs.

Objectives

Primary objective

The primary objective was to investigate antibiotic prescribing practices with respect to ARIs at the outpatient department of Hlatikulu Government Hospital over a one-month period.

Secondary objectives

Secondary objectives were to:

- Describe the demographics (age and gender) of the population of patients with ARIs at the outpatient department of Hlatikulu Government Hospital.
- Determine whether or not inappropriate antibiotic prescribing for ARIs was most common at nurse or doctor level.
- Determine the type of antibiotics inappropriately prescribed most often.
- Explore the knowledge of and attitudes and perceptions towards prescribing for ARIs by prescribers, and explore factors that influenced their prescribing.

Method

Study design

A descriptive cross-sectional study was undertaken to quantify the prevalence of inappropriately prescribed prescriptions for ARIs at the outpatient department of Hlatikulu Government Hospital over one month.

Setting and study population

Hlatikulu Government Hospital is the sole regional and referral hospital in the Shiselweni region of Swaziland. It has a catchment of 241 365 persons (17%) of the total estimated population of Swaziland of 1 419 623.[14] It receives patients from three health centres and 19 rural clinics. In 2012, 434 292 patients were seen at the outpatient department in the hospital. The hospital serves a peri-urban population of Siswati ethnicity (97%) primarily. Eighty per cent of the population do not have medical aid, and on average, there is unemployment of 40%.[15]

The study population comprised patients with ARIs who presented to the outpatient department of Hlatikulu Government Hospital for the month of February 2014. Their prescription notes were used as the source of data collection. Patients at this hospital go home with their prescription notes after being issued medicine, and there are no remaining patient records. The outpatient department staff at Hlatikulu Government Hospital includes five permanent doctors and a minimum of two consulting nurses daily.

Sampling technique

The prescription notes were systematically sampled by reviewing every third ARI prescription presented at the hospital's outpatient department dispensary in February 2014.

Outcomes

Primary outcome

The primary outcome was to determine the proportion of antibiotic prescriptions for ARIs deemed inappropriate, i.e. prescribed for a cough ≤ 14 days, with no suspicion of pneumonia, based on fever with a focal exam, the absence of infiltrate on the chest radiograph, tachypnoea or a toxic appearance, and no suspicion of pertussis or mycoplasma.[9,10] The proportion of antibiotic prescriptions that were inappropriate was a binary variable.

Secondary outcomes

Secondary outcomes from the prescription notes included:

- The professional level of the prescriber, doctor or nurse
- The type of antibiotic prescribed
- *The patient demographics:* These were age in years and the sex of the patient
- *The presence of fever:* Fever was defined as an axillary temperature ≥ 37.5 °C
- A cough duration of ≤ 14 days
- The presence of signs of pneumonia from radiological changes or tachypnoea.

Secondary outcomes from the questionnaires included:

- The duration (in months) of the prescriber's profession
- Awareness by prescribers of the existence of the Swaziland Standard Treatment Guidelines (STGs)
- The routine use of the STGs by prescribers
- The perceptions of prescribers on a well presented section in the STGs on the common cold
- Perceptions of the influence of patient expectations on prescribing
- Open-ended answers regarding the choice of preferred prescription drugs for ARIs, and the definition of rational drug use.

Data collection

Physician-collected data were obtained in the study from the outpatient prescription notes, through the use of a data collection form.

A self-administered questionnaire was handed out to available and willing prescribers in the outpatient department after obtaining written consent, so as to assess their knowledge of and attitudes and practices towards prescribing for ARIs. The questionnaire was adapted from a Nigerian study with the same objective.[3]

Data entry, storage and analysis

Obtained data were entered into a database using Microsoft® Excel®, and then imported into Stata® (version 11) for analysis. The entered data were reviewed again to check for any incorrect entries. Information was stored on the primary investigator's computer, and was only accessible to one person as the file was protected with a password. Daily back-up of the electronic data was performed.

Statistical considerations

Sample size estimation

There is a prevalence of inappropriate antibiotic prescribing of between 30% and 70% in most countries.[13] It was estimated that a percentage of 50% would provide the maximum required sample size in this study. An attempt was made to estimate the percentage to within 5% of the true value, at 95% CI as follows:

$$n \text{ (sample size)} = \frac{0.5 \times 0.5 \times 1.96^2}{0.05^2} = 385$$

Four hundred and ten prescription notes were viewed and used in the data entry.

Data analysis

Stata® version 11 software was used for the data analysis, and results were tabulated or presented graphically. A prevalence value was calculated with a 95% CI for the primary outcome. The chi-square test was used to determine if there was an association between the type of prescriber and the inappropriate prescription of an antibiotic, and also to establish if there was an association between the age group of a patient and the inappropriate prescription of an antibiotic. A p-value of < 0.050 was considered to be statistically significant.

Results

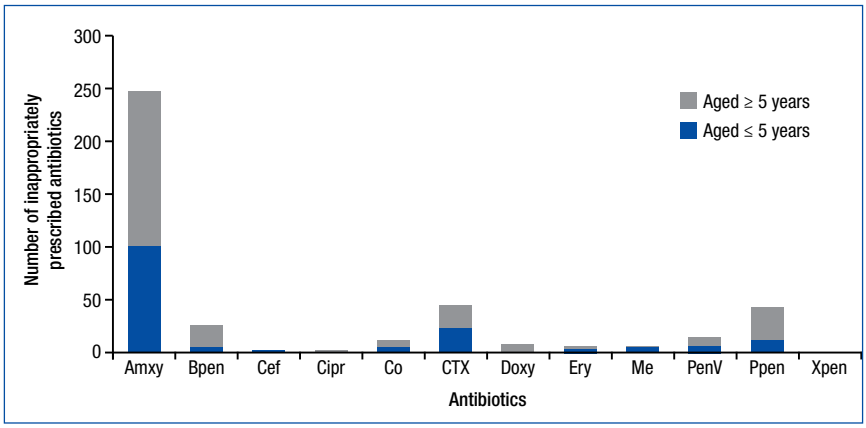
Prescription notes (Table I) were reviewed for the month of February 2014 from patients with a mean age of 20 years, ranging from six weeks to 92 years. Forty-one per cent were aged ≤ 5 years. The patients were predominately female, with a male to female ratio of 1.00:1.42. Doctor prescribers in this month attended to twice as many prescriptions for ARIs than nurse prescribers. The study results are detailed in Table I.

The prevalence of inappropriate antibiotic prescribing was found to be 79% overall (95% CI: 75-83), and 82% (95% CI: 76-88) for infants aged ≤ 5 years. There was no association between inappropriate prescribing and age group (p-value 0.273), nor an association between inappropriate prescribing and prescriber level (p-value 0.623) (Figure 1).

Table I: The demographic characteristics of the patients and the results

Characteristics	Values
Age (years)	
Mean, SD	20.06, 22.64
Range	6 weeks–92 years
Age of infants ≤ 5 years' old	
Mean, SD	1.72, 1.12
Proportion of infants aged ≤ 5 years, n/N (%)	169/410 (41)
Sex, number of males to number of females (male to female ratio)	169:241 (1.00:1.42)
Males, n/N (%)	169/410 (41)
Females, n/N (%)	241/410 (59)
Prescribers	
Number of nurse prescribers to number of doctor prescribers (Nurse to doctor ratio, N (n))	133:277 (1.00:2.08)
Nurse prescribers, n/N (%)	133/410 (32)
Doctor prescribers, n/N (%)	277/410 (68)
Overall prevalence of inappropriate prescriptions, n/N (%), (95% CI)	324/410 (79), 0.75-0.83
Prevalence of inappropriate prescriptions for infants aged ≤ 5 years, n/N (%), (95% CI)	138/169 (82), 0.76-0.88
Prevalence of inappropriate prescriptions for infants aged ≥ 5 years, n/N (%), (95% CI)	186/241 (77), 0.72-0.83
Association between age group and inappropriate prescribing, chi-square, p-value	1.20, 0.273
Prevalence of inappropriate prescriptions from nurses, n/N (%) (95% CI)	107/133 (80), 0.74-0.87
Prevalence of inappropriate prescriptions from doctors, n/N (%) (95% CI)	217/277 (78), 0.73-0.83
Association between types of prescriber and inappropriate prescribing, chi-square, p- value	0.24, 0.623

CI: confidence interval, SD: standard deviation



Amxy: amoxicillin, Bpen: benzathine penicillin, Cef: cefaclor, Cipr: ciprofloxacin, Co: co-amoxyclav, CTX: cotrimoxazole, Doxy: doxycycline, Ery: erythromycin, Me: metronidazole, PenV: penicillin, Ppen: procaine penicillin, Xpen: benzyl penicillin

Figure 1: The number of inappropriately prescribed antibiotics by type in the overall sample and in infants aged ≤ 5 years

Out of (387 times), in 49 cases 7 antibiotics were inappropriately prescribed as follows:

- *Penicillin:* 14 (3.6%)
- *Co-amoxyclav:* 12 (3.1%)
- *Doxycycline:* 8 (2.1%)
- *Erythromycin:* 6 (1.6%)
- *Metronidazole:* 6 (1.6%)
- *Cefaclor:* 2 (0.5%)
- *Ciprofloxacin:* 1 (0.3%).

Ten questionnaires were completed by six doctors and four nurse prescribers in the outpatient department of the hospital. The doctors had been practising from 2 years and 7 months to 24 years, with an average of 13 years and 8 months. All of them were aware of the local STGs and owned a copy. Three doctors said that they routinely used the STGs when prescribing. The other three did not. Of the three who used the STGs, only one reported that the section on the common cold was well presented. The three who did not use the STGs concurred that the section on the common cold was well presented. Only two doctors admitted to being influenced by patients with respect to their prescribing habits.

Question 8 in the questionnaire reads as follows:

A 10-year-old boy presents to the outpatient department of Hlatikulu Government Hospital with two-day history of a runny nose, headaches, a sore throat and a dry cough. He is afebrile and his chest is clear on auscultation. What is your preferred management combination for the patient?

a. Paracetamol, an antihistamine and nonpharmacological measures (adequate fluid intake and steam inhalation) to relieve the symptoms

b. Cotrimoxazole, paracetamol and nonpharmacological measures (adequate fluid intake and steam inhalation)

c. Amoxicillin, antihistamine and paracetamol

In answering question 8, one doctor chose option c), and the rest of the doctors option a). Only one nurse reported her duration of service, i.e. of 15 years. Three of the four nurses who completed the questionnaire were aware of the local STGs. Of these three, one owned a copy. Surprisingly, the nurse who said that he or she was unaware of the STGs also reported having a copy. Two of the nurses stated that they used STGs routinely, and one of these thought that the section on the common cold was well presented. Two out of the four nurses reported that they were influenced by patients when prescribing.

Question 8 in the questionnaire was answered by only three of the nurses. Two chose option c), i.e. Amoxicillin, antihistamine and paracetamol, and one option b), i.e. co-trimoxazole, paracetamol and nonpharmacological measures such as adequate fluid intake and steam inhalations.

All of the participants offered varied responses to the definition of rational drug use. The listing of responses to the definition of rational drug use was as follows:

- Patients receiving treatment appropriate to the List of Essential Medicines
- Using exactly what the patient needs
- Using a drug, if necessary
- Using a few drugs for any ailment
- Using a limited number of drugs, as far as possible
- Only using a drug when a patient presents with signs of bacterial infection
- The rational and efficient use of a drug that is efficacious
- The appropriate use of prescribed drugs for patients
- Only using drugs when they are really necessary

With regard to the last question in the questionnaire, which asked to identify their preferred prescription drug for patients with ARIs, all four nurses cited amoxicillin and paracetamol. One suggested co-trimoxazole in place of amoxicillin. Of the six doctors, only one identified an antibiotic, i.e. amoxicillin, and four analgesia and antihistamines as their preferred choice of drug when treating patients with ARIs. One doctor offered a non-specific answer, stating that he or she would choose the drug based on the cause of the ARI.

Discussion

A high level of inappropriate antibiotic prescribing (i.e. 79%) for patients with ARIs at Hlatikulu Government Hospital was reflected in this study for the month of February 2014. The 95% CI range was narrow, i.e. 95% CI: 75-83, demonstrating precision and confidence in our estimate. The prevalence of inappropriate antibiotic prescribing of antibiotics for infants aged ≤ 5 years was also high at 77% (95% CI: 72-88), similar to the prevalence found for the whole sample. This was supported by the nonsignificant association that was found between the age of the patient and inappropriate prescribing of an antibiotic for an ARI. The prevalence values for inappropriate antibiotic prescribing were high, and almost equal with regard to nurse (80%, 95% CI: 74-87) and doctor (78%, 95% CI: 73-83) prescribers. The CIs overlapped, indicating no significant difference in inappropriate prescribing between the doctors and nurses. This was supported by the nonsignificant association found using the chi-square test, which indicated that inappropriate antibiotic prescribing was rampant in both doctor and nurse prescribers and for all age groups. Similarly, an association between antibiotic prescribing and patient age and other factors, such as gender, race, ethnicity, smoking status, co-morbidities and clinical setting, was not found in a 2006 study.[16]

Our estimate of the prevalence of overall inappropriate antibiotic prescribing of 79% was within the upper limit of the range of previous inappropriate prescribing prevalence values reported in previous studies.[13] A much higher prevalence of inappropriate antibiotic prescribing in the outpatient department at Hlatikulu Government Hospital was reflected in our study than that

reported in a more recent regional study conducted in Lesotho in 2013 by Adorka et al. In the latter study, it was found that 57% of inpatient and only 19% of outpatient prescriptions were classified as inappropriately prescribed antibiotics, but were not limited to ARIs.[12] A prevalence of 12% of inappropriately prescribed antibiotics was reported in a survey on general clinic conditions in primary clinics in Harare,[11] and the single largest cause of errors was said to relate to ARIs. Procaine penicillin was the most commonly abused antibiotic, unlike the finding in our study, where it ranked fourth. Similarly, a lower inappropriate antibiotic prescribing rate of 34% was reported in a cluster randomised clinical trial in 2009[17] before an intervention was introduced. A prevalence of inappropriate antibiotic prescribing specific to ARIs of 60%,[18] nearer to our value, was reported in a Turkish study. However, a relatively high prevalence of inappropriate antibiotic prescribing was exposed in our study when compared to that reported in the Harare, Lesotho and Turkey studies.

Amoxicillin was the drug of choice for most prescribers at the outpatient department of Hlatikulu Government Hospital in our study, and was prescribed inappropriately in 64% of cases. Penicillin was the most misused antibiotic class. It would be interesting to note resistance patterns with respect to penicillin in upcoming years. Cephalosporin and quinolone were the least misused in our study. It is possible that they are being reserved for persistent ARIs and severe pneumonia. A prospective study was held in 13 European countries on primary care presentations of ARIs, and amoxicillin was reported to be the most commonly misused antibiotic with a prevalence of 29%, nearly half that of our rate.[19] Macrolides were second in popularity in the European study their-study, and in ours ranked as the third least popular antibiotic group. Tetracycline was also found to be unpopular in both studies. Fluoroquinolone ranked as the least popular antibiotic in the European study (5.0%), similar to the findings in our study (0.26%).

All of the prescribers were aware of the STGs in our study. The one nurse who filled in the response that he or she was unaware of the STGs subsequently responded that he or she owned a copy of the STGs. Thus, it is possible that he or she ticked "No" erroneously. All of the doctors owned a copy of the STGs, whereas only half of the nurses owned a copy. Fifty per cent of all the prescribers reported that the section on the common cold was well presented, 80% of whom were doctors. It is possible that most of the nurses lacked confidence with regard to providing their assessment of the section on the common cold as half of them did not own a copy of the STGs. Dissemination of the STGs to nurses needs to be stepped up and personal copies supplied.

Amoxicillin was the most commonly listed preferred antibiotic by prescribers, who listed antibiotics among their choice of preferred drugs for ARIs on the last response of the questionnaire which asked for the preferred prescription drug for ARI. This is in line with our review of prescriptions in which it was also shown that amoxicillin was the most popular antibiotic. Most of the doctors demonstrated knowledge of prescribing for ARIs, as five of the six doctors stated that they would not choose an antibiotic, but rather symptomatic management, in response to the open-ended question on their preferred drug regimen for ARIs. Just one doctor listed antibiotics as the preferred drug with which to treat ARIs. This was in contrast to the nurses, who demonstrated lack of knowledge with respect to prescribing practices, as three of the four nurses who responded to question 8 chose a regimen with an antibiotic. All of the nurses listed antibiotics in response to the open-ended question on what was their preferred drug choice.

However, most prescriptions reviewed in this study were by doctors (67.56%). Doctors also had a high prevalence of inappropriate prescribing (78%), despite the doctors demonstrating that they had knowledge of the appropriate prescribing approach to ARIs. This suggests that other factors play a role in influencing prescribing practices aside from knowledge.[20] It is possible that prescribers are pressured to prescribe antibiotics to meet patient expectations. Forty per cent of them (33% of the doctors, and 50% of the nurses) reported being influenced by patients with respect to their prescribing methods. Patient expectations, attitudes and misconceptions need to be assessed in further studies. In a study in America, ≥ 70% of the interviewed general public believed that antibiotics were needed once a patient had a green or yellow mucous discharge,[20] thus patient misconceptions exist. Doctors often overestimate patients' wish for antibiotics.[21] There is a need to make prescribers aware of these misconceptions and to desist from routinely prescribing antibiotics for ARIs as this creates an impression that antibiotics are necessary to treat ARIs. Instead, prescribers should be encouraged to improve communication with patients and to conduct a thorough physical examination. This will communicate to patients that their symptoms are being taken seriously. In turn, this should allay patient fears.[20,21]

It is possible that diagnostic uncertainty with regard to differentiation between the viral and bacterial cause of ARIs is influencing prescribing, causing prescribers to choose the "safer" route by suggesting antibiotic cover. Ambiguity could also result in resistance in prescribers, despite being equipped with the necessary knowledge, to prescribe appropriately by following through with appropriate behaviour. All 10 prescribers in this study failed to cite the full WHO definition on rational drug use[7] and its five pillars.

Continued medical education is important for both doctors and nurses. Peer education should be put in place to translate knowledge into behavioural change in prescribers as they are more likely to adopt the behaviour of their peers, than to adhere to guidelines established by authorities. Focusing on small group levels, and giving feedback on their prescribing skills to clinicians, has been found to be effective in the adoption of treatment guidelines and recommendations.[22] This study, when published, will provide beneficial information for dissemination to prescribers. Public education of patients is also imperative.[20,22]

There were limitations to this study, although it contributed to a background pharmacological database and to health services

in Swaziland. It took place over just one month. There is also seasonal variation with ARIs, and so further studies are required, spanning a year, in order to incorporate this. The survey section of our study lacked power and generalisability. A further study, with a larger sample of prescribers, is desirable. Large multi-cluster studies are required in order to determine antibiotic prescribing practices in health centres, ranging from clinic to tertiary level, and covering in- and outpatients, as well as public and private facilities representative of the entire health service delivery of Swaziland. It is possible that some patients had co-morbidities, such as dysentery, for which antibiotics were prescribed. This is most likely in patients who received metronidazole, but there were only a few. The prevalence of inappropriate antibiotic prescribing would still have been high even if these patients had been excluded from the analysis. Thus, this study is generalisable to regions in southern Africa with a similar patient background, and with prescribers who follow a similar medical school of thought.

Conclusion

Inappropriate antibiotic prescribing for ARIs at the outpatient department of Hlatikulu Government Hospital was rampant among doctors and nurses, and with respect to all patient age groups. Amoxicillin was the most commonly abused antibiotic. There is need to include nurses in continuing medical education as they displayed lack of knowledge of appropriate prescribing practices for ARIs. There is a need to structure strategies for doctors in order to translate their knowledge into behavioural change with regard to appropriate antibiotic prescribing for ARIs.

Declaration

This research project was conducted as part of the academic requirements of the Master of Science in Clinical Epidemiology degree, Stellenbosch University.

Conflict of interest

The authors declare that they had no financial or personal relationships which may have inappropriately influenced them when writing this paper.

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