JIDC | THE JOURNAL OF INFECTION IN DEVELOPING COUNTRIES

Original Article

Improvement of antibiotic use in sore throat, tonsillitis and acute otitis media in Palestine: a prospective full cycle audit

Haytham AbuMohsen[1], Mohammad Abusheikha[1]

[1] Tubas Governmental Hospital, West Bank, occupied Palestinian territory

Abstract

Introduction: Antibiotics are commonly prescribed for upper respiratory tract infections (URTIs) which are generally caused by viral pathogens and do not require antibiotics under most circumstances. Adherence to the international guidelines regarding the necessity of prescribing antibiotics and the selection of antibiotics used for these illnesses have never been reviewed in West Bank.

Methodology: This study was a prospective full cycle audit and re-audit done in West Bank, Palestine. Audit and re-audit phases involved short interviews. The intervention phase included surveys, oral presentations, and development of mobile/web applications. p values of < 0.05 were considered significant.

Results: A total of 297 cases were reviewed during the audit and reaudit phases. These cases included tonsillitis (56.9%), sore throat (29.6%) and acute otitis media (13.5%). Improvements in the percentages of correct antibiotics prescriptions in the reaudit phase were noticed, including + 6.5% for correct direct antibiotics prescriptions, + 44.4% for correct backup antibiotics prescriptions, and + 63.4% for correct no antibiotics prescriptions. Improvements in the percentages of prescribing the correct choice of antibiotic (+ 41.4%) and frequency, dosage and duration (+ 13.3%) were also recorded.

Conclusions: There was inadequate adherence to the international guidelines of antibiotic prescription for URTIs indicating a possible national problem. There is an evident trend toward using the second-line antibiotics for URTI. Improvements were observed in antibiotic prescribing patterns over a four months period. Therefore, our study's improvement strategies and approaches can be extended to other disease management systems and locations.

Key words: Sore throat; Pharyngitis; Tonsillitis; Acute Otitis Media; Audit; URTIs.

J Infect Dev Ctries 2022; 16(12):1826-1834. doi:10.3855/jidc.17245

(Received 21 August 2022 – Accepted 31 October 2022)

Introduction

Upper respiratory tract infections (URTIs) are one of the most common presentations in medical practice, particularly in children, and they are characterised by diverse symptoms [1–3]. The three major categories of URTIs are pharyngitis, rhinosinusitis, and acute otitis media (AOM) [4]. Acute pharyngitis is a microbiological infection in the respiratory mucosa of the throat or tonsil resulting in throat pain, while AOM is an infection of the middle ear manifested by the presence of physical evidence of middle ear inflammation and other symptoms such as pain, irritability, or fever [4,5].

Depending on the age, 70-90% of the acute URTIs are caused by viral pathogens. Majority of cases require only supportive care such as analgesia, decongestants, and rehydration [3,6,7]. However, a minority of URTIs are caused by bacterial pathogens, mostly group A beta-hemolytic streptococci (GAS). These could lead to fatal intra/extra-cranial complications if they are not appropriately treated and monitored properly [7–9]. The Centers for Disease Control and Prevention (CDC) has recommended amoxicillin or penicillin as the first choices for treatment of GAS [10].

Antibiotic resistance is considered a serious clinical threat that could be fatal at the individual and population levels [11]. Geographical areas with high antibiotic use were found to have high antibiotic resistance [12]. Antibiotics are commonly prescribed in general medicine for treating URTIs [13–15]. Antibiotic overuse is increasing worldwide, and multidrug-resistant pathogens are not uncommon in Palestine [16–18]. The primary reason of antibiotic overuse is the uncertainty in differentiating bacterial from viral infections [9]. Therefore, the National Institute for Health and Care Excellence (NICE) created guidelines for URTI treatment, including acute sore throat (2018) and acute otitis media (2022). These guidelines advise that only the patients who meet specific criteria should receive antibiotics in order to balance infection complications, antibiotic resistance and adverse reactions [19,20].

Audits conducted in various nations have demonstrated that physicians do not generally adhere to the international guidelines for appropriate antibiotic use for URTI [13,14] . However, to our knowledge, there are no published studies assessing the adherence of general practitioners to URTI treatment guidelines in West Bank – Palestine. Additionally, there is a gap in the auditing process in Palestine [21], and this study may be the first published complete cycle audit in West Bank. There are no local guidelines provided for URTI treatment by the Palestinian Ministry of Health. Therefore, we adopted the international NICE guidelines. This audit aims to assess the effect of adopting the international clinical guidelines for treating URTIs, mainly the practice of prescribing antibiotics, over a period of four months using readily accessible methods and resources. The adoption of international clinical guidelines will lead to a greater emphasis on prescribing the appropriate antibiotic for suspected bacterial infection in the correct dose, frequency, and duration, thereby reducing the incidence of bacterial URTI complications. This will ultimately result in a decrease in the rate of antibiotic resistance, the cost of treatment, and the side effects of antibiotics.

Methodology

Study design, setting, and variables

This study is a full audit cycle (audit, implementation and re-audit) that was done at a Government Hospital, in West Bank - Palestine. Audit and reaudit phases included 297 patients who presented between March-June 2022 to the emergency department of the Government Hospital with a diagnosis of sore throat, tonsillitis or AOM. Random shift selection using random.org was done at the beginning of the audit/reaudit phase to make a schedule that covers 30 shifts in each phase. Data collection was carried out by short interviews with the emergency department doctors (non-training emergency service medical doctors) who were attending to cases with URTI. The intervention phase was held during April-May 2022 and included a survey to assess the underlying causes of non-adherence, followed by several interventions to improve the reaudit outcomes, including presentations, smart applications and circulars that will be discussed below in the implementation phase section. Sociodemographic information (age and gender) and past medical history (any immunodeficiency disease, penicillin allergy, pregnancy or breastfeeding) were collected for each patient. Since the clinical data differed according to the patient's diagnosis, clinical data for each diagnosis are discussed in details in the audit phase session.

Audit phase

The audit phase was carried out in March 2022 before any intervention was done. Data were collected prospectively through a short 1–3 minute interview with the physician after attending a case of URTI. The doctor in charge determined the diagnosis of the case. The clinical data included criteria specified by the NICE guidelines. Patients with acute pharyngitis were assessed for the onset of symptoms including occurrence of a fever of 38 °C or cough in the last 24 hours, presence of purulence or severe inflammation upon oropharyngeal examination, and presence of swollen or tender lymph nodes. In the case of patients with AOM, we assessed the onset of symptoms and the presence of fever ≥ 38 °C in the last 24 hours, in addition to the questions on ear pain involvement (unilateral or bilateral), presence of discharge, and otoscopic ear exam findings.

Additionally, we checked if the patient developed any serious complications of URTIs, including: sepsis, peritonsillar or intracranial abscess, or mastoiditis. We also checked if the patient had significant dehydration (if the patient needed fluid replacement, based on assessment by the doctor in charge). The data also included information on the patient's management in the emergency department such as any intramuscular injections that were administered and the outpatient prescription details (analgesia, decongestant, antibiotics). We noted the information on antibiotics in detail, including its generic name, dose, frequency, duration and when to collect the antibiotic if needed.

Implementation phase

The implementation phase was between April 1 and May 31, 2022. NICE guidelines were adopted and used in the analysis due to the lack of local guidelines for URTIs in Palestine. Data were analyzed and checked according to the NICE acute sore throat (2018) and AOM (2022) guidelines. The analysis showed a deficit in the adherence to the correct prescribing practice of the antibiotics in the hospital. We surveyed 20 physicians attending shifts in the emergency department to assess the physicians' knowledge and the reasons behind the deficit in adherence. The first part of the survey assessed the knowledge of the physicians regarding the international URTI guidelines. The first question required a yes/no response and indicated that only 20% of the physicians use clinical criteria to treat URTIs. The rest of the questions required short-answers

about the appropriate choice of antibiotics for URTIs (first and second lines), and doses and durations of antibiotics; 70-85% of the questions were answered correctly. The second part of the survey was designed to determine the reason behind the over-use of antibiotics and use of second-line antibiotics instead of those in the first-line. It included check-list questions with additional blank space if the reason is not listed. The first question was about the reason for prescribing an antibiotic for patients who do not need one. The responses indicated that lack of time, pressure from the patients to get an antibiotic prescription and fear of secondary infections were the main reasons for antibiotic overuse (Figure 1). The second question explored the reason for prescribing a second-line antibiotic instead of first-line. The responses indicated that the top reasons were: belief that the Palestinian population is resistant to first-line antibiotics, fear of complications in infection, and belief that second line antibiotics guarantee higher success rate of treatment (Figure 2).

We began addressing the lack of knowledge by scheduling weekly educational presentations during the implementation phase. The oral presentations covered the following topics: introduction to URTIs, NICE guidelines for URTIs, antibiotic overuse and resistance, summary of the audit and survey results and recommendations, review of existing research on the different lines of antibiotics along with their failure and complication rates, and strategies to deal with demanding patients. At the same time, we designed mobile and desktop applications to ease the process of evaluating patients for antibiotic prescription, choosing the right antibiotic along with the dosage, frequency and duration, and when to collect the antibiotic if needed, which will ultimately address the lack of time issue. The application had provision to enter the age and weight of the patient, and a check list of the symptoms of each URTI; once the fields were filled out, the application gave recommendations regarding the need for an antibiotic, the appropriate choice of the antibiotic along with the dose, frequency and duration. Additionally, we put up large-size informational posters on the walls of the emergency department and shared a digital copy of the poster with the emergency department so that they could save it for future use. The posters included the scoring system and the antibiotic choices based on the NICE guidelines for the treatment of URTIs. The physicians attended a month-long individualized training on how to use these applications, thus making them easily accessible and usable. We also shared structured feedback to improve the prescribing practice of all physicians after each shift during the last month of the implementation phase.

Re-audit Phase

The re-audit phase was carried out in June 2022 in the same manner as the audit phase. No recommendations, feedback or presentations were shared during this phase because we wanted to assess the effect of the measures taken during the implementation phase.

Statistical analysis

The data were collected in Microsoft Excel and analyzed using SPSS (Version 22.0) for Windows. Sociodemographic and relevant clinical data were presented as means ± standard deviation (SD). Other clinical data were categorized and presented through custom tables using frequencies and percentages.

Figure 1. Results of survey about the cause behind overuse of antibiotics in URTI cases.

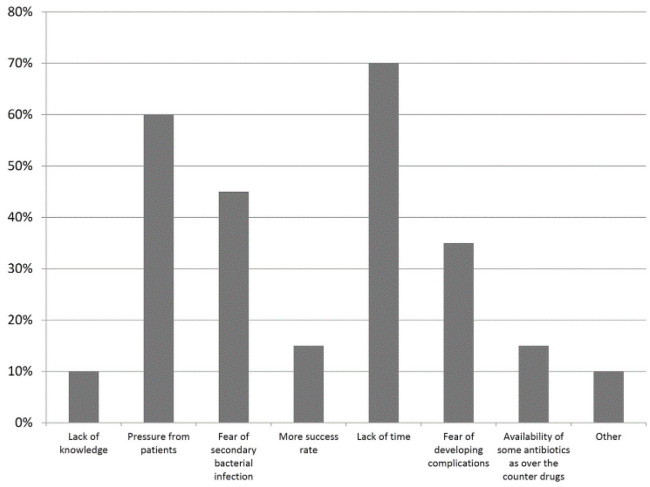
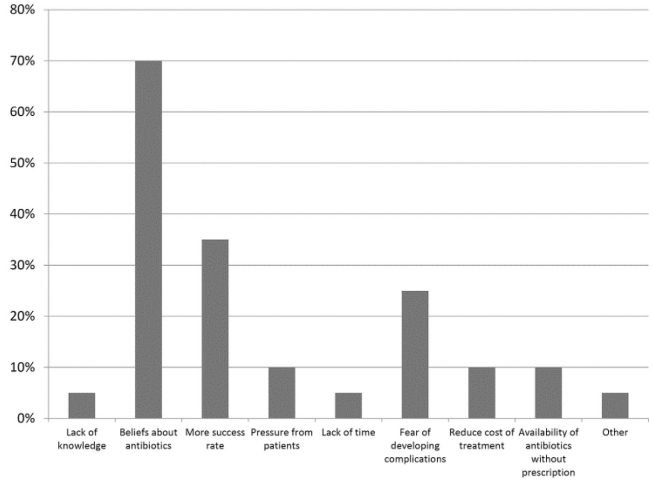


Figure 2. Results of survey about the causes behind prescribing second-line antibiotics in URTI cases.



Comparisons between groups were carried out using the Chi square test. We used multinomial logistic regression, to assess associations by calculating the odds ratios (OR) and their 95% confidence intervals (CIs). *p* values of < 0.05 were considered statistically significant.

Ethical consideration

Local ethical guidelines were followed. Written approvals were obtained from the Palestinian Ministry of Health and the hospital administration. Verbal consent from doctors to participate in the study were taken prior to each shift. Consent from patients was waived as the required data has no risk to them. All data were collected and treated with high confidentiality and were utilized only for the purpose of research.

Ethics approval and informed consent

We obtained approval to access medical records from the Palestinian Ministry of Health and the Tubas Government Hospital Administration. All procedures followed the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000. All data were collected and treated confidentially, kept safe and available to the researchers only. We used codes instead of names. Informed consent was waived as the study was a retrospective study and had no more than minimal risk.

Results

A total of 297 cases were observed in our study, including 169 cases in the audit phase and 128 cases in the re-audit phase. The mean age of the patients was 10.33 ± 12.54 years, and the mean onset of symptoms was 3.01 ± 2.19 days. The mean FeverPAIN score of the sore throat and tonsillitis patients was 2.45 ± 1.27. The general and clinical characteristics of the patients during the audit and the re-audit phases are presented in Table 1. Regarding the gender distribution, 57.9% were males, and 42.1% were females. Of the 297 cases, 169 cases had tonsillitis (56.9%), 88 cases had sore throat (29.6%), and 40 cases had AOM (13.5%). None of the patients were immunodeficient (*p* value = 0.000), however, 1.3% had penicillin allergy. Only a small proportion of the patients was pregnant (1%) or breastfeeding (0.7%).

The clinical characteristics and management options of sore throat, tonsillitis and acute otitis media patients are summarized in Table 2. A higher proportion of males had tonsillitis (61.5%) and AOM (62.5%), while a slightly higher proportion of females had sore throat (51.1%). More than half of the patients (56.2%) visited the hospital within ≤ 3 days after the onset of symptoms, 69.4% of the patients experienced a fever of ≥ 38°C in the last 24 hours, and 48.3% had a cough (*p* value < 0.05). Upon oropharyngeal examination of sore throat and tonsillitis patients, 21.4% of the cases showed signs of severe inflammation, while 36.2% of the patients had purulence discharge (*p* = 0.000). Ear examination of AOM patients indicated that most cases had unilateral involvement (60%), while the rest had bilateral involvement; only 12.5% developed otorrhea. Only 2.7% of the patients presented with fatal complications, and 13.7% developed significant dehydration. The majority of patients (66.3%) were given intramuscular injections in the hospital, including dexamethasone 4 mg (49.5%) or a mixture of diclofenac 75 mg and dexamethasone 4 mg (16.5%) (*p*=0.000).

Table 1. General and clinical characteristics of the patients during the audit and the re-audit phases.

	Phase			
Number of patients	**Audit Phase 169 Patients n (%)**	**Re-audit 128 Patients n (%)**	**Total 297 Patients n (%)**	***p* value**
Gender				
Male	101 (59.8%)	71 (55.5%)	172 (57.9%)	0.458
Female	68 (40.2%)	57 (44.5%)	125 (42.1%)	
Diagnosis				
Tonsillitis	97 (57.4%)	72 (56.3%)	169 (56.9%)	
Sore Throat	46 (27.2%)	42 (32.8%)	88 (29.6%)	0.395
AOM	26 (15.4%)	14 (10.9%)	40 (13.5%)	
Immunodeficiency	0 (0.0%)	0 (0.0%)	0 (0.0%)	0.000
Penicillin allergy	2 (1.2%)	2 (1.6%)	4 (1.3%)	0.079
Pregnant or breastfeeding				
Pregnant	3 (1.8%)	0 (0.0%)	3 (1.0%)	0.312
Breast Feeding	1 (0.6%)	1 (0.8%)	2 (0.7%)	

N: number; AOM: acute otitis media.

Table 2. Clinical characteristics and management approaches of sore throat, tonsillitis, and acute otitis media patients.

Number of patients	Diagnosis				*p* value
	Sore Throat 88 Patients n (%)	Tonsillitis 169 Patients n (%)	AOM 40 Patients n (%)	Total 297 Patients n (% of all cases)	
Gender					
Female	45 (51.1%)	65 (38.5%)	15 (37.5%)	125 (42.1%)	0.122
Male	43 (48.9%)	104 (61.5%)	25 (62.5%)	172 (57.9%)	
Attended rapidly < 3 days	55 (62.5%)	102 (60.4%)	10 (25.0%)	167 (56.2%)	0.004
Fever > 38 °C in the last 24 hours	49 (55.7%)	143 (84.6%)	14 (35.0%)	206 (69.4%)	0.000
Severe throat inflammation	4 (4.5%)	51 (30.2%)	-	55 (21.4%)	0.000
Throat purulence	8 (9.1%)	85 (50.3%)	-	93 (36.2%)	0.000
Cough	58 (65.9%)	66 (39.1%)	-	124 (48.3%)	0.000
Ear involvement					
Unilateral	-	-	24 (60.0%)	24 (60.0%)	-
Bilateral	-	-	16 (40.0%)	16 (40.0%)	-
Ottorhea			5 (12.5%)	5 (12.5%)	
Developed complication	1 (1.1%)	7 (4.1%)	0 (0.0%)	8 (2.7%)	0.195
Significant dehydration	8 (9.1%)	29 (17.2%)	3 (7.5%)	40 (13.5%)	0.098
Painkillers	81 (92.0%)	152 (89.9%)	37 (92.5%)	270 (90.9%)	0.000
Antihistamines or Anticholinergic	23 (26.1%)	10 (5.9%)	1 (2.5%)	34 (11.5%)	0.000
IM Injections					
Dexamethasone	28 (31.8%)	109 (64.5%)	10 (25.0%)	147 (49.5%)	
Diclofenac and Dexamethasone	30 (34.1%)	14 (8.3%)	5 (12.5%)	49 (16.5%)	0.000
Diclofenac	0 (0.0%)	0 (0.0%)	1 (2.5%)	1 (0.3%)	
Antibiotic	54 (61.4%)	156 (92.3%)	36 (90.0%)	246 (82.8%)	0.000

N: number; IM: intramuscular; AOM: acute otitis media.

Table 3. Change in the adherence of the hospital physicians to NICE URTI guidelines regarding the prescribing practice of antibiotics.

	Audit	Reaudit	Reaudit change	*p* value
	169 Patients n (%)	128 Patients n (%)	(%)	
Was the patient prescribed antibiotics?	147 (87.0%)	99 (77.3%)	-9.7%	0.029
If the patient was prescribed a prescription, was it prescribed in the correct dose, frequency, duration, and collection time?	41 (24.3%)	95 (74.2%)	49.9%	0.000
If the patient needed a direct antibiotic, was a direct antibiotic prescription given?	29 (93.5%)	43 (100.0%)	6.5%	0.091
If the patient needed a backup antibiotic, was a backup antibiotic prescription given?	2 (2.0%)	26 (46.4%)	44.4%	0.000
If the patient does not need an antibiotic, was no antibiotic prescription given?	10 (26.3%)	26 (89.7%)	63.4%	0.000
Was the patient prescribed a sufficient dose, frequency, and duration antibiotic prescription?	126 (85.7%)	98 (99.0%)	13.3%	0.000
Was the patient prescribed or given any type of analgesia (prescription or intramuscular)?	160 (94.7%)	125 (97.7%)	3.0%	0.196
If the patient was prescribed an antibiotic, was he/she prescribed a first-line antibiotic?				
Yes				
Penicillin	0 (0.0%)	0 (0.0%)	0.0%	
Amoxicillin	0 (0.0%)	41 (41.4%)	+ 41.4%	0.000
Total	0 (0.0%)	41 (41.4%)	+ 41.4%	
No				
Amoxi-clav	96 (65.3%)	35 (35.4%)	- 29.9%	
Cefdinir	13 (8.8%)	4 (4.0%)	- 4.8%	
Cefixime	18 (12.3%)	10 (10.1%)	- 2.2%	0.000
Cefuroxime	4 (2.7%)	0 (0.0%)	- 2.7%	
Azithromycin	16 (10.9%)	9 (9.1%)	- 1.8%	
Total	131 (89.1%)	49 (49.5%)	- 41.4%	

N: number; URTI: upper respiratory tract infection; NICE: The National Institute for Health and Care Excellence.

Most of the patients were prescribed painkillers (90.9%) and antibiotics (82.8%), and only 11.5% of them were prescribed antihistamines or anticholinergic medications ($p = 0.000$).

The change in the adherence of the physicians to the NICE URTI guidelines from the audit to the re-audit phases regarding the practice of antibiotic prescriptions, including the time to collect the prescription and contents of the prescription, are discussed in Table 3. The antibiotic prescription rate generally decreased from 87% in the audit phase to 77.3% in the re-audit phase ($p = 0.029$). The table also demonstrates the improvement in the prescribing practice in the reaudit phase compared to the audit phase. There was an obvious positive change in the percentage of overall accurate prescriptions (+ 49.9%, $p = 0.000$) in the reaudit phase. This change was a result of 6.5% positive change for accurate direct antibiotic prescriptions, + 44.4% for accurate backup antibiotic prescriptions ($p = 0.000$), and + 63.4% for no antibiotic prescriptions ($p = 0.000$). There was a significant improvement of + 13.3% in accurately prescribing the dose, frequency and duration of antibiotics, thus approaching a total of 99% improvement in the reaudit phase ($p = 0.000$). There was + 41.4% improvement in the first line antibiotics prescription including only amoxicillin (+ 41.4%) ($p = 0.000$), and the same percent reduction in the second line antibiotics, mostly amoxi-clav (-29.9%), azithromycin (-1.8%) and the other cephalosporins (-9.7%) ($p = 0.000$). There was also an overall increase of 3.0% in analgesia use in managing URTI cases.

Discussion

Full cycle audits are barely used in Palestine and this full cycle audit is one of the few available ones. This highlights the need for introducing and encouraging such type of research in Palestine. This audit aims to measure the adherence of some of the Palestinian Government Hospital doctors, specifically in West Bank, to the international guidelines when treating sore throat, tonsillitis, and AOM, and tries to significantly improve physicians' compliance by implementing different interventions within a short period of time. In addition, it aims to provide an effective model for other international facilities that suffer from similar problems.

The inappropriate use of antibiotics in URTIs is a global issue, even in developed countries [22,23]. Although antibiotics have no effect on the symptoms and recovery time of viral URTIs, physicians prescribe antibiotics for viral infections [24–26]. Antibiotics were prescribed for 87.0% of the patients during the audit phase in our study; this prevalence is slightly higher than other Arabian countries: Saudi Arabia (79%) [14] and United Arab Emirates (88%) [27]; and much higher than the prevalence in developed countries like UK (30.1%) [28], Taiwan (16.8%) [29], and other countries [13,14,30,31]. This highlights the urgent need for well-planed strategies and interventions to correct or at least stop the progression of such a problem.

Recently, it has been recommended to use a rapid antigen detection test or throat culture before prescribing antibiotics for acute pharyngitis [10,32]. However, this test is unavailable at the Palestinian Ministry of Health facilities, making it challenging to implement some criteria, such as modified the center criteria [32]. Even though clinically based criteria are less effective than laboratory tests and cultures, the available literature states that they are efficacious when used correctly and they can reduce the practice of prescribing inappropriate antibiotics [33,34]. Several audit cycles have reported that introducing clinical evidence-based criteria for assessing and treating URTIs reduced the overuse of antibiotics [35,36].

NICE recommendations and FeverPAIN scores were used for the assessment and management of acute tonsillitis and sore throat. They were used to determine the need for antibiotics, the time to collect antibiotics, and the appropriate antibiotic choice, dosage, frequency and duration [19,37]. The score comprises of five components: getting medical help rapidly within ≤ 3 days, fever $\geq 38°C$ in the last 24 hours, absence of cough, and evidence of purulence or signs of severe inflammation upon throat examination. The presence of each component added one point to the score. A score of 0-1 carries a low risk of bacterial infection and should not be prescribed antibiotics. A score of 2-3 has a moderate risk and should be prescribed a backup antibiotic that should be collected if symptoms worsen or the patient does not improve within three days. A score of 4-5 indicates a high risk of bacterial infection and should be prescribed an antibiotic immediately. In the case of AOM, NICE guidelines recommend that antibiotics should be given directly if the patient's age is < 2 years and the patient has bilateral ear involvement, or if the patient has otorrhea regardless of age. Apart from these cases, the patient should be prescribed no antibiotics or a backup antibiotic prescription [19,20]. These results, in addition to the positive results from our study, indicate the capability of using clinical guidelines to improve the practice of prescribing antibiotics, especially in developing countries that suffer from limited resources and laboratory equipment.

The most frequently reported reason for antibiotic overuse was the lack of time to use the criteria. This issue was mainly managed by offering widely available large wall posters and easy-to-use mobile and computer-based score calculator applications. A previous trial has reported that these types of calculators were the most significant factors in the improvement in antibiotic use [13]. We recommend encouraging the use of the available technologies as they are time effective, and help achieve accurate and fast management for the patients.

NICE guidelines and the CDC recommend penicillin and amoxicillin as the first-line of treatment against bacterial URTIs [10,19,20]. The most frequently reported motive for second-line antibiotic prescription is the belief that the patients have resistance to first-line antibiotics, even without the presence of any local or global evidence to support these beliefs [10]. Although several global studies reported non-significant difference in the outcomes of using second-line antibiotics in URTIs, physicians still have the wrong beliefs. In order to address this issue, we reviewed several international studies that reported minimal differences in the outcomes (success and complication rates) of using the second-line of antibiotics compared to the first-line one [38–41]. These efforts were made to improve both the knowledge gap of the physician and to discuss and defend their false beliefs.

During the audit phase, we found that physicians tend to mainly prescribe second-line antibiotics, especially Amoxi-Clav, to guarantee a more successful treatment strategy. The trend toward the use of second line antibiotics for URTIs was also reported by another Arabian study [14]. Some studies have shown that Amoxi-Clav was more effective in treating bacterial pharyngitis, including reducing the duration of symptoms, recurrence and failure rate [38,42–44]. Globally, it was reported that the shorter time needed by Amoxi-Clav (3-5 days) to treat infection compared to 10 days needed by first-line antibiotics is considered a motive for the physicians to prescribe it and improve the compliance rate [45]. Even though third-generation cephalosporins are only indicated in the presence of penicillin resistance, a trend towards the use of these antibiotics as the first-line treatment for the general population is starting to emerge in Palestine [46]. Regular educational seminars throughout the year, combined with evaluating the physicians' knowledge is highly recommended to manage such a problem; this approach is easy and cost effective in the developing countries.

A surprising positive change of + 49.9% was noticed in the correct antibiotic prescribing practice with the proper dose, frequency, duration and when to collect the antibiotics if needed. Moreover, an improvement of + 41.4% was noticed in prescribing first-line antibiotics instead of second-line options. This change was considered remarkably successful when compared to other URTI improvement audits from other countries. For example, our improvement is numerically higher than the results of a two-cycles of audit with +14% improvement in the adherence to URTIs NICE guidelines [13], and a 1-year full cycle clinical audit that succeeded in reducing unnecessary antibiotic prescriptions for URTIs by 16% [31]. We recommend the use of our approach in other facilities that treat URTIs. Further auditing of antibiotic practice in other types of human infections along with the use of similar means used in our study is also recommended.

Our study had several limitations. Firstly, this audit involved a single government hospital and cannot be generalized for the overall Palestinian population. Secondly, refusal of some physicians to participate in the study, physicians' lack of time to do the interview, and poor system record keeping in the hospital were some of our major challenges. Thirdly, some physicians did not attend some of the trainings, and some others refused to use the mobile/desktop applications. Finally, a minor limitation was the lack of financial support to make more poster presentations and pay for better designed applications.

Conclusions

We found poor adherence to the international guidelines of antibiotic prescription for URTIs which might indicate a national problem. There is a noticeable trend towards using the second-line antibiotics for URTI in Palestine. Our interventions to improve compliance with the national antibiotic guidelines for URTI appeared to have positively changed the prescribing practice over a short period of time. This improvement highlights the importance of using audits in West Bank, Palestine. Moreover, we believe that our study's improvement strategies and approach could be carried out easily in other medical facilities. We faced several limitations, but with patience and strategic planning, we overcame them.

Acknowledgements

We would like to thank the Ministry of Health staff and the Governmental Hospital staff who helped us and facilitated

our work. We would also like to thank Dr Basma Damiri for her help with the data analysis.

Authors' Contributions

HA: study design, data collection, analysis and coordination, and manuscript drafting; MA: study design, data collection, manuscript drafting. Both the authors have read and agreed on the journal to which the article was submitted and gave approval of the last version to be published.

References

1. Wessels MR (2022) Clinical practice. Streptococcal pharyngitis. N Engl J Med 364: 648-655.
2. Spinks A, Glasziou PP, Del Mar CB (2013) Antibiotics for sore throat. Cochrane Database Syst Rev 11: CD000023.
3. Worrall GJ (2007) Acute sore throat. Can Fam Physician 53: 1961–1962.
4. Morris PS (2009) Upper respiratory tract infections (including otitis media). Pediatr Clin North Am 56: 101–117.
5. Harmes KM, Blackwood RA, Burrows HL, Cooke JM, Harrison RV, Passamani PP (2013) Otitis media: diagnosis and treatment. Am Fam Physician 88: 435–440.
6. Jain N, Lodha R, Kabra SK (2001) Upper respiratory tract infections. Indian J Pediatr 68: 1135–1138.
7. Bartlett A, Bola S, Williams R (2015) Acute tonsillitis and its complications: an overview. J R Nav Med Serv 101: 69–73.
8. Luo R, Sickler J, Vahidnia F, Lee Y-C, Frogner B, Thompson M (2019) Diagnosis and management of group A streptococcal pharyngitis in the United States, 2011-2015. BMC Infect Dis 19: 193.
9. Treebupachatsakul P, Tiengrim S, Thamlikitkul V (2006) Upper respiratory tract infection in Thai adults: prevalence and prediction of bacterial causes, and effectiveness of using clinical practice guidelines. J Med Assoc Thai 89: 1178–1186.
10. Centers for Disease Control (2022) Pharyngitis (Strep Throat). Available: https://www.cdc.gov/groupastrep/diseases-hcp/strep-throat.html. Accessed: 27 Aug 2022.
11. Lipsitch M, Bergstrom CT, Levin BR (2000) The epidemiology of antibiotic resistance in hospitals: paradoxes and prescriptions. Proc Natl Acad Sci U S A 97: 1938–1943.
12. Hicks LA, Chien Y-W, Taylor TH, Haber M, Klugman KP, Active Bacterial Core Surveillance (ABCs) Team (2011) Outpatient antibiotic prescribing and nonsusceptible *Streptococcus pneumoniae* in the United States, 1996-2003. Clin Infect Dis 53: 631–639.
13. Razai M, Hussain K (2017) Improving antimicrobial prescribing practice for sore throat symptoms in a general practice setting. BMJ Qual Improv Rep 6: u211706.w4738.
14. Olwi RI, Olwi DI (2021) Trends in the use of antibiotics for pharyngitis in Saudi Arabia. J Infect Dev Ctries 15: 415–421. doi: 10.3855/jidc.12822.
15. Goossens H, Ferech M, Vander Stichele R, Elseviers M, ESAC Project Group (2005) Outpatient antibiotic use in Europe and association with resistance: a cross-national database study. Lancet 365: 579–587.
16. Karam G, Chastre J, Wilcox MH, Vincent J-L (2016) Antibiotic strategies in the era of multidrug resistance. Crit Care 20: 136.
17. Chen L, Al Laham N, Chavda KD, Mediavilla JR, Jacobs MR, Bonomo RA, Kreiswirth BN (2015) First report of an OXA-48-producing multidrug-resistant Proteus mirabilis strain from Gaza, Palestine. Antimicrob Agents Chemother 59: 4305–4307.
18. Al Jarousha AMK, El Jadba AHN, Al Afifi AS, El Qouqa IA (2009) Nosocomial multidrug-resistant *Acinetobacter baumannii* in the neonatal intensive care unit in Gaza City, Palestine. Int J Infect Dis 13: 623–628.
19. National Institute of Health and Care Excellence (nd) Sore throat (acute): antimicrobial prescribing. Available: https://www.nice.org.uk/guidance/ng84/. Accessed: 27 Aug 2022.
20. National Institute of Health and Care Excellence (nd) Otitis media (acute): antimicrobial prescribing. Available: https://www.nice.org.uk/guidance/ng91. Accessed 27 Aug 2022.
21. Alyacoubi S, Böttcher B, Albarqouni L, Elessi K (2021) Clinical audit as a quality improvement tool in the Gaza Strip: an audit of audits. Lancet 398 Suppl 1: S13.
22. Gottlieb S (2004) Study shows new approach to managing sore throats. BMJ 328: 914.
23. Centor RM, Witherspoon JM, Dalton HP, Brody CE, Link K (1981) The diagnosis of strep throat in adults in the emergency room. Med Decis Making 1: 239–246.
24. Woolley SL, Bernstein JM, Davidson JA, Smith DRK (2005) Sore throat in adults - does the introduction of a clinical scoring system improve the management of these patients in a secondary care setting? J Laryngol Otol 119: 550–555.
25. Brumfitt W, Slater JD (1957) Treatment of acute sore throat with penicillin; a controlled trial in young soldiers. Lancet 272: 8–11.
26. Krober MS, Bass JW, Michels GN (1985) Streptococcal pharyngitis. Placebo-controlled double-blind evaluation of clinical response to penicillin therapy. JAMA 253: 1271–1274.
27. John LJ, Cherian M, Sreedharan J, Cherian T (2014) Patterns of antimicrobial therapy in acute tonsillitis: a cross-sectional hospital-based study from UAE. An Acad Bras Cienc 86: 451–457.
28. Shallcross L, Beckley N, Rait G, Hayward A, Petersen I (2017) Antibiotic prescribing frequency amongst patients in primary care: a cohort study using electronic health records. J Antimicrob Chemother 72: 1818–1824.
29. Chang L-Y, Lai C-C, Chen C-J, Cho C-Y, Luo Y-C, Jeng M-J, Wu K-G (2017) Recent trends in prescribing antibiotics for acute tonsillitis in pediatric ambulatory care in Taiwan, 2000-2009: a nationwide population-based study. J Microbiol Immunol Infect 50: 500–506.
30. Patel C, Green BD, Batt JM, Kholmurodova F, Barnes M, Geyer WJ, Benson J (2019) Antibiotic prescribing for tonsillopharyngitis in a general practice setting: can the use of modified centor criteria reduce antibiotic prescribing? Aust J Gen Pract 48: 395–401.
31. Alfaqawi M, Abuowda Y, Böttcher B, Alserr K, Elmassry AE (2021) Antibiotic use in acute upper respiratory tract infections and uncomplicated lacerations in the Gaza Strip: clinical audit and re-audit. Lancet 398 Suppl 1: S7.
32. Roggen I, van Berlaer G, Gordts F, Pierard D, Hubloue I (2013) Centor criteria in children in a pediatric emergency department: for what it is worth. BMJ Open 3: e002712.
33. Flynn M, Hooper G (2020) Antimicrobial stewardship though FeverPAIN score: successes and challenges in secondary care. Clinical Infection in Practice 7–8: 100024.
34. Ebell MH (2014) Diagnosis of streptococcal pharyngitis. Am Fam Physician 89: 976–977.

35. Woolley SL, Bernstein JM, Davidson JA, Smith DRK (2005) Sore throat in adults - does the introduction of a clinical scoring system improve the management of these patients in a secondary care setting? J Laryngol Otol 119: 550–555.
36. Palla AH, Khan RA, Gilani AH, Marra F (2012) Over prescription of antibiotics for adult pharyngitis is prevalent in developing countries but can be reduced using McIsaac modification of centor scores: a cross-sectional study. BMC Pulm Med 12: 70.
37. Seeley A, Fanshawe T, Voysey M, Hay A, Moore M, Hayward G (2021) Diagnostic accuracy of Fever-PAIN and centor criteria for bacterial throat infection in adults with sore throat: a secondary analysis of a randomised controlled trial. BJGP Open 5: BJGPO.2021.0122.
38. Dykhuizen RS, Golder D, Reid TM, Gould IM (1996) Phenoxymethyl penicillin versus co-amoxiclav in the treatment of acute streptococcal pharyngitis, and the role of beta-lactamase activity in saliva. J Antimicrob Chemother 37: 133–138.
39. Principi N, Marchisio P (1991) Cefixime vs amoxicillin in the treatment of acute otitis media in infants and children. Drugs 42 Suppl 4: 25–29.
40. Casey JR, Pichichero ME (2004) Meta-analysis of cephalosporins versus penicillin for treatment of group A streptococcal tonsillopharyngitis in adults. Clin Infect Dis 38: 1526–1534.
41. Wagner FP, Mathiason MA (2008) Using centor criteria to diagnose streptococcal pharyngitis. Nurse Pract 33: 10–12.
42. Chen LE, Shen YZ, Jiang DY, Feng GL, Zhang XL, Wang YF (2017) Amoxicillin and clavulanate potassium in treating children with suppurative tonsillitis. J Biol Regul Homeost Agents 31: 625–629.
43. Skarpeid PL, Høye S (2018) Phenoxymethylpenicillin versus amoxicillin for infections in ambulatory care: a systematic review. Antibiotics 7: 81.
44. Asensi F, López-Hontangas JL, Otero M, Santos M, Román J, Pérez-Tamarit D (1999) Comparison between penicillin and amoxicillin-clavulanic acid for the treatment of recurrent tonsillopharyngitis in childhood. Rev Esp Quimioter 12: 211–214.
45. Hedrick JA (2010) Community-acquired upper respiratory tract infections and the role of third-generation oral cephalosporins. Expert Rev Anti Infect Ther 8: 15–21.
46. Idsoe O, Guthe T, Willcox RR, de Weck AL (1968) Nature and extent of penicillin side-reactions, with particular reference to fatalities from anaphylactic shock. Bull World Health Organ 38: 159–188.

Corresponding author

Haytham AbuMohsen, MD
Tubas Governmental Hospital, PO Box 7,
West Bank, occupied Palestinian territory, 00970.
Tel: +972595705394,
Fax: +97292574399
Email: hithammohamad97@gmail.com.

Conflict of interests: No conflict of interests is declared.