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Effectiveness of clinical pathway for upper respiratory tract infections in emergency department

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ABSTRACT

Objective: We aimed to demonstrate the benefits of implementing a clinical pathway to decrease the inappropriate use of antibiotics in upper respiratory tract infections (URTI) in an emergency department (ED).
Methods: The study was performed in a hospital with 300 beds. All patients who applied with URTI from 1st to 30th of April 2017 were included and the appropriateness of the antibiotics were compared with the patients in the same period in 2016. A checklist for the clinical pathway of URTI was completed by the ED physicians.
Results: 351 patients were included, 176 these patients were in pre-ASP period and 175 patients were in post-ASP period. The rate of prescriptions including antibiotics was 49% in pre-ASP period and has decreased to 29% in post-ASP period ($p < 0.001$). Adherence to clinical pathway has increased from 50% to 80% ($p < 0.001$). In the post-ASP period, clinical pathway was used in 133 out of 175 patients (76%) and the consequently rate of appropriate antibiotic use was 82%.
Conclusion: The implementation of clinical pathway for URTI has decreased inappropriate antibiotic use in ED. As the secondary effect, using clinical pathway in ED also has increased the awareness of ED physicians who did not adhere to clinical pathway.

Introduction

The Organization for Economic Co-operation and Development (OECD) Health Policy Studies reported that Turkey is one of the countries with the highest rates of antimicrobial resistance (2018), therefore control of antibiotic consumption is an urgent need (Isler et al., 2019). Upper respiratory tract infection (URTI) is one of the leading causes of outpatient admission and antibiotic prescription (Shapiro et al., 2014; Sharma et al., 2017; Steinman et al., 2003). High rates of antibiotic consumption in URTI increase the risk of adverse events, healthcare costs, and antimicrobial resistance (Grijalva et al., 2009; Jenkins et al., 2013). Around half of the antibiotic prescriptions in the emergency department (ED) are either unnecessary or inappropriate (Jenkins et al., 2013).

Unnecessary antibiotic consumption in viral infections and antimicrobial resistance has prompted the implementation of antimicrobial stewardship programs (ASP). The ASPs including implementation of national guidelines (Ouldali et al., 2017) and pharmacist intervention (Davis et al., 2016; Santiago et al., 2016; Zhang et al., 2017) have been shown to decrease inappropriate antibiotic prescription in the ED. However, more clinical data are needed (Barlam et al., 2016). The Guideline for "Implementing an antibiotic stewardship" by the Infectious Diseases Society of America (IDSA) has suggested facility-specific clinical pathways to optimize prescribing practices for areas of high antibiotic consumption. In this study we have demonstrated the benefit of implementing a clinical pathway by decreasing inappropriate antibiotic prescription among the patients with diagnosis of URTI in an emergency department.

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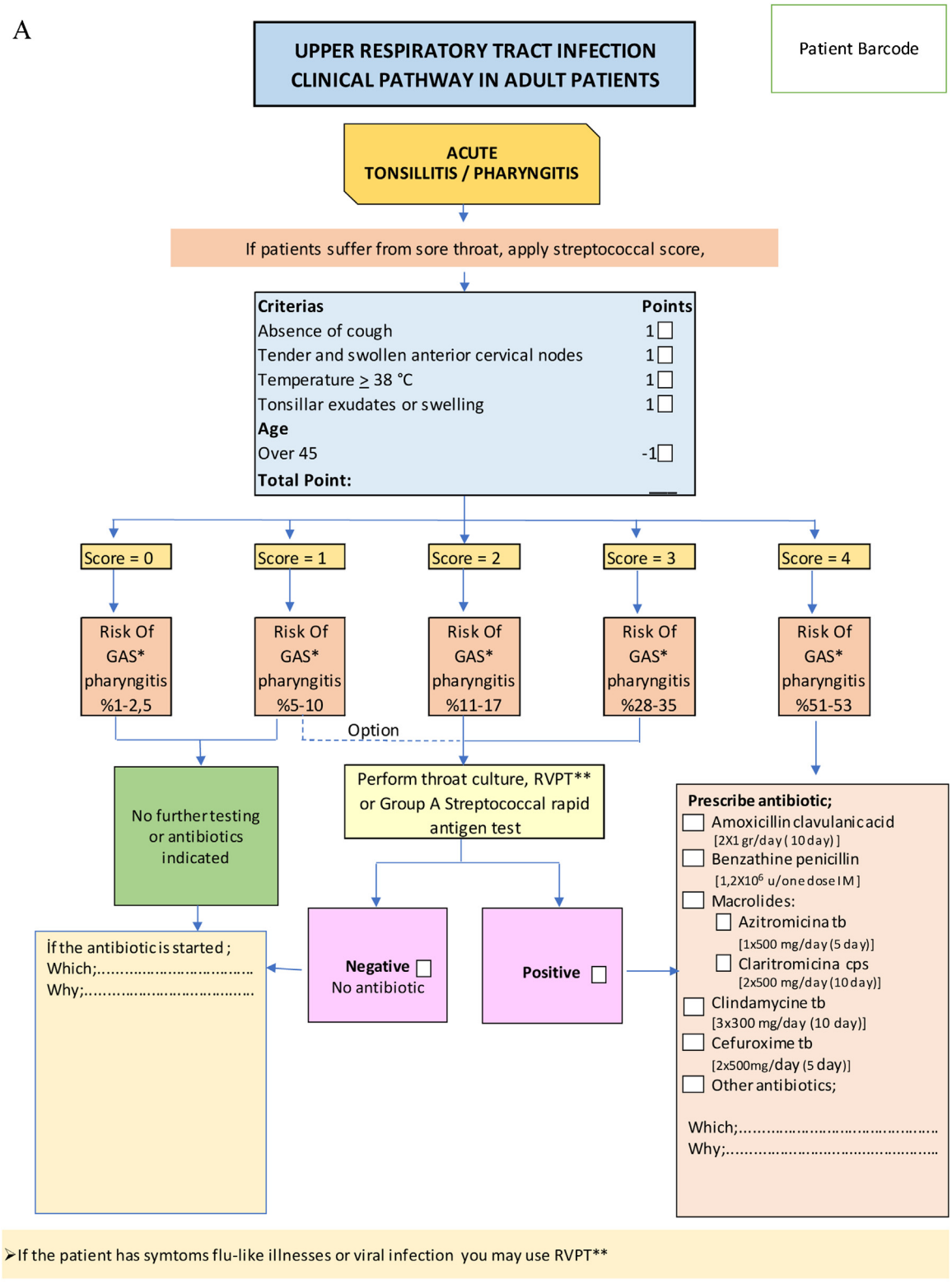

Figure 1. (A) Upper respiratory tract infection clinical pathway in adult patients, page 1. (B) Upper respiratory tract infection clinical pathway in adult patients, page 2.

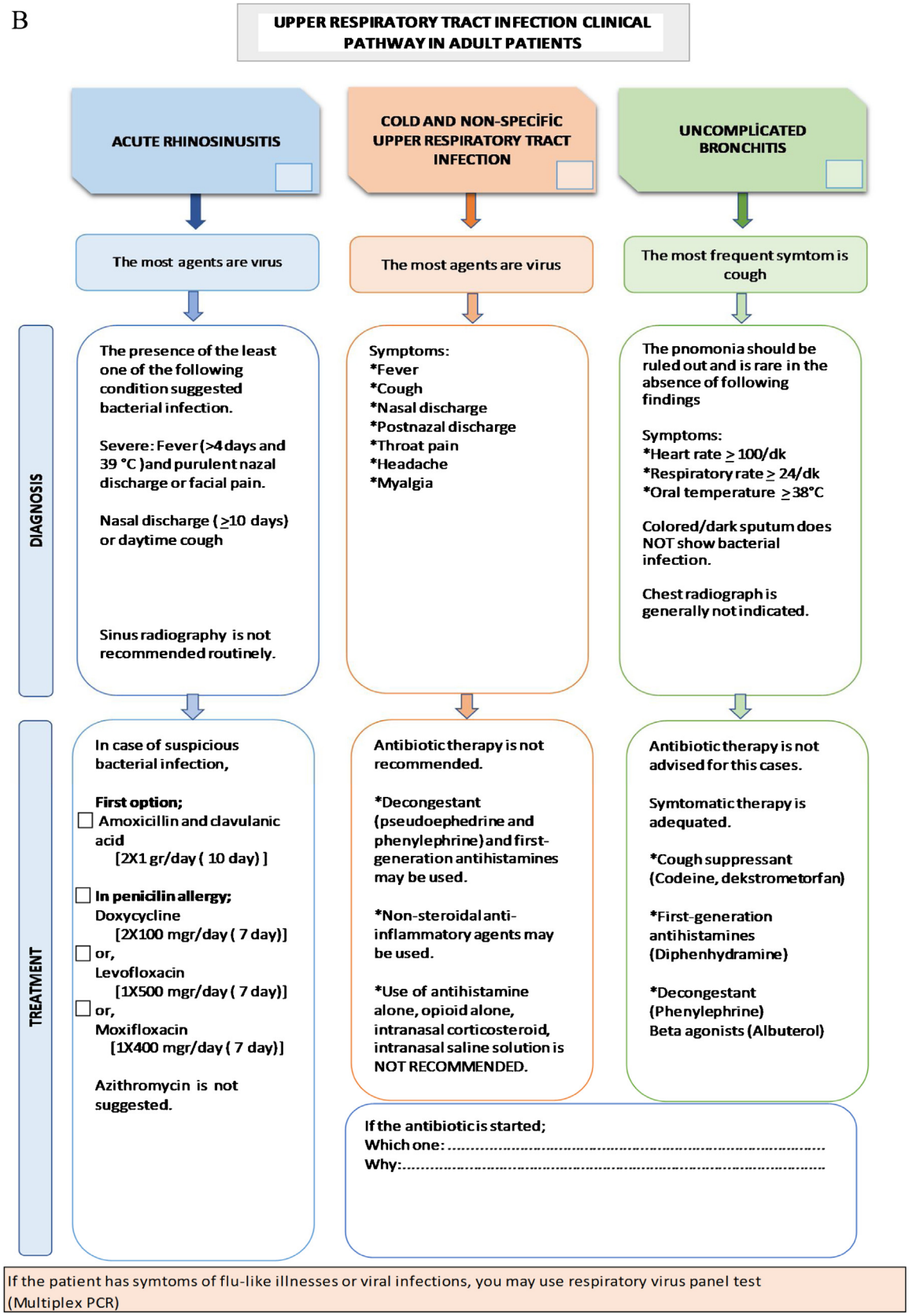

Figure 1. (Continued)

Methods

Study design and population

The study was performed in a private foundation hospital in Istanbul with 300 beds. We prepared an URTI clinical pathway (CP) which is one sheet, two pages and implemented it in March 2017 to optimize antibiotic use in ED (Figure 1A and B). In our study design we used the checklist of "Standards for Quality Improvement Reporting Excellence (SQUIRE 2.0).

The charts of the patients who applied to the ED with diagnosis of URTI from 1 st to 30th of April 2017 were evaluated for adherence to CP, prospectively. The findings were compared with the data obtained during the same term in 2016. Assessment of the appropriateness of antibiotic prescriptions was evaluated with the same infection control team and we have utilized the same CP during evaluation phase in two parts. The patients who were hospitalized because of various other comorbidities were excluded.

Definition of clinical pathway

The URTI clinical pathway was created based on a modified CENTOR score that was developed for acute tonsillitis/pharyngitis (Choby, 2009) and deduced from the recommendation of Centers for Disease Control and Prevention (CDC) and Infectious Diseases Society of America (IDSA). Clinical pathway was applied for acute tonsillitis / pharyngitis, acute rhinosinusitis, common cold, non-specific URTI and bronchitis (Chow et al., 2012; Shulman et al., 2012) (Figure 1A and B).

According to the clinical pathway; patients with CENTOR score results of $\leq$0 were to be discharged without antibiotic order and further laboratory tests. If the CENTOR score was equal to one, the patients could be discharged without antibiotic therapy and laboratory tests, but if needed, further laboratory tests such as throat culture, respiratory virus panel test or Group A streptococcal rapid antigen test was requested. For patients with CENTOR score of two or three, further laboratory tests were to be done. If the results were negative, patients should be monitored without antibiotic therapy. If the results were positive, the physicians should prescribe an appropriate antibiotic that was listed in the CP. The patients with CENTOR score of four were prescribed an appropriate antibiotic from the CP list.

Implementation and evaluation of ASP

1. ED physicians were informed about the CP. The patients who were older than 15 years old with suspected diagnoses of URTI were included.
2. In suspected cases of URTI, the checklist for URTI was inserted to the patient folders by the ED physicians.
3. The ED physician should complete the checklist according to the subcategory (for acute tonsillitis / pharyngitis, acute rhinosinusitis, common cold, non-specific URTI and bronchitis) of the CP. Prescribed antibiotics which were not compliant with the CP should be justified and noted on the inserted checklist attached to the patient's folder.
4. Assigned ED nurse prepares the list of patients with URTI and shares it with the infection control (IC) nurse on a daily basis.
5. Assigned IC nurse reviews the charts of all patients and checks whether the charts have complied with the CP or not.
6. Assigned IC nurse and assigned ID physician review the charts and the prescriptions adherence to the CP.

Statistical analysis

Mean comparisons for continuous variables were done using independent group t tests. Proportion comparisons for categorical variables were done using Chi-Square tests, although the Fisher's Exact Test was used, when data were sparse. Significance was set as $p < 0.05$ using two-sided comparisons. STATA SE/15.0 software package was used in the analysis.

Results

We included 351 patients; 176 patients in pre-ASP period and 175 patients in post-ASP period from ED were included. The mean age was 38 (16–90) years and 51% were female. Two groups were similar in terms of age, gender and chronic diseases (Table 1).

The rate of prescriptions including antibiotic was 49% in the pre-ASP period. It was decreased to 29% in post-ASP period ($p < 0.001$). The rate of prescriptions including antiviral drugs was 18% in the pre-ASP period. This was increased to 26% in the post-ASP period ($p = 0.04$). Adherence to clinical pathway was found at 50% in the pre-ASP period. This was increased to 80% in the post-ASP period ($p < 0.001$, Table 2). In total, the most commonly prescribed antibiotics were amoxicillin and clavulanic acid (36.8%), cefuroxime (29%) and azithromycin (13%) were similar both in the pre-ASP and in the post-ASP periods. Additional to these outcomes, readmission rate in one week was not significant in both phases (pre-ASP; 14/176 and post-ASP; 11/175, $p = 0.543$) and no mortality was detected within 30 days in both phases.

In the post-ASP period, the CP was applied to 133 out of 175 patients (76%), which resulted in 82% of appropriate antibiotic usage. However, among 42 out of 175 patients (24%) the CP was not applied by ED physicians and in this case the rate of appropriate antibiotic use was 73% (Figure 2).

We also analyzed rapid antigen test in both terms, and the rate of using Group A Streptococcal rapid antigen test increased from 2% to 26% ($p < 0.001$) in the post-ASP period. However, the increase in the rate of using rapid influenza diagnostic test with PCR was not significantly different (in pre-ASP; 16%, in post-ASP; 19%). The use of molecular respiratory panel test was limited (Table 3).

Discussion

Antibiotic consumption is high among the patients with respiratory tract infections in ED (Donnelly et al., 2014; McKay et al., 2016; Timbrook et al., 2017). Turkey was reported as having the highest rate of antibiotics in OECD countries and it was also shown that the highest number of antibiotics were prescribed in

Table 1
Characteristics of the patients.

	Total n = 351 (%)	Pre-ASP n = 176 (%)	Post-ASP n = 175(%)	*p*
Mean age (sd; min-max)	38 (14;16–90)	37 (13;16–90)	39 (15;16–89)	0.132
Female gender	179 (51)	101 (57)	78 (45)	0.15
Diagnosis				
Upper respiratory infection	278 (79)	146 (83)	132 (75)	0.082
Tonsillitis	34 (10)	14 (8)	20 (11)	0.271
Bronchitis	22 (6)	7 (4)	15 (9)	0.076
Pharyngitis	12 (3)	7 (4)	5 (3)	0.564
Rhinosinusitis	5 (1)	2 (1)	3 (2)	0.648
Comorbidities				
Diabetes mellitus	8 (2)	3(2)	5(3)	0.469
Chronic heart disease	11(3)	6(3)	5(3)	0.767
Other disease	19(5)	12(7)	7(4)	0.243

Table 2
Number of prescriptions.

	Total n = 351 (%)	Pre-ASP n = 176 (%)	Post-ASP n = 175 (%)	p
The number of the prescriptions including antibiotics	137 (39)	85 (49)	52 (29)	<0.001
The number of the prescriptions including antivirals	78 (22)	31 (18)	47 (26)	0.04
Adherence to clinical pathway	226 (64)	87 (50)	139 (80)	<0.001

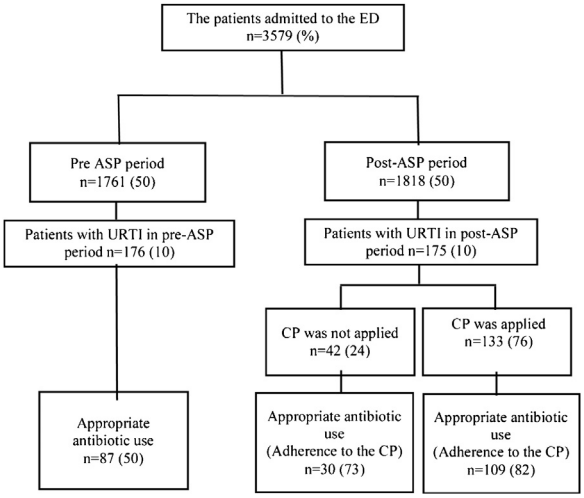

Figure 2. The evaluated patients with URTI in pre-ASP and post-ASP period.

Table 3
Laboratory Tests.

	Total n = 351 (%)	Pre-ASP n = 176 (%)	Post-ASP n = 175 (%)	p
Group A Streptococcal rapid antigen test	48 (14)	3 (2)	45 (26)	<0.001
Rapid Influenza A-B Test	62 (18)	29 (16)	33 (19)	0.559
Rapid Respiratory Tract Virus Test	3 (1)	1 (1)	2 (1)	0.559

primary health care facilities (Isler et al., 2019). Inappropriate antibiotic use in URTI has forced us to administer a clinical pathway in ED to decrease antibiotic prescription. In this study, we demonstrated the significant beneficial effect of a clinical pathway for decreasing inappropriate antibiotic use among patients with URTI in ED. Prescriptions including at least one antibiotic were decreased, while antiviral use was increased and adherence to clinical pathway was increased in the post-ASP period when compared with pre-ASP period (Table 2).

The clinical pathway specific for the patients with febrile neutropenia was shown to decrease inappropriate antimicrobial use (Madran et al., 2018). In a recent study conducted in a tertiary university hospital in France, several ASPs including local treatment guidelines were implemented in ED and unnecessary antimicrobial prescriptions were decreased after implementation of these ASPs (Dinh et al., 2017).

We observed that the rate of appropriate antibiotic use was increased in the second phase, despite the fact that CP was not applied among the patients (Figure 2). This observation could be related to the influence of the clinical pathway to all the physicians, despite lack of their full adherence to the CP.

Rapid microbiological diagnostic tests including Group A Streprococcal rapid antigen test in ED are practical to discriminate bacterial and viral URTI. In our study, Group A Streprococcal rapid antigen test was a component of our clinical pathway and its increased usage may have contributed to decreasing antibiotic consumption. The rapid influenza diagnostic test was not used frequently. This could be due to its lower sensitivity. Molecular based tests were shown to decrease inappropriate antibiotic use in patients with respiratory tract infection in recent studies (Branche et al., 2015; Keske et al., 2018). In a study conducted in our center, the impact of molecular rapid diagnostic test on ASP was assessed in cases of URTI. It was shown that the rapid molecular test decreased inappropriate antibiotic use in viral URTIs (Keske et al., 2018). However, implementing this test in ED may not be practical and cost effective.

The control group in our study was retrieved retrospectively; this could be one of the limitations of our study, but a prospective design would not be possible while we were improving the system. In our algorithm, we suggested amoxicillin-clavulanic, although amoxicillin was suggested in the IDSA guideline. This was because of considering the acceptance rate of physicians. But, in the future, amoxicillin-clavulanic acid could be replaced by amoxicillin. Our study has shown the beneficial effects of implementing a clinical pathway for URTI in decreasing antibiotic consumption; however, long term follow-up is necessary.

In conclusion, the implementation of a clinical pathway for URTI has significantly decreased inappropriate antibiotic use in ED. The implementation of the ASP in ED has increased the awareness of ED physicians who did not use the clinical pathway.

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Institutional review board of Koc University approved the study with the number of 2018.084.IRB1.013.

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There is no conflict of interest for any authors.

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