

Assessment of a new algorithm in the management of acute respiratory tract infections in children

Seyed Ahmad Tabatabaei¹, Seyed Alireza Fahimzad², Ahmad Reza Shamshiri³, Farideh Shiva⁴, Shadab Salehpor⁵, Shirin Sayyahfar⁶, Ghamartag Khanabaei¹, Shahnaz Armin⁷, Sedigheh Rafii Tabatabaei⁴, Alireza Khatami⁸, Maryam Kadivar⁹

¹Assistant Professor, Department of Pediatrics, Mofid Children Hospital, Shahid Beheshti University of Medical Sciences. ²Assistant Professor, Department of Pediatrics, Pediatric Infections Research Center, Shahid Beheshti University of Medical Sciences. ³PhD Candidate, Department of Epidemiology and Biostatistics, School of Health and Institute of Health Research, Tehran University of Medical Sciences. ⁴Assistant Professor, Pediatric Infections Research Center, Department of Pediatrics, Shahid Beheshti University of Medical Sciences. ⁵Assistant Professor, Department of Pediatrics, Shahid Beheshti University of Medical Sciences. ⁶Assistant Professor, Department of Pediatrics, School of Medicine, Tehran University of Medical Sciences. ⁷Associate Professor, Pediatric Infections Research Center, Department of Pediatrics, Shahid Beheshti University of Medical Sciences. ⁸Associate Professor, Department of Radiology, School of Medicine, Shahid Beheshti University of Medical Sciences. ⁹Assistant Professor, Department of Pathology, School of Medicine, Tehran University of Medical Sciences, Tehran, Iran

Objectives: To assess the practicability of a new algorithm in decreasing the rate of incorrect diagnoses and inappropriate antibiotic usage in pediatric Acute Respiratory Tract Infection (ARTI). **Materials and Methods:** Children between 1 month to 15 years brought to outpatient clinics of a children's hospital with acute respiratory symptoms were managed according to the steps recommended in the algorithm. **Results:** Upper Respiratory Tract Infection, Lower Respiratory Tract Infection, and undifferentiated ARTI accounted for 82%, 14.5%, and 3.5% of 1 209 cases, respectively. Antibiotics were prescribed in 33%; for: Common cold, 4.1%; Sinusitis, 85.7%; Otitis media, 96.9%; Pharyngotonsillitis, 63.3%; Croup, 6.5%; Bronchitis, 15.6%; Pertussis-like syndrome, 82.1%; Bronchiolitis, 4.1%; and Pneumonia, 50%. **Conclusion:** Implementation of the ARTIs algorithm is practicable and can help to reduce diagnostic errors and rate of antibiotic prescription in children with ARTIs.

Key words: Acute respiratory tract infection, algorithm, children

INTRODUCTION

Acute Respiratory Tract Infections (ARTIs) are the most common reasons for children visiting a physician, leading to increased utilization of health services including hospital admissions.^[1] Furthermore, Lower Respiratory Tract Infections (LRTI) are major cause of morbidity and mortality (25%-50%) in developing countries.^[2-4] Incidence rates of ARI in children of developing and developed countries are comparable, but cause-specific mortality rates from ARTIs are 10 to 50 times higher in underdeveloped countries.^[5,6]

However, most childhood ARTIs have a viral etiology.^[7,8] They are the principal reason for antibiotic prescriptions in the pediatric population (e.g., 46% in a Dutch study^[9]) resulting in increasing bacterial resistance, adverse drug effects, and increased financial burden.

Facilities for identifying various organisms are totally lacking in underdeveloped societies, and limited in transitional countries. WHO has initiated a program for clinical management and control of ARTIs which has resulted in the reduction of ARTI mortality rates by 25% to 67%.^[4,10,11] Some countries

have programmed to recommend guidelines approach to ARITs.^[12-14] We developed an algorithm for the diagnosis of ARTIs in children solely based on clinical manifestations, with minimal use of laboratory facilities and the main objective of this study was to assess the practicability of this algorithm, how much the ARITs and antibiotics usage are common and in comparison with other studies could it reduce the rate of incorrect diagnoses and inappropriate antibiotic usage.

MATERIALS AND METHODS

This prospective cross-sectional study was conducted from October 2007 to September 2008, on children aged between one month and 15 years with acute respiratory symptoms, cough, fever, hoarseness, and nasal discharge with or without tachypnea, in the outpatients clinics of a university-affiliated children's hospital in Tehran.

ARTI was defined as respiratory symptoms lasting < 3 weeks. All consecutive patients above the age of one month and below the age of 15 years with ARTIs symptoms brought to the outpatients clinics were included and patients with more than 3 weeks' signs

Address for correspondence: Dr. Alireza Fahimzad, Pediatric Infections Research Center, Mofid Children's Hospital, Shariati St., Tehran, Iran.

E-mail: pediatric_center@yahoo.com

Received: 05.04.2011; **Revised:** 12.10.2011; **Accepted:** 01.01.2012

and symptoms, chronic lung or heart diseases, and primary or secondary immunodeficiency were excluded. Informed consent was obtained from the parents before inclusion in the study.

Demographic and clinical data were collected from the visit notes. Algorithm designed for this study was derived from clinical manifestations of ARTIs described in the Nelson Textbook of Pediatrics.^[15] In this algorithm, the physician categorizes the patients into lower and upper ARTI according to respiratory rate and lung findings on auscultation [Figure 1].

Tachypnea was defined according to the standard reference charts set by the WHO for different age groups and fever as an axillary temperature of >38°C.

Trained physicians examined the patients and classified

them according to the algorithm into nine primary diagnoses:

Upper Respiratory Tract Infections (URTIs): Common Cold, Sinusitis, Otitis media, and Pharyngotonsillitis.

Lower Respiratory Tract Infections (LRTIs): Croup, Bronchitis, Pertussis-like syndrome, Bronchiolitis, and Pneumonia.

All data were fed into the computer and analyzed by SPSS 11.5 software (Chicago, USA). The study variables were categorical and were summarized as frequency and percentages.

RESULTS

The algorithm was used for management of 1 209 patients,

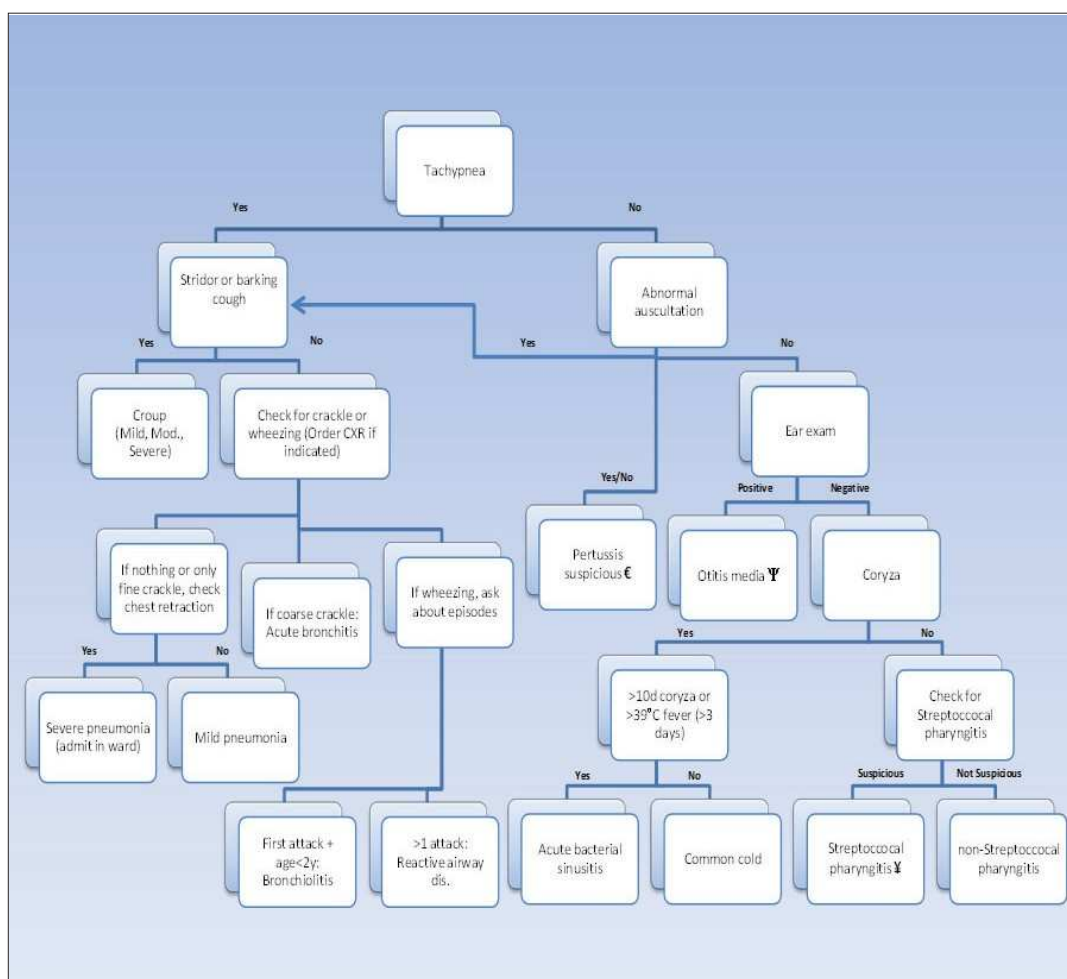


Figure 1: Acute Respiratory Tract Infection Algorithm; Ψ presence of ≥2 following criteria: a) otic pain or irritability, b) redness of tympanic membrane, c) absence of tympanic membrane landmarks like incus, promontory, cone of light, d) bulging of tympanic membrane or perforated membrane; €presence of ≥2 following criteria: a) recent family history of cough ≥2 weeks, b) paroxysmal cough attacks with no sigh between them, c) post cough emesis, d) presence of whooping or apnea after cough attacks; ¥presence of ≥2 following criteria: age between 5 to 15 years old, b) exudative pharyngitis, c) tenderness of anterior neck adenitis, d) high-grade fever (tem ≥39°C)

Male: female = 1.2: 1; and 44.8% were <2 years. URTI, LRTI, and Undifferentiated ARTI accounted for 996 (82%), 176 (14.5%), and 42 (3.5%) cases, respectively. Specific diagnoses are presented in [Figure 2].

Antibiotics were prescribed in 33% of all visits; rates of antibiotic prescription in URTI were: Common cold, 4.1%; Sinusitis, 85.7%; Otitis media, 96.9%; and Pharyngotonsillitis, 63.3%. For LRTIs: Croup, 6.5%; Bronchitis, 15.6%; Pertussis-like syndrome, 82.1%; Bronchiolitis, 4.1%; and Pneumonia, 50% [Table 1]. Clinicians prescribed antibiotics in 33% of all visits. Most commonly used antibiotics were amoxicillin/ clavulanate (34.5%), amoxicillin (20.8%), azithromycin (17.5%), erythromycin (8.7%), and penicillin (8.5%).

DISCUSSION

By using the recommended algorithm, physicians prescribed antibiotics for approximately one-third of children with ARTI. These figures are in sharp contrast to another study in our center, which reported antibiotic prescription rate of >80% in children with ARTI.^[16] ARTIs are the number one reason for antibiotic prescribing in the United States accounting for about 50% of all antibiotic prescription.^[17] As reported from Scandinavia, prescribing patterns for ARTIs vary widely between physicians.^[18] Antibiotic therapy in ARTIs is often guided by clinical manifestations as etiological pathogens may remain undiscovered in most cases even if all invasive diagnostic steps were taken.^[19,20] Also, cultural factors such as prescribing practices, parents'

expectations, and structure of the healthcare system may result in differences in clinical practice and antibiotic consumption between countries.^[21,22]

Some physicians prescribe antimicrobials for bronchitis if the child complains of productive cough, although controlled trials have failed to demonstrate the benefit of antibiotic treatment for acute bronchitis.^[23] The belief that purulent nasal discharge is an indication for antibiotics seems to be common, despite evidence that purulence of nasal discharge does not indicate bacterial infection.^[24,25]

Our research team had attempted to reduce antibiotic prescribing for respiratory tract infections by an educational intervention similar to some other studies.^[26,27] Studies have shown the importance of parental demands for antibiotic treatment, and trials that included educational interventions for both parents and physicians had promising results, with Smabrekke *et al.* demonstrating a reduction in antibiotic prescriptions for acute otitis media, from 90% to 74%, and also a reduction in broad-spectrum antibiotic use.^[28-30]

Our findings reveal that using the suggested algorithm is practicable, and may be effective in defining various forms of ARI more clearly, thereby improving antibiotic prescription patterns for these infections in children. The main limitation of our study is the lack of a control group that was managed without using the algorithm; however, as stated above, a previous study done in the same hospital, which investigated antibiotic usage in outpatients with acute respiratory infections, does show a very high rate of antibiotic prescription, prior to the use of the algorithm.^[16] Further multi-central researches and control group are necessary.

REFERENCES

1. Naghipour M, Cuevasb LE, Bakhshinejada T, Mansour-Ghanaei F, Noursalehi S, Alavy A, *et al.* Contribution of Viruses, Chlamydia spp. And Mycoplasma pneumoniae to Acute Respiratory Infections in Iranian Children. *J Trop Pediatr* 2007;53:179-84.
2. Pio A, Leomski J, Ten Dam HG. The magnitude of the problem of acute respiratory infections. In: Douglas R, editor. *Acute respiratory infections in children. Proceedings of an international workshop.* Adelaide, Australia: University of Adelaide, 1985. p. 3-16.
3. Garenn M, Ronsmans C, Campbell H. The magnitude of mortality from acute respiratory infection in children under 5 years in developing countries. *World Health State Q* 1992;45:180-91.
4. World Health Organization. Clinical management of acute respiratory infection in children: A WHO memorandum. *Bull WHO* 1981;59:707-16.
5. World Health Organization. A programme for controlling acute respiratory infections in children. Memorandum from a WHO meeting. *Bull World Health Organ* 1984;62:47-58.
6. Mohs E. Acute respiratory infections in children: Possible control measures. *Bull Pan Am Health Organ* 1985;19:82-7.

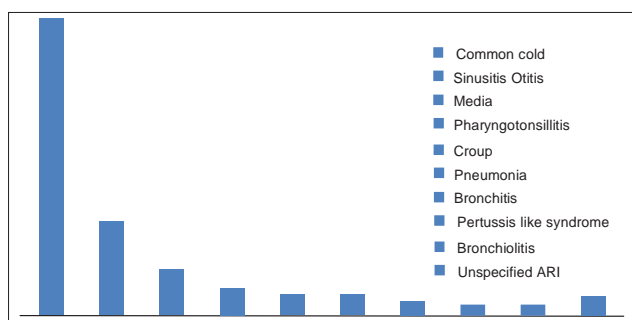


Figure 2: Acute Respiratory tract infection frequency

Table 1: Frequency of antibiotic usage in acute respiratory tract infections

Infection Type	Percent %
Common cold	4.1
Sinusitis	85.7
Otitis Media	96.9
Pharyngotonsillitis	63.3
Croup	6.5
Bronchitis	15.6
Pertussis-like syndrome	82.1
Bronchiolitis	4.1
Pneumonia	50

7. Van Gageldonk-Lafeber AB, Heijnen ML, Bartelds AI, Peters MF, Van der Plas SM, Wilbrink B. A case-control study of acute respiratory tract infection in general practice patients in the Netherlands. *Clin Infect Dis* 2005;41:490-7.
8. Farha T, Thomson AH. The burden of pneumonia in children in the developed world. *Paediatr Respir Rev* 2005;6:76-82.
9. Akkerman AE, van der Wouden JC, Kuyvenhoven MM, Dieleman JP, Verheij TJ. Antibiotic prescribing for respiratory tract infection in Dutch primary care in relation to patient age and clinical entities. *J Antimicrob Chemother* 2004;54:116-21.
10. Stansfield SK. Acute respiratory infection in the developing world: Strategies for prevention, treatment and control. *Pediatr Infect Dis J* 1987;6:622-9.
11. World Health Organization. A program for controlling acute respiratory infections in children: A WHO memorandum. *Bull WHO* 1984;62:47-58.
12. Green RJ, Zar HJ, Jeena PM, Madhi SA, Lewis H. South African guideline for the diagnosis, management and prevention of acute viral bronchiolitis in children. *S Afr Med J* 2010;100:320, 322-5.
13. Regoli M, Chiappini E, Bonsignori F, Galli L, de Martino M. Update on the management of acute pharyngitis in children. *Ital J Pediatr* 2011;37:10.
14. Werner K, Deasy J. Acute respiratory tract infections: When are antibiotics indicated?. *JAAPA* 2009;22:22-6.
15. RM Kliegman, BF Stanton, Joseph W. St. Geme III, NF Schor, RE Behrman. *Nelson Textbook of Pediatrics*. 18thed. Part 18, section 2.
16. Shiva F, Eidikhani A, Padyab M. Prescription practices in acute pediatric infections. *J Pediatr Infect Dis* 2006;1:25-8.
17. Steinman MA, Gonzales R, Linder JA, Landefeld CS. Changing use of antibiotics in community-based outpatient practice 1991–1999. *Ann Intern Med* 2003;138:525-33.
18. CDC: The CAUSE (careful antibiotic use to prevent resistance); Available from: <http://www.cdc.gov/ncidod/dbmd/cause/oct97.htm> [Last cited on 1997 Oct day].
19. Lidman C, Burman LG, Lagergren A, Ortvist A. Limited value of routine microbiological diagnostics in patients hospitalized for community-acquired pneumonia. *Scand J Infect Dis* 2002;34:873-9.
20. McKean MC. Evidence based medicine: Review of BTS guidelines for the management of community acquired pneumonia in adults. *J Infect* 2002;45:213-8.
21. Christiaens T, De Backer D, Burgers J, Baerheim A. Guidelines, evidence, and cultural factors. *Scand J Prim Health Care* 2004;22:141-5.
22. Visvanathan V, Nix P. National UK survey of antibiotics prescribed for acute tonsillitis and peritonsillar abscess. *J Laryngol Otol* 2010;124:420-3.
23. Orr PH, Scherer K, Macdonald A, Moffatt ME. Randomized placebocontrolled trials of antibiotics for acute bronchitis: A critical review of the literature. *J Fam Pract* 1993;36:507-12.
24. Wald ER, Milmo GJ, Bowen A, Ledesma-Medina J, Salamon N, Bluestone CD. Acute maxillary sinusitis in children. *N Engl J Med* 1981;304:749-54.
25. Wald ER. Purulent nasal discharge. *Pediatr Infect Dis J* 1991; 10:329-33.
26. Munck AP, Gahrn-Hansen B, Sogaard P, Sogaard J. Long lasting improvement in general practitioners' prescribing of antibiotics by means of medical audit. *Scand J Prim Health Care* 1999;7:185-90.
27. Finkelstein JA, Stille C, Nordin J, Davis R, Raebel MA, Roblin D, et al. Reduction in antibiotic use among US children. *Pediatrics* 2003;112:620-7.
28. Smabrekke L, Berild D, Giaever A, Myrbakk T, Fuskevåg A, Ericson JU, et al. Educational intervention for parents and health care providers leads to reduced antibiotic use in acute otitis media. *Scand J Infect Dis* 2002;34:657-9.
29. Perz JF, Craig AS, Coffey CS, Jorgensen DM, Mitchel E, Hall S, et al. Changes in antibiotic prescribing for children after a community-wide campaign. *JAMA* 2002;287:3103-9.
30. Panagakou SG, Spyridis N, Papaevangelou V, Theodoridou KM, Goutziana GP, Theodoridou MN, et al. Antibiotic use for upper respiratory tract infections in children: A cross-sectional survey of knowledge, attitudes, and practices (KAP) of parents in Greece. *BMC Pediatr* 2011;5:1-10.

How to cite this article: Tabatabaei SA, Fahimzad SA, Shamsiri AR, Shiva F, Salehpor Sh, Sayyahfar Sh, et al. Assessment of a new algorithm in the management of acute respiratory tract infections in children. *J Res Med Sci* 2012; 17(2): 182-5.

Source of Support: Nil, **Conflict of Interest:** None declared.