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ORIGINAL ARTICLE

Validating a Guidelines-Based Asthma Decision Support System: Step Two

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Purpose. Previously we described a computerized asthma decision support system and measured its accuracy in classifying asthma severity using pulmonologists as the gold standard. It is possible that the computerized decision support system may outperform pulmonologists in classifying asthma severity. The purpose of this study was to determine whether the computerized decision support system or pulmonologists have better accuracy with the 2007 edition of the Global Initiative for Asthma guidelines in classifying asthma severity. **Design.** One hundred asthma case scenarios were developed by a medical resident and classified according to the 2007 Global Initiative for Asthma guidelines. These case scenarios were deemed the gold standard. These case scenarios were then entered into a computerized asthma decision support system and also presented to a group of 10 practicing pulmonologists. Sensitivity, specificity, and agreement were calculated for the computerized decision support system and the pulmonologists. **Results.** The sensitivity and specificity of the computerized decision support system was 100%. The sensitivity of the pulmonologist was 94.2% and the specificity was 70.0%. Agreement between the computerized decision support system and the gold standard was perfect with a Kappa = 1.00. The Kappa between the pulmonologists and the gold standard was equal to 0.672. **Conclusion.** The computerized decision support system outperformed pulmonologists in the task of assigning asthma severity according to the 2007 Global Initiative for Asthma guidelines.

Keywords asthma; decision support system; medical decision making; guidelines

INTRODUCTION

Asthma is a chronic inflammatory disease of the airways that has affected 32.6 million people in the United States at some point in their lifetime (1). Currently there are 11,351 board-certified pulmonologists (2) and 5,846 board-certified allergists (3) to treat this population. As a result, most asthmatics are treated by primary care physicians. For this reason several guidelines have been published globally to help physicians diagnose and treat asthma (4–8). However, compliance with these guidelines has been very poor, possibly contributing to sub-optimal asthma outcomes (9–15). A tool that improves physician compliance with published guidelines has the potential to improve the quality of care delivered to asthmatics.

Previously we described a computerized decision support system (CDSS) that was used to categorize asthma severity according to the Global Initiative for Asthma (GINA) guidelines (16). This study was conducted on real patients in an asthma subspecialty clinic and found that the CDSS had an accuracy of 91% when pulmonologists were used as the gold standard. One of the limitations of the study was using the pulmonologists as the gold standard. It is possible that the CDSS may outperform even expert asthma clinicians in classifying asthma severity. The purpose of this study was to determine whether the CDSS or pulmonologists have better accuracy with the 2007 edition of the GINA guidelines in classifying asthma severity.

METHODS

This study compared the accuracy of a CDSS to a group of pulmonologists in assigning asthma severity. A medical resident created 100 asthma case scenarios and assigned a level of asthma severity using the 2007 GINA guidelines as a template. The case scenarios included typical patient information gathered at an outpatient office visit for asthma including race, age, sex, height, peak expiratory flow rate measurements, current medicines, the frequency of daytime symptoms, the frequency of nighttime symptoms, the number of days activity was limited by asthma, the frequency of asthma attacks, the frequency of rescue inhaler use, and resource utilization including emergency department visits and hospitalizations. The asthma severity assigned to the case scenario by the resident was determined to be the gold standard. The medical resident had no knowledge of the CDSS when creating the case scenarios. The medical resident was provided normative data for peak flow measurements to be used for the cases. The case scenarios were then entered into the CDSS and results from the CDSS for each case were printed. The case scenarios were also printed and distributed evenly to 10 board-certified pulmonologists. The pulmonologists were asked by the medical resident to classify the asthma case scenarios as controlled, partly controlled, and uncontrolled. The pulmonologists then returned the case scenarios to the medical resident. The asthma severity assigned for each case by the CDSS and the pulmonologists was then compared to the gold standard.

Descriptive statistics, including counts and percentages, were calculated. Sensitivity and specificity were calculated. To construct a two-by-two table to calculate sensitivity and specificity, the three levels of asthma severity defined in the GINA guidelines had to be translated into two categories: “disease present” and “disease absent.” “Partly controlled” and “uncontrolled” were combined into “disease

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TABLE 1.—Accuracy matrix for the CDSS compared to the gold standard.

		Gold Standard		Total
Asthma Severity		Not Controlled	Controlled	
CDSS	Not Controlled	69	0	69
	Controlled	0	30	30
	Total	69	30	99

present,” whereas “controlled” was considered “disease absent.” Kappa was used to measure agreement. The SAS version 9.1 was used for all analysis.

RESULTS

Of the 100 case scenarios distributed to the pulmonologists, 99 were returned completed. Therefore, only 99 of the case scenarios were included in the study. According to the gold standard, 30 patients had their disease controlled, 43 had it partly controlled, and 26 had it uncontrolled. The sensitivity of the CDSS for asthma severity when compared to the gold standard was 100% and the specificity was 100%, consistent with a perfect test (see Table 1). The sensitivity of the pulmonologist for asthma severity when compared with the gold standard was 94.2% and the specificity was 70.0% (see Table 2). Agreement between the CDSS and the gold standard using all three levels of asthma severity according to the GINA guidelines was also perfect with a Kappa = 1.00 (see Table 3). The Kappa between the pulmonologists and the gold standard was equal to 0.672 (see Table 4).

DISCUSSION

In our study, both the CDSS and the pulmonologists performed well in the task of assigning asthma severity. While the CDSS did outperform the pulmonologists in the assignment of asthma severity, assigning asthma severity is only one step in the treatment of asthma. The currently designed CDSS cannot entertain alternative diagnoses to asthma or incorporate patient co-morbidities that may complicate asthma care. Despite these limitations, our hope is that the CDSS may be able to be used by non-expert asthma clinicians to help improve the delivery of asthma care.

This study was designed to the strength of a microprocessor. The data provided in the case scenarios included all data requested by the CDSS. These are also the data required to use the GINA guidelines. Logic dictates that if guideline rules can be correctly translated into computer code and the required patient data is entered correctly, then a computer will correctly apply the guideline every time. Logic also dictates that once asthma severity is correctly determined, recommending appropriate care according to the GINA guidelines

TABLE 2.—Accuracy matrix for the pulmonologists versus the gold standard.

		Gold Standard		Total
Asthma Severity		Not Controlled	Controlled	
Expert Asthma Clinician	Not Controlled	65	9	74
	Controlled	4	21	25
	Total	69	30	99

TABLE 3.—Agreement matrix for the computerized decision support system versus the gold standard.

		Gold Standard		
Asthma Severity		Controlled	Partly Controlled	Uncontrolled
CDSS	Controlled	30	0	0
	Partly Controlled	0	43	0
	Uncontrolled	0	0	26

TABLE 4.—Agreement matrix for the pulmonologists versus the gold standard.

		Gold Standard		
Asthma Severity		Controlled	Partly Controlled	Uncontrolled
Expert Asthma Clinician	Controlled	21	9	0
	Partly Controlled	4	31	8
	Uncontrolled	0	9	17

will be easily implemented. The CDSS has the capability to recommend appropriate medication as outlined by the GINA guidelines as based on asthma severity; however, this feature was not included in this assessment.

There are several limitations to this study. The most relevant is that the study was conducted on asthma case scenarios rather than real patients. The CDSS will only be useful in patients in whom the diagnosis of asthma has been previously established. Additionally, the CDSS cannot account for co-morbid conditions such as chronic obstructive pulmonary disease (COPD) or heart failure that may be contributing to patient symptoms. Still, the CDSS may be used as an adjunct by physicians to improve the quality of care delivered to asthma patients. Further research, in the form of a randomized clinical trial, will be necessary.

DECLARATION OF INTEREST

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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