Patient Education and Counseling xxx (2011) xxx–xxx

Contents lists available at ScienceDirect

Patient Education and Counseling

journal homepage: www.elsevier.com/locate/pateducou

E-Health

A computerized education module improves patient knowledge and attitudes about appropriate antibiotic use for acute respiratory tract infections

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ARTICLE INFO

Article history:
Received 2 September 2010
Received in revised form 21 January 2011
Accepted 6 February 2011

Keywords:
Acute respiratory infection
Respiratory tract infection
Patient education
Appropriate antibiotic use
Interactive computerized education module
Educational computer kiosk

ABSTRACT

Background: Over-use of antibiotics for acute respiratory infections (ARIs) increases antimicrobial resistance, treatment costs, and side effects. Patient desire for antibiotics contributes to over-use.
Objective: To explore whether a point-of-care interactive computerized education module increases patient knowledge and decreases desire for antibiotics.
Methods: Bilingual (English/Spanish) interactive kiosks were available in 8 emergency departments as part of a multidimensional intervention to reduce antibiotic prescribing for ARIs. The symptom-tailored module included assessment of symptoms, knowledge about ARIs (3 items), and desire for antibiotics on a 10-point visual analog scale. Multivariable analysis assessed predictors of change in desire for antibiotics.
Results: Of 686 adults with ARI symptoms, 63% initially thought antibiotics might help. The proportion of patients with low (1–3 on the scale) desire for antibiotics increased from 22% pre-module to 49% post-module ($p < .001$). Self-report of "learning something new" was associated with decreased desire for antibiotics, after adjusting for baseline characteristics ($p = .001$).
Conclusion: An interactive educational kiosk improved knowledge about antibiotics and ARIs. Learning correlated with changes in personal desire for antibiotics.
Practice implications: By reducing desire for antibiotics, point-of-care interactive educational computer technology may help decrease inappropriate use for antibiotics for ARIs.

1. Introduction

Acute respiratory tract infections (ARIs), including nonspecific respiratory tract infections, acute bronchitis, sinusitis, otitis media, and pneumonia, are often treated with antibiotics and account for 75% of annual outpatient antibiotics prescriptions [1]. Adverse consequences of over-prescription and over-use of antibiotics for ARIs include increases in resistant bacteria [2], side effects of unnecessary treatment, and increased expense incurred from cost of antibiotics [3].

Effective interventions to reduce inappropriate antibiotics prescribing target both patients and providers. Patients' expectations guide provider prescribing habits, and providers whose patients expect antibiotics are more likely to prescribe them [4–7]. Patients' desire for antibiotics may be grounded in misconceptions about viral respiratory illnesses and their treatments [8,9]. These misconceptions are compounded by clinicians' limited ability to educate patients about appropriate antibiotic use and ARIs during a typical office visit, given time constraints and other competing demands [10,11]. The Health Belief Model suggests that change in patient knowledge is often prerequisite to change in patient attitudes and behaviors [12], and this may hold true for changing patient expectations for antibiotics. Of particular relevance in this case is education about the potential harms of antibiotics—modifying patients' perceived susceptibility to and severity of adverse effects such as diarrhea, yeast infections and allergic reactions. Improved knowledge of these harms could reduce inappropriate patient expectations and demands for antibiotics. Multidimensional educational interventions targeting patients and providers have led to decreases in antibiotic prescribing for ARIs in the primary care and acute care settings [13–17]. In prior research, we have shown that interactive computerized education using audiovisual and touchscreen formats is acceptable and effective in

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doi:10.1016/j.pec.2011.02.005

educating patients with limited language and literacy proficiency about appropriate antibiotic use [18]. However, the degree to which patient learning is associated with changes in desire for antibiotics for ARIs is not known.

This paper examines patient responses to an interactive computerized education module to reduce unnecessary antibiotic prescribing in the emergency department (ED) setting. This module was part of a cluster randomized trial of a multidimensional patient and provider education intervention, the Improving Antibiotic Use in Acute Care Treatment (IMPAACT) project. The IMPAACT study, detailed below and elsewhere [17], found a significant 10% decrease in antibiotic prescribing for ARIs associated with the intervention. Here we examine data from the interactive computerized education module to determine whether the module improved self-reported knowledge about appropriate antibiotic use for ARIs, and whether self-report of improved knowledge was related to a decrease in desire for antibiotics at that visit.

2. Methods

2.1. Study design

The IMPAACT study, a cluster-randomized controlled trial at 16 Veteran's Affairs (VA) and non-VA hospital emergency departments, implemented a multidimensional patient and provider education program to reduce inappropriate antibiotic prescriptions over two winter seasons. The trial was part of a joint Agency for Healthcare Research and Quality and VA Health Services Research and Development Service Award program (Translating Research into Practice-II) to implement a quality improvement project focused on antibiotic use in EDs participating in a nationwide research collaboration (Emergency Medicine Network, http://www.emnet-usa.org) paired with VA sites within the same metropolitan regions. The eight intervention sites received patient and clinician education around appropriate antibiotic use for acute respiratory infections [19–21]; the primary tool for patient education was the kiosk-based interactive computerized education module which is the focus of this analysis. The overall intervention design was based on the PRECEDE model of health promotion and behavior change, which focuses on the need for predisposing strategies, reinforcing strategies, and enabling strategies to create positive change [12]. Predisposing strategies in the IMPAACT intervention included provider education, enabling strategies included patient education (i.e., reducing inappropriate patient expectations and demands for antibiotics would make it easier for physicians to unnecessary antibiotic prescriptions), and reinforcing strategies included use of physician champions and physician profiles/feedback.

2.2. Site selection and patient population

Kiosks were freely available in 4 VA and 4 non-VA ED waiting rooms across the United States during the study period. Details of the hospital sampling strategy have been described elsewhere [17,22]. Participating ED sites were in major urban centers across the United States. Although demographic information other than age was not obtained from patients completing the kiosk, a separate follow-up survey study at the IMPAACT sites provides insight into the patient population. Forty-five percent of VA ED patients surveyed and 64% of non-VA patients were non-white. Only 21% of VA patients and 20% of non-VA patients were college graduates or beyond. The substantial majority reported annual household incomes under $30,000 (71% at VA and 70% at non-VA sites) [23].

2.3. Intervention

Kiosks with the interactive computerized education module were freely available in each ED waiting room during the study period. Patients with ARI symptoms were directed to the kiosks by signs displayed on the kiosks and by ED staff. Rotating messages on the screens suggested the content. No registration or screening was required to initiate the module. Importantly, completion of the module was completely voluntary. To eliminate the need for informed consent as a barrier, no personal identifying information was collected through the module.

The kiosk module and content were adapted from previously described versions [18]. Specifically, the module was designed for a low-literacy audience; written information had a target literacy level of 6th grade, and all information was delivered in audio form as well, through phone sets mounted on the kiosks. Spanish language translations were field tested and refined with our target audience, and back translation confirmed key concepts and messages were retained.

Patients initiated the module by choosing either English or Spanish language. They were then asked whether they were ill with a cough or cold; a subsequent question asked them to select specific symptoms. Patients were asked whether they thought that antibiotics would help relieve their symptoms (‘‘Do you think that antibiotics will help you feel better today?’’) They were asked ‘‘On a scale of 1 to 10, how much do you want antibiotics today?’’ and pressed the appropriate number on a horizontal visual scale of 1 (‘‘I don't want antibiotics’’) to 10 (‘‘I definitely want antibiotics’’). The module contained three questions about appropriate antibiotic use. The first was ‘‘Most cold and flu symptoms such as sort throat, cough, and runny nose are caused by. . .’’ with the choice of viruses or bacteria. The second question was the true/false statement ‘‘Antibiotics can cure cold and flu symptoms caused by viruses.’’ The third question was ‘‘Which of these side effects are caused by taking antibiotics?’’ with the choices of rashes, allergic reactions, or diarrhea; the answer was ‘‘all of the above’’.

Interspersed with the questions were brief dramatizations in which actors representing physicians and patients provided information about appropriate antibiotic use. These educational video clips were tailored to the specific symptoms selected (sore throat, sinus pain, cough, or a combination of symptoms) and incorporated the key Health Behavior Model domains of perceived benefits, perceived severity, and perceived susceptibility. The first segment of each video addressed perceived benefit from antibiotics by explaining that the most likely cause of the patient's illness was a virus, and that antibiotics do not benefit patients with viral infections. The second segment addressed perceived severity of illness, explaining that some bacterial infections are becoming resistant to antibiotics, and that this process can be minimized by judicious antibiotic use. The final segment addressed perceived susceptibility to adverse effects of antibiotics by describing common side effects including allergic reactions, diarrhea, and skin rashes.

Following the video segments, patients were again asked to rate how much they wanted antibiotics on the same 1–10 scale. They were also asked whether they had learned anything new from the computer kiosk. At the conclusion of the module, patients received handouts with recommendations tailored to the specific symptoms they reported. Duration of a complete interaction with the kiosk was about 5–10 min. Screen shots of specific components of the module are available in Appendix A.

Patients who did not complete the entire module either actively exited the program (by pressing ‘‘restart’’ on the touchscreen) or left the module allowing it to time-out after a 3-min period.

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2.4. Data collection

All patient responses were stored in data banks in the kiosks. Data were manually downloaded by study staff and sent to the study coordinating center via electronic mail; no electronic personal health information was collected. Data collected included site, date, and time of interaction; age; language selected (English or Spanish); whether patients were ill with cough or cold symptoms; specific symptoms reported; whether patients thought antibiotics would help; and answers to the three knowledge questions in the module. The kiosk also recorded patients' rating of their desire for antibiotics at the beginning and at the end of the module, and recorded whether they felt they had learned anything new. Additionally, a question at the end of the module invited patients to enter their own comments or thoughts about the kiosk.

2.5. Data analysis

The 1–10 scale rating desire for antibiotics pre- and post-module was categorized as low (1–3), moderate (4–7), and strong (8–10) for analysis, as responses were clustered around 1, 5, and 10. The two questions about whether most colds and flus are caused by viruses (henceforth referred to as "causes of ARIs") and whether antibiotics can cure viral illness ("antibiotics and viral illness") were combined into a composite knowledge score based on their similarity. The third question about side effects ("side effects") was treated as a separate variable. Answers to the questions about whether the patients felt antibiotics would make them better and whether they felt they had learned something new were treated as dichotomous ("yes" versus "no/maybe/don't know") in bivariate and multivariable analysis.

Descriptive statistics were performed to evaluate characteristics of the patients and their responses, including age, language, knowledge about antibiotics and ARIs, desire for antibiotics pre- and post-module, and learning from the module, for all patients together and for each language group separately. We used a *t*-test to compare mean age in the two groups, and chi-squared tests for comparisons of the remaining categorical outcomes. McNemar's test was used to assess within-group changes in proportions of patients in the low and strong categories of desire for antibiotics before and after completing the module. We also used a chi-squared test to determine whether an association existed between answering questions about antibiotics and ARIs incorrectly and reporting learning something new from the module.

We used multivariable logistic regression to evaluate predictors of having a change in desire for antibiotics, and to determine whether learning something new from the module was associated with a decrease in desire for antibiotics for ARI. Our dependent variable—defined as having any (i.e. at least a one point) decrease in antibiotic desire after completing the module—was based on subtracting the rating of desire for antibiotics assessed at the beginning of the module from the rating assessed at the end. Independent variables included in the model were knowledge about antibiotics and ARIs, baseline antibiotic desire (low/moderate/strong), and reporting learning something new from the module. Age, language, and VA status were controlled for *a priori.* All analyses adjusted for clustering by site.

Model adequacy was assessed using the link specification test and the Hosmer–Lemeshow goodness-of-fit test.

In developing our multivariable models, we considered the need for separate analyses of subgroups, particularly patients who chose the Spanish versus English-language modules. We noted

Table 1
Patient data and responses from a point-of-care interactive computerized education module about antibiotics and ARIs.

	Adults with ARI completing module				Adults with ARI not completing module	
	N = 686	Module language		*P*	*N* responding	
		Spanish (*N* = 64)	English (*N* = 622)			
Age: mean, median	40.6, 39	40.5, 40	40.6, 33.5	.804	1341	44.5, 42
Range	18–94	19–90	18–94			18–94
Symptoms *n* (%)					1341	
Cough	148 (22)	12 (19)	136 (22)	.564		287 (21)
Sore throat	149 (22)	26 (41)	123 (20)	<.001		291 (22)
Congested/runny nose	115 (17)	8 (13)	107 (17)	.338		282 (21)
Combination	274 (40)	18 (28)	256 (41)	.043		481 (36)
Think antibiotics will help? *n* (%)					1316	
Yes	278 (41)	29 (45)	249 (40)	.413		490 (37)
No	154 (22)	17 (27)	137 (22)	.408		329 (25)
Maybe	157 (23)	16 (25)	141 (23)	.673		292 (22)
Don't know	97 (14)	2 (3)	95 (15)	.008		205 (16)
Pre-module desire for antibiotics *n* (%)					1264	
Low (1–3)	148 (22)	20 (31)	128 (21)	.048		285 (23)
Moderate (4–7)	304 (44)	30 (47)	274 (44)	.665		505 (40)
Strong (8–10)	234 (34)	14 (22)	220 (35)	.03		474 (38)
Knowledge *n* (%) correct						
Question 1: causes of ARIs	440 (64)	35 (55)	405 (65)	.098	662	389 (59)
Question 2: antibiotics and viral illness	410 (60)	30 (47)	380 (61)	.027	496	276 (56)
Question 3: side effects of antibiotics	531 (77)	31 (48)	500 (80)	<.001	198	145 (73)
Post-module desire for antibiotics *n* (%)						
Low (1–3)	335 (49)[*]	31 (48)[†]	304 (49)[*]	.947		
Moderate (4–7)	163 (24)	16 (25)	147 (24)	.807		
Strong (8–10)	188 (27)[‡]	17 (27)[§]	171 (27)[‖]	.874		
Learned something new						
Yes	515 (75)	52 (81)	463 (74)	.23		
No	90 (13)	5 (8)	85 (14)	.187		
Maybe	81 (12)	7 (11)	74 (12)	.821		

[*] $p < .001$ for within-group change in proportion with *low* pre- versus post-module desire (exact McNemar probability).
[†] $p = .043$ for within-group change in proportion with *low* pre- versus post-module desire.
[‡] $p = .001$ for within-group change in proportion with *strong* pre- versus post-module desire.
[§] $p = .607$ for within-group change in proportion with *strong* pre- versus post-module desire.
[‖] $p < .001$ for within-group change in proportion with *strong* pre- versus post-module desire.

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significant differences between patients who chose the Spanish versus English modules in baseline knowledge about antibiotics and ARIs (Table 1). Therefore we tested for interaction between baseline knowledge (as measured by answers to the three questions embedded in the module) and language, and between self-report of learning something new and language, using a threshold p-value of .10. There was a significant interaction between language and answering one question correctly about antibiotics and ARIs ($p = .033$); however, inclusion of this term in the model did not substantively alter the magnitude of the association between baseline knowledge and our primary outcome (having a decrease in desire for antibiotics). There was also no significant difference between proportions of Spanish-language versus English-language patients who reported learning something new from the module ($p = .230$), and no significant difference in proportions who decreased their desire for antibiotics ($p = .298$). Finally, we ran the model with data from only patients who chose the English-language module, and found it essentially the same as the model with all patients. Based on these data, we felt it appropriate to pool the groups for our multivariable model.

All statistical computations were performed with Stata 11.0 software (College Station, TX). The institutional review boards at each participating site and at each of the two study coordinating centers reviewed and approved this study prior to study initiation.

3. Results

During 7 months of availability of the computer kiosk module at the 8 study sites, 2027 patients ages 18 and older with ARI symptoms (cough, sore throat, congested or runny nose, or a combination) initiated the module. Of those, 686 (34%) completed the module and are the focus of this analysis. 35% of the 1779 adults with ARI who chose the English module and 26% of the 248 who chose the Spanish language module completed it ($p = .004$); those who completed the module were slightly younger than non-completers (mean age 41 vs 45; $p < .001$). There was no significant difference across categories of desire for antibiotics between those who completed and did not complete the module ($p = .162$; Table 1).

Of adults with ARI completing the module 64 (9%) used the Spanish-language module. Roughly equal numbers of patients selected cough, congestion or sore throat as their single major symptom, and 274 (40%) reported a combination (Table 1). When asked whether antibiotics would help them feel better, 41% of patients answered "yes", 23% answered "maybe", 14% answered "don't know", and 22% responded "no".

The proportion of patients giving correct answers to each of the three knowledge questions (causes of ARIs, antibiotic effectiveness, and antibiotic side effects) ranged from 60% to 77% (Table 1). Only 39 (6%) gave incorrect answers to all three questions, and 248 (36%) answered all three correctly. Upon completing the module, the majority (75%) reported they had learned something new, regardless of baseline knowledge about antibiotic use for ARIs. Significantly fewer patients who answered all three knowledge questions correctly reported learning something new from the module, compared to patients with one or more incorrect answers (64% vs 78%; $p < .001$).

Upon completion of the module, the proportion of patients with low (1–3) desire for antibiotics increased from 22% to 49% ($p < .001$), and the proportion who strongly (8–10) wanted antibiotics decreased from 34% to 27% ($p < .001$) (Table 1).

Patients who chose the Spanish module were more likely than English-speaking patients to report sore throat, and less likely to report a combination of symptoms (Table 1). Spanish-speaking patients were significantly less likely to correctly answer the question about whether antibiotics can cure viral illness versus English-speaking patients, but significantly more likely to correctly answer "all of the above" when asked about antibiotic side effects. A greater proportion of Spanish-speaking patients had low desire for antibiotics prior to completing the module. The proportion of patients with low desire for antibiotics increased significantly in both language groups; in the Spanish-language group there was no significant change in the proportion of patients with strong desire for antibiotics at the beginning and end of the module.

54% of patients choosing the English-language module and 47% of those choosing the Spanish module had any (1-point or greater) decrease in desire for antibiotics ($p = .298$).

In multivariable logistic regression analysis controlling for age, language, baseline desire for antibiotics, VA location, and knowledge, self-report of having learned something new at the end of the module was significantly associated with having any (at least a 1-point) decrease in desire for antibiotics (adjusted OR 1.67, 95% CI: 1.14, 2.45). Baseline desire for antibiotics was also significantly associated with having at least a one point decrease in desire for antibiotics in our multivariable model. Paradoxically the magnitude of the association was greater for those with moderate (scale 4–7) pre-module antibiotic desire compared with strong (scale 8–10) pre-module desire (adjusted OR = 4.0; 95% CI: 3.1, 5.3 vs adjusted OR 2.9;

Table 2
Logistic regression model for having any (at least a one point) decrease in desire for antibiotics after completing an interactive computerized education model*.

Predictor	Odds ratio	P	95% confidence interval	
			Lower bound	Upper bound
Pre-module desire for antibiotics on 1–10 scale (reference 1–3)				
Low (1–3)	1.00	Reference		
Moderate (4–7)	4.01	.000	3.05	5.27
Strong (8–10)	2.86	.000	1.76	4.66
Knowledge about antibiotics and ARIs (2 questions)				
0 correct answers	1.00	Reference		
1 correct answer	1.84	.025	1.08	3.15
2 correct answers	1.57	.048	1.00	2.45
Knowledge about side effects of antibiotics (1 question)				
Incorrect	1.00	Reference		
Correct	1.13	.706	0.59	2.19
Learned something new	1.67	.009	1.14	2.45
Age†	0.99	.090	0.98	1.00
Language	0.90	.614	0.61	1.34
VA location	1.22	.028	1.02	1.45

* Logistic regression model adjusted for age, language, VA location, knowledge, baseline desire for antibiotics, and self-report of learning something new; p-value for Hosmer–Lemeshow goodness-of-fit test: .7738.
† Odds ratio for each one-year increase in age.

95% CI: 1.8, 4.7; respectively), although confidence intervals between these 2 subgroups overlap. Knowledge about antibiotic use and ARIs, and clinical setting (VA sites) were also associated with a decrease in desire for antibiotics (Table 2).

4. Discussion and conclusion

4.1. Discussion

After completing a brief interactive computerized education module on a waiting room kiosk, over half of the patients seeking care for ARIs in ED settings reported a decrease in desire for antibiotics. The significant increase in the proportion of patients who reported low desire for antibiotics pre- and post-module, and concurrent decrease in proportion of patients with strong baseline desire for antibiotics pre- and post-module, demonstrate a substantive change in attitude towards receiving antibiotics within this patient population.

Our multivariable model suggests that patients with a moderate pre-visit desire for antibiotics were more likely to have decreased desire for antibiotics after the module than patients with a strong pre-visit desire for antibiotics, although the difference between the two groups had a borderline statistical significance. This finding may reflect the fact that those strongly wanting antibiotics to begin with were less readily convinced of the lack of benefit and possible harms of antibiotics for their ARIs. Another explanation is that the population of patients with strong desire for antibiotics included some for whom antibiotics were truly indicated. Future studies could examine more closely the reasons why some patients strongly desire antibiotics before evaluation by a physician, and clarify their responsiveness to educational interventions.

Three-quarters of patients reported having learned something new from the module, and self-report of having learned something new was a significant predictor of having a decrease in desire for antibiotics. This finding is consistent with the Health Belief Model's tenet that changes in patient attitudes and behaviors (in this case, desire for antibiotic treatment for ARIs and demand for antibiotics) are predicated on changes in knowledge. Other important domains in the Health Belief Model such as perceived susceptibility, perceived severity and perceived control were incorporated into the content of the educational material, although we did not include questions to assess whether patients' perceptions in these domains changed as a result of the module.

Patients' gain in knowledge was assessed subjectively in this study; we do not know what dimensions of knowledge improved, or how much they improved. Although having at least one incorrect answer to the knowledge questions was associated with an increased self-report of learning something new, the large proportion of patients who reported learning something new overall suggests that patients' learning went beyond the fundamental principles addressed in the questions. This would be expected since the educational video segments contained more in-depth information about ARIs and development of resistance to antibiotics than was reflected in the 3 knowledge questions.

Although we do not know how long patients retained the new information they learned in this study, the primary goal of patient education in this context was to modify expectations about and demand for antibiotics at the immediate visit with a health care provider.

We also acknowledge that patients' reports of learning something new, and their post-module ratings of desire for antibiotics, may have been subject to social desirability rather than reflecting true change in knowledge or desire for antibiotics. However, the anonymous nature of the kiosk and lack of any incentive for "right" or "wrong" answers likely minimized the role of social desirability in this setting. Further, to the extent that participants *did* perceive learning something new about antibiotics and ARIs or decreasing their desire for antibiotics as socially desirable, this in itself is not without value given our broader goal of decreasing demand for inappropriate antibiotic prescriptions.

We are not able to determine if attitudinal changes were correlated with patient behaviors (such as requests for antibiotics) or physician prescribing behavior. This would have required obtaining patient identifiers on the module, which would have raised a different series of issues with regard to informed consent and data security given the public access to this learning program, as well as creating additional concerns about the potential for observation and response bias to influence our results. From the original evaluation of the IMPAACT project, we already know that EDs that received both patient and physician education demonstrated a greater reduction in antibiotic prescribing for ARIs compared with EDs that received only physician education—suggesting that the patient education component of the IMPAACT project was important for physician behavior change [17]. Patient-level educational modules have been shown to be successful in other areas of health care including tobacco use, high-risk sexual behavior, and chronic disease management [24–28].

Similarly, because use of the educational module was completely voluntary, we did not collect any personal health information that would allow us to more closely examine patient characteristics in our study sample, or collect data on patients who did not interact with or complete the kiosk in a way that would allow us to compare those who did and did not participate. We also do not know why those who did not complete the module stopped, although we were not surprised by the number of non-completers given the hectic setting of a crowded ED waiting room and the knowledge that numerous competing distractions and being called for appointments were very likely contributors, aside from loss of interest in the module itself. We believe that our approach of asking little or no personal identifying information from patients was important to maximizing the intervention's accessibility in the busy setting of an inner-city ED.

Another limitation of this study is that we do not determine whether a given patient's desire for antibiotics was appropriate. This may have accounted for some of the patients increasing their desire for antibiotics or else (appropriately) starting and ending the module with a strong rating of how much they wanted antibiotic treatment. However, if we assume that patients using the kiosk module are representative of the general population of patients seeking care for ARIs, then based on previous studies one could safely assume that the large majority of these patients would not have a condition for which antibiotics are indicated [3].

Finally, our findings also provide indirect evidence (in the absence of specific sociodemographic characteristics of our study population) that patient-facing health information technology is an acceptable strategy for reaching this vulnerable population based on the racial/ethnic diversity, limited education, and low income of the patient population that typically uses EDs for management of ARIs. This study adds further credibility to our previous research showing that a prototype of this module increased self-reported learning, trust and acceptance among a population of participants with confirmed low educational status and computer literacy [18].

4.2. Conclusion

As part of a national multicenter trial of a multidimensional patient and physician intervention to reduce antibiotic prescribing for ARIs, we made a bilingual interactive educational computer kiosk available in 8 hospital emergency departments during two winter seasons. The kiosk was designed to improve patient knowledge about antibiotics and ARIs and reduce patient desire for antibiotics. Findings from this study support the concept that

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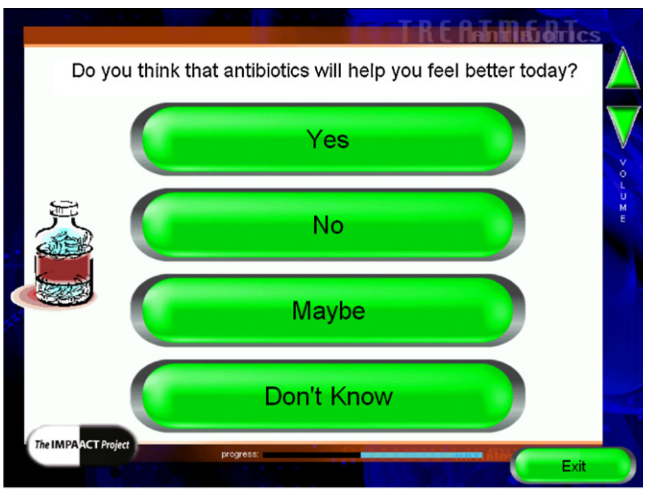
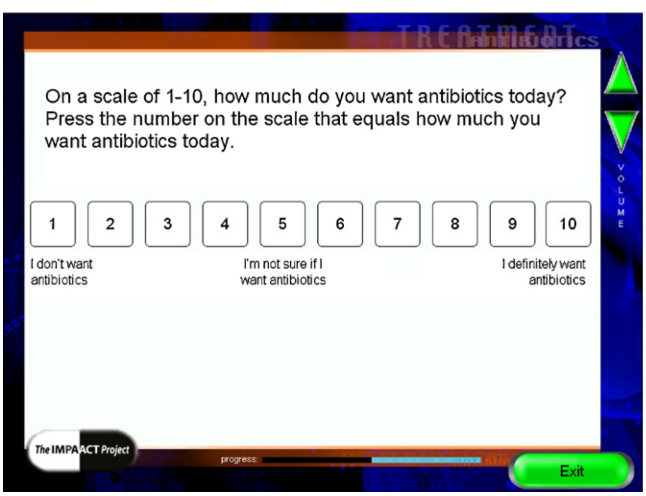
the module was successful at improving knowledge and reducing desire (and expectations) for antibiotics, and that the experience of learning something new was related to the change in patients' desire for antibiotics.

4.3. Practice implications

Our findings support the role of computerized interactive education to improve patient knowledge and attitudes as part of comprehensive efforts to improve health care quality. Computerized patient education using touchscreen audiovisual formats could be particularly helpful in educational strategies that must accommodate patient populations with low literacy and language barriers. Further research may also explore enhancement of patient education and quality of care through other computerized platforms, such as mobile devices and the Internet.

Appendix A. A computerized education module improves patient knowledge and attitudes about appropriate antibiotic use for acute respiratory tract infections. Screen shots from module.





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Please cite this article in press as: Price EL, et al. A computerized education module improves patient knowledge and attitudes about appropriate antibiotic use for acute respiratory tract infections. Patient Educ Couns (2011), doi:10.1016/j.pec.2011.02.005