



Editorials

Asthma mobile applications Are they ready for prime time?



We are moving rapidly into the era of digital health care, which includes mobile health applications, wearable devices, health information technology, telehealth and telemedicine, and personalized medicine. The increase in the use of smartphones in the population has allowed for the rapid increase in the downloading and use of medical health applications. In June 2015, Krebs and Duncan¹ performed a cross-sectional survey of 1,604 mobile telephone users in the United States and found that slightly more than half had downloaded a health-related mobile app. These authors found that medical monitoring was one of the reasons for the use of these apps by the population. Numerous participants mentioned that they wanted an app to track symptoms and make possible diagnostic suggestions.

Asthma is one of the most common chronic conditions that could benefit from the advancement of digital technology in the health care arena. During the last few years, more and more mobile health applications have been developed to help educate the patient with asthma on how to better monitor and manage their disease.^{2–4} When doing a search with the term *asthma* on the Apple iTunes App Store on February 2, 2018, I got results showing more than 230 apps. There is no doubt that the patient who takes control of their asthma and remains adherent to therapy will have reduced exacerbations, improved quality of life, and minimized health care costs. The question that needs to be answered is whether mobile health applications for asthma can be proven to aid in asthma control and adherence to treatment, which should lead to improved patient outcomes and lower medical costs.

Stukus et al⁵ have tried to answer the question of the role of asthma mobile apps used by the patient and/or caregiver in the management of asthmatic children primarily on Medicaid. They performed a 6-month randomized trial in patients from 6 months to 21 years who had recently had an exacerbation that required an emergency department visit. Patients were randomized to use of AsthmaCare, an asthma mobile device for iOS and Android devices developed by several of the authors, or conventional care. The primary outcomes were a comparison of emergency department visits, urgent care visits, and hospitalizations 6 months before and 6 months after randomization to the app and usual care and 6 months before randomization and 6 months after randomization comparison in both groups. The app provided daily reminders that appear on screen, similarly to an appointment notification from within a calendar, for medication use and personalized trigger avoidance measures.⁶ Users activate an interactive asthma treatment plan through input of respiratory symptoms and/or use of rescue

medication based on a proprietary algorithm that is adherent to treatment guidelines and is written on a third-grade reading level. Importantly for the pediatric patient, AsthmaCare uses game-playing features through rewarding points based on controller medication use and degree of interaction with the app. Unfortunately, the study failed because there was no statistical difference in the primary outcomes between the users of the app and conventional care groups 6 months after randomization and 6 months before and 6 months after randomization in either group.

So why did use of this asthma mobile application fail to reduce asthma-related visits or hospitalizations? Does it mean that this technology is not valuable in the care of children and adolescents with asthma? I think there are several liabilities that we need to consider in this study to help answer these questions. First, this study was not truly randomized because the authors point out that a high number of patients or caregivers were not able to download the application in the acute care setting but given instructions to do so at home. Unfortunately, the authors point out that confirmation of successful download and use of the app was never obtained. Furthermore, is the appropriate time to train on an asthma mobile application in the acute care setting? Can the patient or caregiver truly concentrate to understand the instructions on how to use the mobile application during treatment for an acute asthma exacerbation? Would it have been better to train them on how to use the app on an outpatient basis when the patient is not acutely ill? Although everyone enrolled in the study had to have a smartphone device, we do not know whether this inner-city population of older children and adolescents had access to the device most of the time or if it was primarily with the parent or caregiver. To obtain the most value from this app in asthma management, you need it with you most of the time. As the authors point out, this study was short because there was only a small number of primary outcome events during the 6-month period. Looking at other outcome measures, such as patient adherence to therapy, avoidance of triggers, and school absences, may have yielded better results.

Even though this study failed to achieve its primary goals, the authors should be congratulated because we need more rigorous studies in evaluating usability and outcomes of mobile applications in asthma. I believe the future is bright for this type of technology in health care. Unfortunately, many applications at this time require a high level of navigation by the patient, which may lower their acceptance and continued use.⁷ The primary reason in the study by Krebs and Duncan¹ for quitting the use of medical mobile apps was the demanding nature of data entry. Hopefully, new technologies, such as conversational artificial intelligence (think Amazon Alexa), will reduce this burden and improve user satisfaction. We as allergists should be working with application

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vendors to make sure that these tools provide clinical evidence of asthma control and that they can be easily adopted and adhered to by our patients with asthma. The prime time in digital health care technology is just about here.

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Just do the right thing



Early in my training as an allergy-immunology fellow at Wilford Hall Medical Center, I had a patient in whom more than one therapeutic approach might apply. I could not decide which pathway to choose and sought the advice of Mike Ruff, a physician on staff. He simply said, “Ted, just do the right thing.” This advice has been valuable to me over the years.

When we know what is right and we do not act on it, we have the potential of creating a more difficult problem to solve. This describes the situation in the article by Clark et al¹ entitled “Changes in emergency department concordance with guidelines for the management of stinging insect-induced anaphylaxis: 1999–2001 vs 2013–2015” in this issue of the *Annals*. When presented with an acute stinging insect hypersensitivity reaction, the right thing to do is crystal clear. It has been published in guidelines and practice parameters for as long as I have been in practice, most recently in the *Annals* last year.² The right thing to do consists of 4 items. First and foremost, treat an acute reaction with epinephrine. Second, at discharge, give the patient autoinjectable epinephrine (AIE) for future exposures. Third, educate the patient about avoiding stinging events. Fourth, refer the patient to a specialist to evaluate for specific IgE because prophylaxis with immunotherapy is effective in reducing future reactions and hence reducing the probability of death from a subsequent reaction.

It has become increasingly evident in recent years that it is important, in any endeavor, to measure the success of that endeavor then seek to improve the outcome and measure it again. Clark et al¹ did just that. In 2005, she and her colleagues measured the occurrence of the 4 criteria listed above in 15 emergency departments (EDs) as documented in patient medical records for 1 year. Records were selected by diagnosis codes and reviewed to ensure they met criteria for anaphylaxis. Although there was considerable variation among the different hospital EDs, the summary was that only 30% of the patients received epinephrine for anaphylaxis, 34% received a prescription for AIE, 23% received instructions for avoiding offending insects, and 28% received referrals to an allergist. In the world of continuous improvement, this is clearly a wonderful opportunity. The first step is to make a change. Because the recommendations were all in the allergy-immunology literature, but acute reactions are seen and treated in the ED, it seems reasonable to place the recommendations into the emergency medicine (EM) literature. Interestingly, I reviewed PubMed for anaphylaxis guidelines in 8 EM journals (*Annals of Emergency Medicine*, *American Journal of Emergency Medicine*, *Journal of Emergency*

Medicine, *Academic Emergency Medicine*, *Emergency Medicine Journal*, *Pediatric Emergency Care*, *Emergency Medicine Clinics of North America*, and *Internal and Emergency Medicine*) and found only 1 article. This was based on a 2011 roundtable meeting on anaphylaxis in the ED between EM physicians and allergy-immunology physicians. The results of the meeting were published by Nowak et al³ in January 2013 in the *Journal of Emergency Medicine* and entitled *Customizing Anaphylaxis Guidelines for Emergency Medicine*. These guidelines were for anaphylaxis in general and not for the specific cause of insect stings. The article contained the same 4 recommendations as above, except the recommendation for avoidance was not specific to insects only but was to avoid the suspected agent.

Step 2 is to measure again, which is where the current article by Clark et al¹ comes in. Using the same protocol, she and her colleagues looked at the results for 14 of the 15 original hospital EDs and six new hospital EDs from January 2013 to December 2015. The results are fascinating.

Use of epinephrine was up significantly from 30% to 49% ($P < .001$). The authors remind us that this was a retrospective medical record review and maybe the use of the patient's own AIE by the patient or the family might not have been documented; therefore, the improvement might have been even more significant. Overall, a much larger improvement would have been better, and if you get into the details (see Fig 1 in the article), you find that 2 hospital EDs never gave epinephrine. This is a shocking result by itself, but the summary improvement suggests education might have been helpful.

The rate of prescribing AIE at discharge increased from 34% to 57% ($P < .001$). Again, the authors note that the patient may have already had AIE, so there would be no need to document in the record that it was prescribed. Again, heading in the right direction, but there is much room for improvement. The data support the hypothesis that educating the EM physicians was useful but maybe not sufficient unless we accept that it takes much longer for recommendations to penetrate the whole EM population. Even this is not too bothersome if the patient is referred to an allergist as soon as possible to mitigate the possible effect of this oversight.

Giving instructions to avoid insects did not change at all (23% to 24%), but this is the least of the recommendations and can easily be covered by the specialist if the patient sees the allergist-immunologist. Therefore, this lack of change was again not too bothersome.

The referral to an allergist was dismal. Referrals went from 28% to 12% ($P = .002$). The study was not structured to answer the question of why this is so, but the authors speculate that EM physicians and patients with insect sting hypersensitivity are unaware of