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Web-based interventions for treating youth with asthma: Is efficacy on the horizon?

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IN THIS ISSUE

eHealth and Asthma

In this issue of the **LARS eNEWS** we examine patient care delivered through digital communication technologies, or what is termed *eHealth*[1]. There is a wide array of technology-based programs that fall under this broad catchall with almost all capitalizing on the delivery of some form of cost-effective health promotion intervention using communication technology*. Examples of interactive human-computer technologies include mobile phones, smartphones, Voice over Internet Protocol (VoIP) like Skype, computer-telephone integration like Interactive Voice Response (IVR), electronic health records (patient portals), computerized kiosks, personal digital assistants, telemedicine, and wearable devices that facilitate remote patient monitoring. All of these "gizmos" can be used to contact patients, provide them with educational materials, deliver office visit and medication reminders (using Short Messaging Service texts or through emails), and in some cases even deliver therapeutic services using synchronous† computer-mediated communication. There are even efforts underway to use virtual simulation and avatar guided imagery as a therapeutic device for treating mental health[2] and chronic diseases[3,4].

Despite the rapid growth of the *eHealth* industry, several pressing questions remain. For one thing, the jury is out as to whether Internet-based behavioral interventions actually work and more specifically "how they work[5,6]." This is a crucial part of prevention science, making sure that programs are theoretically consonant and closely adhere to the published standards for evidence-based practice. Furthermore, many *eHealth* programs are multimodal (consisting of more than one intervention modality) and few efficacy evaluations have tested the relative value of different components using dismantling designs and componential analyses[7,8]. In other

*eHealth can be represented in any number of ways but should involve at a minimum reference to the Internet and delivery of some form of health care service. The terms electronic and media technologies, electronic health care, medical informatics, information and communication technology for the provision of health care can all be used interchangeably in this case.

†Synchronous computer mediated environments rely on virtual person-to-person communication (mediated by computers) that is "responsive" between two or more parties and conducted in the moment (real time) like a chat, virtual classroom or instant messaging. It can be conducted using VoIP video conferencing where people see each other to mimic face-to-face communication. Asynchronous is not conducted "in the moment" where both people are communicating in real time. The latter would entail posting a message to a discussion board (thread) using a blog or creating a wiki. Here, the individual receives a timely response albeit not immediately after the message is posted and does not have the immediacy one encounters with a virtual chat. Many modern classroom management systems rely on asynchronous methods, for example, teachers posting assignments, grades, discussion threads, and managing classroom attendance, all familiar to distance learning environments.

words, we don't know what works, for whom, and under what conditions. Questions surrounding the use of virtual simulations would include whether avatar-based systems work more effectively than automated dialogue or synchronous conversations. Furthermore, few studies have addressed whether motivational emails are more efficacious than using chats or "*Ask the Expert*" discussion boards and which modality is likely to promote behavior change.

Self-Management Skills. A core feature of most *eHealth* applications is reliance on self-management skills training as a core intervention modality[9]. For the most part, cognitive-behavioral strategies require behavioral rehearsal and role play leading to mastery of self-regulation and coping skills. Behavioral rehearsal requires hands-on instruction coupled with real time feedback.

Programmatically speaking, it remains unresolved whether we can "adapt" self-management skills training routinely offered in group settings to Internet-based distance learning. Can the Internet be effectively used to teach these skills and can we capitalize on individualized performance feedback as a surrogate for what happens in group settings? To address these and related concerns, we review a handful of Internet-based interventions that target chronic disease self-management. We harness the review by including only programs targeting youth (adolescence). Youth are now active consumers who readily use the Internet[10]. They use it for social networking[11] and evidence is accruing that they also use it to gain access to health information[12]. We also focus on asthma as one illustrative example of the many chronic diseases that affect our nation's youth.[‡]

Asthma Fundamentals. Asthma is a chronic disorder of the airways with intermittent periods of reversible airflow obstruction. Most asthmatics experience wheezing, coughing, shortness of breath, and in some cases chest tightness brought about by hyperactive inflamed airways. People who have asthma are susceptible to asthma attacks during exercise, if they have airway infections, in high airborne allergen periods (spring pollen) and even from air pollution or exposure to second hand cigarette smoke. National prevalence data indicate that roughly 40 million individuals in the U.S. have asthma, and of those 9 million are children. Although adult females are more likely to have asthma (10.7%) than adult males (6.5%), boys (10%) are more likely than girls (7.1%) to have asthma in the <18 category and African-American children are more likely to have asthma (13.4%) compared to white (7.8%) or Hispanic (8%) children. The Center for Disease Control and Prevention estimates that annual economic costs of asthma hover around 56 billion annually[§] and the global estimates are even higher with roughly 300 million people worldwide afflicted with asthma[13].

Asthma is the most frequent chronic disease seen by the pediatric medical community. As a result, there has been a tremendous effort to create asthma educational programs to help combat asthma morbidity**. The four largest factors that contribute to asthma morbidity are lack of adherence to treatment regimens, poor medicine usage (i.e. inhaled corticosteroids), environmental triggers (allergen sensitization), and patient/caregiver education. The general framework for asthma education includes teaching youth to identify and avoid triggers (i.e., pollens, heat, exercise, smoke), manage symptoms when they occur (inhaler preventer or medication), and know what steps to take during an adverse event. Youth are also taught how to become better consumers (of health information), and spirited advocates of their own health. In addition to self-regulation skills, youth are taught a bevy of social skills intended to bolster patient-provider communication. This type of skills training encourages youth to be more vocal (demanding) about needed health information, communicate with allied health professionals, request assistance, and manage their disease in social situations (e.g., explain to peers their disease is not "contagious").

Program Review. The Interactive Multimedia Program for Asthma Control and Tracking (IMPACT) is funded through the CDC National Asthma Education and Prevention Program. This Internet-based multimedia education program consists of short, animated video lessons educating parents and children about asthma, detecting disease triggers, and disease management strategies[14]. Children are exposed to virtual renditions of "real-life" scenarios and asked to make decisions that will affect their asthma. There are also interactive activities where children learn to provide accurate information regarding their symptoms and medications. A 2-condition RCT that exposed children to IMPACT during clinic visits (to avoid confounding program access issues while families were home) provided evidence of significant intervention effects with increased asthma knowledge, decreased asthma symptom days, and fewer ER visits among the treated children (for all three levels within condition: children, 0-6, children 7-17, and caregivers of children 7-17) compared to the treatment-as-usual control condition (who were given basic education using illustrated information sheets, an asthma action plan, and written instructions for self-management provided during routine clinic meetings as part of one-on-one training given by a nurse practitioner). Additional findings showed

[‡]Other chronic diseases would include pediatric rheumatic disorders [juvenile idiopathic arthritis], HIV, cystic fibrosis, epilepsy, cancer, diabetes, sickle cell disease and other hereditary blood and musculoskeletal disorders, all of which are clearly a public health priority.

[§]This number includes medical expenses, loss of productivity, premature death and reflects in 2010 numbers 3,404 deaths, 439,400 hospitalizations, 1.8 ER visits, and 14.2 physician office visits. Reflects combined data from the Behavioral Risk Factor Surveillance System (www.cdc.gove/brfss/), Asthma Call-back Survey (www.cdc.gov/asthma/acbs.htm), and the National Vital Statistics System (http://wonder.cdc.gov) (CDCP, 2013).

**The big four include: ER visits, urgent care calls to physicians, overuse of medication, and missed school days for children and workdays for parents.

intervention children had lower average daily dose of inhaled corticosteroids (fluticasone equivalents) and their increased knowledge was protectively associated with fewer urgent doctor visits (r = .37) and less frequent use of quick-relief medication (r = .30). One caveat worth noting is that the caregiver sample was disproportionately white (90%) and female (88%), suggesting that findings may not be generalizable to low-SES minority youth who

are disproportionately affected by asthma.

A pilot RCT with 58 inner-city children ages 9-17 tested BostonBreathes[††], an asthma educational website designed to improve patient adherence to medical treatment and facilitate patient-provider communication (keep PCPs in the loop with regard to medication adherence and symptom information)[15]. The study included three experimental conditions: a treatment-as-usual care condition combined with written asthma education materials, a BB website condition coupled with *discussion boards* to foster provider-patient communication, and a BB website-only condition with no discussion board.[‡‡] All children had two baseline pre-randomization home visits to assess baseline controller device use with a PiKo digital spirometer to assess forced expiratory volume (FEV). The discussion board consisted of health and monitoring data culled from the BB website, which was posted for review by the patient, caregiver, and provider. Patients or caregivers could also reach out to respiratory nurse experts for asthma-related advice. At 6-month follow-up both intervention and control children reported fewer wheezing days. Intervention children reported fewer night-time awakening and parent loss of sleep days. In addition, a subgroup of low-controller medication adherence (determined at baseline screening) intervention children significantly improved their asthma treatment adherence (using a preventer more frequently). Overall, this proof-of-concept study reinforces that a web-based education, monitoring and communication platform may favorably influence younger patient's asthma-related knowledge and use of an asthma preventer (controller).

Social Stigma. Many youth experience social stigma from asthma, experiencing certain physical limitations that truncate social and athletic endeavors. This can induce feelings of social marginalization and alter relations with peers. In a feasibility study, Letourneau and colleagues[16] examined whether a 12-session online social support program mixed with weekly synchronous chat sessions (using peer mentors and health professionals) would decrease social isolation in asthmatic youth. The results of this one-group pre-post design showed that youth (avg. age 13) who accessed Ability Online (24/7 monitored Internet community) and used electronic mail, message boards, and chat rooms reported significant decreases in loneliness and social dissatisfaction over a 3-month period. Qualitative analyses showed trends for greater confidence in social support, increased support network size, and greater confidence in their disease management decisions. Overall, the study reinforces the importance of examining the "emotional" components of disease management and using technology to overcome disease-related barriers.

Figure 1 shows the core instructional modalities (components) of six programs we reviewed. As the figure shows, some programs heavily rely on a limited set of strategies (e.g., information, action plans, interactive quizzes), while others compile programs built around a more varied set of methods (e.g., logs, feedback, message alerts, ask the expert, tailored messaging, and medication reminders, to name a few).

FUTURE CONSIDERATIONS

Given space limitations, there are a number of issues that we did not address, but that may be incredibly important for the advancement of *eHealth* initiatives in the treatment and remediation of chronic diseases like asthma. One issue that comes to mind is the use of "tailoring" strategies in *eHealth* programs. Tailoring algorithms use risk "markers" or certain screening/selection criteria to direct individuals to a particular "level" of a program.

Figure 1.

Components: Asthma Self-Management Interventions	IMPACT	My Child's Asthma	Asthma Research Study	BostonBreathes	Asthma Village	My Asthma Portal (MAP)	
Asthma information and self-care education; explain asthma & why develops, mitigate impact on activities, use of controller, resume medications, triggers, smoking, pets, action plans peak flow meters	X	X		X		X	
Asthma action plans	X					X	
Self-monitoring; log, track progress				X	X	X	
Immediate feedback from devices; real-time feedback				X		X	
Messages and alerts to patients				X		X	
Games, quizzes	X			X			
Availability for daily use			X				
Report limitations in activities, missed school				X			
Report ED or urgent care visits	X			X			
View progress - graphs symptoms, peak flow, med use				X			
Communication with peers - discussion boards, chat rooms				X	X		
Communicate primary care provider				X			
Ask the expert, contact case manager				X		X	
Rewards				X		X	
Tailored messages						X	
Physical activity						X	
Medication adherence						X	

Note. IMPACT: Krishna, S., Francisco, B. D., Balas, E. A., König, P., Graff, G. R., & Madsen, R. W. (2003).; My Child's Asthma: Meischke, H., Lozano, P., Zhou, C., Garrison, M. M., & Christakis, D. (2011).; Asthma Research Study: Blake, K., Holbrook, J. T., Antal, H., Shade, D., Bunnell, H. T., McCahan, S. M., ... & Wysocki, T. (2015).; BostonBreathes: Wiecha, J. M., Adams, W. G., Rybin, D., Rizzodepaoli, M., Keller, J., & Clay, J. M. (2015).; Asthma Village: Koufopoulos, J. T., Conner, M. T., Gardner, P. H., & Kellar, I. (2016).; My Asthma Portal (MAP): Ahmed, S., Ernst, P., Bartlett, S. J., Valois, M. F., Zaihra, T., Paré, G., ... & Tamblyn, R. (2016).

[††]The BB educational videos can be viewed at: http://www.bu.edu/fammed/bostonbreathes/menu.htm.

[‡‡]Interestingly, the final RCT sample was culled from 983 children who had asthma based on medical records review, 520 were contacted, 391 completed a phone screening, 89 were eligible, 58 agreed and 42 were retained at the 6-month follow-up, reinforcing the arduous nature of conducting research with high-risk populations.

A "tailored" or adaptive program requires a match between the program content (instructional modules) and the individual's current or most pressing healthcare and psychological needs. This is one of the benefits of *eHealth*, the ability to deliver flexible, tailored programming (and tailored messages based on performance) that results in customizable self-care regimens. Not every individual experiencing a chronic disease requires the same instructional set to advance their self-management skills. Assessing self-efficacy, social support, perceived risks, coping mechanisms and other measures of psychosocial functioning may provide a valid and reliable "heuristic" that can be used to guide website usage and benefit from focused (selective) interventions[17].

Instructional Technology. There is also the issue of scaffolding, an instructional technique that is used to move students progressively toward the goal of learning and mastery. Scaffolding suggests an exoskeleton where the individual benefits from educational "supports" that assist the learning process. The Russian barrister and educational innovator Lev Vygotsky coined the term as a way of describing the relationship between the expert and the novice[18]. The expert needs to have a sense of where the novice can perform (mastery level) and then slowly encourage this individual to move beyond the "zone of proximal development" to higher states of learning achievement. The eventual goal is to build proficiency that fuels development of reliable cognitive schemata and foster self-efficacy beliefs, a mainstay of social learning theory[19]. In *eHealth* terms scaffolding would entail a series of modules that assess the youth's initial level of proficiency, then guide them through a series of increasingly difficult challenges until a higher state of proficiency is achieved. This progressive instructional framework is geared toward moving the individual toward greater autonomy of learning. The end game is youth that can navigate the healthcare system, have higher health literacy, show autonomy with respect to their medical care (appointment and medication adherence), and independently engage a full spectrum of disease management skills. All of this will eventually help them reconcile the effects of their chronic disease in terms of day-to-day living needs. Unfortunately, cross-fertilization between instructional theory and *eHealth* technology remains a novel, if not untested, frontier.

Finally, Internet interventions routinely boast there is cost savings associated with using digital communication technology to deliver health promotion[20,21]. The basis for these claims rests with personnel savings gained from not requiring in-person "facilitators" that deliver interventions "face-to-face." Other capital cost savings revolve around not using facility rentals, serving participants refreshments, using large incentives to attract participants to meetings, and costs savings associated with online data collection. Notwithstanding these considerations, few studies exist that provide cost estimates for the different build components needed to develop a web-based intervention. Software programming costs, delivery costs (purchasing a domain name, constructing a web portal, 24/7 server maintenance, and redundant storage systems), along with other web "development" costs including conducting RCTs have not been subject to serious cost analysis. We recently reviewed the literature examining economic cost-analysis for drug prevention and found considerably "variance" in the way cost estimates are provided[22]. The same is likely to hold true for determining relative costs (social and economic) for *eHealth* interventions, especially given the lack of standardized cost accounting methods. Future studies may want to augment the literature by providing "hard" tractable cost estimates in their overall determination of efficacy.

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LARS Research Institute is dedicated to assisting members of the scientific community develop, implement, and evaluate comprehensive, evidenced-based Internet, clinic, school- and community-based behavioral interventions. Our portfolio includes offering services in the fields of drug and violence prevention, chronic disease self-management, and professional development/training for healthcare professionals and community health workers. We strive to improve our nation's healthcare systems by disseminating proven, evidence-based programs using rigorous scientific methods, applying state-of-the-art implementation methods, and adhering to industry standards supporting high quality program evaluation using state-of-the-art statistical techniques. Our goal is to create positive health outcomes and psychological benefits for individuals experiencing health disparities, and at the same time reducing the financial burden on our healthcare systems.

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