Innovative & interactive iPad interventions: The new wave of delivering pediatric behavioral, emotional & social care

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Innovative & interactive iPad interventions: The new wave of delivering pediatric behavioral, emotional & social care

Abstract
When a child requires hospitalization, medical professionals focus first and foremost on meeting the physical needs of the patient. A developing trend in pediatric care, however, takes into account the social and emotional needs of the child, and recognizes the impact of emotion, behavior and social supports on healing and wellness. Research indicates the effectiveness, and necessity, of the comprehensive biopsychosocial approach to pediatric hospital care, utilizing specific behavior management techniques rooted in t

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INNOVATIVE & INTERACTIVE IPAD INTERVENTIONS:
THE NEW WAVE OF DELIVERING PEDIATRIC BEHAVIORAL, EMOTIONAL &
SOCIAL CARE

By

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Introduction

When a child requires hospitalization, medical professionals focus first and foremost on meeting the physical needs of the patient. A developing trend in pediatric care, however, takes into account the social and emotional needs of the child, and recognizes the impact of emotion, behavior and social supports on healing and wellness. Research indicates the effectiveness, and necessity, of the comprehensive biopsychosocial approach to pediatric hospital care, utilizing specific behavior management techniques rooted in teaching skills of coping, pain management, relaxation, emotional expression and appropriate support seeking.

Equipping young patients with such a skill set will enable them to better cope with the emotional aspect of being sick or injured, and provide them with vital, life-long skills. An exciting new practice is the integration of psychosocial interventions with innovative interactive patient care technology. This pilot study describes how one Midwestern children’s hospital has begun to explore the use of tablet-based applications to teach and support patients with the skills necessary to cope with pain, stress, and other behavioral issues of pediatric hospitalization.

Literature Review

As a leader in pediatric medicine, the University of Michigan C. S. Mott Children’s Hospital is a strong advocate for the Patient & Family Centered Care Model. This approach, as defined by the University of Michigan, “is a model of providing care that recognizes and respects the uniqueness of each family and encourages and empowers families to partner with health care providers. Opinions are asked, values are respected, and family members are viewed as key components of their child’s health care team. This partnership will provide your child with the best opportunity to heal”. (Department of Patient & Family Centered Care, 2013). In striving to
better align with this model, it is vital that health care professionals consider the unique and extensive needs of their pediatric patients.

A recent study at Cincinnati Children's Hospital indicated that the top pediatric psychosocial referral concerns are: adjustment, pain, depression, and anxiety (Piazza-Waggoner, 2013). These concerns increase in significance as levels of medical acuity and lengths of hospital stay increase, with major reasons for pediatric psychiatric referral being those related to behavioral problems (Shaw, Wamboldt, Bursch, & Stuber, 2006).

Research from the New York University Child Study Center (CSC) reveals that many chronically-ill children are at risk for experiencing psychological problems. These problems are considered to be normal responses of coping and dealing with one's illness, rather than an indication of a more serious emotional disturbance (Kopelowicz, 2001). A specific example of this phenomenon is a scenario demonstrated by the CSC in which, “a 5-year-old girl with a brain tumor may tantrum due to anxiety about being separated from her parents while receiving radiation treatments. These situations are instances of reactions precipitated by particular illness-related events” (p. 3) As most of these psychological and behavioral problems are a normal outcome of illness and pediatric hospitalization, medical professionals need to be prepared to treat these issues along with the physical ailment presented.

As discussed above, hospitalization, especially when prolonged, presents great challenges for ill children. Beyond the obvious biological or medical needs, hospital personnel must consider the psychological (mental and emotional) and social (environmental) implications of being sick or injured. The biopsychosocial approach “systematically considers biological, psychological, and social factors and their complex interactions in understanding health, illness,
and health care delivery” (Engel, 2010). This approach is a pivotal asset in providing pediatric patients with the most innovative and comprehensive interventions.

There is a general consensus highlighting the need for research focused on identifying the specific mental health needs of patients (Tunick, 2013). Research is also needed on how to better help patients cope with the day-to-day and long-term stressors resulting from those needs (Hardy, Willard, Watral, & Bonner, 2010). Hardy, Willard, Watral, and Bonner’s (2010) findings indicate children who receive psychosocial therapy show fewer signs of upsetting behavior such as aggression, depression, worry, and somatic complaints, thus advocating for the importance of further research in this field. The identification of patients’ psychosocial needs is required before research-based approaches for meeting these needs can be developed and implemented. Findings from Tulipani, Morecelli, Spedicato, Maiello, Todarello, and Porcelli support the “need for a clinometric-based biopsychological approach to medical problems” through interventions such as mindfulness, cognitive-behavioral and relaxation therapy, support seeking and emotional expression (p. 161). Specific research regarding divisions of psychosocial treatment, such as coping skills, behavior management, pain management, relaxation, and emotional expression, continue to shape today’s evolving pediatric health care system, as detailed in the paragraphs to follow.

**Coping Skills & Behavior Management**

Cognitive-behavioral interventions and coping skill development are critical entities in helping pediatric patients manage the wide array of challenges they face (Piazza-Waggoner, 2013). A lack of basic coping skills enables disruptive behaviors. Studies show maladaptive internalizing coping styles are approximately six times more likely to occur in children with recurrent abdominal pain than their typical peers (Ibeziako & Bujoreanu, 2011) and twenty
percent of Boston Children Hospital’s psychology referrals in the Pediatric Intensive Care Unit (PICU) are for coping and adaptation. Consequently, teaching coping skills and providing cognitive-behavioral therapy is critical in the care of pediatric patients (Tunick, 2013). Ibeziako and Bujoreanu suggest, “cognitive-behavioral therapy is the hallmark of treatment to address and overcome the internal conflicts and underlying stressors and provide active coping strategies” (p. 387).

Pain Management & Relaxation

Another key component of patient psychosocial health is pain management and relaxation. There is wide support for the benefits of relaxation and pain management interventions in reducing procedural pain and distress (Kazak, Blackall, Himelstein, Brophy, & Dollar, 1995; Piazza-Waggoner, 2013). These studies also support the implementation of relaxation and distraction techniques, in conjunction with a family-centered care approach, for the effective management of procedural pain for pediatric leukemia patients. While this technique is beneficial to those with leukemia, further research attests that pain management techniques, such as relaxation, biofeedback, and deep-breathing exercises, are effective in meeting the needs of a wide spectrum of pain-oriented disorders, including chronic headache, recurrent abdominal pain, fibromyalgia, sickle cell disease, and juvenile idiopathic arthritis (Eccleston, et al., 2012).

While relaxation and pain management techniques are designed primarily to reduce the impact of pain, it is worth noting these interventions can have a much wider impact, according to research at Georgia State University. Teaching a patient about pain management techniques, like deep-breathing and self-calming exercises, equips patients with skills to manage their fears and anxieties, as well as pain (Cohen, 2008).
Emotional Expression & Support Seeking

Additional key components in supporting patient health are the provision of an outlet for emotional expression and the encouragement of appropriate support seeking behaviors. Providing patients with emotional support and validating their experiences increases strategies for coping, enhances quality of life and minimizes psychological distress (Phoenix & Coulson, 2011).

Proven success has been shown in the area of emotional expression and support seeking across various settings throughout the health care field. Mo and Coulson (2012), maintain that use of such interventions has succeeded in a range of settings, including HIV/AIDS social support groups and online support groups for women with breast cancer. These emotional interventions are particularly important to provide to patients at an early age. Ibeziako and Bujoreanu (2011) explored in their research the fact that “difficulty in identifying and describing emotional distress verbally” can lead to further psychosocial complications, such as the building up of anxiety and development of somatic symptoms (p. 386).

New Era of Technology

Great advances can be found in the clinical setting in attending to patients' social and emotional needs. Research has demonstrated a wide array of interactive patient care methods, ranging from the use of social networking, to online multi-player gaming intervention, to methods using smartphone and tablet applications. Regardless of the technological approach, results have shown a direct positive impact on the confidence and empowerment of patients by way of better understanding and coping with the emotional ramifications of their illness (Carpenter, Stoner, Schmitz, McGregor, & Doorenbos, 2012; Phoenix & Coulson, 2011).
Because these new technologies are so appealing, engaging, patient-friendly, and widely accessible, health care professionals are beginning to uncover the potential of smartphone and tablet applications to deliver behavioral health interventions (Dennison, Morrison, Conway, & Yardley, 2013). As hospital personnel and researchers invest more time into the development of the new wave of interactive patient care, copious benefits are revealed, including improved patient mood and motivation; increased staff efficiency in recording and tracking behavior; and reduction of pediatric procedural pain and anxiety (McQueen, Cress, & Timothy, 2012; Dennison, Morrison, Conway, & Yardley, 2013).

As the integration of smartphone and tablet applications into the clinical setting becomes widely accepted, opportunities for research arise. How effective are these technologies at teaching the skills of support seeking, emotional expression, relaxation, and coping? Despite current trends and innovations, few studies explore the groundbreaking potential of these applications for health related issues, especially within the pediatric population (Dennison, Morrison, Conway, & Yardley, 2013).

Of the tablet and smartphone application-based interventions that have been implemented, studies have demonstrated success in using apps to manage chronic disease, procedural anxiety, depression and challenging behaviors (Watts, Mackenzie, & Andrews, 2013; Wang, et al., 2014; Johnson, et al., 2014; Pramana, Parmanto, Kendall, & Silk, 2014). Specifically, Cognitive Behavioral Therapy programs have provided evidence of significant improvements for patients with anxiety and depression (Pramana, Parmanto, Kendall, & Silk, 2014; Watts, Mackenzie, & Andrews, 2013). In terms of advocating for the use of the tablet and smartphone platforms, Watts, et al. identified the benefits of the ubiquity of mobile apps, their low cost and the public's familiarity and interest in using this form of technology (2013). Wang,
et al. also commented on the benefits of using smartphone apps, in that patients can become more involved in the management of their own health care and are provided extended care and support outside of the traditional hospital setting (2014). Regardless of the type of psychological intervention, each of these studies recognized the inadequate research currently available on the potential of application-based interventions and in turn called for necessary attention and investment in this area of research (Johnson, et al., 2014; Wang, et al., 2014; Watts, Mackenzie, & Andrews, 2013).

To address the scarcity of research in this area, this project partners with the University of Michigan Mott Children's Hospital to explore how iPads and applications can address and support the biopsychosocial needs of pediatric patients. Medical procedures, pharmaceuticals, and the like, treat the body, but what about the patient as a whole? This pilot study, based upon the Patient & Family Centered Care and biopsychosocial models, aims to examine how specific iPad applications can be used to help children manage pain and anxiety while improving their coping and goal setting skills. Results of this study will hopefully inform future research and facilitate the development of a therapeutic app and iPad lending station in the Hospital.

Methods

Research Design

This study was designed to establish a direction and inform a protocol, to measure patient, parent and psychologist team member satisfaction of iPad interventions for pediatric psychology. The iPad applications were categorized into the areas of coping skills, relaxation, pain management and goal-setting. Based upon the patient's need, various apps were prescribed to enhance current psychological interventions. Follow up surveys were employed to measure
participants' satisfaction with these new means of intervention. Study team members included three psychology professionals, one psychologist and two psychology fellows, from the Hospital's Department of Pediatric Psychology.

Participants

Patients were recruited by professionals from the Department of Pediatric Psychology. All participants were originally hospitalized for a primary medical condition (i.e., cancer, colitis, migraine, etc.) but were referred to the Department of Psychology because of issues related to coping with the emotional side of being sick or injured. Patients were offered the opportunity to participate in the study if they were referred to Pediatric Psychology for one of these four main areas of need: medical adherence behaviors, coping skills, pain management, and relaxation techniques. Of the five patients who participated in the pilot study, ages ranged from five to sixteen; four in-patients/one outpatient; four female/one male; varying races and ethnic backgrounds (three Caucasian, one African American, one Arabic); and had diagnoses over an array of medical conditions (inclusive of cancer, autoimmune disorders, ulcerative colitis, severe migraines, and primary sclerosing cholangitis).

Procedure

Applications. To identify the applications (iOS apps) to be used as interventions, an extensive review of the literature was conducted in parallel to collaboration with the Hospital's pediatric psychology team members. With the goal of creating an innovative and impactful application catalog, insight was also sought from school professionals and online iTunes reviews. Applications initially were tested by study team members to assess for accessibility, functionality, and relevancy to patient intervention. Descriptions of the various applications are
presented in the following paragraphs. Additional applications were then added to the devices to enhance the study, in regards to security and data collection.

Security was a pivotal part of this study, in that in order to reach the final aim of creating a therapeutic app and iPad lending station, measures must be taken to ensure that the iPads would be returned as easily as they were lent out. Find My iPad presents the capability to track Apple devices on a map format, allowing remote control of the device from iCloud. With this application, if one of the iPads is misplaced or stolen, various capabilities are available to protect iPad content and aid in the return of the device. The standard capabilities of Find My iPad include GPS tracking, remote password locking, capability of sounding an alarm from the missing iPad, and displaying telephone number and message on the locked home screen of the stolen or missing device.

The app Tab Survey was selected for data collection purposes, in part because results could be remotely accessed online from another computer. This was helpful in seeing real-time data and managing the surveys. The app allows for multiple types of survey questions as well as the use of smiley faces for the Likert scale, rather than numbers, making the survey more accessible to younger patients.

The following intervention apps were included in the catalog. Pain management applications included Belly Bio, Inner Balance, Breathe2Relax, Tactile Breather, Bubble Wrap, eSense Skin Response, and Me Moves. These pain-specific apps incorporated techniques such as distraction, relaxation, biofeedback, and deep-breathing exercises. Relaxation applications, focused on helping patients cope with their fears, anxieties, and pain, included Relax Melodies, Gaze HD Beach Like, Sosh, Pandora, Smiling Mind, and Take A Chill. Coping and emotional
expression applications were categorized together in that many of the apps co-treated, helping patients identify internal conflicts and underlying stressors and consequently providing them with effective coping strategies and appropriate formats to openly communicate and deal with these concerns. Applications specific to coping skills and emotional expression were Calm Counter, Cognitive Behavioral Therapy apps (CBT* ABC Way for Kids and Teens), Super Better, T2 Mood Tracker, Healing Buddies Comfort Kit, and Self-Help for Anxiety Management (SAM). Goal-setting apps to help with managing medication and other prescribed behaviors and protocols included My Med Schedule, Epic Win, iReward Chart, Life Skills Sticker Chart.

Making such a large number of apps available to patients and physicians was a conscious choice; at this stage in the study, physicians sought a wide range of options when treating patients. Specific apps used with each study participant will be addressed in the results section of this paper.

Once all of the applications for security, data collection and intervention were chosen, the core image (also known as the base set of applications) was created. The core image was set in such a way that intervention apps were sorted by categories of patient need, so that psychology team members working with the app could easily direct patients to the applications most beneficial to their specific situation. Additional settings were also taken into consideration, including connecting the iPad to the guest network of the hospital, restricting location change (to prevent disabling Find My iPad), and setting the background of the home screen to a message of where to return the devices if stolen. The core image was then installed on each of the ten iPads using the Apple Configurator application on the Mac Mini. By using Apple Configurator, the potential of reimageing, or resetting, the iPads back to the basic core image after each patient use is available, thus providing the protection of patient data.
Clinical Sessions. For this phase of the study, the majority of the participants used the iPad for interventions during one-on-one consults with their designated psychology team member. For a few select patients, an iPad was loaned out if one of the patient’s guardians agreed to fill out the respective loan agreement. Present during consult sessions were the patient, the parent, a psychology team member, and the principal investigator (who recorded observations in field notes). Psychology team members worked with the patient, training them to use the device and app. Sessions included introduction of the skill (i.e., using biofeedback to decrease stress), guided use of the relevant iPad application, and independent practice. Some participant sessions were single, one hour sessions, others involved repeated sessions. At the end of the intervention period, the patient, parent and psychology team member were asked to complete a quality improvement survey.

Survey. In collaboration with the psychology team members, surveys were developed to measure satisfaction with the app as a therapeutic tool. Surveys were specific to patient, parent or psychology professional, as well as to one of the four areas of focus: pain management, coping skills, relaxation, and goal setting/treatment adherence. Psychology team members, for example, were given the following statements and asked to rate them on a Likert scale: 1) This intervention technique was a helpful addition to other interventions already in place, 2) I feel these interventions helped this patients meet their treatment goals, 3) The patient showed signs of improved coping with their health issue, 4) I feel the patient can now better manage his or her pain / relaxation / coping / goals (please pick and circle one), 5) The patient seemed engaged in the intervention. Patient and parent Likert scale items included questions modeling the following: 1) I learned something new about coping from using these apps, 2) I would use the apps at home, 3) I would recommend the apps to other patients and families within the hospital.
4) I would use the apps again, 5) I liked using the iPad for obtaining treatment goals, 6) The iPad encouraged me to practice the intervention(s) introduced by the psychology team members, etc. 

Lastly, all three groups (psychology team members, patients, and parents) were asked open ended questions to provide more detailed insight as to which apps they liked best, which they liked least, their reasoning supporting these responses, and any additional thoughts they had to share.

Results

Following are the results of the study, presented by patient. With each case study, patient background, psychological intervention experience, and study participation are detailed. For the privacy of patient data, in compliance with HIPAA, patients have been assigned pseudonyms.

Case Study #1: Kaitlyn

Kaitlyn was admitted to the Hospital for ulcerative colitis at the age of 16. She was then referred to Pediatric Psychology to help her cope with the pain and anxiety associated with her condition. Upon Kaitlyn's initial consultation with her psychology practitioner, she was introduced to the concept of how deep breathing and biofeedback can be used to control her pain, anxiety, and nausea during stressful medical procedures and discomforting flare-ups. During Kaitlyn's second consultation, the psychologist introduced the application, Inner Balance. This application works with a sensor that clips to the patient's earlobe to measure his/her heart rhythms while practicing guided deep breathing exercises, thus monitoring the patient's coherence (synchronization of heart, mind and emotions) to help manage pain and anxiety. During Kaitlyn's three sessions using the iPad for intervention, she was provided multiple opportunities to interact with Inner Balance and was also exposed to various other guided deep
breathing applications like Tactile Breather and Breathe2Relax. Surveys were then completed by the psychologist, patient and parent.

The psychologist reported finding the intervention technique to be a helpful addition to previous interventions, especially in assisting the patient to meet her behavioral goals. Furthermore, the psychologist reported that the patient showed signs of learning to cope with her diagnosis; and strongly agreed that the patient can now better manage her pain and stress. As for Kaitlyn, she reported neutrally for the majority of the questions like whether or not she learned something new about coping from using these apps, whether or not other kids in the hospital should use them, how she liked using the apps to help her cope, and her satisfaction with hospital care based upon using the iPad. However, Kaitlyn did agree that the tricks she learned would help her manage her pain at home and that she would use these apps again.

Kaitlyn’s mother, who was also present for all three sessions, had a similar response as her daughter, being noncommittal as to whether or not her daughter would use these techniques at home or if the iPad encouraged her to practice pain management techniques. Kaitlyn’s mother provided positive feedback in that she agreed that her daughter learned something new using the apps. she could see her daughter using the skills at home, she would recommend the app to other patients and families in the hospital, her daughter seemed to like using the iPad and that she was more satisfied with her treatment as a result.

Kaitlyn, her mother, and the psychologist agreed that Inner Balance proved to be a very good app for this patient; the psychologist stated that it “was great to have a portable biofeedback option for use at bedside. The app was easy to use and the patient was able to see her progress session to session (and I was able to tell if she’d been practicing the skill). The sensor worked
great and seemed accurate. I like that they are easy to use. Patient seemed to like it too”. The other breathing applications tried, such as Breathe2Relax, were proven less helpful. The psychologist stated, “Other breathing apps offered were refused by the patient after she’d mastered the biofeedback; think they were too easy as she’d already mastered the skill and had her own strategies to practice. While I like the Belly Bio breathing app for the iPhone, the iPad is too heavy to use on the belly for a kid with abdominal issues (like this patient was diagnosed)”.

Case Study #2: Olivia

The next patient was 14-year-old, Olivia, who was diagnosed with Hodgkin’s lymphoma and was in the Hospital for chemotherapy and a bone marrow transplant. To help her cope with her transplant and the side effects of the cancer, Olivia was referred to Pediatric Psychology for consultation. Olivia had worked multiple times with her psychology practitioner on deep-breathing exercise for pain management and relaxation, prior to being introduced to this study’s iPad intervention. During this intervention, Olivia worked primarily with the Inner Balance sensor and application, along with a variety of other guided deep breathing apps.

Due to the timeframe of Olivia’s hospital stay, only one session occurred before survey completion and patient checkout. However, despite the limited intervention timeline, the involved parties provided valuable feedback. The psychology team member strongly agreed that this intervention technique was beneficial in all five surveyed categories, in that the app was a helpful addition to other interventions in place, it helped the patient meet her treatment goals, the patient showed signs of improved coping, the patient could better manage her pain and relaxation, and the patient seemed engaged in the intervention.
Olivia spoke to this last point of engagement in reporting that “having an app that senses what my body is doing is a lot more encouraging and helpful in practicing these breathing techniques. (:” Olivia also responded very positively to the survey, strongly agreeing that she would use the tricks she learned to help manage her pain at home, recommend the intervention to others in the hospital, would use the app again, liked using the iPad while in the hospital, was encouraged to practice the coping skills by having access to the iPad, and experienced increased satisfaction with her treatment. Her lowest survey score was that for learning something new about coping with her pain from using the apps. While the patient shared that she did learn something new, since she had worked with the psychology practitioner multiple times on deep breathing prior to this iPad intervention, it would appear that practice was more relevant than the acquisition of new knowledge in this scenario. In regards to which iPad app was most helpful in this intervention, Inner Balance was once again cited by the psychology team member as the “most helpful due to the complexity of biological information it provides”.

Olivia’s mother also provided resounding support for the iPad intervention; responding with “strongly agree” for all seven Likert scale items, commenting, “Both apps shown looked helpful, keep up the great work”. This practitioner also commented that Belly Bio once again fell short, noting that it was “a bit heavy on the iPad” especially for younger patients and those with abdominal pain. Yet, she did note that it would still be useful to keep the app on the iPad as a means of introduction of alternate applications for patients to use on their smartphone. Lastly, the psychology practitioner shared additional comments regarding the iPad intervention program as a whole, writing, “Having an iPad that is accessible to each practitioner will be so useful in teaching relaxation strategies. Increased accessibility will allow them (us) to use these interventions much more often. Technology will also increase engagement among youth in the
hospital, and increase buy-in related to behaviors that can change our biology (specifically in regards to the biofeedback app used in this case study).

Case Study #3: Caden

Caden was a five-year-old patient with Hemophagocytic lymphohistiocytosis. This is a rare form of cancer that affects patients’ immune systems, often associated with increased risk for infection, and is treated by a regimen of chemotherapy medicine and ultimately a bone marrow or stem cell transplant. Due to the amount of medication Caden required for treatment, he was referred to Pediatric Psychology for patient and family support for increasing medical adherence. To aid in this process, the application iReward Chart was used to create and implement an interactive reward chart for Caden. Initially, the psychologist reported the app “challenging to tailor goals to program because it is outlined by days of the week”; ultimately, a plan was developed to use these daily slots to mark two stars per each slot. Caden was prescribed multiple medicines per day; each time he took his medicine he earned a star on iReward Chart, and subsequently he was awarded a prize for every two stars he earned. The iPad was then loaned out to the family so the patient could interact with the intervention first hand.

Following up a week later, the psychology team member reported that the intervention was “extremely helpful at promoting behavioral compliance”, a contributing factor to recovery. The psychologist attributed Caden’s compliance to the strengths of iReward Chart, including its engaging noises and cheers upon earning a star, the app’s age appropriateness, and the “ceremony” it provided after patient success. All participants, Caden, his mother, and his psychologist had nothing but positive responses to the Likert scale items; all strongly agreeing that the intervention was beneficial in helping Caden learn a new way to reach his goals,
encouraging and engaging him to meet his goals of taking his medications, and helping him to cope with his medical diagnosis. Caden and his mother reported that they would strongly agree in recommending it to other patients and families in the hospital setting, that they liked using the app, and that they would like to use it again (so much so that Caden’s mother commented on her desire to use the application on her own smartphone after the iPad intervention was complete). With a big smile on his face, Caden shared with the study team that he “loved it all” and that “It’s going great!” His mother supported this, saying that, “I loved how easy he took his medicine after the app. It was a big deal before the app. It was a life saver, loved everything about it”.

Case Study #4: Alicia

The study’s next participant was Alicia, a 15-year-old outpatient treated by Pediatric Psychology for migraines. To help Alicia cope with her migraines, her psychology practitioner worked with her in the areas of prevention and pain management. For this patient, the primary method of migraine prevention consists of taking medicine and reducing stress within her environment, so the guided breathing biofeedback sensor application, Inner Balance, was selected for the intervention. Because of the short time frame for this intervention, a single session, the psychologist was noncommittal as to whether or not Alicia showed signs of improved coping with her health issues. The psychologist did report that the “biofeedback information (provided with Inner Balance) was helpful”. Alicia specifically commented that the app was helpful in improving her focus on breathing.

Alicia and her psychologist also worked with a variety of other relaxation apps, like Gaze HD Beaches Lite and Relax Melodies HD, to help promote relaxation with soothing sounds and
imagery; during this session Alicia was so engaged and moved by the imagery and sounds of the app that she exclaimed, “Oh my gosh, that’s going to make me cry!” The psychologist agreed that these interventions were also helpful in addition to other interventions already in place, that the apps aided Alicia in better managing her pain and stress, and that she seemed engaged in the intervention. Alicia spoke to her own engagement by strongly agreeing that she learned new ways to relax from this intervention, will use these new skills when trying to relax in the future, liked using the iPad during her session, and would use these apps again; she even requested the names of the applications to be written down so that she would be able to download them on her own smartphone following the appointment. Alicia also in strongly supported other patients using these apps, instructing study team members, “Use these types of apps in the hospital! They would have helped me a lot while I was in here (the Hospital), and they can teach you a lot!”

Case Study #5: Rebecca

Rebecca was a 15-year-old patient admitted to the Hospital for treatment of primary sclerosing cholangitis and Crohn’s disease. To cope with her hospitalization, pain and procedural anxiety, Rebecca was referred to Pediatric Psychology. At the time of this intervention, Rebecca was experiencing significant discomfort (in terms of pain and nausea), frustration, and general difficulty coping with her hospitalization. Her psychologist reported that these complications often manifest as “behavioral non-compliance and irritable mood”. During consult, the psychologist once again used Inner Balance, which the practitioner found to be “helpful in a variety of ways for this patient, as she suffers from significant anxiety, chronic pain, and nausea. Biofeedback seemed to be helpful with buy-in.”
Due to the Rebecca’s uncomfortable condition during the intervention, she was not able to fill out the patient satisfaction survey. However, the study team did have the opportunity to receive her mother’s feedback, which indicated support for using the deep breathing exercises at home and her favorable impression of the use of the iPad intervention to cope with pain. Rebecca’s mother also felt her daughter learned something new about coping from using the app, would use the app again provided the chance, and that having access to the app on the iPad would increase Rebecca’s practice of deep breathing exercises.

The psychologist supported much of this intervention as well, with the exception of neutrality on the patient showing signs of improved coping (since this was only the first consult) and the patient’s engagement in the interventions (which was compromised due to nausea and abdominal pain). Even still, the practitioner was a strong advocate for this format of intervention and agreed that this intervention would help Rebecca better meet her treatment goals and give her the skill set necessary to better manage her pain and coping. Despite the conclusion of the research timeline, the psychologist still plans on collaborating with Rebecca to work on deep breathing using Belly Bio Interactive Breathing on the patient’s personal smartphone to reduce Rebecca’s anxiety, as well as manage her nausea and abdominal pain.

Additional Participants

At the time of publication of this monograph, several additional participants were slated to join the study. Hope, a 15-year-old outpatient, Hope, is scheduled to meet for help with stress and pain management for migraine prevention. The psychologist plans on using similar applications used with Alicia, including Inner Balance, Breathe2Relax, Gaze HD Beaches Lite, and Relax Melodies HD. Another potential participant, Noah, has been referred for coping and
pain management. Following are the psychology team member’s plans for the upcoming intervention:

Noah is a 6-year-old, previously healthy little boy who underwent a traumatic lawnmower accident, which resulted in partial to full amputation of both feet. Since he has been presenting with significant anxiety surrounding his pain and symptoms of an acute stress reaction (trauma). I envision using the iPad to build upon and practice the family’s skills with diaphragmatic breathing using Breathe2Relax or the Tactical Breather and introduce imagery techniques using the Gaze app (beach scene). I would also use the iPad to promote adjustment to hospitalization by using Dr. Panda, as well as age-appropriate stress management apps given his intensive and lengthy medical course (e.g., bubble paper, I Need a Break, etc.). Use of technology would provide an engaging modality which may help to distract Noah from his pain in order to reinforce therapeutic techniques for pain and coping with hospitalization (University of Michigan, C.S. Mott Children’s Hospital Psychology Team Member).

Yet another future participant patient is eight-year-old, Lilly. Lilly was diagnosed with Opsoclonus Myoclonus Syndrome (OMS), an autoimmune neurological disorder, and is receiving outpatient consultation from Pediatric Psychology to aid in coping with her rare medical condition. They psychology team member plans on working with her to create a “coping tool kit”. This tool kit, which is typically a physical shoebox full of supports, would be virtualized using apps modeled on the psychologist’s iPad that the patient could download on her parent’s device. The psychologist discussed using relaxing sound and imagery apps, such as Gaze HD Beaches Lite and Relax Melodies HD, and Self-Help Anxiety Management (SAM) app for coping techniques and soothing coloring activities. The practitioner also spoke to the
highlights of this intervention for a patient like Lilly, expressing that "It would accomplish the same coping intervention goals as normal, just increasing buy-in and portability."

**Discussion**

This study's results indicate the iPad intervention program at Mott Children's Hospital is a promising platform for a portable, engaging and interactive intervention for Pediatric Psychology. Patients, parents and psychology team members provided great insight as to the potential of utilizing iPads and iOS apps for reaching and enhancing biopsychosocial intervention goals. Analysis of the Likert scale responses from all 13 perspectives (patients, parents and psychology team members) indicated an 85 percent satisfaction rate with the iPad intervention (satisfaction, in this case, is defined as responding in agreement or strong agreement for the items surveyed, i.e., "I strongly agree that the intervention was helpful"). No participant responded in the negative on any Likert scale items. Parents were most often satisfied with the intervention, 89% of their responses were either agree or strongly agree. Psychology team members reported 83% satisfaction and patients reported 82%.

Several Likert scale items were collapsed into categories. Intervention Success was measured by collapsing questions of patients' learning, attainment of treatment goals, and management of their pain, stress, behavior and/or emotions. Eighty-two percent of these survey items were answered as Agree or Strongly Agree, indicating at least an initial vote of confidence on the efficacy of the interventions. Patient Engagement was measured by collapsing the following: patient interest and engagement in using the iPad interventions in the hospital and upon discharge; feedback on using the iPad for intervention support; and whether or not the patient would agree to use the apps again. Engagement and usability questions also took into
consideration recommendation to other patients and families as well as participant satisfaction of hospital interventions as enhanced with iPad applications. Eighty-five percent of these types of questions were answered as Agree or Strongly Agree. Additional comments and case notes also spoke to the promise of accessibility and portability the iPad intervention program provides.

The study is not without limitations, and one of the biggest was its tight timeline. Working with the Hospital to secure the University of Michigan Internal Review Board approval and to acquire and deploy the iPad lending station took far longer than anticipated and this translated into a shorter data collection period and sample size than originally planned. Even so, data was gathered from 2-3 perspectives per case study, and since all participants responded quite positively to the apps, a level of confidence in the potential of this type of intervention is evident. A second study limitation is the absence of any pre-intervention assessment, so that a pre/post intervention comparison of any sort is impossible.

Although not covered in the survey questions, at least one negative aspect of the intervention was found following a review of case notes and informal comments from patients and clinicians. The iPad itself was heavy for some patients to use; one app in particular, Belly Bio, required patients to place the iPad on their stomach to guide them in deep-breathing exercises, which was difficult for our participants with abdominal conditions. In future interventions, use of the iPad Mini might be warranted.

Future Research and Project Continuation

Pediatric Psychology staff members are pleased with the results of this pilot study and are eager to expand upon using the iPad as a means of enhancing their interventions of pain management, coping, relaxation and medical adherence. As expressed earlier, additional
candidates are ready for study participation, so more data will be collected to continue the investigation and further refinement of app selection and patient protocols.

Beyond service quality improvement, one psychology post-doctoral fellow took the initiative to develop this study further and “explore the utility of mobile health technology to address pain with children seen by an inpatient consultation-liaison psychology service” (Limke, 2014). This new research aims to study how the use of mobile health technology (e.g. the applications deployed in this pilot study) can enhance pain management intervention, for instance, by reducing pain and/or anxiety associated with chronic pain. The study will follow patients post discharge and will measure both patient and caregiver satisfaction.

Although the pilot study described in this monograph had a small sample size, it has the possibility of making a lasting impact. Currently, ten iPads are installed at the Hospital with the engaging, accessible, intervention-enhancing iOS applications described in this study and 14 more iPads are hopefully on their way. Now any pediatric patient will be able to go to the lending station and check out one of the Pediatric Psychology imaged iPads and gain access to a coping tool kit full of exciting and engaging apps. Thus a question is posed, what child, or any patient for that matter, does not face the challenges of discomfort, worry, or adjustment when admitted to the hospital? It is time we start addressing, and more importantly, responding, to the emotional turmoil patients experience on a daily basis, in addition to their medical treatment. These iPad and app-based interventions offer an innovative way to do just that and are indicative of new biopsychosocial treatment options that address the needs of the whole patient.

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