

2015

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### Recommended Citation

Wytiaz RM, Lee HM, Odukoya OK, et al. Smart Phone Apps: An Innovative Approach to Improving Pediatric Medication Adherence. *Inov Pharm.* 2015;6(4): Article 222. <http://pubs.lib.umn.edu/innovations/vol6/iss4/4>

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## Smart Phone Apps: An Innovative Approach to Improving Pediatric Medication Adherence

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**Key Words:** Smart Phone App, Medication Adherence, Children, Adolescents, Pharmacists, Self-Management, Chronic Illness

### Abstract

*Children suffering from chronic illnesses often struggle to adhere to their medication regimens and are rarely involved in the management of their medications. The use of innovative technology, such as medication adherence mobile apps, may be beneficial in increasing medication adherence rates and self-care knowledge in the pediatric population. Children serve as an optimal population with which to use mobile apps as intervention tools, as children utilize smart phone technology far more than most other populations. By striving to improve children's medication perceptions, adherence and willingness to continue medication therapy for a chronic condition may improve during adolescent years and may persist as they transition into adulthood. As community pharmacists interact with children with chronic conditions during routine visits, they can also engage them in conversations about their medication adherence through use of mobile apps. Although many medication adherence apps are currently available on the market, none of these apps are tailored towards pediatric patients. Thus, further research should be conducted in order to develop mobile apps conducive to this population.*

### Introduction

Over the past 20 years, the number of children (ages 4 to 11) and adolescents (ages 12-19) diagnosed with a chronic medical condition has steadily increased from 13% to 27% in the United States.<sup>1,2</sup> Children and their family caregivers manage complex treatment regimens, including multiple medications and routine visits to healthcare professionals. Consequently, 50% to 88% of these children and adolescents struggle with adhering to their medications, which may compromise patient care.<sup>3</sup> Medication nonadherence may lead to negative health outcomes, such as increased disease symptoms, increased hospital visits, increased morbidity and mortality rates, and increased healthcare costs.<sup>4</sup>

Medication nonadherence in children does not solely affect the child's current disease state as it may also affect their adult health. Because children are of a habit-forming age, many of their behaviors evolve into their adult life, affecting their future health.<sup>5</sup> Therefore, improving children's adherence to medication regimens is essential.

Teaching children about medications and medical conditions is a simple way to begin improving medication adherence from an early age. Smart phone apps serve as an innovative

approach to engaging children in medication education. In today's society, children utilize smart phones in their daily lives frequently, thus the accessibility of smart phones increases the potential of integrating mobile apps into pediatric patient care to improve medication adherence.<sup>5</sup>

### Improving Children's Medication Adherence

Parents or primary caregivers traditionally manage the mediations of children. Parents and caregivers are typically more knowledgeable about medications, therefore they naturally assume the role of medication manager.<sup>6</sup> In this position, parents and caregivers are responsible for engaging children in health behaviors and processes that are needed for managing their child's chronic condition. Although studies show that children above the age of six possess the ability to understand and recognize various brand-name medications, caregivers continue to primarily manage children's medications.<sup>7</sup> Consequently, children hold a minimal or even non-existent role in their medication regimen, causing children to become passively engaged in their medication taking.

Since children generally rely on their parents for taking medications, children struggle to adhere to their medication regimen when caregivers are absent. These bouts of medication nonadherence can occur in several situations, such as a caregiver forgetting to remind a child to take the medication, a child being physically separated from a caregiver, or a child beginning to gain more independence during his or her transition into adulthood.<sup>8</sup> These medication-taking gaps will only widen if they are not given the appropriate attention. Medication perceptions must be addressed during the childhood and adolescent years, as many of the beliefs formed during this time may persist into the transition into adulthood.

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As children enter adolescence, they start to gain responsibility for their self-care and medication management, while at the same time, they start to claim their individual independence.<sup>9</sup> By striving to improve medication perceptions in this population, adherence and willingness to continue medication therapy for a chronic condition will improve throughout both adolescent and adult years.<sup>10</sup>

### Emergence of Medication Adherence Mobile Apps

Many studies regard the use of medication adherence mobile apps as an “innovative and non-invasive” approach to assessing and improving nonadherence rates in children.<sup>11,12,13</sup> Over the past two years, the number of medication adherence apps available on the market significantly increased from 160 to 461.<sup>14,15</sup> This remarkable increase confirms the rising demand of medication adherence apps, which can be used by nearly all patient populations. In today’s world, nearly 64% of Americans own a smart phone, with smart phone ownership the highest among younger Americans.<sup>16</sup> About three in four children classify themselves as “mobile internet users,” accessing the internet on cell phones, tablets, and other mobile devices most frequently.<sup>17</sup>

Children may benefit from the utilization of medication adherence apps to self-manage their personal medications and to improve their individual health. Children traditionally indicate “forgetting” as the main reason for nonadherence in their medication regimens.<sup>18</sup> Since children are typically with their smart phones at all times, mobile apps may help remediate this forgetfulness by sending administration reminders for each medication. Medication adherence apps provide a reliable way for children to take their medications consistently. Such apps could enable children to adopt more responsibility in their medication regimen, allowing them to oversee their medication list, set alarms for separate medications, and document successful administration of each medication. These apps may also encourage children to learn more about their condition and healthy lifestyle behaviors.

Children serve as an optimal population with which to use mobile apps as intervention tools, as children utilize smart phone technology far more than most other populations. Nearly 7 in 10 teens use their phone for entertainment purposes, a much larger percentage than the 2 in 5 adults who use their smart phones in this way.<sup>19</sup> Each day, children are exposed to and interact with numerous apps, quickly learning how to navigate and use each one. Therefore, children would be able to easily adopt the practice of using medication adherence apps. As the number of children who own smart phones rapidly increases, all the newly developed mobile apps become more accessible. Unlike typical medical devices, which must be separately purchased, the smart phones of patients

can be transformed into personal intervention tools by simply downloading a free medication adherence app. This innovative technique may be a major benefit to this population as they become adults. Currently, approximately 92% of older adults suffer from chronic disease, and almost 77% suffer from at least two conditions, thus requiring medication therapy.<sup>20</sup> Introducing medication apps to children today may be beneficial, as they may need to rely more heavily on adherence devices as they age in order to improve their health outcomes.

### Current Challenges

Despite the benefits associated with smart phones and healthcare in children, medication adherence apps tailored towards the medication and health education needs of children are virtually non-existent. We evaluated 461 medication adherence apps found in the Apple App Store and Google Play Store. We found that there is currently no systematic approach for easily categorizing or finding apps tailored towards children. No specific apps designed for children were identified, as each app reviewed focused on the general adult population. The lack of child-tailored medication adherence apps hinders children from attaining full advantage of this innovative technology to improve their health.

Although numerous medication adherence apps exist, patients struggle to find the best mobile app for their particular situation. It is difficult for patients to narrow the wealth of medication adherence app choices in order to find something appropriate for their specific situation. Therefore, most users download the most popular app in the store, which may not necessarily be the best clinically-suited app.<sup>21</sup> The basic information initially presented about each app in the App Store or Play Store is limited, allowing users to only gain full information after downloading and using the app. The App Store and Play Store simply provide the name of the app, the developing and sponsoring companies’ names, numerical star reviews, and select screens shots of the app. Thus, determining the right app for a particular individual is a prolonged process, as learning thorough details about different apps can be quite complicated.

There are limited studies testing the effectiveness of using mobile apps to improve pediatric medication adherence. Future research should explore children’s preferences for the design and usability of medication adherence apps. Implementation of a systematic medication adherence app search system is needed in order to help children find the best app for their age group, disease state, personal preferences, and other unique needs.

### Role of Pharmacists

Pharmacists are well-positioned to improve medication use in children through individualized recommendations, thus demonstrating the benefits of pharmaceutical care to children in their early stages of life.<sup>22</sup> Implementation of pharmacy programs that include innovative services tailored toward children can provide significant professional, economic, and therapeutic rewards.

Children with chronic diseases visit the pharmacy with their parents to retrieve their prescriptions, and these regular visits will allow pharmacists to build long-term relationships with the children. A standing relationship with patients facilitates formation of a more personal rapport. By getting to know pediatric patients, pharmacists are in a more suitable position to make individualized recommendations.<sup>23</sup> Pharmacists appreciate the differences between children and adults in terms of pharmacotherapy, therefore they are apt to tailor counseling to the pediatric population. Pharmacists can provide children with simple explanations of their illnesses via child-friendly aids, which encourage children to take greater responsibility in their medication regimen.<sup>24</sup> The increasing prevalence of pharmacists and pharmacies in the healthcare profession allow pharmacists to serve as an accessible means for patients to receive medication counseling. By suggesting innovative tools like medication adherence apps to children, pharmacists can play a role in increasing adherence and ultimately health outcomes for pediatric patients.

There are numerous tools that can be utilized by pharmacists to aid them in determining the most suitable medication adherence app for a specific patient. Pharmacists can utilize the website, MedAppFinder.com, to learn about different medication adherence apps for patients.<sup>25</sup> This website allows users to find medication adherence apps based on desired important features. Although this website assists in identifying the most suitable medication adherence apps, it does not allow users to find apps geared towards specific populations, particularly children. To recommend the most appropriate apps to patients, pharmacists should utilize not only MedAppFinder.com, but also examine recently published articles regarding healthcare technology such as medication adherence apps. It is crucial for pharmacists to remain abreast of the rapidly evolving medication adherence app market in order to recommend the best-fitting apps to individual patients.

There is currently no standardized way to review medication adherence apps. However, a recent study explored the use of a novel tool, Mobile App Rating Scale (MARS). MARS is a simple, objective, and reliable tool for classifying and assessing the quality of mobile health apps.<sup>26</sup> This is the first tool to provide a multidimensional measure of app quality related to usability

and validity. Pharmacists can use MARS to evaluate the app's engagement, functionality, aesthetics, and information quality level for specific patients. MARS is scored based on the mean scores of these objective parameters, which is combined with an overall mean app quality total score.<sup>26</sup> The objectivity of MARS is strengthened by the exclusion of a subjective quality subscale from the overall mean app quality score.<sup>26</sup> The use of MARS in pharmacy practice can serve as a guideline to review medication adherence apps to ensure that the most appropriate recommendations are conveyed to patients.

### Conclusion

It is well known that medication nonadherence is costly in the United States. Thus, the use of mobile apps may help to reduce healthcare expenses in pediatric patient care. The marriage of smart phones and medication adherence is particularly ideal for use in children, as they enjoy using the latest technologies. However, there is a lack of medication adherence apps tailored towards educating children about medication use and health. Adapting medication adherence apps to children specifically, will encourage them to take greater responsibility in their medication regimen. Increased responsibility will allow children to further educate themselves about their chronic conditions and self-care. Stronger pediatric medication education will aid children in their transition from childhood into adolescence and adulthood, which will facilitate medication adherence in these stages of life as well.

In order for this transition to be successful, children must begin to play an active role in their health during their early years. A discussion between the child, parent or caregiver, and community pharmacist could be beneficial in determining the child's level of responsibility in their care. Community pharmacists should target medication counseling not only to parents, but also to children, in order to involve them in medication management. Parents and caregivers of children suffering from chronic conditions must make frequent visits to community pharmacies to retrieve their child's necessary medications. Children often accompany their parents or caregivers on these trips, allowing community pharmacists to form a personal and intimate relationship with the child. Creating these relationships will allow pharmacists to suggest innovative medication adherence tools, such as mobile apps, that are conducive to particular patients. Despite this perceived benefit, more research regarding children, medication adherence responsibility, and mobile app preferences must be conducted before developing child-geared medication adherence apps. With the development of smart phone apps tailored toward children, pharmacists will be able to suggest these personalized tools, which will facilitate children's adherence to their medications, and ultimately improve therapeutic outcomes for children.

## References

1. Modi, AC, Pai, AL, Hommel, KA, et al. Pediatric self-management: a framework for research, practice, and policy. *Pediatrics*. 2012;129(2):473-485.
2. Centers for Disease Control and Prevention. 2015. Children. Retrieved from <http://www.cdc.gov/parents/children/>
3. McGrady, ME, Hommel, KA. Medication adherence and health care utilization in pediatric chronic illness; a systematic review. *Pediatrics*. 2013;132(4):730-740.
4. DeMaria, C, Lussier, MT, Bajcar, J. What do children know about medications? *Can Fam Physician*. 2011;57(3):291-295.
5. Lotstein DS, Seid M, Klingensmith G, et al. Transition from pediatric to adult care for youth diagnosed with type 1 diabetes in adolescence. *Pediatrics*. 2013;131(4):e1062-70.
6. Smith BA, Shuchman M. Problem of nonadherence in chronically ill adolescents: strategies for assessment and intervention. *Current Opinion in Pediatrics*. 2005;17:613-618.
7. Curry H, Schmer C, Ward-Smith P, et al. Kid cards: teaching children about their medicines. *Journal of Pediatric Health Care*. 2006;20(6):414-418.
8. Nazziwa R, Kakooza Mwesige A, Obua C, et al. Adherence to antiepileptic drugs among children attending a tertiary health unit in a low resource setting. *Pan Afr Med J*. 2014; 17:44.
9. Desai M, Oppenheimer JJ. Medication adherence in the asthmatic child and adolescent. *Curr Allergy Asthma Rep*. 2011;11(6):454-64.
10. Koster ES, Heerdink ER, de Vries TW, Bouvy ML. Attitudes towards medication use in a general population of adolescents. *Eur J Pediatr*. 2014;173(4):483-8.
11. Gauthier P, Cardot J. Teenagers as a moving target: how can teenagers be encouraged to accept treatment? *J. Pers. Med*. 2012, 2(4), 277-286
12. Nickels A, Dimov V., Innovations in technology: social media and mobile technology in the care of adolescents with asthma. *Curr Allergy Asthma Rep*. 2012 Dec;12(6):607-12.
13. Mulvaney SA, Ho YX, Cala CM, Chen Q, Nian H, Patterson BL, Johnson KB. Assessing Adolescent Asthma Symptoms and Adherence Using Mobile Phones. *J Med Internet Res* 2013;15(7):e141
14. Dayer L, Heldenbrand S. Smartphone medication adherence apps: Potential benefits to patients and providers. *J Am Pharm Assoc*. 2013 Mar-Apr; 53(2): 172-181.
15. Heldenbrand S, Martin B, Dayer L, et al. Navigating the Adherence App Marketplace: Rating the Quality of the Medication Adherence Apps. *J Am Pharm Assoc* 2015;55:e113-e263.
16. Smith A. U.S. Smartphone Use in 2015. *Pew Research Center*. 1 April 2015. Accessed 19 Sept 2015. <http://www.pewinternet.org/2015/04/01/us-smartphone-use-in-2015/>.
17. Madden M, Lenhart A, Duggan M, et al. Full Report: Teens and technology 2013. *Pew Internet & American Life Project*. 2013. Accessed 16 October 2015. <http://www.pewinternet.org/2013/03/13/teens-and-technology-2013-2/>
18. Koster ES<sup>1</sup>, Philbert D, de Vries TW, van Dijk L, Bouvy ML., I Just Forgot to Take it. *J Asthma*. 2015 Jun 2:1-7.
19. Lenhart A. Cell phones and American adults: they make just as many calls, but text less often than teens. Washington, DC: Pew Research Center <<http://pewinternet.org/Reports/2010/Cell-Phones-and-American-Adults.aspx>> (2010). Accessed 17 September 2015.
20. National Council on Aging. 2014. Healthy Aging [Fact Sheet]. Retrieved from [https://www.ncoa.org/wp-content/uploads/FactSheet\\_HealthyAging.pdf](https://www.ncoa.org/wp-content/uploads/FactSheet_HealthyAging.pdf)
21. Comstock J. IMS: 1 in 10 health apps connects to a device, 1 in 50 connects to healthcare providers. *MobiHealthNews*. <http://mobihealthnews.com/46863/ims-1-in-10-health-apps-connects-to-a-device-1-in-50-connects-to-healthcare-providers/>. Published on 17 Sept 2015. Accessed 19 Sept 2015.
22. Dundee FD, Dundee DM, Noday DM. Pediatric counseling and medication management services: opportunities for community pharmacists. *J Am Pharm Assoc*. 2002;42(4):556-66.
23. Garjani A, Rahbar M, Ghafourian T, et al. Relationship of pharmacist interaction with patient knowledge of dispensed drugs and patient satisfaction. *Eastern Mediterranean Health Journal*. 2009;15(4):934-943.
24. Sanghera N, Chan PY, Khaki ZF, et al. Interventions of hospital pharmacists in improving drug therapy in children. *Drug Safety*. 2006;29(11):1031-1047.
25. Heldenbrand S, Martin B, Dayer L, et al. Navigating the Adherence App Marketplace: Rating the Quality of the Medication Adherence Apps. *J Am Pharm Assoc* 2015;55:e113-e263.
26. Stoyanov S, Hides L, et al. Mobile App Rating Scale: A New Tool for Assessing the Quality of Health Mobile Apps. *JMIR Mhealth Uhealth*. 2015;Jan-Mar;3(1);e27