

Viewpoint

# Medication Adherence and Technology-Based Interventions for Adolescents With Chronic Health Conditions: A Few Key Considerations

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## Abstract

The number of children and adolescents with chronic health conditions (CHCs) has doubled over the past two decades. Medication adherence is a key component of disease management within these groups. Low adherence to prescribed medications is a known problem in adolescents with CHCs and is related to health outcomes, including quality of life, disease complications, and mortality. Adolescence is a critical time to create routines and health behaviors that optimize disease self-management and transition to adult care. The mounting interest in the development and use of mobile health tools provides novel opportunities to connect patients, particularly adolescents, with their providers outside of the clinic and to improve health outcomes. There is growing evidence to support the efficacy of technology-based approaches, in particular text-messaging and mobile apps, to improve adherence behavior in adolescents, although cost-effectiveness and long-term health benefits remain unclear. In this short viewpoint article, we review some important considerations for promoting medication adherence in adolescents with CHCs using technology-based approaches.

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**KEYWORDS**

adolescents; adherence; compliance; technology interventions; mobile apps; text messaging

The number of children and adolescents with chronic health conditions (CHCs) continues to increase and has doubled over the past two decades, which represents an important public health concern [1]. Pediatric patients with CHCs, particularly adolescents, face challenges when trying to manage their illnesses and optimize their self-management skills. Adolescents with CHCs form a special subpopulation of pediatric patients (12-17 years old) learning how to self-manage medical decisions in preparation for an inevitable transition to adult care. Although the number of adolescents with CHCs is increasing, the number of validated self-reported scales for medication adherence that have been developed and tested specifically for adolescents is limited. Assessment of adolescent patients using parental proxy

reports is not ideal. The use of tools designed for (and validated in) adults may be problematic, given the unique physiological, developmental, psychosocial, and education/vocational considerations of adolescence.

Adolescence is a critical time to create routines and health behaviors that optimize disease self-management and preparation for a seamless transition to adult care. The involvement of adolescents with CHCs in their own care can be demanding for both families and health care professionals, although it is an important investment given the short-term and long-term gains [2]. Medication adherence is a key component of disease management and low adherence to prescribed medications is a

known problem in adolescents with CHCs, which is related to health outcomes, including quality of life, disease complications, and mortality [3]. Moreover, medication nonadherence has been associated with more frequent utilization of health services as well as higher health care expenses across pediatric CHCs [4]. Nevertheless, approaches to increase adherence to prescribed medications among adolescents with CHCs that are efficacious, practical, and cost-effective are lacking.

Taking daily medication(s) is a daunting task for many adolescents with CHCs, regardless of the prescribed regimen. Despite differences in disease-specific monitoring and treatment requirements among adolescents with CHCs, recent data suggest that barriers are similar across conditions [5]. Hanghoj and Boisen systematically reviewed data on perceived barriers from 2501 adolescents who had at least one of 14 chronic illnesses [5]. In order of frequency, the common barriers to medication adherence included: (1) aspects of physical well-being, such as side effects (including changes in physical appearance), reduction in symptoms/feeling well, and pill taste or swallowing problems; (2) forgetting to take medications, in part due to competing activities or changes in schedule; (3) desire to be normal and forget, ignore, or be free of their disease; and (4) lack of support from peers, parents, and health professionals. Therefore, the challenges that adolescents with CHCs need to overcome to optimize their medication adherence may be multi-faceted, but amenable to common adherence-enhancing interventions [5].

Clinics need information on evidence-based approaches to be able to implement these initiatives in the practice environment. Patient-centered and stakeholder-informed interventions developed with and for adolescents with CHCs are essential to improve adherence and enhance uptake, as well as engagement with interventions over time (particularly technology-based approaches). Access to personal technology, in particular smartphones, is becoming ubiquitous [6-8]. The mounting interest in the development and use of mobile health tools provides novel opportunities to connect patients with their providers outside of the clinic to improve health outcomes. Adolescents have adopted communication technology at a relatively fast pace, regardless of their socioeconomic status. A recent report indicates that most adolescents have widespread access to personal technology tools, including smartphones (73%), tablets (58%), desktop computers (87%), and/or laptop computers (81%) [6]. These findings suggest that technology-based interventions may present a unique opportunity to improve medication adherence and enhance self-management skills in adolescents across CHCs.

The use of personal and widely available technology-based approaches (in particular text-messaging, mobile apps, and mobile social media) to improve adherence behavior and other health outcomes in adolescents has shown overall acceptability and feasibility, with modest evidence for efficacy [9-12]. Nevertheless, the long-term health benefits, cost-effectiveness, and sustainability of patient engagement through technology-based approaches remain unclear [13,14]. Additionally, text messaging delivery methods often lack innovative features targeted to adolescents. Furthermore, methods to quantify patient fatigue, which is assumed to occur among adults with frequent text messaging, and the sustainability of patient engagement may apply differently to adolescents, representing a challenge for researchers. Therefore, while the evidence to date is encouraging and promising, further study of technology-based interventions for adolescent self-management and medication adherence, with rigorous study designs and across a wide range of CHCs, are needed. Moreover, further research is needed to explore adolescents' insights into the role and the design of technology-based interventions in identifying facilitators or preferred strategies to improve medication adherence. The consistent use of reporting guidelines for technology-based interventions is also critical to support the evidence generated, and conclusions that can be drawn, from adherence intervention studies [15].

While research efforts continue to produce better evidence for these technologies to promote health outcomes among adolescents with CHCs, we encourage medical providers to begin a conversation with leadership within their provider group or hospital about the incorporation of mobile technology into the practice environment, and to ask patients about their use of mobile technology and apps to promote self-care.

In conclusion, the number of adolescents with chronic illnesses continues to increase. Medication nonadherence is a challenge in adolescents across chronic conditions. Adolescents are frequent users of technology and engaging adolescents with chronic illnesses in their self-management could be invaluable for improving long-term outcomes. The use of technology-based interventions to improve medication adherence has shown promising results, and seeking adolescents' perspectives could enhance uptake and long-term engagement, and minimize patient fatigue. Following guidelines for reporting results of technology-based interventions, and validating adolescent-specific adherence assessment instruments, would enhance further comparative research across studies.

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## Conflicts of Interest

None declared.

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## References

1. Van Cleave J, Gortmaker SL, Perrin JM. Dynamics of obesity and chronic health conditions among children and youth. *JAMA* 2010 Feb 17;303(7):623-630. [doi: [10.1001/jama.2010.104](https://doi.org/10.1001/jama.2010.104)] [Medline: [20159870](https://pubmed.ncbi.nlm.nih.gov/20159870/)]
2. Sabate E. Adherence to long-term therapies: evidence for action. Geneva: World Health Organization; 2003. URL: <http://apps.who.int/iris/bitstream/10665/42682/1/9241545992.pdf> [WebCite Cache ID 6pIt6ezF8]

3. Rapoff M. Adherence to pediatric medical regimens. In: Issues in Clinical Child Psychology, 2nd Edition. New York: Springer Science; 2010.
4. Graves MM, Roberts MC, Rapoff M, Boyer A. The efficacy of adherence interventions for chronically ill children: a meta-analytic review. *J Pediatr Psychol* 2010 May;35(4):368-382 [FREE Full text] [doi: [10.1093/jpepsy/jsp072](https://doi.org/10.1093/jpepsy/jsp072)] [Medline: [19710248](https://pubmed.ncbi.nlm.nih.gov/19710248/)]
5. Hanghøj S, Boisen KA. Self-reported barriers to medication adherence among chronically ill adolescents: a systematic review. *J Adolesc Health* 2014 Feb;54(2):121-138. [doi: [10.1016/j.jadohealth.2013.08.009](https://doi.org/10.1016/j.jadohealth.2013.08.009)] [Medline: [24182940](https://pubmed.ncbi.nlm.nih.gov/24182940/)]
6. Lenhart A. Pew Research Center. Washington, DC; 2015. Teens, social media & technology overview 2015 URL: <http://www.pewinternet.org/2015/04/09/teens-social-media-technology-2015/> [accessed 2017-05-15] [WebCite Cache ID [6pLxGjb7Q](https://www.webcitation.org/6pLxGjb7Q)]
7. Smith A. Pew Research Center. Washington, DC; 2015. U.S. smartphone use in 2015 URL: <http://www.pewinternet.org/2015/04/01/us-smartphone-use-in-2015/> [accessed 2017-05-14] [WebCite Cache ID [6pLxWHxOV](https://www.webcitation.org/6pLxWHxOV)]
8. Badawy SM, Thompson AA, Liem RI. Technology access and smartphone app preferences for medication adherence in adolescents and young adults with sickle cell disease. *Pediatr Blood Cancer* 2016 May;63(5):848-852. [doi: [10.1002/pbc.25905](https://doi.org/10.1002/pbc.25905)] [Medline: [26844685](https://pubmed.ncbi.nlm.nih.gov/26844685/)]
9. Badawy SM, Barrera L, Sinno MG, Kaviany S, O'Dwyer LC, Kuhns LM. Text messaging and mobile phone apps as interventions to improve adherence in adolescents with chronic health conditions: a systematic review. *JMIR Mhealth Uhealth* 2017 May 15;5(5):e66 [FREE Full text] [doi: [10.2196/mhealth.7798](https://doi.org/10.2196/mhealth.7798)] [Medline: [28506955](https://pubmed.ncbi.nlm.nih.gov/28506955/)]
10. Badawy SM, Kuhns LM. Texting and mobile phone app interventions for improving adherence to preventive behavior in adolescents: a systematic review. *JMIR Mhealth Uhealth* 2017 Apr 19;5(4):e50 [FREE Full text] [doi: [10.2196/mhealth.6837](https://doi.org/10.2196/mhealth.6837)] [Medline: [28428157](https://pubmed.ncbi.nlm.nih.gov/28428157/)]
11. Majeed-Ariss R, Baildam E, Campbell M, Chieng A, Fallon D, Hall A, et al. Apps and adolescents: a systematic review of adolescents' use of mobile phone and tablet apps that support personal management of their chronic or long-term physical conditions. *J Med Internet Res* 2015 Dec 23;17(12):e287 [FREE Full text] [doi: [10.2196/jmir.5043](https://doi.org/10.2196/jmir.5043)] [Medline: [26701961](https://pubmed.ncbi.nlm.nih.gov/26701961/)]
12. Thakkar J, Kurup R, Laba T, Santo K, Thiagalingam A, Rodgers A, et al. Mobile telephone text messaging for medication adherence in chronic disease: a meta-analysis. *JAMA Intern Med* 2016 Mar;176(3):340-349. [doi: [10.1001/jamainternmed.2015.7667](https://doi.org/10.1001/jamainternmed.2015.7667)] [Medline: [26831740](https://pubmed.ncbi.nlm.nih.gov/26831740/)]
13. Payne HE, Lister C, West JH, Bernhardt JM. Behavioral functionality of mobile apps in health interventions: a systematic review of the literature. *JMIR Mhealth Uhealth* 2015;3(1):e20 [FREE Full text] [doi: [10.2196/mhealth.3335](https://doi.org/10.2196/mhealth.3335)] [Medline: [25803705](https://pubmed.ncbi.nlm.nih.gov/25803705/)]
14. Badawy SM, Kuhns LM. Economic evaluation of text-messaging and smartphone-based interventions to improve medication adherence in adolescents with chronic health conditions: a systematic review. *JMIR Mhealth Uhealth* 2016 Oct 25;4(4):e121 [FREE Full text] [doi: [10.2196/mhealth.6425](https://doi.org/10.2196/mhealth.6425)] [Medline: [27780795](https://pubmed.ncbi.nlm.nih.gov/27780795/)]
15. Eysenbach G, CONSORT-EHEALTH Group. CONSORT-EHEALTH: improving and standardizing evaluation reports of Web-based and mobile health interventions. *J Med Internet Res* 2011 Dec 31;13(4):e126 [FREE Full text] [doi: [10.2196/jmir.1923](https://doi.org/10.2196/jmir.1923)] [Medline: [22209829](https://pubmed.ncbi.nlm.nih.gov/22209829/)]

## Abbreviations

**CHC:** chronic health condition

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