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Digital Interventions in management of Asthma in Children: A Systematic Review

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Abstract

A rising variety of digital solutions are being developed to assist persons with asthma in self-management. Digital technologies, in general, are advanced technologies that can capture, interpret, and transfer information, with smartphone or online applications, tech devices, and other telephone or digitally interventions being common applications.This review aimed to identify the digital interventions available in the management of asthma. Online database search was performed in Pubmed, CINHAL, Medline and relevant studies were included. Following on from this, databases were accessed to enable a more in depth search of the literature using key words and Boolean operators to generate articles relevant to the topic. These articles were filtered using an inclusion /exclusion criterion in order to refine the results to a manageable level or eight articles. These 8 articles were analyzed and the results reported that there is a wide variety of digital interventions being explored. Although several of the research looked at yielded excellent outcomes, there is still a lack of convincing proof of their usefulness in attaining diverse goals. Because asthma is a long-term illness, the research period of included studies may not be long enough to detect substantial health effects, or other factors may be at play in the association between medication adherence and health outcomes.Although some evidence supported the usefulness of the digital therapies evaluated, particularly in terms of improving treatment and drug adherence, the evaluation found that further research is needed to assess their value in terms of treatment outcomes and other clinical outcomes.

Introduction

Asthma has been the most frequent severe ailment affecting children across the world, with major health implications. It is one of the leading causes of paediatric morbidity and illness. In practically every country, this is a very pressing issue. Although particular data for many nations is not accessible, asthma has substantial expenditures worldwide.(1). Many of the detrimental impacts of childhood asthma on individuals and healthcare systems may be avoided, as seen by the mortality disparity between nations.(2). By allowing for early and preventative measures, effective management programmes are expected to be a cost-effective technique for improving asthma control and decreasing financial burden across countries.

Any medical action that involves a technological strategy and has a remote component is classified as a digital health intervention. DHT is a subset of e-Health that refers to the use of wireless communication technology to aid health-care tasks such as data collection, transmission of health-care information, and patient monitoring and treatment. The most common technology tool used to improve drug adherence is the mobile phone, or short messaging service.The findings are inconsistent, especially in terms of efficacy and app quality. People must be willing to employ digital interventions for them to be successful. Despite the fact that digital therapies have indeed been found to be generally acceptable to a

larger audience, when reviewing digital treatments, children and youth require specific consideration.

Adolescents are an especially difficult group to manage, and their lack of health literacy and self-management skills can have a negative impact on treatment compliance and clinical outcomes. The monitoring equipment was considered as reassuring by individuals who saw asthma as a severe threat. Many teens, on the other hand, were wary of the device, fearing it would get them in problems if they did not take their prescription properly, and that their healthcare providers simply don't trust them to do so.(5)This highlights the need of examining digital treatments geared particularly for children and adolescents, since their needs and reactions to interventions may differ from those of the general population.

Aim

This study aims to analytically review current data contributing to the digital ways in managing asthma in children

Research Question

The research question of this study is to ascertain what is known about variousdigitalinterventions available in managing asthma in children

Methodology

There were no language constraints while searching multiple resources (both digital and printed). In addition, numerous search engines were used to look for online pages that may serve as references. Inclusion and exclusion criteria were documented. Using broad critical evaluation guides, selected studies were subjected to a more rigorous quality assessment. These in-depth quality ratings were utilised to investigate heterogeneity and make conclusions about meta-analysis appropriateness.

A comprehensive technique was developed for this assessment in order to determine the appropriate sample group. The criteria for evaluating the literature were developed with P.I.C.O. in mind.

Due to the fact that this research will be examining the efficacy of an intervention, both RCTs and uncontrolled clinical trials were judged suitable. (Pati & Lorusso, 2018) emphasise though that the inclusion and technology used to prevent bias in a literature search may add bias, detailed documentation of the inclusion and criteria for inclusion may assist generate trust and credibility.

Criteria for PICO

Participants	Adolescents below 18 years of age
Intervention	Any eHealth technique targeted towards assisting asthma management
Comparison/Control	NA
Outcome	interventions aimed at promoting adherence to treatment

Data Collection Strategies

Three databases were chosen and utilised throughout the data collection method for this investigation. PubMed, CINAHL, and also the Cochrane library were consulted. To avoid

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oversaturation of the data, keywords were searched and Logical operators were used inside the search. (Pati & Lorusso, 2018) demonstrate that depending on how a search is conducted, purposeful or accidental bias may be evident. As a result, demonstrating that a comprehensive, lengthy, and broad search was undertaken is critical.

Keywords usedas per MeSH: Asthma, Telehealth, Intervention, Management

Inclusion/exclusion criteria.

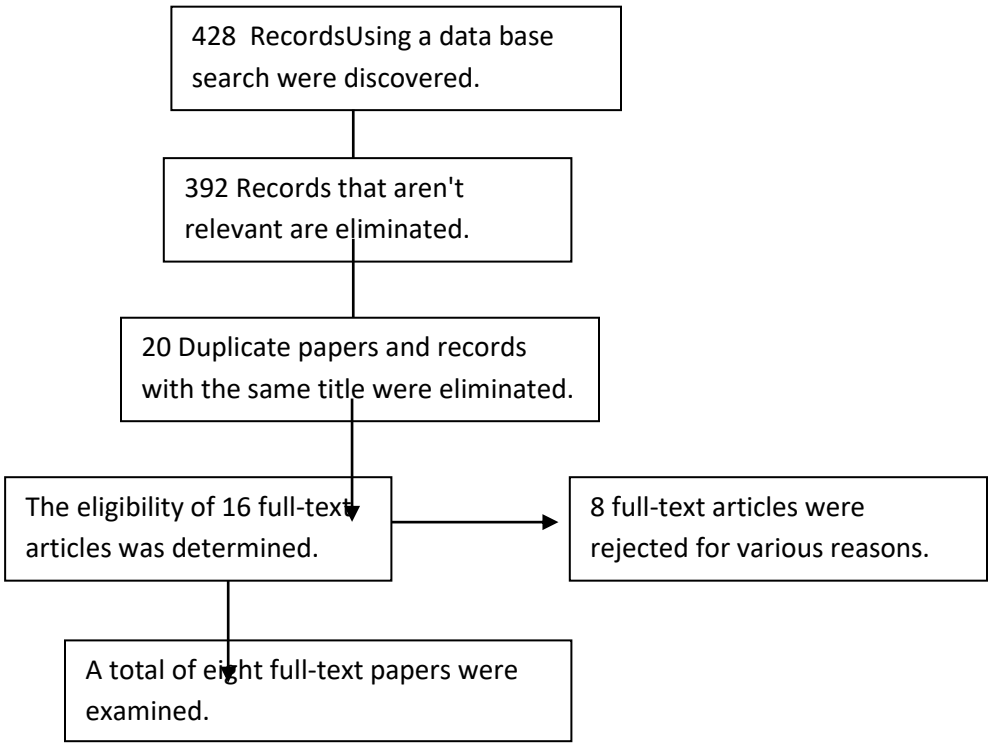
Articles were eliminated that have not been originally published in English due to the probability of linguistic prejudice as a consequence of the authors' limited expertise and the chance of an incorrect translation. (15). Boolean search for relevant terms were used and then filtering them using different filters depending on my inclusion criteria (See table below). This limited my query to 214 CINAHL records, 139 Medline records, and 75 PubMed records.

A PRISMA flow diagram was framed. Numerous things were deleted due to their insignificance to the study's subject. Duplicates were removed and studied the abstracts of each article. Additionally, papers were excluded that did not include meta - analytic review, leaving a total of eight publications that fit the inclusion criteria for this systematic review.

16 studies that we recognised as potentially helpful but later eliminated are included, along with their respective reasons for exclusion.

Inclusion Criteria	**Exclusion Criteria**
Adolescents below the age of 18 years	Adolescents above 18 years of age
Any kind of digital technologies related to asthma management	Articles published more than 10 years ago
Randomised control trials	Articles published in other languages

PRISMA FLOWCHART



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Results

The finished compositions will be subjected to critiques and analysis. Eight studies are included in the study. The table below summarises each article.

Author and date	**study design**	**Sample size**	**Intervention**	**Key findings**
Bender et al 2015 (16)	RCT	1187	Automated telephone software with speech recognition	Significant impact on adherence shows that low-cost SR adherence programmes combined with an electronic health record have a lot of impact
Perry et al 2017 (17)	RCT	393	School based telemedicine intervention	The intervention and usual-care groups had no statistically significant differences
Britto et al 2017 (18)	RCT	64	Reminder via text messages	During the texting intervention, there was a small increase in control of asthma.
Goossens et al 2014 (19)	RCT	209	Electronic monitoring (RTMM device) with text messages	no improved health outcomes
Reece et al 2017 (20)	RCT	48	Asthma WinApp	Improvement in ACTs is linked to documented daily usage of the Asthma Action Plan.
Beerthuizen et al 2016(21)	RCT	272	Web monitoring	From a financial standpoint, web-based monitoring was chosen in the healthcare industry.
Shinoneau et al 2019(22)	RCT	43	Inhaler Electronic monitoring device and reminders	Treatment adherence was higher in children who used EMD.
Sandra Voorend Var Bergen etal (23)	RCT	268	Web Monitoring	ICS might be significantly lowered while maintaining control.

Results

Bender et al (16)employed speech recognition phone calls to parents that were automatically personalised using clinical and biographical data from the electronic health record.The intervention's high impact on compliance indicates that low SR compliance programme

coupled with an electronic patient record have a lot of potential. It's possible that the lack of change in acute medical visits is due to already limited frequency of asthmatic emergency hospital appointments.Perry etal (17)conducted a studyand provided intervention by telemedicine to participants and provided treatment recommendations to primary care providers. There have been no substantial differences in reported symptom-free days between both the interventions and regular groups at the end of the investigation. Participants in the study acknowledged utilizing peak expiratory flow monitors to evaluate asthma and consuming their asthma medications as prescribed more regularly than those in the current set.Other outcome measures, such as life quality, identity, asthmatic awareness, and lung capacity, showed no differences across groups.Britto et al (18) conducted a RCT.Participants developed individual messages are being sent to mobile phones over the three months of the intervention. In 22 of the subjects, adherence was objectively checked. The adolescent participants gave the text messaging system a high rating for acceptance.Asthma control increased from start to month one in both the texting and control groups. Participants' quality of life increased and their anxiety over asthma reduced while in the messaging group. Goossens et al (19)performed intervention by RTMM device.Parents whose children seemed to neglect to inhale received SMS messages.. In this patient population, RTMM improves respiratory compliance, but there is no indication of positive health outcomes at starting year. This is not a profitable approach.Reece et al (20)did a 12-week RCT in which they utilised the app and continued to journal on paper. PEFRs were measured, as well as medication adherence. Patients in focus groups said they wanted to use the app on a daily basis to help with asthma management and that they didn't want to write on paper anymore.Beerthuizen et al(21)conductedweb-based strategy and in the FE_{NO}-based strategy. Although no statistically significant differences in QALYs and costs were identified as compared to normal treatment, From a healthcare aspect, web monitoring was preferred, whereas the FENO-based technique was preferred from a social standpoint..Simoneau et al(22) conducted The BreatheSmartTM EMD (one for the controller and one for the rescue inhaler) is linked with a mobile application that provides reminders and collects real-time adherence data. Adherence to controller therapy is higher among children who use an EMD with daily updates as compared to a typical group of children receiving standard specialised treatment. However, adherence remained unacceptably poor in both groups, suggesting that other impediments persist.Sandra et al (23)The online group's therapy was personalised based on ACT obtained via a website at 1-month intervals, the FENO group's treatment was designed .The main outcome was the change in the proportion of symptom-free days from baseline (SFD). Monitoring strategies had no effect on the difference in SFD from baseline. Using ACT monitoring, ICS might be greatly decreased while retaining control..

Discussion

This review looked at a variety of digital treatments for monitoring or enhancing medication adherence that were studied in the studies. EMDs were the most prevalent form of intervention studied. These EMDs, on the other hand, included a variety of capabilities, including reminders, text messages, and web sources that could be linked to offer personal feedback and track adherence statistics. Apps were another popular intervention that was studied. During the examination, inconsistencies in evidence demonstrating the efficacy of digital technology in achieving various goals were uncovered. The strategies' efficacy in enhancing treatment or medication adherence received the most endorsement.The findings of research examining the intervention's influence on asthma control and health outcomes were inconsistent, with some studies indicating positive effects and others indicating no effect. Patient impressions, acceptability, and usability were all rated well throughout the investigations. Only one research looked at the cost-effectiveness of these options, and the treatment was determined to be ineffective due to minimal improvements in health outcomes.This review discovered that a wide range of digital treatments are being investigated. Although

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several of the research looked at yielded excellent outcomes, there is still a lack of convincing proof of their usefulness in attaining diverse goals. Because Because asthma is a continues to progress, the study durations (varying from three to twenty-four months) may not be long enough to detect significant health consequences, or other variables may be at play in the link among medication compliance and clinical outcomes (eg, technique). Understanding the cause of the disparity might aid in the development of more successful online therapies and improved study methods. Perry et al(17)In SFD, our primary outcome, Perry et al reported no significant changes across groups. Despite evidence of high morbidity, only about 50 % of people were given a controllers, showing a significant gap in the administration of rules and standards asthma therapy in this rural community. These findings are in line with the high risk for death and minimal use of controller medications. To enhance results, many advocate a more focused strategy that involves provider education and interventions to groups assure the adoption of guidelines-based care.(24)Adolescents find text messages interesting and well-liked, as they are created and controlled by them. There were some There were no significant changes in asthma control, quality of life, or asthma exacerbations (annual rate 0.23 versus 0.37). Others have shown a relationship between low ICS compliance and an increased hazard of serious a attacks, but in rare studies.(25)

Limitations

Databases were used to seek down pertinent information in the search approach. Keyword combinations and Boolean operators were used to accomplish this. Although the study's aims stated that official statistics would be included, owing to time restrictions, this was not done, and hence there may be evidence selection bias. This is where, according to (AM et al., 2016), specific studies and all available data may be disregarded. While doing a literature search for this study, it became evident that there was a lot more data available, among other things. Furthermore, the studies included in this review are susceptible to volunteer bias, in which people who voluntarily choose to engage in the study may differ consistently from the general population.The research findings can serve as a starting point for future research and technology development in the area of asthma management and control.

Recommendations

These digital technology must be integrated into treatment processes. Most studies, including cost-effectiveness, did not particularly analyse technology. Although several of the technologies assessed had the ability to integrate patient data with patient health registers to generate treatment plans, this was not investigated as a substantial benefit of the technology. Patient users were also a prominent subject of acceptance and efficiency studies. Studying how these techniques connect with and adapt existing therapy routes may aid in their invention, enhancement, and long-term use.

Conclusion

There is a vast body of study that encompasses a wide spectrum of techniques, according to the findings. While there was some evidence that the digital treatments studied were effective, particularly in terms of enhancing treatment and drug compliance, further study is needed to determine their utility in terms of asthma symptoms.

References

1. Nunes C, Pereira AM, Morais-Almeida M. Asthma costs and social impact. Asthma Res Pract 2017 31 [Internet]. 2017 Jan 6 [cited 2021 Dec 27];3(1):1–11. Available from: https://asthmarp.biomedcentral.com/articles/10.1186/s40733-016-0029-3
2. Wolfe I, Thompson M, Gill P, Tamburlini G, Blair M, Van Den Bruel A, et al. Health services for children in western Europe. Lancet [Internet]. 2013 Apr 6 [cited 2021 Dec 27];381(9873):1224–34. Available from: http://www.thelancet.com/article/S0140673612620856/fulltext
3. Hamine S, Gerth-Guyette E, Faulx D,

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Green BB, Ginsburg AS. Impact of mHealth chronic disease management on treatment adherence and patient outcomes: a systematic review. J Med Internet Res [Internet]. 2015 Feb 1 [cited 2021 Dec 27];17(2). Available from: https://pubmed.ncbi.nlm.nih.gov/25803266/

4. Unni E, Gabriel S, Ariely R. A review of the use and effectiveness of digital health technologies in patients with asthma. Ann Allergy, Asthma Immunol [Internet]. 2018 Dec 1 [cited 2021 Dec 27];121(6):680-691.e1. Available from: http://www.annallergy.org/article/S1081120618313140/fulltext
5. Stewart AC, Gannon KN, Beresford F, Fleming L. Adolescent and caregivers' experiences of electronic adherence assessment in paediatric problematic severe asthma. J Child Heal Care [Internet]. 2018 Jun 1 [cited 2021 Dec 27];22(2):238–50. Available from: https://journals.sagepub.com/doi/10.1177/1367493517753082
6. Cronin P, Ryan F, Coughlan M. Undertaking a literature review: a step-by-step approach. Br J Nurs [Internet]. 2008 [cited 2021 Nov 25];17(1):38–43. Available from: https://pubmed.ncbi.nlm.nih.gov/18399395/
7. Cooper C, Booth A, Varley-Campbell J, Britten N, Garside R. Defining the process to literature searching in systematic reviews: A literature review of guidance and supporting studies. BMC Med Res Methodol [Internet]. 2018 Aug 14 [cited 2021 Nov 25];18(1):1–14. Available from: https://bmcmedresmethodol.biomedcentral.com/articles/10.1186/s12874-018-0545-3
8. Perry TT, Margiotta CA. Implementing Telehealth in Pediatric Asthma. Pediatr Clin North Am [Internet]. 2020 Aug 1 [cited 2021 Dec 27];67(4):623–7. Available from: https://pubmed.ncbi.nlm.nih.gov/32650858/
9. Martinez FD, Wright AL, Taussig LM, Holberg CJ, Halonen M, Morgan WJ. Asthma and wheezing in the first six years of life. The Group Health Medical Associates. N Engl J Med [Internet]. 1995 Jan 19 [cited 2021 Dec 27];332(3):133–8. Available from: https://pubmed.ncbi.nlm.nih.gov/7800004/
10. Guilbert TW. Identifying and managing the infant and toddler at risk for asthma. J Allergy Clin Immunol [Internet]. 2010 [cited 2021 Dec 27];126(2):417–22. Available from: https://pubmed.ncbi.nlm.nih.gov/20624654/
11. Biagini Myers JM, Schauberger E, He H, Martin LJ, Kroner J, Hill GM, et al. A Pediatric Asthma Risk Score to better predict asthma development in young children. J Allergy Clin Immunol [Internet]. 2019 May 1 [cited 2021 Dec 27];143(5):1803-1810.e2. Available from: https://pubmed.ncbi.nlm.nih.gov/30554722/
12. Torgerson DJ, Torgerson CJ. Avoiding Bias in Randomised Controlled Trials in Educational Research. Br J Educ Stud [Internet]. 2003 Mar 1 [cited 2021 Jul 11];51(1):36–45. Available from: https://onlinelibrary.wiley.com/doi/full/10.1111/1467-8527.t01-2-00223
13. Duke University. PICO - Evidence-Based Practice - LibGuides at Duke University Medical Center [Internet]. 2020 [cited 2021 Nov 25]. Available from: https://guides.mclibrary.duke.edu/ebm/pico
14. Lipscomb M. Nursing literature reviews : a reflection. :165.
15. Jüni P, Holenstein F, Sterne J, Bartlett C, Egger M. Direction and impact of language bias in meta-analyses of controlled trials: empirical study. Int J Epidemiol [Internet]. 2002 [cited 2021 Nov 25];31(1):115–23. Available from: https://pubmed.ncbi.nlm.nih.gov/11914306/
16. Bender BG, Cvietusa PJ, Goodrich GK, Lowe R, Nuanes HA, Rand C, et al.

© 2021 JPPW. All rights reserved

Pragmatic Trial of Health Care Technologies to Improve Adherence to Pediatric Asthma Treatment: A Randomized Clinical Trial. JAMA Pediatr [Internet]. 2015 Apr 1 [cited 2021 Dec 28];169(4):317–23. Available from: https://jamanetwork.com/journals/jamapediatrics/fullarticle/2108035

17. Perry TT, Halterman JS, Brown RH, Luo C, Randle SM, Hunter CR, et al. Results of an asthma education program delivered via telemedicine in rural schools. Ann Allergy, Asthma Immunol [Internet]. 2018 Apr 1 [cited 2021 Dec 28];120(4):401–8. Available from: http://www.annallergy.org/article/S1081120618301224/fulltext
18. Britto MT, Rohan JM, Dodds CM, Byczkowski TL. A Randomized Trial of User-Controlled Text Messaging to Improve Asthma Outcomes: A Pilot Study. Clin Pediatr (Phila) [Internet]. 2017 Dec 1 [cited 2021 Dec 28];56(14):1336–44. Available from: https://journals.sagepub.com/doi/10.1177/0009922816684857
19. Goossens LMA, Vasbinder EC, Bemt PMLA Van den, Mölken MPMHR. Cost-Effectiveness of Real-Time Medication Monitoring in Children with Asthma. Value Heal [Internet]. 2014 Nov 1 [cited 2021 Dec 28];17(7):A329. Available from: http://www.valueinhealthjournal.com/article/S1098301514025352/fulltext
20. Reece ER, Burnette AF, Lewis-Land CJ. Pilot Study of Asthmawin Mobile Iphone App in the Management of Asthma. J Allergy Clin Immunol [Internet]. 2017 [cited 2021 Dec 28];139(2):AB382. Available from: https://www.jacionline.org/article/S0091-6749(16)32436-8/fulltext
21. Beerthuizen T, Voorend-Van Bergen S, Van Den Hout WB, Vaessen-Verberne AA, Brackel HJ, Landstra AM, et al. Cost-effectiveness of FENO-based and web-based monitoring in paediatric asthma management: a randomised controlled trial. Thorax [Internet]. 2016 Jul 1 [cited 2021 Dec 28];71(7):607–13. Available from: https://thorax.bmj.com/content/71/7/607
22. Simoneau T, Sun Y, Gherlone N, Almeida S, Manice M, Hollenbach JP. A Prospective, Randomized, Controlled Study of Inhaler Electronic Monitoring Devices to Improve Adherence in Children with Asthma. Am Thorac Soc Int Conf Meet Abstr Am Thorac Soc Int Conf Meet Abstr. 2019 May;A7177–A7177.
23. Voorend-Van Bergen S, Vaessen-Verberne AA, Brackel HJ, Landstra AM, Van Den Berg NJ, Hop WC, et al. Monitoring strategies in children with asthma: a randomised controlled trial. Thorax [Internet]. 2015 Jun 1 [cited 2021 Dec 28];70(6):543–50. Available from: https://thorax.bmj.com/content/70/6/543
24. Perry TT, Rettiganti M, Brown RH, Nick TG, Jones SM. Uncontrolled asthma and factors related to morbidity in an impoverished, rural environment. Ann Allergy Asthma Immunol [Internet]. 2012 Apr [cited 2021 Dec 28];108(4):254–9. Available from: https://pubmed.ncbi.nlm.nih.gov/22469445/
25. Engelkes M, Janssens HM, De Jongste JC, Sturkenboom MCJM, Verhamme KMC. Medication adherence and the risk of severe asthma exacerbations: a systematic review. Eur Respir J [Internet]. 2015 Feb 1 [cited 2021 Dec 28];45(2):396–407. Available from: https://erj.ersjournals.com/content/45/2/396
26. Ober C, Thompson EE. Rethinking genetic models of asthma: the role of environmental modifiers. Curr Opin Immunol [Internet]. 2005 Dec [cited 2021 Dec 28];17(6):670–8. Available from: https://pubmed.ncbi.nlm.nih.gov/16214315/
27. Schwartz DA. Gene-Environment Interactions and Airway Disease in Children. Pediatrics [Internet]. 2009 Mar 1 [cited 2021 Dec 28];123(Supplement_3):S151–9. Available from:

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/pediatrics/article/123/Supplement_3/S151/29682/Gene-Environment-Interactions-and-Airway-Disease

28. Head KJ, Kasting ML, Sturm LA, Hartsock JA, Zimet GD. A National Survey Assessing SARS-CoV-2 Vaccination Intentions: Implications for Future Public Health Communication Efforts: https://doi.org/101177/1075547020960463 [Internet]. 2020 Sep 23 [cited 2021 Nov 25];42(5):698–723. Available from: https://journals.sagepub.com/doi/10.1177/1075547020960463

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