Adherence to e-mental health among youth: Considerations for intervention development and research design

Melinda R Achilles1, Melissa Anderson1, Sophie H Li1,2, Mirjana Subotic-Kerry1, Belinda Parker1 and Bridianne O’Dea1,3

Abstract
E-mental health programmes have great potential to provide young people with access to mental health support. However, it is commonly reported that adherence to these programmes is low. Low adherence can be problematic, particularly if young people do not receive the full benefits of a programme. In a research trial setting, non-adherence to treatment recommendations can prevent researchers from drawing strong conclusions about effectiveness. Although adherence has been recognised as an issue in need of attention, many of the reviews available are focused on adults and lack clear direction towards what strategies to employ. This paper presents a broad review of the adherence literature, focusing on factors associated with improving adherence to e-mental health among youth. Our view on the key elements to improve adherence identified from the existing literature are presented, and key recommendations for e-mental health intervention design are provided. These include: developing and communicating adherence guidelines based on individuals’ needs and symptom severity, including customisable features to provide a tailored experience and promote a sense of agency, including engagement checks and adopting a user-centred approach by utilising strategies such as co-design. This paper provides guidance to intervention designers and researchers by outlining recommendations and considerations for intervention development and research design.

Keywords
Adherence, adolescence, e-mental health, mental health, young people

Submission date: 1 April 2019; Acceptance date: 15 March 2020

Adherence to e-mental health interventions
Mental illness can have significant negative impacts on the quality of life of young people (i.e. those aged 12–25 years).1,2 Despite this, more than three-quarters of youth with poor mental health do not seek professional care.3 Delivering psychotherapy through e-mental health interventions can overcome many of the barriers that inhibit seeking help.1,4 These interventions typically provide support or brief therapy delivered through technological or digital platforms.5 Digital cognitive–behavioural therapy has recently been recommended by national health bodies as a first-line treatment for young people with mild depression due to evidence of its effectiveness and potential to improve accessibility.6 E-mental health programmes offer the opportunity for large-scale delivery of psycho-education in schools7 and facilitate the implementation of stepped models of care,8 thereby reducing burden on service providers. Their capacity to be delivered at scale also offers an opportunity to reach more young people in the prevention of mental illness, and early detection and intervention.9 While there is promising evidence to

1Black Dog Institute, Prince of Wales Hospital, Australia
2School of Psychology, University of New South Wales, Australia
3Faculty of Medicine, University of New South Wales, Australia

Corresponding author:
Melinda Achilles, Black Dog Institute Hospital Road, Randwick, NSW 2031, Australia.
Email: m.achilles@blackdog.org.au
suggest e-mental health interventions can provide effective support for young people,\(^{10}\) non-completion is commonly reported, and adherence to e-health programmes is low.\(^9\) This is problematic, since as with all treatment, a certain degree of adherence is needed for an effect on outcomes to occur. Reports also suggest that adolescents’ adherence to medical treatment is challenging, with researchers proposing recommendations including education, communication considerations and motivational strategies involving extra care from health professionals or family involved in a young person’s treatment.\(^{11–13}\) Young people have reported a myriad of factors negatively impacting their engagement and interaction with online programmes, including lack of time, access and technical issues, no perceived need for help, programme relevance, inappropriate content or repetitiveness, doubt regarding programme effectiveness, preferences for face-to-face help, concerns about privacy and anonymity, or perceiving a programme to be boring or activities laborious.\(^{14–17}\) Adding to the complexity of this problem, non-adherence to e-health interventions may also indicate a poorly designed or delivered product, or that users’ needs have been met early. Despite the rapid development of digital mental health interventions,\(^{18}\) ways to overcome many of these barriers are not well understood. This makes it challenging for researchers to develop e-mental health interventions that produce optimal adherence, thereby limiting the potential of these treatments to establish their effectiveness.

The purpose of this paper is to review the current literature pertaining to adherence to e-mental health interventions, and to provide a viewpoint on the association between adherence and intervention outcomes and factors associated with improved adherence. A snowball search strategy was utilised following an initial search of the literature in the PubMed, PsycInfo and Google Scholar databases. This method was chosen because it allowed the inclusion of all data pertaining to adherence (varied definitions of adherence are discussed below) to present a broad perspective and overview of the main themes. It also allowed for a review of the adult literature to fill gaps in the youth literature which would have been prevented in a more systematic review. Our views will be presented as a series of recommendations for those who design and evaluate e-mental health interventions. We have limited our review to interventions designed for treatment rather than prevention due to the limited research available. It is beyond the scope of this paper to discuss ways to engage healthy young people in e-mental health care aimed at prevention, who presumably have different user needs and motivations. More research is needed to help understand the challenges specific to prevention interventions, including how to motivate healthy young people who do not see a need to engage with e-mental health.

The concept of adherence and the impact on outcomes

The first major challenge in this field is the variation in the way adherence is defined and measured. The terms ‘adherence’, ‘usage’, ‘engagement’, ‘attrition’, ‘compliance’ and ‘drop-out’ are used interchangeably to describe users’ interaction with online programmes.\(^{19–22}\) In many e-health interventions, log data are recorded automatically and can provide objective information about how users interact with a programme. Many of these programmes utilise cognitive–behavioural therapy strategies and are delivered in a structured format, grouping topics into approximately five or six modules designed to be accessed sequentially or to be explored freely as a user needs.\(^{9}\) Frequency of logins, time spent online, number of modules or activities completed,\(^{23}\) data entered, minimum number of modules required\(^{20}\) as well as pages accessed and printed are common ways to measure adherence.\(^{19,24,25}\) While these data may be collected, they are often not reported. These research design issues, including various methods to operationalise adherence, make it difficult to review the data systematically and compare the data meaningfully.

The evidence regarding the impact of adherence on the effectiveness of online interventions for mental health remains unclear. While many studies link the notion of adherence to greater symptom improvement in mental health outcomes,\(^{7,14,26–29}\) others suggest the relationship may be more complex, finding weak effects between adherence and outcome.\(^{30–32}\) In an adult sample, Donkin et al.\(^{33}\) proposed that gradual programme use combined with active engagement may provide a more detailed understanding of the treatment process, as treatment effects were only found among those who completed more activities per login. However, in a sample of young adults using a self-directed online programme, Clarke et al.\(^{34}\) found an inverse relationship between programme usage and outcome; that is, fewer page visits and less time online were associated with a greater reduction in depressive symptoms. These counterintuitive findings may be explained by a reduction in participants’ motivation to complete the programme due to symptom improvement. This study, along with another,\(^7\) also found that the more severe the mental health symptoms, the greater the adherence. These findings highlight the necessity for researchers and programme developers to set adherence guidelines prospectively based on the anticipated needs and desired outcome.
for individuals. A recent systematic review of 69 studies measuring adherence to psychological and physical e-therapies among adults found that for psychological interventions, only two measures of adherence – module completion and a composite measure comprised of time online and number of activities completed – were related to positive treatment effects. This suggests that the relationship between adherence and outcome is still largely unclear and may vary depending on the type of health condition targeted and how adherence is operationalised.

In addition to symptom severity, youth studies have found living rurally and high self-esteem as well as higher academic achievement were associated with greater adherence. There is also evidence to suggest that monitored settings, such as the school environment or primary-care settings, can increase adherence to online programmes for youth. Reasons for this may relate to participants having a dedicated time to complete the intervention, participants feeling a sense of accountability to perform tasks in the school environment or the social presence of school staff. Evidence suggests that guided interventions promote adherence in adults. However, the degree of human support needed to produce the same effects for youth is unclear. A pilot study examined whether the presence of a small online peer-support network that enabled adolescent participants to monitor peers’ activities and provide supportive accountability influenced adherence. This study found a positive relationship between communication between participants and the mean time spent on the site. Users also reported feeling motivated to engage with the site in the first few weeks when site use was high, but this was not sustained, as site use dropped off in the later weeks. However, as this study had quite a small sample (N = 13), further research is needed to determine the potential of peer networks to promote adherence. Other factors are largely unknown.

Improving adherence in e-mental health for youth

Defining adherence

In face-to-face therapy, the degree to which a patient engages with therapy as rated by the therapist has been found to be a better predictor of treatment outcome than attendance alone. Applying this concept to online therapies, simple usage metrics may fail to provide an accurate reflection of genuine treatment engagement. Sieverink et al. argued that the amount of activity completed within a programme is simply a measure of attendance, whereas adherence should reflect compliance with the recommended and intended use of a programme. This is supported by Doherty et al. who posited that adherence should focus explicitly on the engagement with treatment components rather than the technology, as it is simply the delivery tool. Therefore, we suggest researchers establish an upfront expectation of what is required from a user based on the level of engagement and use needed for a therapeutic benefit and use this as their definition of adequate engagement. This can be estimated and evaluated if the exact therapeutic dose is unknown and adjusted based on outcomes. Researchers should also have a clear understanding of the time needed for users to engage with content so that expectations and experiences are realistic and aligned. Relatedly, this definition of adherence should be made explicit to users early in programme engagement. To assist users in understanding their expectations for effective engagement, designers can consider embedding a section in the onboarding process that outlines the recommended use to experience a beneficial effect and asks users to agree to it or to input what they think is achievable.

Programme flexibility/personalisation

Delivering personalised interventions includes tailoring content specific to individuals’ symptom profile or the individual’s level of severity, allowing participants to select the order of module completion or the choice of session scheduling with customised reminders. Incorporating features that enable personalisation can create a sense of ownership and agency over one’s treatment and content, allowing users to explore the modules that suit their needs and preferences. Batterham et al. found some indication that a tailored intervention designed for youth was related to slightly better adherence compared to a static intervention, although these findings were not significant. Importantly, however, participants in this study were significantly more satisfied with the tailored programme, providing support for the creation of programmes designed to meet participants’ treatment needs. In line with this, Mohr et al. suggested that in order to avoid the potential negative effects of rigid adherence guidelines, it may be useful to involve participants in the process of setting usage and interaction goals for their treatment. There has been support for this idea in a study with adults, which found that adherence rates improved by >20% after four adherence strategies were implemented – two of which related to providing participants with freedom to choose and tailor their treatment. However, as these changes to the delivery of the programme were made in unison, it is difficult to determine whether the combination of the four changes or individual adoptions led to the improved adherence rates.

Understanding participants’ contact preferences in regards to the time and frequency of reminders and
offering choice flexibility may ensure that reminders and notifications are received at actionable times of the day and are not intrusive. Programme designers might also consider enabling users to opt out of reminders and notifications, especially given these features may not be useful to promote self-directed use in young people. However, more research has been recommended in this area in order to understand whether reminders are beneficial. The Persuasive Systems Design (PSD) framework has been applied to conceptualise the various components in online psychological therapies that might influence individuals’ attitudes or behaviour. In this context, PSD features are often utilised in programmes to facilitate adherence. Two features commonly used in youth e-health interventions include tunnelling and reduction. Tunnelling involves guiding users through therapeutic content in a structured and linear manner, and reduction involves breaking down complex activities into simple steps. Reduction strategies such as minimising the length and wordiness of modules are related to higher adherence. However, evidence on the effectiveness of tunnelling is unclear. For example, Burckhardt et al. found that after converting an unstructured free-to-use programme to a structured school-based programme, the positive effects on mental health outcomes were not observed. The authors of this study proposed that participants may have resented the pressure to use the programme due to the imposed usage recommendation in comparison to the free-to-use version of the programme. Supporting the idea of offering programme flexibility, Doherty and Coyle found evidence to suggest that allowing young users to explore a programme and find treatment that meets their needs is useful to encourage adherence. Related to this, health research has highlighted that providing young people with a sense of control and agency through treatment decisions may be a developmentally appropriate way to improve adherence. Other researchers have suggested that allowing users to choose modules freely may increase participants’ self-efficacy. Further research measuring factors that might influence participants’ self-efficacy is needed, given its relationship with self-efficacy and adherence in health research. On the other hand, it is important to consider that many e-mental health interventions are purposely designed in a structured manner to mirror the delivery of face-to-face therapy. Therefore, it may be necessary to weigh up these factors when planning the structure of an online programme.

Co-design/participatory design

Involving the end users in guiding the design and development of an intervention is important in order to ensure it is appropriately matched with a youth’s goals and needs. A recent review examining the effectiveness of e-mental health interventions for young people identified that all programmes failed to use or report Participatory Design methods. Ignoring the end user or assuming what they need may result in programme designers inadvertently including features that are: mismatched to a young person’s preferences, age inappropriate, patronising, tedious, repetitive or aesthetically unappealing. On the other hand, tailoring the programme and its content to users’ needs and preferences may help to increase adherence by ensuring interventions are credible, useful and engaging. It is necessary to apply user-centred design practices so that programmes include content and features that are relevant to young people, and are not directed by unfounded ideas and beliefs. This co-design process is also important, as young people are digital natives and may have preferences that are different from those of adult users. Finally, it is important for researchers to consider carefully the unique e-mental health needs and preferences of all young people and to ensure that disadvantaged and rural youth are represented in the design process.

Supported use

Intervention designers may also consider whether it is appropriate to provide guidance to support and monitor participants’ adherence and reinforce participants’ accountability. Digital treatments can be utilised in a number of different ways, including as a purely self-directed treatment programme, treatment supported by a non-therapist or a blended care model whereby the treatment is digitally led with therapist support or therapist-led with digital support. There is evidence to suggest that face-to-face or digital support may positively influence programme support and outcomes. The supportive accountability model suggests that adherence to treatment increases when users’ actions are accountable to a respected and credible support person. Offering online or digital components of therapy as an adjunct to therapist-led support may offer an alternative for young people who prefer professional contact. This method of support may also be cost-effective and efficient for consumers and therapists. However, more research has been recommended to understand how this method is implemented, including considering the varying needs of different populations such as young people. Depending on the level of support required, this does not necessarily need to be provided by therapists, as research has demonstrated that automated support can provide the same benefits to adherence as human support, and the qualification of those providing guidance may not be a significant influence. There is also great potential for artificial intelligence and advanced
computational methods, including chatbot technologies, to be utilised in interventions as an adjunct or alternative to human support. Employing data-driven methods can also help to ensure resources such as face-to-face help are utilised efficiently. An example of this is monitoring automatic usage data to recognise users not engaging with a programme and targeting these users with a tailored engagement strategy which may include face-to-face support.

**Further evaluations**

To encourage active engagement, designers can embed a range of activities in e-mental health programmes, including multiple-choice quizzes and case-enhanced learning strategies that use educational stories to exemplify problem solving. These activities can also be used to evaluate knowledge and retention. Providing feedback on users’ answers can ensure they are achieving the desired outcomes. Engagement checks such as reviewing responses to online activities or measuring the completion of the non-compulsory activities can then help to ascertain whether users are indeed engaging with the intervention. Donkin et al. recommended embedding a time-out function when a user is not actively engaged to help ensure this measure is accurately represented. Without this function, it is difficult to determine whether increased time online is due to actual engagement or simply a participant leaving a programme open. To ensure accurate representation further of time online as a measure of adherence, it is also important to consider how a user’s stage of development may impact their comprehension and processing speed. To understand whether a young person is engaging with various treatment components both online and offline, researchers may also consider gathering information from key observers such as parents, teachers or siblings.

Adherence to treatment may be improved by implementing adaptive intervention designs such as randomised encouragement trials, which aim to deliver treatment that meets patients’ needs by determining intervention goals and doses individually. It is also important for researchers to consider carefully the approach used to analyse data in a randomised control trial (RCT). Following an intention-to-treat analysis, a complier average causal effect (CACE) analysis has been recommended as an alternative to per-protocol or on-treatment analyses, as CACE analysis does not interfere with randomisation and takes into account the proportion of participants who comply with treatment. CACE analysis estimates the treatment effects of the intervention group compared to the proportion of compliers in the control group, thereby improving the validity of the comparison.

It is important for researchers to consider the factors that impact adherence when designing interventions for youth, but also important to measure, report and describe these clearly in study protocols. Asking participants to report reasons for non-use is also important for uncovering new factors and learning how to address these. Much of what is currently understood regarding factors that may improve adherence is based on predictive modelling. However, experimental research is needed to examine whether design and service elements affect adherence rates and to understand the effect of different doses of treatment. To attempt to understand what the active elements are of online interventions, researchers can consider alternative study designs to the RCT such as the multiphase optimisation strategy (MOST) methodology or a fractional factorial design.

Investigating young people’s treatment expectations and their desired outcomes of e-mental health interventions can also highlight factors that may be influencing their adherence patterns. Researchers can consider measuring the predictors of adherence and engagement.
in traditional therapy such as the therapeutic alliance, an individual’s level of motivation and need for treatment care. \textsuperscript{31,47} Measuring such factors can shed light on how the therapeutic dose may differ among participants, as well as what the unintended side effects may be. A user may experience outcomes that are different from those intended, or experience longer-term benefits that are not immediately recognisable or measured. \textsuperscript{25} Importantly, this would help determine whether early treatment improvements do influence further programme usage. \textsuperscript{20} Currently, research on the effects of alliance on adherence in e-mental health programmes is scarce. \textsuperscript{70,71} However, one study demonstrated a positive relationship between perceived emotional connection with the programme (myCompass) and number of logins, psychoeducation modules completed and frequency of self-monitoring. \textsuperscript{72}

**Conclusion**

There is currently insufficient evidence to outline clearly how to increase adherence to e-mental health among youth. This is partially due to differences in the operationalisation and reporting of adherence, large variability in the delivery and design of online interventions and the heterogeneity of users across studies. Continued evaluation of youths’ adherence to online treatment is needed to develop this area and to validate researchers’ investment in modifying and creating interventions. The research reviewed in this paper highlights important considerations that can be applied to the design of research studies and online interventions for youth. Table 1 outlines a summary of recommendations for intervention and research design to improve adherence to e-mental health. It is important to consider how a young person’s stage of development, treatment needs and experience with technology might influence their interaction with, and sustained use of, an online intervention. It is recommended that future research continues to trial and report which strategies are effective, or not, at promoting engagement and adherence. More research is needed to understand the relationship between these individual variables, adherence and outcome. The current research highlights the complexity in understanding usage data, the importance of understanding why and how individuals with different needs adhere to programmes and how individual factors impact treatment benefits. Therefore, when designing interventions, determining guidelines for adherence and measuring how adherence relates to treatment outcomes, it is necessary for researchers to consider that users may desire different outcomes or goals from those intended by developers\textsuperscript{49} and that partial completion of online programmes may be beneficial and satisfy some users’ needs. \textsuperscript{69} The authors note that this paper was limited by its broad search strategy and cannot be considered a comprehensive review. This approach was taken due to the limitations outlined above, including the limited youth-focused adherence research published, differences in definitions and inconsistent reporting of programme usage and meaningful engagement. The authors aimed to summarise the main themes pertinent to readers interested in young people’s adherence to e-mental health.

**Conflict of interest:** The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

**Contributorship:** M.R.A. researched the literature and conceived the manuscript design with B.O.D. M.R.A. and B.O.D. contributed to the first draft writing and edits. All authors edited, reviewed and approved the final draft of the manuscript.

**Ethical approval:** Not Applicable

**Funding:** The authors disclosed receipt of the following financial support for the research, authorship and/or publication of this article: This work is supported by The Prevention Hub Mental Health Research Program funded by the Australian Government Department of Health.

**Guarantor:** M.R.A.

**Peer review:** This manuscript was reviewed by reviewers who have chosen to remain anonymous.

**ORCID iD:** Melinda R Achilles \(\text{https://orcid.org/0000-0002-4246-3412}\)

**References**

1. Sawyer MG, Arney FM, Baghurst PA, et al. The mental health of young people in Australia: key findings from the child and adolescent component of the national survey of mental health and well-being. *Aust N Z J Psychiatry* 2001; 35: 806–814.
2. McGorry PD, Purell R, Hickie IB, et al. Investing in youth mental health is a best buy. *Med J Aust* 2007; 187: S5–S7.
3. Burgess PM, Pirkis JE, Slade TN, et al. Service use for mental health problems: findings from the 2007 National Survey of Mental Health and Wellbeing. *Aust N Z J Psychiatry* 2009; 43: 615–623.
4. Gulliver A, Griffiths KM and Christensen H. Perceived barriers and facilitators to mental health help-seeking in young people: a systematic review. *BMC Psychiatry* 2010; 10: 113.
5. Hollis C, Falconer CJ, Martin JL, et al. Annual research review: digital health interventions for children and
young people with mental health problems – a systematic and meta-review. *J Child Psychol Psychiatry* 2017; 58: 474–503.

6. Wise J. Depression in children: offer digital CBT as first line treatment, says NICE. *BMJ* 2019; 364: l364.

7. Calear AL, Christensen H, Mackinnon A, et al. Adherence to the MoodGYM program: outcomes and predictors for an adolescent school-based population. *J Affect Disord* 2013; 147: 338–344.

8. O’Dea B, King C, Subotic-Kerry M, et al. Smooth sailing: a pilot study of an online, school-based, mental health service for depression and anxiety. *Front Psychiatry* 2019; 10.

9. Clarke AM, Kuosmanen T and Barry MM. A systematic review of online youth mental health promotion and prevention interventions. *J Youth Adolesc* 2015; 44: 90–113.

10. Grist R, Croker A, Denne M, et al. Technology delivered interventions for depression and anxiety in children and adolescents: a systematic review and meta-analysis. *Clin Child Fam Psychol Rev* 2019; 22: 147–171.

11. Lask B. Motivating children and adolescents to improve adherence. *J Pediatr* 2003; 143: 430–433.

12. Taddeo D, Egedy M and Frappier J-Y. Adherence to treatment in adolescents. *Paediatr Child Health* 2008; 13: 19–24.

13. Butow P, Palmer S, Pai A, et al. Review of adherence-related issues in adolescents and young adults with cancer. *J Clin Oncol* 2010; 28: 4800–4809.

14. Manicavasagar V, Horswood D, Burckhardt R, et al. Feasibility and effectiveness of a web-based positive psychology program for youth mental health: randomized controlled trial. *J Med Internet Res* 2014; 16: e140.

15. Kuosmanen T, Fleming T and Barry M. The implementation of SPARX-R computerized mental health program in alternative education: Exploring the factors contributing to engagement and dropout. *Child Youth Serv Rev* 2018; 84: 176–184.

16. Burckhardt R, Manicavasagar V, Batterham PJ, et al. A web-based adolescent positive psychology program in schools: randomized controlled trial. *J Med Internet Res* 2015; 17: e187.

17. Lillevoll KR, Yangberg HCB, Griffiths KM, et al. Uptake and adherence of a self-directed Internet-based mental health intervention with tailored e-mail reminders in senior high schools in Norway. *BMC Psychiatry* 2014; 14: 14.

18. Torous J, Andersson G, Bertagnoli A, et al. Towards a consensus around standards for smartphone apps and digital mental health. *World Psychiatry* 2019; 18: 97.

19. Beatty L and Binnion C. A systematic review of predictors of, and reasons for, adherence to online psychological interventions. *Int J Behav Med* 2016; 23: 776–794.

20. Castro A, López-del-Hoyo Y, Peake C, et al. Adherence predictors in an Internet-based Intervention program for depression. *Cogn Behav Ther* 2018; 47: 246–261.

21. Eysenbach G. The law of attrition. *J Med Internet Res* 2005; 7: e11.

22. Wildeboer G, Kelders SM and Van Gemert-Pijnen JE. The relationship between persuasive technology principles, adherence and effect of web-Based interventions for mental health: a meta-analysis. *Int J Med Informatics* 2016; 96: 71–85.

23. Neil AL, Batterham P, Christensen H, et al. Predictors of adherence by adolescents to a cognitive behavior therapy website in school and community-based settings. *J Med Internet Res* 2009; 11: e6.

24. Donkin L, Christensen H, Naismith SL, et al. A systematic review of the impact of adherence on the effectiveness of e-therapies. *J Med Internet Res* 2011; 13: e52.

25. Sieverink F, Kelders SM and Van Gemert-Pijnen JEWC. Clarifying the concept of adherence to eHealth technology: systematic review on when usage becomes adherence. *J Med Internet Res* 2017; 19: e402.

26. Hilvert-Bruce Z, Rossouw PJ, Wong N, et al. Adherence as a determinant of effectiveness of internet cognitive behavioural therapy for anxiety and depressive disorders. *Behav Res Ther* 2012; 50: 463–468.

27. Kelders SM, Bohlmeijer ET, Pots WT, et al. Comparing human and automated support for depression: fractional factorial randomized controlled trial. *Behav Res Ther* 2015; 72: 72–80.

28. Whitten AE, Proudfoot J, Clarke J, et al. Breaking open the black box: isolating the most potent features of a web and mobile phone-based intervention for depression, anxiety, and stress. *JMIR Mental Health* 2015; 2: e3.

29. Anderson RE, Spence SH, Donovan CL, et al. Working alliance in online cognitive behavior therapy for anxiety disorders in youth: comparison with clinic delivery and its role in predicting outcome. *J Med Internet Res* 2012; 14: e88.

30. Farrer LM, Griffiths KM, Christensen H, et al. Predictors of adherence and outcome in Internet-based cognitive behavior therapy delivered in a telephone counseling setting. *Cogn Ther Res* 2014; 38: 358–367.

31. Fuhr K, Schröder J, Berger T, et al. The association between adherence and outcome in an Internet intervention for depression. *J Affect Disord* 2018; 229: 443–449.

32. Van Der Zanden R, Kramer J, Gerrits R, et al. Effectiveness of an online group course for depression in adolescents and young adults: a randomized trial. *J Med Internet Res* 2012; 14: e86.

33. Donkin L, Hickie IB, Christensen H, et al. Rethinking the dose–response relationship between usage and outcome in an online intervention for depression: randomized controlled trial. *J Med Internet Res* 2013; 15: e231.

34. Clarke G, Kelleher C, Hornbrook M, et al. Randomized effectiveness trial of an Internet, pure self-help, cognitive behavioral intervention for depressive symptoms in young adults. *Cogn Behav Ther* 2009; 38: 222–234.

35. Calear AL, Christensen H, Mackinnon A, et al. The YouthMood Project: a cluster randomized controlled trial of an online cognitive behavioral program with adolescents. *J Consult Clin Psychol* 2009; 77: 1021.

36. Fridrici M and Lohaus A. Stress-prevention in secondary schools: online-versus face-to-face-training. *Health Educ* 2009; 109: 299–313.
37. Van Voorhees BW, Vanderplough-Booth K, Fogel J, et al. Integrative internet-based depression prevention for adolescents: a randomized clinical trial in primary care for vulnerability and protective factors. *J Can Acad Child Adolesc Psychiatry* 2008; 17: 184.

38. Mohr DC, Cuijpers P and Lehman K. Supportive accountability: a model for providing human support to enhance adherence to eHealth interventions. *J Med Internet Res* 2011; 13: e30.

39. Baumeister H, Reichler L, Munzinger M, et al. The impact of guidance on Internet-based mental health interventions – a systematic review. *Internet Interv* 2014; 1: 205–215.

40. Ho J, Corden ME, Caccamo L, et al. Design and evaluation of a peer network to support adherence to a web-based intervention for adolescents. *Internet Interv* 2016; 6: 50–56.

41. Lee P, Zehgeer A, Ginsburg GS, et al. Child and adolescent adherence with cognitive behavioral therapy for anxiety: predictors and associations with outcomes. *J Clin Child Adolesc Psychol* 2019; 48: S215–S226.

42. Doherty G, Coyle D and Matthews M. Design and evaluation guidelines for mental health technologies. *Interact Comput* 2010; 22: 243–252.

43. Yardley L, Spring BJ, Riper H, et al. Understanding and promoting effective engagement with digital behavior change interventions. *Am J Prev Med* 2016; 51: 833–842.

44. Titov N, Dear BF, Johnston L, et al. Improving adherence and clinical outcomes in self-directed Internet treatment for anxiety and depression: randomised controlled trial. *PLoS One* 2013; 8: e62873.

45. Batterham PJ, Callear AL, Farrer L, et al. FitMindKit: Randomised controlled trial of an automatically tailored online program for mood, anxiety, substance use and suicidality. *Internet Interv* 2018; 12: 91–99.

46. Andersson G, Estling F, Jakobsson E, et al. Can the patient decide which modules to endorse? An open trial of tailored internet treatment of anxiety disorders. *Cogn Behav Ther* 2011; 40: 57–64.

47. Doherty G, Coyle D and Sharrar J (eds). Engagement with online mental health interventions: an exploratory clinical study of a treatment for depression. In: *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, Austin, TX, 5–10 May 2012, pp.1421–1430. New York: ACM.

48. Garrido S, cheers D, Boydell K, et al. Young people’s response to six smartphone apps for anxiety and depression: focus group study. *JMIR Ment Health* 2019; 6: e14385.

49. Kelders SM, Kok RN, Ossebaard HC, et al. Persuasive system design does matter: a systematic review of adherence to web-based interventions. *J Med Internet Res* 2012; 14: e152.

50. Wozney L, Huguet A, Bennett K, et al. How do eHealth programs for adolescents with depression work? A realist review of persuasive system design components in internet-based psychological therapies. *J Med Internet Res* 2017; 19: e266.

51. Oinas-Kukkonen H and Harjumaa M. Persuasive systems design: key issues, process model and system features. In: *Howlett M and Mukherjee I (eds) Routledge handbook of policy design*. New York: Routledge, 2018. pp.105–123.

52. Robertson EG, Wakefield CE, Marshall KH, et al. Strategies to improve adherence to treatment in adolescents and young adults with cancer: a systematic review. *Clin Oncol Adolesc Young Adults* 2015; 5: 35–49.

53. Martos-Méndez MJ. Self-efficacy and adherence to treatment: the mediating effects of social support. *J Behav Health Soc Issues* 2015; 7: 19–29.

54. Náfárdi L, Nakamoto K and Schulz PJ. Is patient empowerment the key to promote adherence? A systematic review of the relationship between self-efficacy, health locus of control and medication adherence. *PLoS One* 2017; 12: e0186458.

55. Mohr DC, Weingardt KR, Reddy M, et al. Three problems with current digital mental health research… and three things we can do about them. *Psychiatr Serv* 2017; 68: 427–429.

56. Garrido S, Millington C, Cheers D, et al. What works and what doesn’t? A systematic review of digital mental health interventions for depression and anxiety in young people. *Front Psychiatry* 2019; 10: 759.

57. Wadley G, Lederman R, Glesson J, et al. (eds). Participatory design of an online therapy for youth mental health. In: *Proceedings of the 25th Australian Computer–Human Interaction Conference: Augmentation, Application, Innovation, Collaboration*, Adelaide, Australia, November 2013, pp.517–526. New York: ACM.

58. Hagen P, Collin P, Metcalf A, et al. *Participatory design of evidence-based online youth mental health promotion, intervention and treatment*. Melbourne, Australia: Young and Well Cooperative Research Centre, 2012.

59. Jeminiwa RN, Hohmann NS, Fox BI. Developing a theoretical framework for evaluating the quality of mHealth apps for adolescent users: a systematic review. *J Pediatr Pharmacol Ther* 2019; 24: 254–269.

60. Orlowski S, Lawn S, Matthews B, et al. People, processes, and systems: an observational study of the role of technology in rural youth mental health services. *Int J Ment Health Nurs* 2017; 26: 259–272.

61. Mohr DC, Burns MN, Schueller SM, et al. Behavioral intervention technologies: evidence review and recommendations for future research in mental health. *Gen Hosp Psychiatry* 2013; 35: 332–338.

62. Fairburn CG and Patel V. The impact of digital technology on psychological treatments and their dissemination. *Behav Res Ther* 2017; 88: 19–25.

63. Kleboer A, Smit J, Bosmans J, et al. European COMPARative Effectiveness research on blended Depression treatment versus treatment-as-usual (E-COMPARED): study protocol for a randomized controlled, non-inferiority trial in eight European countries. *Trials* 2016; 17: 387.

64. D’Alfonso S, Santesteban-Echarri O, Rice S, et al. Artificial intelligence-assisted online social therapy for youth mental health. *Front Psychol* 2017; 8: 796.
65. Becker D. Possibilities to improve online mental health treatment: recommendations for future research and developments. In: Arai K, Kapoor S and Bhatia R (eds) Advances in Information and Communication Networks. FICC 2018. Advances in Intelligent Systems and Computing. Vol. 886. Cham: Springer, 2019.

66. Connell AM. Employing complier average causal effect analytic methods to examine effects of randomized encouragement trials. *Am J Drug Alcohol Abuse* 2009; 35: 253–259.

67. Hewitt CE, Torgerson DJ and Miles JNV. Is there another way to take account of noncompliance in randomized controlled trials? *Can Med Assoc J* 2006; 175: 347.

68. Dunn G. Complier-Average Causal Effect (CACE) Estimation. In: Lovric M (ed) *International encyclopedia of statistical science*. Berlin: Springer, 2011. pp.273–274.

69. Christensen H, Griffiths K, Mackinnon A, et al. Online randomized controlled trial of brief and full cognitive behaviour therapy for depression. *Psychol Med* 2006; 36: 1737–1746.

70. Holdsworth E, Bowen E, Brown S, et al. Client engagement in psychotherapeutic treatment and associations with client characteristics, therapist characteristics, and treatment factors. *Clin Psychol Rev* 2014; 34: 428–450.

71. Pihlaja S, Stenberg J-H, Joutsenniemi K, et al. Therapeutic alliance in guided internet therapy programs for depression and anxiety disorders – a systematic review. *Internet Interv* 2018; 11: 1–10.

72. Clarke J, Proudfoot J, Whitton A, et al. Therapeutic alliance with a fully automated mobile phone and web-based intervention: secondary analysis of a randomized controlled trial. *JMIR Ment Health* 2016; 3: e10.