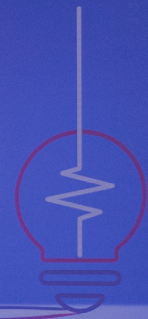




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Evaluating Digital Interventions for ADHD  
Diagnosis and Management in Adults  
within the UK (Excluding Scotland)

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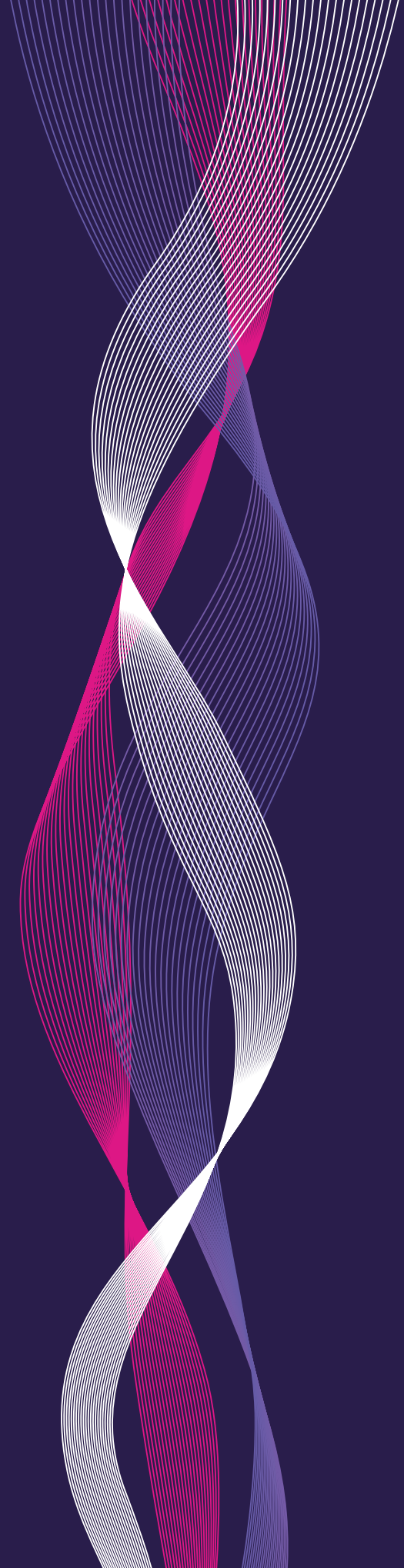
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## Executive Summary

This research report investigates digital interventions available to help manage and/or diagnose ADHD in adults in the UK (excluding Scotland). In March 2024, the Digital Mental Health Innovation Cluster (DMHIC)<sup>1</sup> proposed to the Programme Board to map the current activity, innovation and gaps in Adult ADHD services in Scotland in response to the growing service demand for this area. This design led approach for service mapping will be supported by the DHI Design team and underpinned by research identifying adult ADHD practice and digital technology across the UK.

This report evaluates digital interventions for diagnosing and managing ADHD in adults within the UK (excluding Scotland). Commissioned by the Digital Mental Health Programme Board in March 2024, the study aims to assess peer-reviewed literature and commercially available digital tools (e.g., mobile apps, telehealth platforms) and their effectiveness in managing ADHD compared to traditional methods. ADHD diagnosis and management remains a challenge in the UK due to long waiting lists and resource shortages, necessitating innovative digital solutions.

The study was a meta-analysis conducted in two phases. Phase 1 identified 13 peer-reviewed digital interventions across 14 studies, analysing their content and features.

Phase 2 identified 10 science-based commercially available digital interventions (usually mobile apps), analysing their content, focusing on commonalities in terms of their intended purpose and key features, as well as outcome measures and effectiveness.

The key findings were:

- Both peer-reviewed and commercially available digital interventions were similar in terms of their intended purpose and features; but lacked empirical evidence.
  - Only one of the peer-reviewed studies had tested any of the commercially available apps; the commercially available apps were scientifically approved, but usually without RCTs to support their effectiveness in adult ADHD populations.

- The interventions aimed to decrease core ADHD symptoms of inattention and hyperactivity/impulsivity, as well as comorbid difficulties such as anxiety, and depression.
  - The interventions, where evidence was available, were mostly successful in decreasing ADHD core symptoms, but not comorbid difficulties, such as anxiety and depression. It was suggested they could supplement traditional therapy models and aid ADHD self-management.
- The interventions employed adaptations of therapeutic models (e.g., CBT) and/or psychoeducation in app format to improve ADHD self-management via increasing knowledge of the condition, and through teaching coping strategies.
  - The interventions often aimed to increase planning, organisation, time management, and problem-solving, which are related to ADHD core symptoms and poor outcomes.
  - These included gaming interventions, psychoeducation for attentional abilities, and medication adherence interventions (e.g., alerts, habit builders, goal setting features, and various tracking features for mood, sleep, etc.).
- The interventions with elements of social support (e.g., direct contact with an ADHD specialist or coach using a chat function, and/or users' interactive spaces, e.g., via forums) were more successful.
- The psychoeducation content was key across the interventions, but the interventions were more successful in decreasing ADHD symptoms, if information was delivered interactively, i.e., based on user input, rather than offering all information at once (like in traditional learning modules), which can be overwhelming to ADHD individuals.
- The diagnostic digital interventions were lacking. Two identified options to supplement and accelerate parts of the diagnostic process and to free up clinician time are discussed in the report.

The report recommends using either one of the existing apps or creating a new app incorporating the listed features. These should include therapeutic model adaptation, psychoeducation, social support, and various trackers and alerts to help both the people on the diagnosis waiting list, and those diagnosed to increase their ADHD self-management capacity.

<sup>1</sup> In 2022 the DHI were commissioned by the Scottish Government to establish and manage a national Digital Mental Health Innovation Cluster (DMHIC). This was formally launched in March 2022 uses an innovation hub model to encourage identification, development and evaluation of technologies focused on the mental health needs of the population. Developing Innovation hubs will help support individuals, organisations, academics, and commercial companies to work together to identify, design and develop innovative digital solutions while being guided by expertise within the mental health field including people with lived experience.

DMHIC was also anticipated to contribute to:

- wider mental health ambitions as set out in the plan,
- to inform future Scottish Government digital mental health policy priorities,
- and to enable appropriate local digital mental health innovations to become scaled and/or adopted nationally.

# 1. Introduction

The NHS Scotland is focusing on improving its neurodivergent services for patients and healthcare professionals, reflected in the newly published 'Learning Disabilities, Autism and Neurodivergence Bill proposal'. The issues include extensive waiting lists and overdemand of services across the NHS Scotland Health Boards. Neurodivergent services refer to clinical services for neurodivergent or neurodiverse people (Scottish Government, 2023a). Neurodivergence or neurodiversity was defined as a variation in normal human evolution creating a difference in how the brain processes information and other cognitive processes altering neurodivergent people's thoughts, emotions, and behaviours. Neurodiversity includes autism, attention deficit hyperactivity disorder (ADHD), dyslexia, dyspraxia, Tourette syndrome, and complex tic disorders (Oxford Health NHS Foundation Trust, 2019), and people who identify with these are acknowledged by the Scottish Government as being neurodivergent (Scottish Government, 2023a)

The Digital Mental Health Innovation Cluster (DMHIC) is collaborating with the Scottish Government to help address the issue of extremely long waiting lists for adult ADHD diagnosis, and limited support and treatment for adult ADHD populations across the NHS Scotland Health Boards. The need for adult diagnoses has been growing, with increasingly more adults in Scotland self-referring for the ADHD diagnosis (Scottish Government, 2023b).

The Scottish Government and NHS Scotland are addressing the presented issues through potential development and implementation of digital therapeutics, i.e., digital health interventions (DHIs). These are presently referred to as 'digital interventions' for the rest of the report. These digital interventions could aid adult ADHD diagnosis and/or treatment. Not only are digital interventions cost-effective, they also may free up clinical appointments and decrease the number of face-to-face appointments that ADHD adults need to attend in their ADHD diagnostic and treatment journey (Scottish Government, 2023b).

This report presents an evaluation of currently available digital interventions across the UK (excluding Scotland) and wider, including both commercially available validated apps and peer-reviewed studies of relevant digital interventions targeting adult ADHD. This research was a content meta-analysis, rather than a systematic review, and as such does not claim to have reported every study and digital intervention available.

Furthermore, only scientifically validated digital interventions (i.e., applications or apps) were included, rather than all available apps marketed towards ADHD on app stores (e.g., iOS App Store). The included interventions were analysed for their content, focusing on commonalities in terms of their intended purpose and key features, as well as outcome measures and effectiveness. Finally, the findings were discussed to make recommendations for future digital interventions which may aid diagnosis and/or management of adult ADHD in Scotland.

## 2. Background

### 2.1 Attention Deficit Hyperactivity Disorder (ADHD)

ADHD is a common neurological condition within the overarching neurodivergence or neurodiversity umbrella term. ADHD starts in early childhood (usually before age 12), and often continues into adulthood. It is estimated that on average 5% of the global population are ADHD. Most recent UK figures suggest between 3 and 4 % of UK adults are ADHD, with a male-to-female ratio of approximately 3:1 (NICE, 2024).

ADHD is characterised by differences or deficits in the brain's executive functioning<sup>2</sup>, manifesting in two symptom dimensions of inattention and hyperactivity/impulsivity (American Psychiatric Association, 2013). Therefore, ADHD individuals tend to have diminished or unstable attentional abilities across tasks in multiple life settings (e.g., home, work, school), as well as being prone to high hyperactivity and impulsivity. Furthermore, the ADHD symptoms were shown to manifest as emotion dysregulation, where ADHD people find it difficult to manage their moods, feelings, and emotions. As a result, this often has negative outcomes on their sense of self and identity, self-worth, and which are further reinforced with negative feedback from their environments (e.g., negative feedback by managers if they struggle completing work tasks) (Soler-Gutiérrez et al., 2023). Furthermore, due to these issues, ADHD adults are known to be prone to issues with sleep, physical activity (e.g., Zhu et al., 2023) and nutrition leading to health issues (e.g., Ryu et al., 2022). The indicated symptoms may manifest in various ways, depending on a variety of individual and demographic factors, such as the person's gender and age, with stark differences between children and adults (e.g., Gilbert et al., 2023).

#### 2.1.1. ADHD Subtypes

The DSM-5 Diagnostic Manual (American Psychiatric Association, 2013) divides adult ADHD into three subtypes or 'presentations' depending on which of the two ADHD dimensions are more prevalent. Table 1 details symptoms/issues related to each of the three ADHD subtypes, (predominantly) Inattentive (20-30% of ADHD population), (predominantly) Hyperactive-Impulsive (15% of ADHD population), and the most common, Combined (inattentive and hyperactive-impulsive) (50-75% of ADHD population) (e.g., Salvi et al., 2019)<sup>3</sup>. Table 1. presents an overview of the most common subtype characteristics/presentations in ADHD adults (Pearson, 2024). Additionally, ADHD adults might not present with all the listed presentations of each subtype (Royal College of Psychiatrists, 2024).

Table 1: 'Adult ADHD Three Subtypes or 'Presentations'

ADHD Subtype	Inattentive	Hyperactive-Impulsive	Combined
<b>Subtype Characteristics</b>	Fails to give close attention to details or makes careless mistakes.	Fidgets with hands or feet or squirms in chair.	Both Inattentive and Hyperactive-Impulsive Characteristics Apply
	Has difficulty sustaining attention.	Has difficulty remaining seated.	
	Does not appear to listen.	Extreme restlessness in adults	
	Struggles to follow through on instructions.	Difficulty engaging in activities quietly.	
	Has difficulty with organisation.	Adults will often feel inside like they were driven by a motor.	
	Avoids or dislikes tasks requiring a lot of thinking.	Talks excessively.	
	Loses things.	Blurts out answers before questions have been completed.	
	Is easily distracted.	Difficulty waiting or taking turns.	
Is forgetful in daily activities.	Interrupts or intrudes upon others.		

<sup>2</sup>: Executive functioning describes a group of brain's processes aiding cognition and include (but are not limited to) working memory, attention, and inhibitory control, which aid planning, meeting goals, self-controlled behaviours, etc. (Diamond, 2013).

<sup>3</sup>: Across literature, the inattentive and hyperactive-impulsive subtypes are preceded by 'predominantly' to reflect that both symptom dimensions are always present for ADHD people, however, both not expressed equally dominantly.

Due to these differences across and within the subtypes' presentations, ADHD people will have varying needs in terms of support and treatment (e.g., Martel, 2013).

It is important to note that the subtype classification has been challenged in the peer-reviewed literature, especially in relation to research into the brain's cognitive processes. Cognitive processes related to the executive functioning, affecting emotions and behaviours in ADHD, were shown to be interdependent and not exclusive<sup>4</sup>(e.g., Wu et al., 2022).

Despite the criticisms, the subtypes and their presentations are presently used to illustrate potential lived experience differences related to inattention and hyperactivity/impulsivity for ADHD people, and which might influence what type of support they require.

### 2.1.2. ADHD & Comorbidities

As ADHD falls within the neurodivergence or neurodiversity umbrella term, it is highly comorbid with other neurodivergent types, including (but not limited to) autism, dyspraxia, and dyslexia (e.g., Hours et al., 2022, Rong et al., 2021). Furthermore, neurodivergent people often experience a range of comorbid mental health conditions, especially depression, anxiety, and OCD.

Due to the overlap with other neurodivergence types and mental health conditions, ADHD adults often experience complex difficulties affecting multiple life settings (e.g., home, work, education, relationships) (e.g., Katzman et al., 2017).

They may experience mental and physical difficulties (especially with chronic burnout) due to overcompensating for where their abilities to manage adult commitments are lacking due to their neurodivergence (e.g., Oscarsson et al., 2022) and require additional support in education, workplace, and home to be able to function and thrive (National Institute of Mental Health, 2021).

## 2.2 Adult ADHD Healthcare Services in the UK

In Scotland, the Royal College of Psychiatrists (2017) published a good practice guideline for adult ADHD. They set out that the diagnostic process starts with a GP referral to an outpatient psychiatric clinic, which then provides an in-person diagnostic assessment, and can offer treatment. The latest guidelines detail the entire process, including diagnostic assessment tools, and various considerations related to diagnosis and treatment for ADHD people in the UK. Furthermore, ADHD service provision in the UK, including assessment and treatment, is underpinned by the National Institute for Health and Care Excellence (NICE) guidelines (2019)<sup>5</sup>. The guidelines are evidence-based and offer recommendations for improvement of services. The key recommendation is to ensure continuity of care for people with ADHD, and access to a holistic treatment plan which addresses psychological, behavioural and occupational/ educational needs (NICE, 2019).

Due to limited resources and increasing numbers of adults on waiting lists to get diagnosed, there has been a focus on finding alternative ways to manage this process and make it more efficient (Scottish Government, 2023a). One of the suggested solutions is to divide ADHD service provision across primary care and create more flexibility, aligning it with treatment for other common mental health conditions. It was also suggested to include qualified clinicians in primary care, and a referral pathway into secondary or tertiary services for more complex cases. However, inconsistency in the meaning of 'ADHD specialist' in healthcare, secondary or tertiary care services' limited capacity delivering all ADHD services, and reduced capacity due to financial constraints, act as barriers of transferring care between healthcare sectors in the UK (Asherson et al., 2022).

Another way to approach the issue is through use of digital to enable remote assessments. For example, the European ADHD Guidelines Group (EAGG) concluded that adopting remote assessment for people who are able to access such services (e.g., conducting remote triaging or generic symptom questionnaires to assess who requires

<sup>4</sup>: This exclusivity is implied in inattentive and hyperactive/impulsive subtypes.

<sup>5</sup>: NICE provides national guidance and advice to improve health and social care as an executive non-departmental public body, sponsored by the Department of Health and Social Care in the UK.

a formal diagnosis), could provide more clinician time and in-person appointments for those who are higher risk or unable to use remote services due to digital poverty (Santosh et al., 2022).

### 2.2.1 Adult ADHD Treatment Needs

ADHD treatment is recommended by the UK's National Institute for Health and Care Excellence (NICE) guidelines (2019) to include pharmacological treatment with either stimulant or non-stimulant medication, psychological therapy, or combining the two approaches depending on the individuals' need. The evidence for effectiveness of the currently available treatment for adults is lacking. However, for children the evidence has pointed to inconsistencies, suggesting moderate effectiveness of medication treatment when also employing behavioural interventions (Pasarelu et al., 2020). Therefore, learning to self-manage ADHD has emerged as a key aspect of improving outcomes for the ADHD population. For example, Rasmussen et al. (2024) found that ADHD adolescents transitioning into adulthood wanted to have more knowledge about ADHD and treatment options, found it difficult to access appropriate support, wanted to develop self-help strategies, and preferred to not be prescribed medication for ADHD. Gender differences are also a key consideration for adult ADHD treatment needs. Among children, ADHD is more commonly diagnosed in boys than girls, suggested to be due to different presentation of ADHD symptoms and behaviours. Boys were shown as more disruptive and externally presenting prompting seeking diagnosis referrals in education, whilst girls tend to internalise the symptoms resulting in an internal struggle but with less disruptive behaviours (Rucklidge, 2010). Hence, among the adult population there are many undiagnosed ADHD women, contributing to the increasing adult ADHD diagnosis waiting lists (Scottish Government, 2023a). Attoe & Climie (2023) conducted a systematic literature analysis and found that adult women who were misdiagnosed suffered negative impacts on their emotional wellbeing, lack of control in their lives, difficult relationships, and finally, reached self-acceptance after getting diagnosed.

These issues were different to those of adult ADHD men.

### 2.3 Digital Interventions to Treat ADHD

Mobile and web apps have been increasingly developed as digital interventions to support ADHD children and their careers, and now also ADHD adults. Advantages of these tools are convenience, avoiding long referral lists, accessibility, removing stigma related to visiting a healthcare professional, and decrease in service demand freeing up clinician time (Andersson & Titov, 2014). Furthermore, use of such apps can encourage condition self-management due to increase in knowledge and independence, and participation in own care. On the other hand, the tools need to be carefully designed to deliver the intended interventions where it was suggested they cannot ever replace face-to-face clinician-patient contact (Banaschewski et al., 2020).

Majority of peer-reviewed studies of digital interventions for ADHD involved ADHD children and youth, and not adults. For example, Lakes et al. (2022) conducted a mapping review of digital interventions for youth with ADHD.<sup>6</sup>The studies were clustered into cognitive training<sup>7</sup>, neurofeedback<sup>8</sup>, and further DHIs, including focus on cognition, social/emotional skills improvement, and behaviour management (e.g., on mobile apps and wearables). Pasarelu et al. (2020) published a systematic review of 109 ADHD mobile apps<sup>9</sup> available to young adult and adult ADHD people. The apps were developed for children, adolescents, parents, teachers, and healthcare professionals. Apps were mostly supporting either/and ADHD treatment through self-management and ADHD symptoms assessment. Virtually no app contained evidence for their effectiveness, and only a few were transparent about how the apps were developed. It was concluded that there is no scientific evidence supporting use of the apps for ADHD self-management and diagnosis, with an urgent need for empirical evidence guiding app development to ensure their usability, appropriateness, and safety.

<sup>6</sup>: Following the PRISMA process, searching between 2004 and 2022, they found 51 studies involving ADHD treatment (Lakes et al., 2022).

<sup>7</sup>: Computer-based intervention to improve attention, working memory and other aspects of cognition (Lakes et al., 2022).

<sup>8</sup>: Measuring patients' brain activity and providing feedback to the patient on selected features of the activity, which helps them regulate the brain activity with the goal to change the underlying neural mechanisms involved in cognition and behaviour (Enriquez-Geppert et al., 2019).

<sup>9</sup>: Pasarelu et al. (2024) identified 355 apps in virtual stores, and excluded over two thirds of them. Apps were deemed ineligible and excluded for being duplicates (144), appeared in both Google Play and iOS Store (19), overlapping results due to multiple searches with different keywords (122), not being in English (36), no longer available (7). Of the eligible apps 54 were excluded for not being designed specifically for ADHD, 7 for including conference information



### 3. Current Study – Objectives, Scope and Methodology

The issues with adult ADHD diagnosis and treatment in Scotland and the UK, as well as lack of clarity on available, empirically supported digital interventions for adult ADHD<sup>10</sup> were the drivers of this research. The research objective is to investigate the effectiveness of evidence-based digital interventions, such as mobile applications, wearable devices, telehealth platforms, and computer-based programs, in diagnosing and managing adult ADHD in the UK (excluding Scotland). Based on the findings, the report makes recommendations on future digital interventions to help diagnosis and management of adult ADHD in Scotland to mitigate the long diagnosis waiting lists and limited availability of treatment options.

This report addresses the following research questions:

1. Adapted therapeutic models (e.g., converting cognitive-behavioural therapy - CBT - to a digital intervention) aiming to improve ADHD core symptoms, and other mental health and life difficulties expressed through various outcome measures, and which were achieved with learning new coping skills and strategies to manage daily struggles, i.e., promoted ADHD self-management (studies 1, 2, 6).
2. Provided psychoeducation to increase understanding of ADHD, and related mental health and life difficulties, also to promote ADHD self-management (studies 3, 3a, 4, 5, 6, 12).
3. Intervention was a 'Serious Game' (educational game), incorporating skills training and psychoeducation (studies 7 and 8).
4. Intervention focused on a particular motor skill with computer-based skills training (study 10).
5. Intervention focused on health behaviour change to improve ADHD symptoms, for example, by increasing physical activity (PA) using wearable smartwatch (study 9).
6. Intervention focused on increasing medication/ pharmacological adherence (studies 11, 12).
7. Intervention provided diagnostic aid (study 13).

Furthermore, the studies were either pilot/ development feasibility studies (without controlled group aspect) (studies 1, 2, 3, 6, 7, 9, 11), Randomized Controlled Trials (RCTs) (studies 4, 5, 8, 10, 12), or qualitative studies exploring experience or aspects of an intervention (studies 3a, 13). No replication studies or RCTs following the listed feasibility studies were identified.

Two studies were conducted in Norway (studies 1, 2), two in Sweden (studies 3, 3a), two in Germany (studies 4, 5), two in Spain (studies 7, 8), and two in USA (studies 9, 11). Furthermore, study 6 originated from Republic of Korea, study 10 from Australia, study 12 from Brazil, and finally, study 13 from the UK. Seven studies targeted only ADHD adults (16+) (studies 1, 2<sup>12</sup>, 4, 5, 6, 10 and 11), while the remaining studies also included children and/or adolescents in their sample (studies, 3, 3a, 7, 8, 9, 13).<sup>13</sup>

<sup>10</sup>: Including but not limited to ADHD individuals from 16 years onwards.

<sup>11</sup>: Table 2 details the authors' name and publishing year, where the full bibliography reference can be found in chapter 5, References.

<sup>12</sup>: The participants were ADHD adults with identified emotion dysregulation.

<sup>13</sup>: Studies 3 and 3a discussed an intervention targeting young ADHD and/or autistic people (sample age range was 15-26 years). Study 7 referred to an intervention aimed at ADHD adolescents (12-19 years old), study 8 included ADHD students between 6 and 16 years old, study 9 included adolescents between 14 and 18 years of age, and, finally, study 13 included ADHD young people and adults, parents of ADHD children, and healthcare professionals involved in ADHD treatment.

**Table 2.**

Peer-reviewed studies involving digital interventions to diagnose and/or treat ADHD in adults.

Study No.	Author (year)	Country	Type of study	Target	Intended purpose	Intervention	Outcomes
<b>Adaptation of therapeutic models</b>							
1	Nordby et al. (2021)	Norway	Feasibility study with uncontrolled within-group pre-post design	ADHD adults (26-32) (13)	Key ADHD challenges and core symptoms of inattention, hyperactivity, depression, anxiety, stress, and quality of life	Self-guided Internet-delivered intervention based on GMT <sup>14</sup> , DBT <sup>15</sup> , and CBT, teaching strategies to cope with ADHD difficulties	<ul style="list-style-type: none"> <li>Low treatment adherence, but amongst participants who adhered, the satisfaction was high.</li> <li>Inattention was significantly lower.</li> <li>Hyperactivity-impulsivity was not significantly changed.</li> <li>No significant changes in anxiety and depression measures.</li> <li>Recommendation: need to alter the intervention to be more interactive and engaging for ADHD populations.</li> </ul>
2	Nordby et al. (2024)	Norway	Feasibility study with an uncontrolled pre post study design	ADHD adults with co-occurring emotion dysregulation (16)	ADHD-related emotion dysregulation and core ADHD symptoms improvement, as well as other ADHD-related difficulties (depression, anxiety, quality of life)	Face-to-face group sessions with supplementary digital app as companion 8-week blended intervention Based on elements from dialectic behavioural therapy (DBT) skills training and positive psychology	<ul style="list-style-type: none"> <li>The intervention was accepted by the participants as helpful, mainly due to meeting others with ADHD.</li> <li>Significant reduction of emotion dysregulation symptoms, inattention, and hyperactivity-impulsivity.</li> <li>No significant effects on depression, anxiety, quality of life, and executive functioning measures.</li> </ul>
<b>Psychoeducation</b>							
3	Wentz et al. (2012)	Sweden	Development of the intervention (validation)	Young people (15-26 years old) with ADHD and/or ASD <sup>16</sup> (10)	Internet-based support and coaching model (IBSC) - 8 weeks Support via chat	Supporting people with their ADHD difficulties, coping	<ul style="list-style-type: none"> <li>The validation showed significant improvement of SOC<sup>17</sup>, self-esteem, and subjective quality of life at follow-up.</li> <li>Majority perceived high fulfilment/importance on the POCR<sup>18</sup>.</li> <li>Recommendation: to use the model to complement other intervention for this population.</li> </ul>

<sup>14</sup>: Goal Management Training

<sup>15</sup>: Dialectical behaviour therapy

<sup>16</sup>: Autism spectrum disorder

<sup>17</sup>: Sense of Coherence

<sup>18</sup>: Patient perspective Of Care and Rehabilitation process



Study No.	Author (year)	Country	Type of study	Target	Intended purpose	Intervention	Outcomes
<b>Psychoeducation</b>							
3a	Sehlin et al. (2018)	Sweden	Qualitative study exploring experience of participating in the intervention	ADHD and/or ASD young people and	IBSC 8-week coaching model (above number 3)	Supporting people with their ADHD difficulties, coping	<ul style="list-style-type: none"> <li>Semi-structured interviews, qualitative content analysis, 3 themes: Deciding to participate; Taking part in the coaching process; and The significance of format.</li> <li>Technology was seen as familiar and appealing, but there was a lack of support otherwise; coaches competent and reassuring - the support used to talk about their diagnosis; written word and being at home was helpful; occasional failures of tech and not being in person were also seen as negative.</li> </ul>
4	Selaskowski et al. (2022)	Germany	RCT	ADHD adults (60)	Psychoeducation app as additional support to a clinical psychoeducation group 8 weekly sessions Psychoeducation group (30) or traditional pen and paper brochures (30)	To improve core ADHD symptoms (inattention and hyperactivity-impulsivity)	<ul style="list-style-type: none"> <li>Significantly reduced ADHD core symptoms in both conditions, but the app psychoeducation significantly more effective in improving inattention and impulsivity.</li> <li>Higher homework compliance than the brochure-assisted psychoeducation.</li> </ul>
5	Selaskowski et al. (2023)	Germany	RCT	ADHD adults (40)	Chatbot-supported psychoeducation- app is called AwareMe ADHS 3- week intervention: chatbot vs conventional psychoeducation app Based on a validated manual for psychoeducation (same app as in study 4)	To improve core ADHD symptoms (inattention and hyperactivity-impulsivity)	<ul style="list-style-type: none"> <li>Observer and patient-rated core ADHD symptoms significantly reduced – both groups had the same or similar results.</li> </ul>



Study No.	Author (year)	Country	Type of study	Target population	Intended purpose	Intervention	Outcomes
<b>Adaptation of Therapeutic Models &amp; Psychoeducation</b>							
6	Jang et al. (2021)	Republic of Korea	Development feasibility/ usability study Randomized non-blind parallel group pilot study	ADHD adults (19-60 years old) (46)	Short-term chatbot based intervention (4 weeks) using CBT and psychoeducation	To improve core ADHD symptoms (inattention and hyperactivity-impulsivity) and comorbid mental health difficulties	<ul style="list-style-type: none"> <li>The empathic and friendly chatbot character was found as the best app feature, whilst the unnatural flow of conversation was found as the worst app feature by the participants.</li> <li>The ADHD symptoms improved in relation to the number of times the participants used the psychoeducation programme.</li> </ul>
<b>Serious Games (Educational Games)</b>							
7	Frutos-Pascual et al. (2014)	Spain	Pilot study	Targets ADHD adolescents (12-19 years old) Participant sample were non-ADHD students (17)	Tele-therapy tool based on Serious Games for Health Based on decision trees with Django, high level Python Web framework	Improving time management skills and the prioritisation of tasks	<ul style="list-style-type: none"> <li>The tool was found effective for improving the organisation and time management skills of the participants. Recommendation was made to redevelop the tool to be customizable to ADHD users working with different skills, in addition to time management and organisation skills.</li> </ul>
8	Garcia-Redondo et al. (2019)	Spain	RCT	ADHD students (6-16 years old) with a Specific Learning Disorder (SLD) diagnosis (44)	Serious game (educational game), 28 sessions (10 mins each) Training with 10 games based on multiple intelligences/abilities related to attention.	Improving attention	There was a significant improvement in attention performance measures, particularly for visual attention. It was recommended to keep developing alike tools which can boost different abilities to improve attention deficit areas in ADHD and LD <sup>19</sup> students.



Study No.	Author (year)	Country	Type of study	Target population	Intended purpose	Intervention	Outcomes
<b>Health Behaviour Change</b>							
9	Schoenfelder et al. (2017)	USA	Pilot study	ADHD adolescents (14-18 years old) (11)	mHealth intervention using an mHealth linked wearable activity tracker (Fitbit Flex) and a Facebook group to increase PA	To improve ADHD symptoms and mood	<ul style="list-style-type: none"> <li>High acceptability and treatment adherence in the study, participants significantly increased their weekly average step count over the study, and improved inattentive symptoms for both self-reported and parent-reported symptoms.</li> </ul>
<b>Computer-Based Skills Training</b>							
10	Bruce et al. (2017)	Australia	RCT	Young (16-19 years old) ADHD drivers with poor hazard perception skills (25)	Immediate intervention group – training session using a computer application Drive Smart Delayed intervention watched a documentary video (control condition) and then Drive Smart computer training session	To improve poor hazard perception skills in drivers	<ul style="list-style-type: none"> <li>Immediate intervention group had significant improvement.</li> </ul>
<b>Medication/Pharmacological Adherence</b>							
11	Biederman et al. (2020)	USA	Pilot study	ADHD adults (18-55 years old) from primary care and psychiatric practices prescribed stimulant medication (117)	Text messaging (SMS) intervention in primary care to help ADHD adults use their prescription and refill it regularly.	To improve medication/ pharmacological adherence to stimulant medication for ADHD	Using documented prescription records checking whether they had timely prescription refills, 81% did compared to 36% with treatment as usual (from EMRs of the same healthcare organisation).



Study No.	Author (year)	Country	Type of study	Target population (participant number)	Intended purpose	Intervention	Outcomes
<b>Medication/Pharmacological Adherence and Psychoeducation</b>							
12	Carvalho et al. (2023)	Brazil	RCT	ADHD adults (73)	FOCUS ADHD app trialled including medication tracker and reminder features, and a library of psychoeducational ADHD-related content	To increase pharmacological adherence in adult ADHD (also included monetary reward as a condition)	<ul style="list-style-type: none"> <li>The group who was offered an incentive in conjunction with app use saw improvements in treatment adherence.</li> </ul>
<b>Diagnostic/Clinical Remote Monitoring</b>							
13	Simons et al. (2016)	UK	Qualitative study with 11 focus groups exploring an intervention	The intervention targets adults and children with ADHD. Participants were adults and young people with ADHD, parents of ADHD children, and healthcare professionals (59)	Remote monitoring technology (RMT) to replace weekly monitoring by clinicians in person when titrating medication for ADHD	Improve the diagnostic process and medication treatment prescribing. Alleviate pressure off clinicians and free up clinician time, reducing face-to-face appointments.	<ul style="list-style-type: none"> <li>It was recommended that RMT<sup>20</sup> is implemented to augment support and care for ADHD patients, and to further implement this past titration period by offering ADHD individuals support through Outcome Measures monitoring for their condition and treatment over time. It was also recommended that an mHealth app that incorporates the key features identified by end users is developed and evaluated.</li> </ul>

20: Remote monitoring technology

Most common clinical measures, i.e., the main digital intervention purposes across the studies included the aim to improve core ADHD symptoms of inattention and hyperactivity/impulsivity. This meant that the success of the intervention was often related to a decrease across inattention and hyperactivity/impulsivity study measures (studies 1, 2, 4, 5, 6, 8, and 9). Further clinical measures related to ADHD difficulties varied across studies. These included depression (e.g., study 1), anxiety (e.g., study 2), mood, quality of life, self-esteem, and Sense of Coherence (SOC)<sup>21</sup> (e.g., study 3).

Studies 1, 2, 3, 3a, and 6 aimed to teach coping strategies related to ADHD difficulties (e.g., with mental health). Specific studies focused on improving time management skills and prioritisation of tasks, which are issues related to deficits in the executive functioning in ADHD (e.g., study 7). Additionally, one study (9) focused on increasing physical activity to decrease ADHD symptoms and improve mood as a health behaviour change method. Finally, two studies (11 and 12) focused on improving medication/pharmacological treatment adherence where improvement in adherence were the main outcome measures.

Across the studies, intervention feasibility and acceptability were investigated with the participants to gauge whether the interventions were perceived as helpful and user-friendly. These measures were also used to explore a possibility for future RCTs and the adjustments required for future intervention redevelopment for these to better suit the ADHD population.

Please, refer to Appendix 2 for a more in-depth description of the listed interventions in Table 2. These include their features, outcomes, and author recommendations in more detail. The studies are discussed according to their categorisation as seen in Table 2 related to the digital interventions' main components.

### 3.1.1 Phase 1 - Conclusions and Recommendations

Overall, there are few peer-reviewed studies that have tested digital interventions aimed to help diagnose and/or manage adult ADHD, and the evidence of the interventions' effectiveness is limited. Among the 13 identified digital interventions across the 14 studies, there were only initial feasibility studies or singular RCTs with no further replication studies.

While the studies showed preliminary support of the digital interventions' effectiveness for adult ADHD, further research is required. Overall, the studies showed the interventions were effective in decreasing core ADHD symptoms of inattention and hyperactivity/impulsivity (e.g., study 1). Furthermore, studies were successful in helping to improve ADHD adults' organisation and time management skills (e.g., study 7), as well as to increase physical activity with a positive effect on core ADHD symptoms (e.g., study 9), and to improve medication adherence (e.g., study 11). However, most interventions did not reduce symptoms of comorbid depression, anxiety, or improve quality of life (e.g., study 2).

There were no trends related to intervention effects on the two symptom dimensions of inattention and hyperactivity/impulsivity. This suggests that the digital interventions thus far have not successfully specifically targeted either core ADHD symptom group. This also means that there is no evidence for ADHD subtype differences related to the digital intervention effects yet, presently suggested to be (at least partially) due to lack of studies into their effectiveness.

ADHD adults appeared to benefit the most from interactive features delivering the interventions combined with social support. For example, adapting therapeutic models (e.g., CBT) to a digital format (e.g., via chatbot) may be helpful for learning coping strategies. However, there should be ways for users to form relationship with others, such as facilitators/coaches/therapists and peers with ADHD, to increase social support. This can be delivered via chat functions and forums on the apps, where users can share their experiences.

21: The "Sense of Coherence" (SOC) stems from the Salutogenic Model of Health, inferring that individuals who see their lives as logical, meaningful, and manageable are more resistant to various risk factors and diseases (Wentz et al., 2012).

Furthermore, interactive psychoeducation via an app emerged as a key component for helping ADHD adults to learn more about their experiences, as well as strategies for self-management of their condition. The key here was for the app to deliver the information in parts based on user input, rather than all at once, which can be overwhelming for ADHD people (e.g., study 6).

There was limited evidence for use of wearables. However, the one study (study 9) did see high engagement with the intervention using Fitbit trackers to reach step goals/increase PA<sup>22</sup> whilst using social support features via a Facebook group with other users.

Finally, use of medication reminder apps was shown as effective to help ADHD adults regularly take and refill their prescription, and it ought to be considered in future digital interventions (studies 11, 12).

There was very limited evidence in peer-reviewed literature relating to digital interventions to diagnose ADHD in adults (study 13). The recommendations were to use remote assessments for parts of the diagnostic process to supplement and accelerate the diagnosis and free up clinician time. For example, that can be done by conducting the initial assessment checking whether the person ought to get formally diagnosed using remote technology instead of a face-to-face appointment.

### 3.2 Phase 2 - Commercially Available Evidence-Based Digital Interventions for Adult ADHD

Phase 2 search identified ten (10) scientifically supported and commercially available applications intended for ADHD adults, which may help with ADHD self-management and/or diagnosis (Table 3).

There were eight apps to help ADHD self-management (apps 1 to 8), and two apps to help diagnose ADHD (apps 9 and 10). The apps mainly originated from the UK (seven in total, including both listed diagnostic tools), while three originated from the USA (apps 4, 6, 7).

Please, refer to Appendix 3 for a more in-depth description of each validated app and the available peer-reviewed evidence evaluating their effectiveness in aiding ADHD self-management or treatment and/or diagnosis (follow Table 3 for further information).

22: Increasing PA was a health behaviour change intervention type.



Table 3: List and details of identified evidence-based adult ADHD self-management and diagnosis digital interventions



ID	Title	Type	Country	Developer	Target Audience	Purpose	Key Features	Clinical Features
<b>ADHD Self-Management</b>								
1	Inflow - Manage your ADHD	App (iOS and Android)	UK	Get Inflow Ltd.	ADHD adults.	<p>ADHD self-management (adults).</p> <p>Science-based digital program to manage ADHD by building a daily routine habit by habit, a day at a time according to person's priorities and needs across life settings (e.g., work, home, education). Focus on executive function skills, so is applicable to autism, OCD<sup>23</sup>, depression, dyslexia, dyspraxia and more.</p>	<p>Designed by people with ADHD. CBT-based.</p> <ul style="list-style-type: none"> <li>· Improving skills in the areas:                             <ul style="list-style-type: none"> <li>· - Focus and Concentration</li> <li>· - Attention and Hyperactivity</li> <li>· - Goal Setting and Consistency</li> <li>· - Mood and Emotional Regulation</li> <li>· - Distraction Reduction</li> <li>· - Cyber Addiction</li> <li>· - Creating a Routine</li> <li>· - Sticking to a Schedule</li> <li>· - Organization</li> <li>· - Time Management</li> <li>· - Impulsivity</li> <li>· - Depression and Anxiety</li> <li>· - Procrastination</li> <li>· - Medication and Treatment Options</li> <li>· - Mindfulness</li> <li>· - Nutrition</li> </ul> </li> <li>· Features:                             <ul style="list-style-type: none"> <li>· - Daily activities and visual reminders integrated easily into your daily life</li> <li>· - Challenges to put what you learn about ADHD/ADD into practice</li> <li>· - Daily focus feature so you can prioritize more effectively</li> <li>· - A stigma-free and supportive ADHD/ADD community to motivate you</li> <li>· - Personalized journal to understand your behaviour habits</li> <li>· - Live events with a psychologist, counsellor, ADHD<sup>24</sup> coach, home organizer and more.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>· Social support network.</li> </ul>
<b>Diagnostic/Clinical Remote Monitoring</b>								

<sup>23</sup>Obsessive compulsive disorder  
<sup>24</sup>Attention Deficit Disorder

ID	Title	Type	Country	Developer	Target Audience	Purpose	Key Features	Clinical Features
<b>ADHD Self-Management</b>								
2	ELFy	App on Apple iOS	UK	ELFy Apps Limited	Includes ADHD and neurodiversity with other mental health conditions.	<p>Helps with medication adherence.</p> <p>Targets 'mental health', depression, bipolar disorder, stress, neurodiverse, ADHD, etc.</p> <p>To ease the burden of long-term conditions on the NHS.</p>	<ul style="list-style-type: none"> <li>Includes medication reminders, prescription reminders, and other key alerts, info and tips, action plans based on conditions and what to do in an emergency. Profile section for key medical ID and important contacts.</li> </ul>	<ul style="list-style-type: none"> <li>Medication Reminder.</li> </ul>
3	Brain in Hand Mobile	App on Apple iOS, Android, Web App	UK	Brain in Hand	Includes ADHD and neurodiversity with other mental health conditions.	<p>Brain in Hand is a web app that helps you manage your mental wellbeing with a mood and sleep diary. You have access to a human specialist that can support you and offer advice when you need it.</p> <p>Brain in Hand is suitable for all adults and children, including those who have autism or need help with their memory or learning skills.</p> <p>Intended for helping mental health, anxiety, mental wellbeing, neurodiverse, autistic spectrum disorders, ADHD.</p>	<ul style="list-style-type: none"> <li>Access to a human specialist who can help with goal setting, making decisions, and solving problems.</li> </ul>	<ul style="list-style-type: none"> <li>Mood Tracker.</li> <li>Self-help.</li> <li>Sleep Diary.</li> <li>Mental health support.</li> <li>Stress</li> </ul>

ID	Title	Type	Country	Developer	Target Audience	Purpose	Key Features	Clinical Features
ADHD Self-Management								
4	EndeavorRX - Kid	App on Apple iOS, Android.	USA	Akili Interactive Labs, Inc.	ADHD and neurodiverse (children) - 8-17 years	Video game treatment to improve attention in child and adolescent ADHD (primarily inattentive and combined due to attention focus).	The goal is to successfully navigate the character through the game with various targets; there is a companion app for parents to track their child's journey. Attention function is measured by computer-based testing. Test of Variables of Attention (TOVA®), of sustained and selective attention and may not display benefits in typical behavioural symptoms, such as hyperactivity. EndeavorRx should be considered for use as part of a therapeutic program that may include clinician-directed therapy, medication, and/or educational programs, which further address symptoms of the disorder. EndeavorRx should be played for approximately 25 minutes a day, 5 days a week for at least 4 consecutive weeks or as directed by the child's health care provider.	Games
5	Hope Programme	App on Apple iOS, Android, Web App	UK	Magic Square Systems Limited	ADHD adults, neurodiverse, Autistic Spectrum Disorder, and many other conditions (includes chronic illness, cancer, mental health conditions, etc).	Evidence based health and wellbeing courses to be completed at one's pace, based on positive psychology, mindfulness, and CBT.	<p>The Hope Programme can help users to:</p> <ul style="list-style-type: none"> <li>· be more relaxed</li> <li>· set goals that are important to YOU</li> <li>· deal with stress and extreme tiredness</li> <li>· share your fears and worries</li> <li>· live well with a long-term condition</li> <li>· cope better with providing care.</li> </ul> <p>The intervention offers meeting similar others and trying a range of interactive activities including goal setting, gratitude, hope for the future, mood, activity and symptoms tracking, journaling and an online forum.</p> <p>Supported by trained facilitators with lived experience.</p>	<p>Self-help</p> <p>Reminders</p> <p>Breathing Exercises</p> <p>Social support network</p> <p>Meditation</p> <p>Instant messaging</p> <p>Symptom Tracker</p> <p>CBT</p> <p>Mood Tracker</p> <p>Pain tracking</p> <p>Physical Intervention</p> <p>Educational</p> <p>Fatigue</p> <p>PROMs (patient reported outcome measures)</p> <p>Mindfulness</p> <p>Mental health support</p> <p>Relaxation Techniques</p> <p>Stress management</p> <p>Information</p> <p>Health Diary</p> <p>Carer Support</p>

ID	Title	Type	Country	Developer	Target Audience	Purpose	Key Features	Clinical Features
<b>ADHD Self-Management</b>								
6	Focus@Will: Control Your ADD	App on Apple iOS, Android	USA	Dulcetta	ADHD, neurodiverse (Adults).	To help adults with ADHD (and other neurodiversity) to focus through tailored music. A proprietary AI engine is linked with the world's largest brain database, and the music is created by the employee musicians specifically for productivity. The music on Focus@Will cannot be found anywhere else; the developers remaster, re-edit, and re-produce each track to remove all distracting elements to help users sustain productivity and focus.	In-app assessment agent uses data from the database to prescribe the best type of music and energy levels for each individual. Features include offline mode, tracking productivity (focus timer as pomodoro timer, create work sessions and break times countless times a day, change the session start/end sounds or turn off completely).	Music
7	7 Cups: Online Therapy & Chat	App on Apple iOS, Android	USA	7 Cups of Tea	ADHD, neurodiverse (and other mental health conditions, and LGBTQI+ support)	To support with emotional and mental health.	Uses anonymous text chats, mindfulness exercises and educational videos. Paid chats are with therapists only for adults, while app is for children (13+) also. The free chats by volunteers are for all users, assisting with emotional and mental wellbeing. There is also community support.	Communication Tool Mental health support Self help

ID	Title	Type	Country	Developer	Target Audience	Purpose	Key Features	Clinical Features
<b>ADHD Self-Management</b>								
8	The ADHD programme	The ADHD	UK	Silvercloud	ADHD adults (16+)	To help ADHD individuals better understanding their diagnosis using CBT.	<p>The programme guides and supports the individuals to improve organisation, attention, and problem-solving skills and to better understand and manage thoughts, feelings, and behaviours. Programme goals are: Become more aware of common myths and misconceptions</p> <p>Address procrastination, concentration, anxiety, and low self-esteem</p> <p>Reflect on hyperactivity, impulsivity, and emotions Challenge negative thinking and assumptions</p>	<p>Modules include: ADHD and Me; Managing the Challenges of ADHD; Attention and Concentration; Self-Esteem and Wellbeing; Overcoming Procrastination; Getting Organised; Self-Care and Social Support; Problem Solving and Moving Forward.</p> <p>Interactive tools include: Staying in the Present, My Attention and Focus, Understanding my Hyperactivity and Impulsivity, My Perfectionist Behaviours, CBT Cycle, Red Flag Thoughts, Blocks to Getting Organised, My Lifestyle Choices, Building Self-esteem.</p>
<b>ADHD Diagnosis</b>								
9	Addhere	Web app	UK	Addhere Technologies Technologies	ADHD and neurodiversity - includes adults (but especially in children)	To support the diagnosis of ADHD.	<p>Scientific evidence-based AI powered app to support diagnosis of ADHD and neurodiverse conditions (especially autism, and especially in children). Can be used by teachers, healthcare professionals, and parents, in a self-driven healthcare approach for children to be assessed. Detects strongest predispositions, and then the users receive online training individualised by the findings.</p>	<p>Clinical tools Neurological Disorder Support</p>

ID	Title	Type	Country	Developer	Target Audience	Purpose	Key Features	Clinical Features
<b>ADHD Diagnosis</b>								
10	QB Test		UK	QBTech	ADHD children and adults (6-60)	To help diagnose ADHD.	<p>QbTest is an FDA<sup>25</sup> -cleared, CE-marked clinical test for attention deficit hyperactivity disorder (ADHD) that objectively measures the three core symptoms: inattention, hyperactivity, and impulsivity.</p> <p>It's been developed to aid healthcare professionals who provide frequent evaluations to treat and test for ADHD. Alternatively, the developers also offer QbCheck, which gives users the ability to assess ADHD remotely or in-clinic and pay flexibly per test.</p>	<p>Modules include: ADHD and Me; Managing the Challenges of ADHD; Attention and Concentration; Self-Esteem and Wellbeing; Overcoming Procrastination; Getting Organised; Self-Care and Social Support; Problem Solving and Moving Forward.</p> <p>Interactive tools include: Staying in the Present, My Attention and Focus, Understanding my Hyperactivity and Impulsivity, My Perfectionist Behaviours, CBT Cycle, Red Flag Thoughts, Blocks to Getting Organised, My Lifestyle Choices, Building Self-esteem.</p>

<sup>25</sup> Administration

### 3.2.1 Phase 2 - Conclusions and Recommendations

Overall, the eight included self-management apps were similar to the Phase 1 interventions. They too mainly included adaptation of therapeutic models to a digital format, and psychoeducation with added social support elements (e.g., Inflow app). The apps were suitable also for other neurodivergence types (e.g., ELFy), or for a range of mental and physical health issues (e.g., Hope Programme).

The identified apps included features such as habit builders and trackers aiming to support people with ADHD to improve their organisation, time management, problem-solving, sleep habits, and comorbid mental health difficulties, such as symptoms of depression and anxiety. Furthermore, features enabling one-on-one support with therapists or facilitators via chat, or spaces for users to talk to each other (via forums) were included to provide social support. Additionally, one app was in the form of a game to help improve attention (EndeavourRX-Kid), one app aided sustained attention via specially curated music (Focus@will), and the apps sometimes included medication reminders (e.g., ELFy).

The empirical evidence for these apps as effective digital interventions to help adult ADHD was very limited. Most of the apps had not been empirically supported with peer-reviewed studies with ADHD participants. Although the included apps were scientifically validated as evidence-based, there was a stark lack of evidence of their effectiveness. This aligned with Pasarelo et al.'s (2020) conclusions from the systematic review on ADHD apps inferring the urgent need for more rigorous RCTs to establish effectiveness, especially in relation to how specific features affect ADHD core symptoms and related behaviours.

The diagnostic ADHD digital interventions were limited; however, it was clear from both Phase 1 and Phase 2 search that using remote means to complete partial ADHD assessments and accelerate the diagnostic process is a viable solution. Specifically, the QB Test is already used across NHS England, and holds empirical support

for its effectiveness in assessing inattention and hyperactivity/impulsivity. A recommendation based on this review is to consider using this in Scotland to aid the diagnostic process in the future.

## 4. Final Conclusions and Recommendations for Future Digital Interventions for Adult ADHD

### Key Findings:

#### 1. Digital Interventions Overview:

- Peer-reviewed studies and commercially available apps share similarities in their goals but often lack empirical evidence, especially for adult ADHD.
- Only a single peer-reviewed study tested commercially available apps, and while most apps are science-based, they rarely undergo Randomised Controlled Trials (RCTs).
- The interventions aimed to address ADHD core symptoms (inattention and hyperactivity) as well as related issues like anxiety and depression.

#### 2. Core Symptom Management:

- Interventions generally succeeded in improving ADHD core symptoms but had limited impact on comorbidities like anxiety or depression.
- Apps adapted therapeutic models (e.g., CBT) to help with ADHD self-management, focusing on psychoeducation and enhancing skills like time management, problem-solving, and organisation.

#### 3. Interactive Features Improve Outcomes:

- Interventions involving interactive elements (e.g., user input-driven learning) and social support (e.g., contact with ADHD specialists or forums) were more effective.
- Gaming and educational tools helped improve attention and executive functioning in adults.

#### 4. Remote Diagnostics & Medication Adherence:

- Diagnostic tools for ADHD are lacking in peer-reviewed literature, though some interventions (e.g., QB Test) showed potential for speeding up diagnosis.
- Apps supporting medication adherence, through reminders and habit-building features, demonstrated effectiveness in improving ADHD management.

### Recommendations:

#### 1. Self-Management App Development:

- An app combining therapeutic models, psychoeducation, interactive features, and social support is recommended. The Inflow app, already scientifically supported, could be further studied and optimised.

#### 2. Diagnostic Process:

- Incorporate digital tools (like the QB Test) into the diagnostic process to alleviate clinician workload and reduce waiting times.
- Develop self-assessment questionnaires that could streamline early-stage diagnosis.

#### 3. Social Support & Interactivity:

- Future interventions should prioritise interactive psychoeducation and features that enable social support networks, which significantly benefit adults managing ADHD.



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# Appendix 1: Research Methodology

## Phase 1 Methodology

An in-depth literature review of peer-reviewed studies of digital interventions to aid adult ADHD diagnosis and treatment was conducted.

Study inclusion criteria included:

1. study investigates the effectiveness of digital interventions with the purpose of providing treatment and/or diagnosis of ADHD;
2. participant sample of the study included ADHD adults (age 16 and over) (studies with digital interventions for ADHD children and adolescents/young people were considered if a part of the study participant pool were over the age of 16); and
3. the study was available in English.

Studies were searched across peer-reviewed journals, including Web of Knowledge, Google Scholar, and University of Strathclyde Library database.

Key search words/phrases included:

*attention deficit hyperactivity disorder; ADHD; neurodiverse; neurodiversity; neurodivergence; neurodivergent; digital health intervention; DHI; digital intervention; digital therapeutics; application; app; computer-based app; mHealth; telehealth; wearable device(s); wearables; self-management; diagnosis; diagnostics; treatment.*

Due to the scarcity of available adult ADHD-specific literature, studies focusing on digital interventions to help ADHD children were scanned for their references. Furthermore, any identified adult ADHD-related studies<sup>26</sup> were also inspected for their references to identify further studies meeting the current study inclusion criteria.

Seventy-eight (78) studies were assessed against the inclusion/exclusion criteria.<sup>27</sup> Finally, 14 studies were included in the analysis, which looked at the purpose, target population, nature of intervention, and effectiveness/outcomes with author recommendations. Potential wider commercial use of interventions was also assessed.

## Phase 2 Methodology

A thorough Internet search was conducted to identify 'live', scientifically evidence-based digital interventions to help diagnose and self-manage ADHD in adults in the UK (and abroad).

The apps were identified using ORCHA Health App library<sup>28</sup>, and Internet search engines, including Google Chrome, Microsoft Edge, and DuckDuckGo.

- The ORCHA search terms included:
  - attention deficit hyperactivity disorder; ADHD; neurodivergence; neurodiversity; neurodivergent; neurodiverse.
- The Internet search utilised the search terms used in Phase 1<sup>29</sup>.

ORCHA library yielded 15 digital interventions (mobile and web apps available on app stores and/or on web browsers), which were inspected for their target audience. Eight apps were excluded for not meeting the study scope criteria<sup>30</sup> (seven targeted ADHD children, and one app was a street navigation app alike Google Maps), leaving seven apps from ORCHA for further analysis.

Internet search results (e.g., websites and blogs discussing ADHD) mentioning a digital intervention were also inspected for references to further digital interventions. This yielded two more digital interventions to include in the analysis.

26: Any study focussing on adult ADHD, whether or not it involved an aspect of digital interventions, was scanned for potentially relevant references for the current study.

27: Sixty-eight (68) studies were excluded as they did not include ADHD adults (16+), 1 study was published only in German, 1 study focussed on ADHD adult's carers and families, and remaining 8 magazines, and 1 was a cookbook. These results show how commercially available apps marketing towards ADHD in most cases are not suitable for this population.

28: <https://ourdorset.orchahealth.com/en-GB>

29: Search key words/terms: attention deficit hyperactivity disorder; ADHD; neurodiverse; neurodiversity; neurodivergence; neurodivergent; digital health intervention; DHI; digital intervention; digital therapeutics; application; app; computer-based app; mHealth; telehealth; wearable device(s); wearables; self-management; diagnosis; diagnostics; treatment.

30: All apps can be found via the following link: <https://ourdorset.orchahealth.com/en-GB/search?search=adhd&page=2&sortBy=Relevance>

The final set of digital interventions were described and analysed for their content. Furthermore, peer-reviewed literature searches were conducted for each identified digital intervention to investigate empirical evidence of its effectiveness in treatment and/or diagnosis of ADHD adults. These findings were used to answer the research questions and make recommendations for development of future digital interventions.

Finally, findings from both Phase 1 and Phase 2 were pooled together to answer the research questions and make recommendations for the current study. Additional adult ADHD resources from peer-reviewed literature were included to aid the discussion and to write the recommendations.

### **Additional Outputs**

A Miro Board visualisation of the key digital interventions and their features for management and diagnosis of adult ADHD was created to accompany this report<sup>31</sup>. The purpose of the Miro Board output was to present the key information in a slightly different format, and to make it available to the DHI and the Scottish Government colleagues to design/implement such digital interventions in Scotland.

31: This output is available separately to this report and is available upon request.



## Appendix 2: Intervention Type Overview (re Table 2)

### 1 - Adapting therapeutic models to a digital therapeutics tool

1	<p>Nordby, E. S., Kenter, R. M. F., Lundervold, A. J., &amp; Nordgreen, T. (2021). A self-guided Internet-delivered intervention for adults with ADHD: A feasibility study. <i>Internet interventions</i>, 25, 100416. <a href="https://doi.org/10.1016/j.invent.2021.100416">https://doi.org/10.1016/j.invent.2021.100416</a></p> <p>Intervention:          Nordby et al. (2021) adapted Goal Management Training (GMT), Dialectical Behaviour Therapy (DBT), and CBT to teach coping strategies across eight (8) modules to ADHD adults. The modules included breathing and inhibition techniques, emotion regulation strategies, planning and organisation techniques, and self-compassion and acceptance strategies. Each module contained two to three coping strategies, and participants were invited to practice these between sessions during the week. The intervention also included ADHD lived-experience videos by similar others to help participants integrate the course material with real life experiences. Additionally, weekly action plans, daily log tracking time and experience practicing the techniques, and daily diary were all included in the intervention throughout the training period.</p> <p>Outcomes:</p> <ul style="list-style-type: none"> <li>• Low treatment adherence, but high satisfaction among the participants who did adhere to the protocol.</li> <li>• There was a significant decrease in inattention, whilst no significant changes in hyperactivity and impulsivity.</li> <li>• There were no significant changes in anxiety and depression measures.</li> <li>• Recommendations were made to redevelop the intervention to be more interactive and engaging for the ADHD adults due to their experiences of restlessness and boredom.</li> </ul>
2	<p>Nordby, E. S., Guribye, F., Schønning, V., Andersen, S. L., Kuntsi, J., &amp; Lundervold, A. J. (2024). A Blended Intervention Targeting Emotion Dysregulation in Adults With Attention-Deficit/Hyperactivity Disorder: Development and Feasibility Study. <i>JMIR formative research</i>, 8, e53931. <a href="https://doi.org/10.2196/53931">https://doi.org/10.2196/53931</a></p> <p>Intervention:          Nordby et al. (2024) created an app to supplement face-to-face group therapy sessions for ADHD adults with issues with emotion dysregulation over eight weeks with trained ADHD healthcare professionals. The app was based on elements from DBT<sup>32</sup> skills training and positive psychology. The group sessions involved key information on ADHD and its strengths and challenges, mindfulness, emotion regulation skills training, crisis management when experiencing intense emotions, and self-compassion work. The participants received homework including various types of journaling and practicing the newly learnt skills. The companion app helped them with skills training and enabled them to get in touch with their group leader and access in-person session content. The participants would also receive text message reminders if they did not complete the online training modules regularly throughout the week.</p> <p>Outcomes:</p> <ul style="list-style-type: none"> <li>• The intervention was accepted by participants as helpful, mainly due to allowing them to meet others with ADHD.</li> <li>• The study found significant reduction of emotion dysregulation symptoms and improvement in both inattention and hyperactivity-impulsivity.</li> <li>• There was no effect on depression, anxiety, quality of life, and executive functioning.</li> </ul>

## 2 - Psychoeducation

Wentz, E., Nydén, A., & Krevers, B. (2012). Development of an internet-based support and coaching model for adolescents and young adults with ADHD and autism spectrum disorders: a pilot study. *European child & adolescent psychiatry*, 21(11), 611–622. <https://doi.org/10.1007/s00787-012-0297-2>

Sehlin, H., Hedman Ahlström, B., Andersson, G., & Wentz, E. (2018). Experiences of an internet-based support and coaching model for adolescents and young adults with ADHD and autism spectrum disorder – a qualitative study. *BMC psychiatry*, 18(1), 15. <https://doi.org/10.1186/s12888-018-1599-9>

Intervention:

Wentz et al. (2012) developed an Internet-based support and coaching model (IBSC) for adolescents with ADHD and/or autism spectrum disorder (ASD), i.e., autism, aiming to facilitate understanding of the individuals' everyday problems in relation to their diagnosis. The programme includes professionals with extensive knowledge of ADHD and ASD who act as coaches. After the initial face-to-face meeting with a coach, participants take part in 8-week internet-based coaching. It consists of two weekly scheduled chat sessions of 30 to 60 minutes from participants' houses using a chat programme, focussing on two topics in each chat session. On weeks three and six there are in-person coach meetings. Coaches and participants can also directly talk via email throughout the process.

Outcomes:

- The validation showed significant improvements of SOC, self-esteem, and subjective quality of life at follow-up.
- Recommendation was to use this model to complement other interventions for this population.
- It was suggested that there might be issues with conducting a future RCT due to ADHD and/or autistic adolescents' difficulties, including unpredictability and various issues, which may harm them during the trial and alter the RCT findings.
- Sehlin et al. (2018) (study 3a) qualitatively evaluated ADHD and/or autistic adolescents and young people's experiences of this coaching programme in Sweden in a sample of 16 individuals. Main findings suggested that the participants enjoyed receiving this support, perceived as positive among lack of support otherwise; they found it helpful to have all the information written down in the chat; being able to take part in the intervention from their home was also seen as helpful. However, the remote intervention delivery mode was also seen as a negative due to lack of in-person contact.

Selaskowski, B., Steffens, M., Schulze, M., Lingen, M., Aslan, B., Rosen, H., Kannen, K., Wiebe, A., Wallbaum, T., Boll, S., Lux, S., Philipsen, A., & Braun, N. (2022). Smartphone-assisted psychoeducation in adult attention-deficit/hyperactivity disorder: A randomized controlled trial. *Psychiatry research*, 317, 114802. <https://doi.org/10.1016/j.psychres.2022.114802>

Intervention:

Selaskowski et al. (2022) created an app providing psychoeducation as a supplement to face-to-face clinical psychoeducation group over eight weeks, and compared to participants who did not use the app but the traditional paper brochure instead.

Outcomes:

- Both conditions saw a significant improvement in core ADHD symptoms. However, the psychoeducational app use was related to a significant improvement in inattention and impulsivity, with higher homework compliance, compared to the paper brochure group.

Selaskowski, B., Reiland, M., Schulze, M., Aslan, B., Kannen, K., Wiebe, A., Wallbaum, T., Boll, S., Lux, S., Philipsen, A., & Braun, N. (2023). Chatbot-supported psychoeducation in adult attention-deficit hyperactivity disorder: randomised controlled trial. *BJPsych open*, 9(6), e192. <https://doi.org/10.1192/bjo.2023.573>

Intervention:

Selaskowski et al. (2023) trialled an app AwareMe ADHS, using an interactive chatbot providing psychoeducational material to ADHD adults based on user input, and comparing it to the control group using a traditional psychoeducation app via chatbot presenting the information linearly (module by module) (same app as in study 4). Therefore, the 3-week intervention aimed to present the psychoeducation content in a more ADHD-centred way.

The eight psychoeducation modules in the intervention include basic ADHD information, personal resources, how to control attention and engage in mindfulness, self-organisation strategies, stress management strategies, ways to manage mood regulation and impulsive behaviour control, relationship considerations, and a final evaluation part. The modules were completed with a quiz to assess users' knowledge. The chatbot was also able to present all module information at once, but the user was able to skip the content more easily than the traditional app format.

Outcomes:

- Both groups saw significant reductions in their core ADHD symptoms (similar effects) reported by participants and by observers (self-report and observer rating, respectively).
- The findings supported use of an app as a future intervention for psychoeducation, with recommendations to redevelop its interactive features so it appeals more to the ADHD population.

### 3 - Adaptation of Therapeutic Models & Psychoeducation

6	<p>Jang, S., Kim, J. J., Kim, S. J., Hong, J., Kim, S., &amp; Kim, E. (2021). Mobile app-based chatbot to deliver cognitive behavioral therapy and psychoeducation for adults with attention deficit: A development and feasibility/usability study. <i>International journal of medical informatics</i>, 150, 104440. <a href="https://doi.org/10.1016/j.ijmed-inf.2021.104440">https://doi.org/10.1016/j.ijmed-inf.2021.104440</a></p> <p>Intervention: Jang et al. (2021) developed an app for ADHD adults using a chatbot combining CBT and psychoeducation content to learn about various aspects of ADHD (e.g., inattention and its effects on the person's life), as well as about comorbid disorders (including depressive disorder, bipolar disorder, anxiety disorder), behaviour change, emotional control, medication, and mindfulness training, to learn to overcome these issues. The CBT element involved chatbot assisting the user with their tasks by encouraging and prompting time management and prioritisation of tasks. These included daily life management, time management, space management, and work management. By engaging in the CBT aspect of the app, and learning to prioritise and manage tasks in more efficient way, it was aimed to help improve the aspects of ADHD symptoms and comorbid mental health difficulties. The trial study compared the intervention to the group using the traditional physical book to learn about ADHD.</p> <p>Outcomes:</p> <ul style="list-style-type: none"> <li>• There was a significant improvement in ADHD core symptoms due to use of the app.</li> <li>• The ADHD symptom improvement was related to number of times participants engaged with the programme, supporting its effectiveness.</li> </ul>
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### 4 - Serious Games (Educational Games)

7	<p>Frutos-Pascual, M., Zapirain, B. G., &amp; Zorrilla, A. M. (2014). Adaptive tele-therapies based on serious games for health for people with time-management and organisational problems: preliminary results. <i>International journal of environmental research and public health</i>, 11(1), 749–772. <a href="https://doi.org/10.3390/ijerph110100749">https://doi.org/10.3390/ijerph110100749</a></p> <p>Intervention: Frutos-Pascual et al. (2014) developed a tele-therapy tool to improve time management skills and prioritisation of tasks based on Serious Games for Health, i.e., educational games, for ADHD adolescents. However, the preliminary study participants were non-ADHD adolescents (12–19 years old). The tool is based on decision trees with Django, which is a high-level Python Web framework.</p> <p>Outcomes:</p> <ul style="list-style-type: none"> <li>• The intervention was related to improvement in organisation and time management skills.</li> <li>• The recommendations were to redevelop the game to be customizable and help improve additional skills related to ADHD population needs in addition to organisation and time management, needing further studies.</li> </ul>
8	<p>García-Redondo, P., García, T., Areces, D., Núñez, J. C., &amp; Rodríguez, C. (2019). Serious Games and Their Effect Improving Attention in Students with Learning Disabilities. <i>International journal of environmental research and public health</i>, 16(14), 2480. <a href="https://doi.org/10.3390/ijerph16142480">https://doi.org/10.3390/ijerph16142480</a></p> <p>Intervention: García-Redondo et al. (2019) developed a serious game (educational game) to improve attention in students<sup>36</sup> diagnosed with both ADHD and a Specific Learning Disorder (SLD). The game included 28 sessions of 10 minutes per session, where the sessions were focusing on various abilities.</p> <p>Outcomes:</p> <ul style="list-style-type: none"> <li>• The study measured attentional abilities with a multitude of measures addressing different attentional abilities. There was a significant improvement in visual attention.</li> <li>• It was suggested to develop further games to improve various types of abilities in this population, as they can help improve attention and positively affect learning.</li> </ul>

36: The sample were between 6 and 16 years of age.

## 5 - Increasing Physical Activity (PA)

9	<p>Schoenfelder, E., Moreno, M., Wilner, M., Whitlock, K. B., &amp; Mendoza, J. A. (2017). Piloting a mobile health intervention to increase physical activity for adolescents with ADHD. <i>Preventive medicine reports</i>, 6, 210–213. <a href="https://doi.org/10.1016/j.pmedr.2017.03.003">https://doi.org/10.1016/j.pmedr.2017.03.003</a></p> <p>Intervention: Schoenfelder et al. (2017) piloted an mHealth intervention using a wearable activity tracker (Fitbit Flex) linked to the mHealth tool, and a Facebook group to help with social support, with the aim of increasing increase PA in ADHD adolescents (14–18 years old), to improve core ADHD symptoms. The participants received daily text messages supporting meeting their PA goals including personalised step count goals.</p> <p>Outcomes:</p> <ul style="list-style-type: none"> <li>• The study showed a significant increase in adolescents’ step count and decrease in inattention symptoms in both self-report and parent-reported ratings.</li> <li>• There was high treatment adherence and intervention acceptability, suggesting the goal setting and the interactive element together with social support aspect of the intervention may be helpful in ADHD populations to increase PA and improve ADHD symptoms.</li> </ul>
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## 6 - Computer-Based Skills Training

10	<p>Bruce, C. R., Unsworth, C. A., Dillon, M. P., Tay, R., Falkmer, T., Bird, P., &amp; Carey, L. M. (2017). Hazard perception skills of young drivers with Attention Deficit Hyperactivity Disorder (ADHD) can be improved with computer based driver training: An exploratory randomised controlled trial. <i>Accident; analysis and prevention</i>, 109, 70–77. <a href="https://doi.org/10.1016/j.aap.2017.10.002">https://doi.org/10.1016/j.aap.2017.10.002</a></p> <p>Intervention: Bruce et al. (2017) trialled use of a computer application Drive Smart as an intervention to improve poor hazard perception skills in young (16–19 years old) ADHD drivers. One group engaged with the training session, whilst the other group watched a documentary video on poor hazard perception skills and then completed the training session.</p> <p>Outcomes:</p> <ul style="list-style-type: none"> <li>• Significant improvements in the group that completed the training without watching the video were found, suggesting that ADHD people benefit from not being overloaded with additional information when learning new skills due to issues with working memory processing.</li> </ul>
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## 7 - Medication/Pharmacological Adherence

11	<p>Biederman, J., Fried, R., DiSalvo, M., Driscoll, H., Green, A., Biederman, I., Woodworth, K. Y., &amp; Faraone, S. V. (2020). A novel digital health intervention to improve patient engagement to stimulants in adult ADHD in the primary care setting: Preliminary findings from an open label study. <i>Psychiatry research</i>, 291, 113158. <a href="https://doi.org/10.1016/j.psychres.2020.113158">https://doi.org/10.1016/j.psychres.2020.113158</a></p> <p>Intervention: Biederman et al. (2020) trialled a text messaging (SMS) intervention in primary care setting to help increase medication adherence, including refilling the prescription regularly, among ADHD adults. The text messages included reminders on taking medication, advice on seeking medical assistance if needed, and when to refill the prescription. To assess the effectiveness, they compared the participant data with electronic medical records (EMRs) in the same healthcare organisation of ADHD adults matched on age, race, and sex.</p> <p>Outcomes:</p> <ul style="list-style-type: none"> <li>• The results were promising in support of the intervention, with 81% of the intervention group refilling their medication on time compared to 36% in treatment-as-usual group.</li> </ul>
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## 8 - Medication/Pharmacological Adherence and Psychoeducation

Carvalho, L. R., Haas, L. M., Zeni, G., Victor, M. M., Techele, S. P., Marrone Castanho, J., Meneghetti Coimbra, I., de Freitas de Sousa, A., Ceretta, N., Garrudo, A., Grevet, E. H., & Rohde, L. A. (2023). Evaluation of the effectiveness of the FOCUS ADHD App in monitoring adults with attention-deficit/hyperactivity disorder. *European psychiatry : the journal of the Association of European Psychiatrists*, 66(1), e53. <https://doi.org/10.1192/j.eurpsy.2023.2422>

### Intervention:

Carvalho et al. (2023) trialled an app FOCUS ADHD, using a Task Manager which supported ADHD adults in all aspects of their treatment plan related to medication. This included treatment information registration (therapeutic plan including medication, dosage, frequency, and other clinical information), patient management support with daily pill reminders, adherence tracking, weekly ADHD symptoms evaluation, registration of adverse events, and an option to add incentives when meeting targets. This app also included psychoeducation content.

### Outcomes:

- The group receiving monetary incentive did see increase in medication adherence, whereas without the incentive there was no improvement. The recommendations were to use incentives with digital therapeutics aiming to increase medication adherence in ADHD adults.

## 9 - Diagnostic/Clinical Remote Monitoring

Simons, L., Valentine, A. Z., Falconer, C. J., Groom, M., Daley, D., Craven, M. P., Young, Z., Hall, C., & Hollis, C. (2016). Developing mHealth Remote Monitoring Technology for Attention Deficit Hyperactivity Disorder: A Qualitative Study Eliciting User Priorities and Needs. *JMIR mHealth and uHealth*, 4(1), e31. <https://doi.org/10.2196/mhealth.5009>

### Intervention:

Simons et al. (2016) explored remote monitoring technology (RMT) as a replacement of weekly stimulant medication titration process which usually occurs with clinicians when a person gets diagnosed with ADHD. This qualitative study involved 11 focus groups with ADHD adults and young people, parents of ADHD children, and healthcare professionals involved in ADHD care (59 participants).

### Outcomes:

- They found that the RMT is a viable option to replace face-to-face appointments, not only in medication titration at the beginning of treatment, but also that it could offer more to patients by implementing various outcome measures throughout their care process monitoring patients' states and progress. This was recommended to be considered for future intervention redevelopments.

## Appendix 3: Overview of ADHD Self-Management Apps (re Table 3)

### Commercially available self-help interventions

Inflow-Manage your ADHD (app) (UK) (Inflow, 2024)  
<https://www.getinflow.io/>

Intervention:

This app involves CBT-based digital programme to improve daily life of ADHD adults<sup>37</sup> by building habits across settings (e.g., at home, at work) according to their individual needs. The app was designed by people with ADHD and ADHD experts, and has been verified on the ORCHA library as a science-based app. The app aims to help with focus, organisation, procrastination, attention, hyperactivity, and anxiety. Its clinical features include CBT, information, and social support network. Other than routine builders, there are educational audios and texts across modules helping ADHD adults learn about healthy habits, organisation skills, whilst managing related difficulties such as anxiety and emotion dysregulation, and an in-app accountability coach in a text format (ORCHA Library, 2024)

### Key Features of the Inflow ADHD App

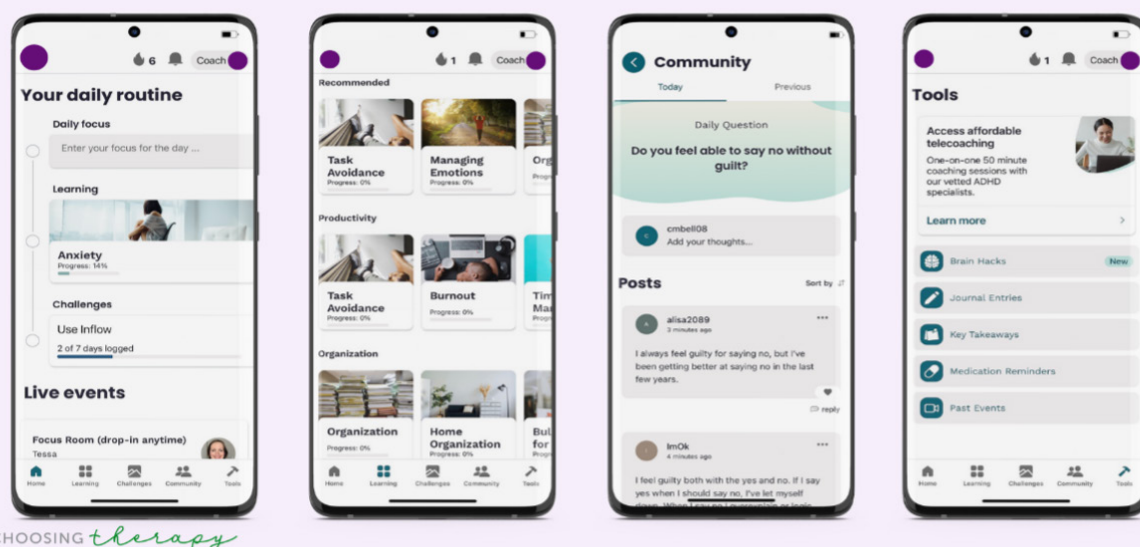


Figure 1. Key features of the Inflow ADHD App. Taken from <https://www.choosingtherapy.com/inflow-adhd-app-review/>.

Empirical Evidence:

In an open feasibility study, Knouse et al. (2022) demonstrated that Inflow was usable and feasible among users who self-identified as needing a CBT-based app for adult ADHD<sup>38</sup>. The study showed high and consistent engagement across the participant sample throughout the 7-week intervention period. Most importantly, on average participants experienced decreases in self-reported ADHD symptoms and functional impairment<sup>39</sup>. Active engagement with the app was also related to this improvement, rather than just frequency and duration of app use. It was recommended to conduct a more rigorous RCT to assess its effectiveness.

No further studies were found related to this app, including RCTs.

37: The app is also suitable for other types of neurodiversity, such as autism, and other mental health difficulties, including anxiety.

38: This means that these were participants who wished to use a therapeutic app believing it will help them with their ADHD.

39: Functional impairment refers to decreases in functional abilities for the sufferers due to their ADHD symptoms and related difficulties (e.g., inability to complete necessary daily tasks).

## Commercially available self-help interventions

2	<p>ELFy app (UK)  <a href="https://www.elfy-apps.com/">https://www.elfy-apps.com/</a>            Intervention:            This app is suitable for people with ADHD, as well as other neurodivergent people, and for those with a variety of mental health conditions (e.g., depression, anxiety). It was developed by medical experts in ADHD and ADHD individuals. The app aims to help increase medication adherence with features such as medication reminders, prescription reminders, and other key alerts, info and tips, action plans based on conditions, and information on what to do in a medication-related emergency. It also features the users' profile section for their key medication information and important contacts (ORCHA Library, 2024).            Empirical Evidence:            There was no available empirical evidence in form of peer-reviewed journals.</p>
3	<p>Brain in Hand Mobile (app and web app) (UK)  <a href="https://braininhand.co.uk/">https://braininhand.co.uk/</a>            Intervention:            Brain in Hand is suitable for mood and mental wellbeing self-management in both neurodiverse children and adults, including ADHD, but also highly suitable for autistic people. It was created in collaboration with healthcare professionals. The app features include a human specialist access to help with setting goals, decision-making and problem-solving, and includes a mood and sleep diary, which were suggested to improve overall wellbeing decreasing ADHD symptoms (ORCHA Library, 2024).            Empirical Evidence:            Tromans et al. (2023) conducted a 12-week long prospective cohort study in England and Wales with 99 autistic adults who were using the Brain in Hand app. Sixty-six completed the study, where there was a significant reduction of anxiety, as well as autism-related functional difficulties (e.g., injurious behaviour). This study largely funded the app's further development. The app developers listed the plans for addressing the needed reiterations and improvements to the app identified in the study. These included developing opportunities for peer support, expanding the emotion tracking feature to be more accurate and useful, and including content of strategies from other autistic people.            No other empirical evidence was found, meaning there are no supportive studies involving ADHD populations.</p>
4	<p>EndeavourRX-Kid (app and web app) (USA)            Intervention:            EndeavourRX-Kid is the first FDA-authorized video game to treat ADHD inattention symptoms in children (8 to 17 years old) created by world-class neuroscientists and award-winning game designers. It aims to decrease inattention in ADHD children and adolescents thus is especially useful for the Inattentive and Combined ADHD subtypes. It is an app-based game where the goal is to successfully navigate the character with various targets. The game features measure and train sustained and selective attention and are not useful for the hyperactivity-impulsivity symptom group. The intervention also includes a companion app for the users' parents to track the children's journey (ORCHA Library, 2024).            Empirical Evidence:            There are five studies supporting the effectiveness and safety of the app in children and adolescents with ADHD. The initial STARS-ADHD RCT study by Kollins et al. (2020) was a multi-centre, randomized, double-blind digital controlled study with 348 children between 8 and 12 years of age with an ADHD diagnosis including inattention (inattentive and combined subtypes). The intervention lasted four weeks. They found that compared to another digital intervention, EndeavourRX significantly improved attention over long period of time, even at follow-up. Furthermore, the other four studies also supported use of the app to help with improving inattention in ADHD children and adolescents accounting for benefit versus risk in employing gaming interventions with children and young people (Kollins et al., 2021, Davis et al., 2018, Yerys et al., 2019, Anguera et al., 2017). Finally, Jurigova et al. (2021) reported a significant decrease in parent-observed inattentive behaviours, which were stable at 9-month post-intervention, in a sample of children with Sensory Processing Dysfunction (SPD) (i.e., seeking or withdrawal behaviours related to sensory inputs), and whom all met criteria for ADHD diagnosis.            Overall, this intervention showed the most empirical support out of any other included app interventions.</p>

40: <https://www.braininhand.co.uk/clinical-studies/>

41: Five clinical studies have been conducted with EndeavorRx in over 600 children with ADHD including: the STARS-ADHD, STARS-Adjunct, and ADHD POC studies, or with comorbid ADHD, including: the SPD+ADHD Pilot and ASD+ADHD Pilot studies.

## Commercially available self-help interventions

5	<p>Hope Programme (app, web app) (UK)  <a href="https://www.h4c.org.uk/hope-programme">https://www.h4c.org.uk/hope-programme</a></p> <p>Intervention:  HOPE was developed by University of Coventry as an accredited programme, delivered under the licence from Hope for the Community (H4C) (NHS, 2024). This app features evidence-based health and wellbeing courses for users to complete in their own time, which were based on positive psychology, mindfulness, and CBT. This app is marketed as helping neurodiverse people, including ADHD, but also towards people with a range of mental and physical health conditions.  The Hope Programme aims to help people relax, set individualised goals, learn coping with stress and tiredness, and to gain social support through talking with the trained facilitators with lived experience and meeting others on the platform (via forum). The app includes various mood, activity, and symptoms trackers and journaling features. It also includes psychoeducation content, as well as training on various strategies to manage aspects of wellbeing with related trackers monitoring learning progress (ORCHA Library, 2024).</p> <p>Empirical Evidence  Wright et al. (2020) and Wright et al. (2022) published studies related to using the Hope Programme to help people with Long Covid, with encouraging results for management of the complex Long Covid psychological and physical symptoms.</p> <p>There was no empirical evidence of its usefulness for helping ADHD people specifically.</p>
6	<p>Focus@Will: Control Your ADD (app) (USA)  <a href="https://www.focusatwill.com/">https://www.focusatwill.com/</a></p> <p>Focus@Will is an app developed to help ADHD adults (and other neurodiverse people) to focus through tailored music. The music is generated by an AI engine linked to the world's largest brain database, and the music is created by musicians for productivity purposes, only to be found in the app. The app music developers remove music elements which research has shown distracts ADHD brains, so that the edited music helps sustain focus on tasks. The science behind it states that the music manages the ratio between the endogenous attention (the current task) and exogenous attention which scans for further stimuli (Focus@will, 2024). The app features an in-app assessment agent using data to select music optimal to the user and has other features such as focus timers, break time timers, and offline mode to access music without the Internet access (ORCHA Library, 2024).</p> <p>Empirical Evidence:  There were no peer-reviewed studies involving this app. However, the developer website stated that there was a series of studies backing up the science behind the app. The website stated that the Focus@will studies resulted in 200-400% increase in focus for active users, with average on-hour focus session productivity of 75%. (Focus@will, 2024). One published study was found. Mossbridge (2016)<sup>42</sup> found partial support that streamlined music would support cognitive tasks and mood improvement. The improvements compared to listening to regular music were in task persistence, implicit precognition, creative thinking, and perceived focus. The strong effect on creative thinking was the most significant finding. Mossbridge suggested that creativity is supported by streamlined music as it encourages less focus on exogenous (external) cues and more on the endogenous (internal) attention, supporting unconscious information processing and bursts of creativity. No differences were found on visual attention, verbal memory, and logical thinking. Participants' emotional states improved (mostly mood measures), however, were not statistically significant. Overall, it was suggested that the streamlined music can help support focus and flow with creativity during work for those who this type of a tool is appealing to.  No other studies were found.</p>

42: Mossbridge is the Science Director at Focus@Will Labs and worked on the app development.



## Commercially available self-help interventions

7	<p>7 Cups: Online Therapy &amp; Chat (app) (USA)  <a href="https://www.7cups.com/">https://www.7cups.com/</a>            Intervention:            7 Cups: Online Therapy &amp; Chat aims to support ADHD and other neurodiverse people (intended for people over age 13), and people with various mental health difficulties and conditions (e.g., anxiety, depression), with improving emotional and mental health. The app was created by healthcare professionals. It incorporates anonymous text chats, mindfulness exercises and educational videos. The free chats are with trained volunteers, and are accessible to all users, offering support on emotional and mental wellbeing. There are options for adult users to access chats with licensed therapists by paying for extra features. Finally, there is a community support section with other users (ORCHA Library, 2024).</p> <p>Empirical Evidence            There were four studies supporting the app's effectiveness in treating women with postpartum depression (Baumel et al., 2018, Baumel &amp; Schueller, 2016), treating people with schizophrenia-spectrum disorders (Baumel et al., 2016), and a study suggesting the app could be effective compared to traditional psychotherapy (Baumel, 2015).</p> <p>There were no studies with ADHD participants.</p>
8	<p>The ADHD programme by Silvercloud  <a href="https://www.silvercloudhealth.com/uk/programmes/mental-health/adhd-support">https://www.silvercloudhealth.com/uk/programmes/mental-health/adhd-support</a>            Intervention:            The ADHD programme adapted CBT to a digital platform to help ADHD adults (age 16+) better understand their diagnosis and what this means for their lives. The programme guides and supports the individuals to improve organisation, attention, and problem-solving skills, and to better understand and manage thoughts, feelings, and behaviours. Specific programme goals were listed as increasing awareness of common myths and misconceptions about ADHD, to address procrastination, concentration, low self-esteem and anxiety, to reflect on impulsivity, hyperactivity, and emotions, and to challenge assumptions and negative thinking. (Silvercloud, 2024).</p> <p>Empirical Evidence:            The website contains a list of peer-reviewed research supporting Silvercloud programmes which involve various mental health conditions<sup>43</sup>, supporting their programme effectiveness (Silvercloud, 2024). However, no studies on ADHD populations were found using the ADHD programme. The evidence mainly surrounds the programme's effectiveness in treating depression and anxiety (e.g., Richards et al. 2020). This intervention is a part of delivery of The Improving Access to Psychological Therapies (IAPT) (UK programme), offering evidence-based treatment to people with mild to moderate anxiety and depression through low-intensity interventions alongside the traditional in-person therapy as a part of the NHS Mental Health Implementation Plan 2019/2020-2023/2024 (NHS, 2019).</p>

## Apps to Aid ADHD Diagnosis

9	<p>Addhere (Web app) (UK)  <a href="https://sci-techdaresbury.com/portfolio-items/addhere-technologies/">https://sci-techdaresbury.com/portfolio-items/addhere-technologies/</a>            Intervention:            Addhere is an AI app, developed to support ADHD diagnosis, especially for children. It also includes other neurodiverse groups, particularly focus on autism. It can be used by healthcare professionals, teachers, and parents, as a self-driven approach to ADHD assessment. The app detects strongest predispositions related to neurodiversity, and then the user receives individually tailored online training (ORCHA Library, 2024).</p> <p>Empirical Evidence:            The scientific support for Addhere stems from a 10-year study which evaluated the app effectiveness in a sample of more than 1500 Brazilian children diagnosed with ADHD using traditional diagnostic methods. The developer website stated that the app is hosted on a highly secure web framework and can significantly reduce the evaluation period to diagnose ADHD, from months or years, to mere days or weeks (Addhere Technologies Ltd., 2023).</p>
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43: List of studies can be accessed at the following link: <https://www.silvercloudhealth.com/uk/research-papers>

## Apps to Aid ADHD Diagnosis

### QB Test

#### Intervention:

QB Test by QBtech is an FDA-approved digital tool to help diagnose ADHD in children and adults (6–60 years). It uses CE-marked<sup>44</sup> clinical tests for ADHD objectively measuring inattention, hyperactivity, and impulsivity. The test includes a 15–20-minute computer-based test using motion tracking to measure core ADHD symptoms, and it is meant to supplement the traditional diagnosis using clinical interviews and rating scales. The tool was created as an aid to healthcare professionals who assess for ADHD. In addition, the package offers QBCheck enabling remote or in-clinic ADHD assessment for clients, which is paid per test.

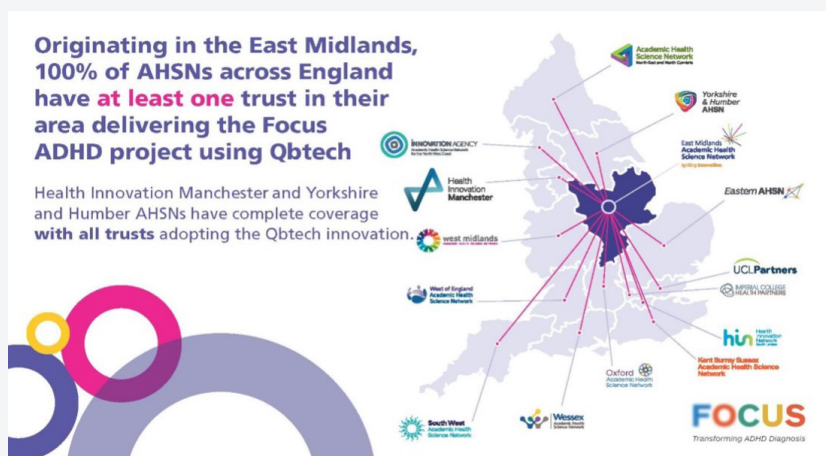
#### Empirical Evidence:

The QB Test developer website stated the tool development was supported by over 20 years of research and 35 studies. The list of studies can be found on the following website:

<https://www.qbtech.com/adhd-tests/clinical-research/>.

QB Test has been involved in the Focus ADHD, UK national innovation programme led by EMAHSN<sup>45</sup>, pioneered in the East Midlands in England. It aimed to improve the way ADHD is diagnosed in children and young people. It is used in 65 trusts in 131 sites, thus over 50% of the providers of ADHD assessment for this age group in the covered area. The results are instantly analysed, providing a report comparing a patients' results against a normative dataset based on age and gender. The test results are used by the clinicians with their clinical assessment data to diagnose ADHD. It aids shortening the diagnostic process, where it was suggested that on the first appointment the clinician can draw diagnostic conclusions. It works on this principle 'rule in/rule out' and means patients have fewer appointments and staff has more time with patients. This pathway is also suggested to increase clinician confidence and understanding, as well as service efficiency. It was already used in the assessment of almost 75,000 people (6–18 years) since AHSN has supported QBTest in 2017 (Health Innovation Network, 2024). Findings from the Focus ADHD Programme National Evaluation (October 2022) stated that 11.5% clinical appointments were saved, school observations reduced by 17%, 92% clinicians found the results helpful to understand the client's symptoms, 86% clinicians felt it was easy to use, 84% clinicians felt that the test made it easier to explain to patients why they had ADHD, and 71% clinicians stated that the QBTest outcomes improved communication with patients (Health Innovation East Midlands, 2024).

Figure 2. Focus ADHD project using QBtech across the East Midlands. Picture from: [https://thehealthinnovationnetwork.co.uk/case\\_studies/improving-assessment-for-adhd-for-children-young-people/](https://thehealthinnovationnetwork.co.uk/case_studies/improving-assessment-for-adhd-for-children-young-people/)



44: CE marking indicates that a product meets the European Union (EU) safety, health, and env requirements and has been assessed by the manufacturer EU safety, health and environmental protection requirements.

45: The East Midlands Academic Health Science Network.