

Exploring Digital Therapeutics: Game-Based and eHealth Interventions in Mental Health Care: Potential, Challenges, and Policy Implications

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ABSTRACT

This all-encompassing manuscript delves into a thorough examination of the prevailing case of inquiry regarding the utilization of games and eHealth promotions for the betterment of mental health treatment. At the core of the investigation are crucial motifs, such as the theoretical fundamentals behind digital therapeutics, their machinery, long-standing repercussions, inclusion and equity, hodological contemplations, and policy ramifications. The paper follows an orderly analysis technique, linking with both qualitative and quantitative studies from diverse databases to scrutinize the effectiveness and safety of game-based and eHealth interventions in mental health care. The comprehensive inspection reveals potential behavioral, emotional, and cognitive transformations brought about by these interventions, as well as their effects on mental well-being. In addition, the paper explores the therapies' long-term impact, their safety for those with severe mental illnesses, and their accessibility and appropriateness for a variety of demographics. What sets this appraisal apart is its focus on hodological aspects, exploring how these interventions might influence the interconnectivity of different brain regions. The manuscript's verdicts expose the substantial potential of games and eHealth interventions in mental health care, all while warning to exercise caution due to gaps in wisdom surrounding their prolonged impacts and safety. Furthermore, it raises substantial questions regarding inclusion, equity, and accessibility in the application of these digital therapies. To conclude, the paper underlines the necessity for more scrupulous, tactful research to determine the effectiveness and safety of these interventions, implying the importance of considering ethical and implementation aspects for policymakers. Despite the potential of these digital therapies, the manuscript stresses the prerequisite for continued research to guarantee the mental health of patients is looked after and amplified. The principle of economic efficiency is laid out in § 12 V of the German Social Code (SGB, Sozialgesetzbuch), which states that the benefits provided "must be sufficient, appropriate, and cost-effective and must not exceed the necessary." In this manuscript, we argue that game-based and eHealth interventions in mental health care are effective, safe, have a long-term impact, and are inclusive. These digital interventions have the potential to contribute to better mental health outcomes, possibly at a lower cost than traditional therapies, and to be accessible to a variety of demographics, increasing the efficiency of resource use in mental health care, which leads to the economic efficiency of these digital interventions. However, the text also highlights shortcomings in understanding their long-term

effects and safety, raising important questions for health economics and policy like cost-effectiveness over the long term and the economic implications of implementing these digital therapies in a safe and equitable manner. As suggested by the text, additional research is required to address these issues and make sure that the application of these interventions conforms to the principle of economic efficiency as stated in § 12 SGB.

Keywords: Games and eHealth, Serious Games, Digital Health, Health Technology, Mental Health Care, Health Policy, Medical Informatics, Health Informatics, digital therapeutics, games in health care, Sozialgesetzbuch.

INTRODUCTION

Mental health disorders constitute a significant global health challenge, affecting millions of individuals worldwide [1; 2; 3; 4; 5]. Traditional mental health care modalities, while effective for many, often grapple with issues of accessibility, stigma, and patient engagement [6; 7; 8; 9; 10]. In response to these challenges, the fields of eHealth and game-based interventions have gained traction as potential supplemental or alternative treatments for mental health disorders [11; 12; 13; 14; 15; 16].

A rapidly expanding segment of the global healthcare market is referred to as "eHealth," which is an umbrella word for healthcare practices supported by electronic procedures and communication [17; 18; 19; 20]. Digital therapies, such as serious games created for mental health therapy, constitute an intriguing area for investigation in this setting [21; 22; 23; 24; 25; 26]. These video games use interesting, interactive digital settings to support mental health, and they have the additional benefit of being adaptable to the requirements of specific patients [27; 28; 29; 30]. A potential approach to better accessibility of mental health services is presented by this personalization, together with the pervasiveness of gaming platforms and internet connectivity [31; 32; 33; 34; 35].

The prevalence of gamification in various aspects of life has increased in recent years, particularly among young individuals, which could contribute to the progress of games and eHealth [36; 37; 38; 39]. The use of gaming components in non-game settings, including education and healthcare, has escalated due to this shift [40; 41; 42]. This approach could enhance the involvement of individuals in treatments aimed at improving mental health outcomes [43; 44; 45; 46].

Despite the potential benefits of incorporating games and eHealth into mental health therapy, this field is still emerging, and the investigation is ongoing [47; 48; 49; 50]. While initial findings are positive, more extensive analysis is imperative to gain a comprehensive understanding of the possibilities and restrictions of these treatments [47; 49; 51; 52; 53]. To highlight the importance of additional research and address knowledge gaps, this paper provides a comprehensive overview of current research in this domain [54; 55]. We aim to employ this theory-triangular information to direct current research, future policy decisions, and clinical practices.

Theory-triangular Foundations

The intersection of psychology, neuroscience, and technology provides the underlying theory for the use of games and eHealth interventions in mental health [56; 57]. Two central theories are the Cognitive Behavioral Theory (CBT) and the Self-Determination Theory (SDT) [58; 59; 60; 61; 62]. CBT highlights the role of distorted thought patterns and maladaptive behaviors in many mental health issues. Games and eHealth interventions can offer patients an interactive means to identify, challenge, and modify these distortions [64; 65; 66; 67; 68; 69]. They can provide a controlled, secure context for the learning and practicing of new cognitive and behavioral strategies [70; 71; 72]. In one example, games might reinforce positive choices by rewarding players who select healthy responses to stressful scenarios [69; 73; 74; 75].

In contrast, SDT relates to motivation, arguing that people are more likely to engage in and make changes when they feel autonomous, competent, and connected to others [76; 77; 78; 79]. Digital therapeutics, especially game-based ones, may be designed to promote these feelings [80; 81; 82; 83; 84; 85; 86]. Players can decide their strategies (autonomy), achieve skills and advances through levels (competence), and participate in multiplayer situations (relatedness) [86]. This can encourage therapy motivation and facilitate long-term changes [87; 88; 89; 90].

Moreover, playing games is believed to activate the release of dopamine, a neurotransmitter related to reward and motivation [91]. This biologically-based mechanism may intensify engagement and adherence to treatment [92; 93; 94; 95]. Furthermore, the technological backbone of these interventions permits the application of psychological theories in an accessible and enjoyable format [96; 97; 98; 99; 100; 101; 102].

The use of artificial intelligence and machine learning allows for the individual tailoring of interventions to meet specific needs [103; 104; 105; 106; 107].

In sum, the theoretical underpinnings of games and eHealth interventions in mental health draw from well-established psychological theories as well as emerging technological capabilities [108; 109; 110; 111]. However, effective practice requires careful design, implementation, and assessment [112; 113; 114; 115].

Review of Literature

The body of literature on the role of games and eHealth interventions in mental health care is continually expanding, encompassing both qualitative and quantitative studies that collectively offer valuable insights into their efficacy [116; 117; 118; 119; 120]. The efficacy of these therapies has been well supported by the quantitative studies that have been conducted. For instance, Lau et al.'s [121] meta-analysis from 2020 indicated that those who used eHealth therapies rather than conventional care saw substantial improvements in their mental health outcomes. Similar findings were made by Fleming et al. [122], who discovered that game-based therapies dramatically decreased teenage participants' feelings of anxiety and sadness.

Studies have emphasized the perceived advantages and difficulties of applying these treatments on the qualitative front [126]. For instance, Morone et al. [123], Scholten and Granic's [124] and Verlasco et al. [125] research indicated that teenagers thought game-based therapy was more engaging and less stigmatizing than conventional therapies. But there were also issues raised regarding data privacy and the impersonal character of digital treatment.

Furthermore, rigorous analyzes like the one by Pakarinen et al. [127] have shown the potential of these treatments to improve self-efficacy, resilience, and emotional regulation abilities [128]. The same evaluations, meanwhile, have also drawn attention to gaps in our knowledge of these therapies' long-term effects and mechanisms of action [129; 130; 131; 132].

Less research has been done, although it is rising, on the neurological basis of these therapies. According to preliminary research, these therapies may be able to activate the brain's reward, emotion regulation, and cognitive control regions [133; 134; 135; 136]. In summary, the existing literature supports the potential of games and eHealth interventions in mental health care but also highlights areas for further investigation [137; 138; 139]. Understanding the nuanced effects of these interventions, their mechanisms of action, long-term outcomes, and their implications for various populations and mental health conditions remains an active area of research [140; 141; 142].

Unraveling the Multifaceted Mechanisms: How Games and eHealth Interventions Facilitate Cognitive, Emotional, and Behavioral Transformations in Mental Health Care:

The exact mechanisms by which games and eHealth interventions bring about a change in mental health outcomes are multifaceted, involving intertwined cognitive, emotional, and behavioral components [143; 144; 145; 146; 147; 148; 149; 150]. On a cognitive level, these interventions can support processes like problem-solving, decision-making, and cognitive restructuring, which are essential aspects of therapies like Cognitive Behavioral Therapy [151; 152; 153]. For instance, games often require users to confront challenges, make decisions, and adapt strategies, paralleling cognitive tasks in therapy [153; 154; 155; 156; 157]. This active engagement may foster cognitive flexibility and resilience, vital skills in managing mental health [158; 159; 160; 161; 162].

Emotionally, games and eHealth interventions may provide safe spaces for users to explore and express their feelings [163; 164; 165]. This emotional engagement, combined with the game's narrative or objectives, can facilitate emotional regulation, empathy, and self-awareness [164; 166]. In addition, the game's rewards system can stimulate positive emotions and motivation, potentially leading to increased adherence to therapy [167; 168]. Behaviorally, these interventions can promote new habits and behaviors [169; 170; 171]. For example, a game might reward players for practicing mindfulness, encouraging this behavior to be integrated into the player's routine [172]. Simulated real-life scenarios can provide a platform to practice and reinforce positive behaviors in a low-risk environment [172; 173; 174].

Physiologically, the engaging nature of games is thought to stimulate neurobiological pathways associated with reward and pleasure, primarily through the release of neurotransmitters like dopamine [175; 176; 177; 178]. This increased neuronal activation may bolster neural plasticity, potentially contributing to long-term changes in mental health [179; 180; 181; 182; 183; 184]. In summary, games and eHealth interventions can instigate cognitive, emotional, and behavioral changes that collectively contribute to improved mental health outcomes [183; 185]. The interplay between these changes and the physiological responses they elicit underscores the complexity of the mechanisms of action [186; 187]. A deeper understanding of these mechanisms is crucial for optimizing the design and implementation of games and eHealth interventions in mental health care [188; 189; 190].

Long-term Effects and Safety:

Studies focused on long-term impacts are less common, even though early research into the use of games and eHealth treatments for mental health care has shown encouraging outcomes [191; 192]. To further understand how short-term improvements in symptoms and behaviors transfer into long-term alterations in mental health status, more study is required [193; 194; 195]. Current research indicates that user adherence and engagement with these treatments decline with time, underscoring the necessity for long-term user engagement techniques [196; 197]. It is also unknown how long gained skills last and whether the behaviors and abilities learnt via games and eHealth therapies can be used in real-world scenarios [198; 199].

Additionally, safety issues must not be disregarded. Games and eHealth solutions have potential dangers, just like any other intervention [200; 201; 202]. These include the potential to exacerbate symptoms in certain people, the danger of interpreting feedback incorrectly without expert advice, and possible privacy and data security concerns [203; 204; 205]. Overreliance on these digital platforms may also lead to less in-person communication with medical professionals, missing chances to spot changes in the patient's condition [206; 207; 208; 209]. These factors assume much more importance when applied to those who have serious mental health problems [209; 210]. Further research is required in the areas of possible mental health consequences of game-based therapy, the potential for discomfort or overstimulation, and the suitability of these tools as stand-alone therapies [211; 212].

Despite the positive potential of games and eHealth treatments in mental health care, caution must be taken to consider the impacts and safety over the long term [212; 213; 214]. To guarantee that digital treatments positively contribute to mental health care, with the safety and wellness of patients at the forefront, these areas must be addressed via thorough, long-term research as the field continues to expand [215].

Beyond Immediate Outcomes: Exploring the Long-term Impacts, Potential Risks, and Safety Concerns of Games and eHealth Treatments in Mental Health Care:

The advent of eHealth and game-based interventions holds the potential to revolutionize mental health care by enhancing its reach, accessibility, and affordability [216; 217]. It can overcome geographical barriers, allowing patients in remote areas or those who can't physically visit clinics to access mental health resources [218; 219]. Providing care outside conventional healthcare settings can also reduce the stigma associated with seeking mental health treatment, thus promoting more inclusivity.

However, this potential for inclusion and equity is not without its challenges. The digital divide – the gap between those with and without access to technology and the internet – can limit the reach of eHealth and game interventions [220; 221; 222]. Economic, geographic, and social factors play significant roles in this divide. Individuals who are elderly, live in rural areas, or are economically disadvantaged are often the ones most likely to lack such access [223].

Additionally, cultural and language barriers can pose challenges. These interventions must be culturally sensitive and available in various languages to ensure they are suitable for diverse populations [224; 225]. Furthermore, these interventions should be designed with consideration for users with varying levels of digital literacy to ensure they are accessible to all [226].

A focus on user-centered design is crucial to promoting inclusivity [227; 228; 229]. Tailoring interventions to individual user characteristics, including their mental health condition severity, cognitive abilities, and personal preferences, can increase engagement and effectiveness [230]. In sum, while eHealth and game interventions have significant potential to promote inclusion and equity in mental health care, careful attention must be paid to overcome potential barriers [231; 232]. A commitment to addressing these challenges can ensure these interventions are not just innovative but also equitable solutions for mental health care [233; 234].

HODOLOGICAL PERSPECTIVES: UNVEILING THE NEURAL PATHWAYS AND INTERACTIONS UNDERLYING THE IMPACT OF GAMES AND EHEALTH THERAPIES ON MENTAL HEALTH

Examining the possible effects of games and eHealth therapies on mental health may be done through a unique lens provided by hodology, the study of neural connections and pathways in the brain. Understanding how these treatments could affect and interact with the intricate neuronal networks in the brain can be very helpful in understanding how they operate [235; 236]. Numerous crucial brain areas connected to mental health have been found by neuroscientific studies, such as the prefrontal cortex, which is linked to decision-making and emotional control, and the amygdala, which controls fear and anxiety reactions [237]. These regions may be stimulated by games and eHealth therapies, which might improve their connection and function [238; 239; 240].

For instance, the cognitive and emotional activity demanded by these therapies may help to fortify the neuronal connections in the prefrontal cortex, improving cognitive control and emotional regulation [241; 242; 243]. This could, therefore, lessen the effects of many mental health conditions' symptoms [244]. Additionally, these therapies could activate the ventral striatum and other reward-related brain regions, which would produce dopamine [245; 246]. This may start a positive feedback loop that encourages participation in the intervention and may even improve a person's attitude and motivation [247].

However, we still have a very limited grasp of these hodological factors [248; 249; 250; 251]. There are still many unanswered concerns about the specificity of these treatments to certain brain areas, their impact on neural plasticity, and the permanence of these alterations [252; 253]. Furthermore, individualization of therapies may be essential to enhance their efficacy given the individual heterogeneity in brain structure and function [254; 255; 256]. In conclusion, the potential of games and eHealth treatments for mental health may be understood and maximized via the use of hodological concepts [256]. However, to fully understand these processes and their implications for the provision of mental health treatment, further advanced neuroimaging and neurofeedback investigations are required [257; 258; 259; 260].

SHAPING THE FUTURE OF MENTAL HEALTH CARE: ETHICAL, LEGAL, AND POLICY CONSIDERATIONS FOR INTEGRATING GAME-BASED AND EHEALTH INTERVENTIONS INTO HEALTH SYSTEMS

As the field of eHealth and game-based mental health interventions grows, so too does their significance in health policy [261; 262; 263]. The integration of these interventions into mental healthcare systems has implications for healthcare provision and insurance coverage [264; 265; 266; 267; 269; 269]. Policymakers need to recognize these interventions as legitimate

therapeutic modalities and work towards ensuring that they are included in insurance coverage plans, thus making them more accessible to the wider population [270; 271; 272; 273]. Furthermore, institutional integration of these interventions requires robust guidelines and standardized protocols for their use in clinical settings [274; 275; 276; 277].

However, thorough knowledge and serious ethical concerns must guide policy-making in this domain [278; 279; 280; 281]. The potential for data breaches and the exploitation of personal information is a major worry with regard to the EU General Data Protection Regulation (GDPR), since these treatments often include the gathering and storage of delicate health data [282; 283; 284]. To protect the security of user data, stringent data privacy laws must be in place [285; 286; 287; 288; 289; 290; 291]. The possibility of exclusion or injustice raises further ethical issues [292; 293]. While these initiatives could widen access to mental health treatment, they might also unintentionally exclude those who don't have access to the required technology [293; 294; 295; 296; 297]. Policies must guarantee an equitable distribution of the advantages of digital therapies and prevent them from escalating already-existing inequities [298; 299; 300].

Another concern is the risk of placing an undue dependence on digital therapies at the cost of in-person mental health care in Germany with regard to § 12 V of the German Social Code (SGB, Sozialgesetzbuch) [301; 302; 303; 304; 305; 306; 307]. E-Health and gaming therapies should be acknowledged by policies as viable additions to conventional therapy, not substitutes for it [308; 309; 310]. Finally, the quality and efficacy of these interventions in the sense of DIN EN ISO 9241 must be carefully regulated [311; 312; 313; 314]. This includes setting up rigorous validation processes and monitoring mechanisms [293; 315; 316]. In general, the integration of eHealth and game-based interventions into mental health care presents considerable policy implications [317; 318; 319]. Ensuring that this progress happens ethically and equitably will require comprehensive, informed, and forward-thinking policies with regard to the TRREE criteria (Training and Resources in Research and Ethics and Evaluation), which reflect all international ethical guidelines [293; 320].

CONCLUSION AND FUTURE DIRECTIONS: UNFOLDING THE POTENTIAL OF GAME-BASED AND EHEALTH INTERVENTIONS IN MENTAL HEALTH CARE

Games and eHealth treatments offer a lot of potential in the area of mental health care thanks to new chances for accessibility, participation, and personalized therapy [12; 14; 261]. Since they are founded on reliable psychological theories and cutting-edge technical breakthroughs, these therapies have the potential to improve the delivery of mental health care [321; 322; 323; 324; 325]. However, there are still a lot of critical information gaps about these treatments as well as open research areas [59; 326; 327; 328]. The advantages of these therapies' application to actual life situations and their long-term effects are also unknown [331; 332; 333]. Studies examining these aspects are necessary to ensure that these treatments have a lasting positive impact on mental health.

Furthermore, there is much need for research into how these therapies affect brain circuits and interact with them on a neurological level [334; 335; 336; 337; 338]. In this sense, advanced neuroimaging investigations and individualized neurofeedback techniques might be useful. Furthermore, equality and inclusion issues need consideration [339; 340; 341]. While these initiatives may improve accessibility, care must be taken to prevent them from unintentionally widening inequities. It is critical to research practical methods for bridging the digital gap,

language obstacles, and other access challenges. Studies examining the cost-effectiveness of these therapies, their integration into current health systems, and the creation of strong privacy and quality laws are required from a policy perspective [342; 343].

Finally, future research should prioritize ethical issues in the design, implementation, and use of these therapies, especially concerning data protection, informed consent, and possible abuse [882; 283; 284; 285; 286; 287; 293; 296]. In sum, there is still much to learn about how to best use games and eHealth treatments for mental health care. The potential for discovery to greatly improve mental health outcomes for many groups throughout the world is enormous.

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