Journal of Clinical and Nursing Research, 2025, Volume 9, Issue 3
http://ojs.bbwpublisher.com/index.php/JCNR
Online ISSN: 2208-3693
Print ISSN: 2208-3685

Advances in the Study of Telemedicine in Patients With Schizophrenia

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Abstract: This article reviews the concept of telemedicine, as well as the current status of its application in patients with schizophrenia, problems, and suggestions for improvement, with the aim of providing a reference for the application of telemedicine in patients with schizophrenia.

Keywords: Telemedicine; Schizophrenia; Internet; Nursing; Review

Online publication: April 3, 2025

1. Introduction

Schizophrenia is a chronic disabling mental illness, one of the top 10 causes of disability worldwide, and one of the most costly mental illnesses to treat [1, 2]. It is characterized by positive psychotic symptoms, negative symptoms, and cognitive impairment [3]. The impact on daily life is profound, often resulting in social isolation, stigmatization, and limited opportunities for intimate relationships, even among those who achieve high levels of personal accomplishment. The presence of unhealthy lifestyles, such as poor diet, weight gain, and smoking, can further compound the issue, leading to a life expectancy that is up to 13 to 15 years shorter than that of the general population [4, 5]. Patients diagnosed with schizophrenia exhibit elevated levels of morbidity and mortality [6]. Their treatment regimens encompass pharmacological, physical, and psychosocial therapies, which have been demonstrated to demonstrate limited effectiveness and exhibit poor medication adherence, a factor that can precipitate relapses and consequently augment the risk and financial burden of hospitalization [7, 8]. Severe mental illness is typically a relapsing condition that persists throughout the patient's lifetime, and the primary objective for patients is to enhance the efficiency and quality of recovery and to prevent relapses.

During the novel coronavirus pneumonia (COVID-19) pandemic, telemedicine videoconferencing and e-mental health represent important tools to maintain continuity of care for patients with schizophrenia without

increasing the risk of transmitting the virus during face-to-face visits [9]. The World Health Organisation (WHO) defines telemedicine as the use of telecommunication and virtual technologies to deliver healthcare services outside of traditional healthcare facilities [10]. The 14th Five-Year Plan emphasizes the integration of information technologies, including cloud computing, big data, the Internet of Things (IoT), blockchain, and 5G, with health services [11]. In this context, the introduction of telemedicine has strongly supported the high-quality development of nursing care in China, enabling instantaneous electronic communication between patients with schizophrenia and healthcare professionals [12]. This paper analyses and summarizes the application of telemedicine in patients with schizophrenia, intending to providing a reference basis for the treatment of schizophrenic patients.

2. Ways in which telemedicine can be used in patients with schizophrenia

Telemedicine, a constituent element of telehealth, seeks to facilitate healthcare and medical education services across geographical regions through communication networks, thereby addressing the challenges posed by the uneven distribution of healthcare resources and the paucity of infrastructure and human resources [13]. In the context of schizophrenia, the implementation of telemedicine is heavily reliant on remote assistive technologies, encompassing telephone, Internet, videoconferencing, mobile applications, and wearable devices. The objective of these technologies is to enhance medication adherence and reduce relapse rates in patients with schizophrenia, thereby facilitating continuity of care and enhancing the management of the condition and its symptoms.

2.1. Telephone and Internet

According to the Centers for Disease Control and Prevention (CDC), 15 million residents are grappling with mental illness, substance dependence, or comorbidities, yet face a dearth of suitable care options [14]. Telemedicine offers more opportunities for healthcare delivery, especially through mobile devices such as the telephone and the Internet, which are widely used in psychiatry [15]. For patients residing in rural and remote areas, telephone calls and text messages can provide a viable means of healthcare delivery. However, these methods have the disadvantage of relatively limited exchange of information. A study by Comendador *et al.* demonstrated that telemedicine monitoring based on telephone interventions was effective in preventing suicidal ideation and depressive symptoms in patients with schizophrenia, and was recognized as an affordable tool for care [16].

2.2. Videoconferencing

Notwithstanding the increased utilization of telemedicine in the domain of mental health, this technology remains in its infancy in China. Videoconferencing, a subfield of telemedicine, finds primary application in the management of mood, adjustment, and anxiety disorders, with comparatively limited utilization in the domain of mental disorders [17]. The potential of videoconferencing lies in its capacity to facilitate support in remote areas, establishing a connection between therapists and patients through real-time interactions [18].

A study by Cairns *et al.* highlighted that individuals diagnosed with schizophrenia spectrum disorders and those with persecutory delusions frequently encounter intrusive and distressing mental imagery [19]. To alleviate this symptom, pictorial telemedicine videoconferencing was used to improve clinical symptoms by locating pre-existing images to reduce the psychological burden or by constructing a safe image scene to enhance the sense of security. Studies have demonstrated that patients exhibit a high level of receptiveness and tolerance to videoconferencing. Sharp *et al.* demonstrated that clinical assessment results obtained through videoconferencing

were comparable to those obtained from face-to-face treatment [20].

In summary, telemedicine videoconferencing provides patients with a convenient and flexible consultation channel and enhances the efficiency and quality of communication between doctors patients, and nurses through its unique real-time interactive features. This demonstrates significant advantages in improving treatment effects, optimizing the allocation of medical resources, and meeting the diversified needs of patients.

2.3. Mobile applications

WeChat boasts a substantial user base in China, with 1.13 billion active users worldwide [21]. Li *et al.* demonstrated that WeChat healthcare services are utilized by a younger, working, urban-dwelling group with a shorter duration of illness compared to telemedicine [22]. WeChat has demonstrated considerable potential in delivering high-quality healthcare services, contributing to reduced follow-up turnover, enhanced medication adherence, and diminished symptoms of illness and the financial burden it imposes. The Actissist app is feasible, acceptable, and safe in a randomized controlled trial of patients with early psychosis [23]. The app aims to alleviate psychotic symptoms by having patients complete a self-assessment questionnaire and customize a personalized program of activities based on the results, such as positive thinking exercises, educational videos, fact sheets, and links to external resources. Additionally, ClinTouch functions as a symptom monitoring application that discovers collects, and wirelessly uploads symptom data to a server for real-time, multiple dynamic monitoring aimed at assessing psychiatric symptoms [24]. A significant reduction in positive symptoms in patients with early psychosis over 12 weeks has been demonstrated, with a substantial decrease in the average severity of symptoms and a 29% reduction in the severity of hallucinations compared to the control group, with significant differences between groups [25]. Consequently, it can be deduced that mobile applications can effectively alleviate patients' psychotic symptoms through continuous monitoring and self-assessment functions, thereby enhancing their treatment engagement and adherence.

2.4. Wearable devices

Wearable devices, defined as portable devices with both affordable and user-friendly features, encompass various forms such as smartwatches, fitness trackers, smart apparel, and ear-worn devices [26]. These devices have demonstrated a wide range of potential applications within the field of treatment and management of schizophrenia, including assisting in clinical diagnosis, early identification of first-episode psychiatric disorders, prevention of relapse risk, and enhancing patients' acceptance of telemedicine services. The potential applications of these devices include assisting clinical diagnosis, early identification of first-episode psychosis, prevention of relapse risk, and improving patient acceptance of telemedicine services. With the increasing popularity of wearable technology, new metrics for remote and real-time clinical decision-making are now available [27]. While not yet a complete replacement for traditional diagnostic procedures, the real-time data provided by these devices has demonstrated significant potential and promise in monitoring and identifying changes in physiological status.

In a study by Cella *et al.*, a combination of active (utilizing the ClinTouch app) and passive monitoring (employing a wrist-worn device that records heart rate variability and electrical skin activity) methods was employed to explore associations between psychotic symptoms, distress fluctuations, and changes in autonomic parameters in individuals with first-episode psychosis [28]. Schlier *et al.* revealed that wearable devices were capable of detecting changes in the autonomic stress response when individuals with schizophrenia were experiencing paranoid episodes [29]. Real-time tracking and detection of autonomic dysregulation can facilitate

the early identification of signs of mental distress in patients, ensuring that they receive an accurate diagnosis promptly [29, 30]. It can be concluded that wearable devices have a high level of acceptance and utilization among patients diagnosed with schizophrenia. The continuous monitoring of patients' autonomic parameters that these devices facilitate provides substantial support for the early identification of psychotic symptoms, thus helping to prevent rapid deterioration and relapse of the condition.

3. Effectiveness of telemedicine in the treatment of schizophrenia

3.1. Improve patient self-management skills

The advent of telemedicine has precipitated the evolution of healthcare services, with home healthcare counseling services being provided to patients diagnosed with schizophrenia. This model has demonstrated significant advantages in the management of patients with schizophrenia, facilitating the monitoring of treatment adherence and increasing the chances of patients receiving appropriate psychosocial interventions. The proliferation of smartphone applications designed for patients with schizophrenia has been a notable development in recent times, with these applications playing an active role in promoting patients' self-monitoring and self-management skills [31].

A randomized controlled trial conducted in Poland explored the efficacy of the MONEO telemedicine platform in 199 patients diagnosed with schizophrenia [32]. Patients utilized smartphones preloaded with the platform to access medication reminders, feedback monitoring, cognitive training, and educational resources. Remote assessments were conducted via videoconferencing and monitored over 12 months in conjunction with psychometric scales and outpatient visits. The results demonstrated that patients who utilized the MONEO platform exhibited significantly superior clinical improvement in comparison to the control group, as evidenced by PANSS, CDSS, and CGI-S scale assessments. This finding suggests that the MONEO platform is efficacious in promoting symptom alleviation and enhancing self-management. In contrast, the FOCUS app utilizes a range of tools designed to aid patients with schizophrenia in self-management, encompassing domains such as enhancing medication adherence, improving social functioning, regulating emotional problems, coping with hallucinatory phenomena, and alleviating sleep disorders [33].

The WellWave application is designed to encourage individuals diagnosed with mental illness to adopt and maintain healthy lifestyles, with a particular focus on facilitating psychiatric recovery through the promotion of gentle physical activity (e.g. walking) and the dissemination of confidential text message reminders. The application also offers access to electronic reading materials and video resources pertinent to psychiatric rehabilitation [34]. A similar approach was adopted in a single-arm trial conducted in the United States, which also demonstrated the efficacy of the app in enhancing self-management for patients with severe mental illness and comorbid medical conditions, in addition to substantiating the effectiveness and feasibility of telemedicine [35].

In summary, telemedicine services based on smartphone applications significantly enhance the self-management ability of patients with schizophrenia by scientifically and rationally managing their daily living habits, medication use, psychological state, and other factors, and by promoting the improvement of patients' self-knowledge, self-monitoring, and self-regulation abilities in an all-round manner.

3.2. Improve patient compliance

The present study examined the issue of medication adherence in patients diagnosed with schizophrenia. A study revealed that the incidence of nonadherence to medication in patients with schizophrenia ranged from 4% to

72%, with an overall average of approximately 50% [36–38]. The most prevalent reason cited for nonadherence is the failure to remember to take medication [39]. This nonadherence can lead to significant consequences, including inadequate symptom management and an elevated risk of relapse, underscoring its status as a substantial challenge in the management of the condition [40]. The advent of telemedicine technology has furnished pragmatic solutions to this predicament. A 9-month study utilized a combination of Med-eMonitor (MM) devices and telephones for remote monitoring to enhance patients' medication adherence [41]. The MM devices functioned as an electronic medication monitoring tool, offering features such as medication reminders, the indication of the correct time to take the medication, warnings of incorrect medication, and feedback on records, in addition to the capacity to transmit reminders of medication infractions to healthcare professionals.

Through regular website monitoring and telephone intervention when necessary, the study found that the average medication adherence of patients under continuous monitoring by the MM device was as high as 91%, which effectively improved patients' medication adherence. Concurrently, a 3-month study demonstrated that 90% of patients utilizing the ClinTouch monitoring system exhibited the capacity to engage in regular monitoring, with patient adherence reaching 84% [26]. It can thus be concluded that the application of the ClinTouch monitoring system significantly improves patients' treatment adherence. Huang implemented an APP-based remote health management model for 92 patients diagnosed with schizophrenia, including condition monitoring, medication guidance, and health education [42]. The study confirmed that the model significantly improved patients' self-efficacy and compliance behavior and enhanced treatment adherence.

In conclusion, telemedicine provides a range of treatment methods for schizophrenic patients, enhances their enthusiasm for disease management and confidence in recovery, and increases treatment compliance, while accurately tracking patients' medication use and correcting deficiencies in medication adherence on time.

3.3. Reducing suicidal ideation in patients

As demonstrated in several studies, patients diagnosed with schizophrenia are observed to experience elevated levels of suicidal ideation, with a lifetime risk of suicide estimated at 5–10% [6,8,43]. In light of this grave situation, targeted interventions to reduce suicidal behavior in patients with schizophrenia are of particular importance. Flaherty *et al.* implemented a telemedicine intervention study for 25 veterans with schizophrenia or schizoaffective disorder who were suicidal [44]. The intervention group utilized a combination of intensive case management and telemedicine monitoring, encompassing face-to-face meetings, telephone communication, and standardized monitoring. This was enhanced by the Health Buddy system, a telephone device that facilitates communication between patients and staff during symptom assessment and visits [45].

The Health Buddy system provides daily psychoeducational support and assists with decision-making. The findings demonstrated that the telemedicine group exhibited a significantly lower rate of hospitalization (5%) compared to the control group (32%), thereby substantiating the efficacy of the telemedicine intervention in diminishing the frequency and duration of hospitalization, while concurrently mitigating the risk of suicide. A congruent approach was adopted by Kasckow *et al.*, who utilized the Health Buddy monitoring system to oversee veterans experiencing suicidal ideation [45, 46]. This study demonstrated the acceptability of this model for patients with schizophrenia and its effectiveness in reducing suicidal ideation. Fleischmann *et al.* showed that 18-month telephone follow-ups significantly reduced suicide attempts, and consequently, suicide rates, in patients compared to a control group [47]. Nevertheless, the present analysis of telemedicine in the prevention of suicidal behavior in patients with schizophrenia covers a relatively limited sample size and evidence, and more research is urgently needed.

3.4. Prevention of relapse in schizophrenia

Schizophrenia is characterized by a high risk of relapse, with early relapse rates ranging from 10% to 80% [48]. A retrospective study encompassing 50 patients with a follow-up period exceeding 15 years demonstrated that the relapse rates at 2, 5, 10, and 15 years following the remission of the initial schizophrenic episode were 52%, 60%, 86%, and 90%, respectively [49]. Social dysfunction is a central feature of schizophrenia spectrum disorders [50]. Social isolation has been demonstrated to exacerbate the process of deterioration of an individual's psychotic symptoms and elevate their risk of relapse. As mobile technologies like smartphones become increasingly prevalent among individuals diagnosed with schizophrenia, researchers have explored their potential for monitoring mental health [51].

A study investigated how digital indicators of social behavior, captured through smartphones, could serve as early warning signals for relapse in individuals with schizophrenia [52]. The study found that smartphone-based social behaviors, especially the reduction of text message communication activities in the evening (after 18:00) and late at night (after midnight), were significantly associated with the risk of relapse. This finding suggests that mobile technologies, such as smartphones, may play a role in preventing relapses by providing objective numerical indicators of social behavior.

A prospective study evaluated a cell phone application called ExPRESS, which was designed to identify early signs of schizophrenia relapse by monitoring early signs, basic symptoms, and psychotic symptoms, thereby reducing the rate of relapse [53]. Ybarra *et al.* developed a text messaging system called T4RP, which was designed to prevent the relapse of schizophrenia [54]. The system is both feasible in practice and has a significant positive impact on the health management and prevention of relapses in patients diagnosed with schizophrenia [55].

Consequently, the utilization of Internet technologies, such as telemedicine, has the potential to reduce the relapse rate of patients diagnosed with schizophrenia, whilst concurrently offering a more convenient mode of care.

4. Shortcomings and prospects of telemedicine in the treatment of schizophrenia

4.1. Lack of harmonized standards and laws

At present, the prevailing telemedicine norms in China are dispersed throughout policy documents and have not been formally incorporated into the national legal system [21]. Despite the rapid development of telemedicine in China, the absence of standardization and a legal framework is still prominent, which is prone to causing duplication and confusion in implementation. This emphasizes the need for urgent improvement in the standardization of telemedicine services and the establishment of a legal protection mechanism. The relevant work must therefore be strengthened.

4.2. Telemedicine construction needs policy support

At this juncture, the financial subsidy system for the construction of telemedicine in China is not yet adequate, resulting in an increased burden on medical institutions in terms of purchasing equipment, building platforms, system maintenance, and personnel training [12, 14]. Moreover, the state has not yet established appropriate fee schedules and explicit management directives for telemedicine.

4.3. Data security and patient privacy to be strengthened

In the context of telemedicine practices, data security assumes paramount importance. Data breaches have the potential to erode patient trust, precipitate legal disputes, and attract the attention of hackers and cybercriminals as lucrative targets for financial gain or identity theft. A study revealed that patients experienced feelings of being monitored and insecure when utilizing telemedicine services [20]. Consequently, healthcare providers must exercise extreme caution and implement robust security measures within all their information systems and network architectures to ensure the protection of patient information from unauthorized access and exploitation. Simultaneously, emphasis should be placed on optimizing the interface design of telemedicine platforms to enhance the user experience by streamlining the use of unnecessary cameras and reducing the number of visual elements that may trigger a sense of surveillance in patients, thereby effectively enhancing their sense of security when receiving telemedicine services.

4.4. Telemedicine health insurance coverage to be improved

The incorporation of telemedicine costs within health insurance policies varies across different regions. A study revealed that only 22.8% (26/114) of hospitals have incorporated telemedicine costs into their health insurance [56]. In the United States, the percentage of health insurance payments for telemedicine ranges from 0% to 67%. Whereas in China, only some provinces, such as Guizhou and Sichuan, have realized health insurance reimbursement [57]. This is particularly problematic in remote areas, where 56% of the rural population is not covered by health insurance [23]. This has significant consequences for patients with severe mental disorders, who are often unable to receive the specialist treatment they require. It is therefore recommended that governments formulate health insurance policies and establish a reasonable benefit distribution mechanism to promote the sustainable implementation of telemedicine in China.

5. Conclusion

The utilization of telemedicine in patients diagnosed with schizophrenia assumes numerous forms, encompassing remote consultation, remote monitoring, online diagnosis, and treatment, amongst others. These forms are designed to address the diverse needs of patients, offering convenient and personalized services. The utilization of telemedicine in this manner has been shown to reduce the relapse rate of schizophrenia, enhance treatment compliance, and alleviate the burden on families and society. Despite the evident benefits of telemedicine in schizophrenia cases, there are still considerable challenges to be addressed, including technical issues, patient acceptance, and the complexities of insurance policies and data security. However, it is important to acknowledge the numerous challenges that hinder its full implementation, including technical barriers, limited patient acceptance, imperfect health insurance payment policies, data security, and privacy protection. These challenges must be addressed to ensure the full potential of telemedicine can be realized and to facilitate its widespread implementation and advancement. However, with the rapid advancements in information technology and the continuous improvement of healthcare policies, there is a growing prospect for the application of telemedicine in the management of schizophrenic patients. The promotion of the in-depth application of telemedicine in the management of schizophrenia patients is to be achieved through interdisciplinary cooperation, technological innovation, and policy guidance, with the objective being the provision of more comprehensive, efficient, and personalized medical services to patients. It is imperative that all sectors of society strengthen their commitment

and support for telemedicine, thereby facilitating the continuous progress and development of mental health.

Disclosure statement

The authors declare no conflict of interest.

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