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Social media and schizophrenia: an update on clinical applications

Social media and schizophrenia

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Abstract

Social media has redesigned the landscape of human interaction, and data obtained through these platforms are promising for schizophrenia diagnosis and management. Recent research shows mounting evidence that machine learning analysis of social media content is capable of not only differentiating schizophrenia patients from healthy controls, but also predicting conversion to psychosis and symptom exacerbations. Novel platforms such as Horyzons show promise for improving social functioning and providing timely access to therapeutic resources. Social media is also a considerable means to assess and lessen the stigma surrounding schizophrenia. Herein, the relevant literature pertaining to social media and its clinical applications in schizophrenia over the past five years are summarized, followed by a discussion centered on user feedback to highlight future directions. Social media provides valuable contributions to a multifaceted digital phenotype that may improve schizophrenia care in the near future.

Core Tip: Recent literature demonstrates that social media data analysis guided by machine learning can differentiate users with schizophrenia from healthy controls as well as predict conversion to psychosis and symptom exacerbations. Novel platforms such as Horyzons can improve social functioning in schizophrenia patients, but long-term engagement is a challenge that may be addressed by streamlining the user experience.

INTRODUCTION

Although the increased prevalence of social media has already transformed daily life, these platforms are poised to further improve the management of various medical conditions. Schizophrenia presents a unique opportunity for advancement in diagnosis and management. Prior studies have established the feasibility and acceptability of social media in patients with schizophrenia[1-3], and the recent research discussed within this article demonstrate that potential benefits are within reach.

The intrinsic sociality of social media platforms such as Facebook and YouTube offers the capability to not only assess and reform the stigma surrounding the condition, but also provides a manner of communication and community that may be more agreeable to individuals with schizophrenia who are likely to self-isolate.

The aim of this article is to review the recent literature on social media with a focus on clinical applications in schizophrenia. A literature search for (social media) AND ((psychosis) OR (schizophrenia)) was conducted on PubMed from 2017 to present, and the most relevant articles were selected for discussion. The contributions of the subsequent studies to schizophrenia diagnosis and clinical management will be reported, followed by a discussion on future directions that details necessary changes and further avenues of research that may augment the promising advances in schizophrenia management.

SOCIAL MEDIA
Diagnosis

The content of several social media platforms was analyzed, and findings will be organized by platform in consideration of the inherent differences between media types (i.e., typed posts on Facebook, Twitter, Reddit; visual content on Instagram). These findings are summarized in Table 1.

Kelly *et al*[4] performed a study that offers insight into the clinical utility of Facebook posts. Blinded clinical raters assessed eight participants with schizophrenia, seven with

depression, and eight health controls using symptom severity scales, including the Brief Psychiatric Rating Scale for psychotic symptoms and the Community Assessment of Psychotic Experiences for global functioning. The clinical raters included psychiatrists and other mental health clinicians, who rated participants on the corresponding scales by both de-identified Facebook posts and in-person assessments. The ratings for the Facebook posts were significantly correlated with in-person assessments across all three categories of psychotic symptoms, depressive symptoms, and global functioning. These results validate the clinical relevance of social media posts.

Birnbaum *et al*[5] analyzed Twitter posts by combining clinical appraisals with machine learning and found significant linguistic differences between individuals who self-disclosed as having schizophrenia from healthy controls. The clinicians evaluated the self-disclosed Twitter users' posts to determine authenticity of the diagnosis. Their appraisals were used to strengthen the machine learning algorithm to achieve an accuracy of 88% in identifying users with schizophrenia. In addition, the schizophrenia group were found to have significantly greater use of interpersonal pronouns, decreased attention on friendship, and increased preoccupation with biological processes. In other studies, machine learning analysis of Twitter posts have also revealed that users with schizophrenia are more likely to tweet about depression, anxiety, and suicidality than control groups, which highlights the importance of social media as a facet of digital phenotyping that may lead to earlier detection of symptoms[6-7].

Machine learning has been found to be similarly capable of identifying users with schizophrenia with up to 93% accuracy in Rezaii *et al*[8], in which 30,000 Reddit posts were analyzed. The authors emphasize that low semantic density and content about voices and sounds were essential factors in predicting conversion to psychosis. Although outside the scope of the present discussion, the study used a mathematical method called vector unpacking that breaks down the meaning of a sentence into a

simplified set of core ideas. Further expanding on linguistic features, Bae et al[9] used machine learning and Reddit posts focusing on schizophrenia to highlight significant differences from the control group, including increased frequency of third person plural pronouns, words representing negative emotions, and topics related to their symptoms. Lastly, Kim et al[10] was likewise able to use machine learning to tie the contents of user posts in Reddit mental health communities with schizophrenia, but expanded its classification to include a range of diagnoses including depression, schizophrenia, borderline personality disorder, and autism. All the above studies demonstrate that social media posts can be used to differentiate schizophrenia patients from healthy controls, forming the foundation for diagnostic relevance in the future.

In addition to the linguistic features of social media posts, the clinical utility of visual content on Instagram has also been explored. Hänsel et al[11] extracted image features such as color composition and the number of faces depicted from nearly 12,000 Instagram posts from 68 individuals with schizophrenia spectrum disorders and 34 healthy controls. The study found that users with schizophrenia posted images with significantly lower saturation, colorfulness, and number of faces. Individuals with schizophrenia also had significantly lower ratios of followers to the number of accounts being followed compared to the control group. The study proves that visual Instagram data can be another clinically relevant component that can ultimately contribute to a digital phenotype with a diagnostic signature.

Management

One of the most researched benefits offered by social media may be found in their characteristic ability to provide users with an alternative form of socializing. Several studies have evaluated the capacity of these platforms to encourage social behaviors in the schizophrenia population, who commonly tend to self-isolate.

Although not in schizophrenia patients, a study by Alvarez-Jimenez *et al*[12] sets the stage for the discussion by investigating social media interventions in young people considered high risk for transition to psychosis. Researchers developed a platform called MOMENTUM, which highlights mindfulness, personal strengths, and self-efficacy. Thirteen of the fourteen participants reported that the platform was helpful, and data showed significant improvements in social functioning and subjective wellbeing, as well as significant increases in mindfulness skills and use of strengths that were both highlighted by the intervention. Thus, the platform MOMENTUM was not only used widely by participants, but also led to measurable improvements in sociality.

Alvarez-Jimenez *et al* also led the first intervention in first-episode psychosis patients *via* a similar platform called Horyzons, which aims to incorporate social networking, psychotherapy, moderation by experts and peers, and the aforementioned emphasis on mindfulness and personal strengths[13]. The primary outcome was social functioning, using the Personal and Social Performance Scale at the final follow-up at 18-months. The study recruited 170 participants between the ages of 16 and 27, who were randomly assigned to the Horyzons intervention in addition to treatment as usual (TAU) or solely TAU, which consisted of generic medical and mental health services.

While no significant effects were found, participants in the intervention group demonstrated a 5.5 times greater increase in their odds of finding employment or furthering their education compared to the control group. Participants can choose from a selection of activities, and topics related to occupational preparation were among the most selected. This included activities such as "Nailing the interview," "How to write a resume," and "Getting your public persona ready." This content likely contributed to the improved vocational and educational attainment compared to the TAU group, in which vocational/educational measures declined over the length of the study. Likewise, 13% of the Horyzons group were hospitalized due to psychosis compared to 27% of the control group, but again this difference was not significant. The

level of engagement with the Horyzons platform may play a role, as 55.5% of intervention participants logged on for at least 6 mo, and 47% logged on for at least 9 mo[14]. Although medication adherence was not a target measure in these studies, it is likely that the reduced hospitalization rates and other benefits are in part due to treatment adherence reinforced through platform participation. The awareness of symptom exacerbations to both participants and moderators may identify medication nonadherence and allow for timely dose adjustments as well. Overall, the Horyzons platform continues to hold promise as a feasible opportunity to prevent relapse and bridge patients from early psychosis treatment to multiple fundamental resources[14-15]. The study was originally developed and performed in Australia, but has since expanded to several other countries as well[15-17], further supporting the accessibility of social media interventions.

From a clinical perspective, Birnbaum *et al*[18] used machine learning models to analyze over 50,000 Facebook posts from 51 patients with first-episode psychosis. The study captured behavioral and linguistic markers associated with predicting relapse, including significant differences in the wording of Facebook posts that preceded relapse hospitalization by one month. These differences included increased use of first and second person and more frequent use of words related to swearing, anger, and death. The related posts showed significantly less mentions of work, health, and friends, yet also involved more frequent co-tagging of friends. The study demonstrates the predictive value that social media can offer in identifying patients most susceptible to relapse. Similarly, patients who displayed increased, above-median Twitter posts related to schizophrenia had a 15% increase in mental health episodes[19]. Temporal analyses showed a seven-day pattern of positively associated Twitter posts and mental health fluctuations on day 1, negative association by day 4, and a return to negative association at day 7. The identified pattern illustrates the potential predictive value of Twitter posts on the symptomatic course of schizophrenia and may be valuable in identifying individual risks for symptom exacerbation.

Lastly, social media can provide additional benefits that improve patients' daily life in unique ways. Pertaining to physical health improvements, Naslund *et al*[20] investigated the role of a Facebook group to support health goals in patients with severe mental illness (SMI). Group participants who achieved weight loss of at least 5% of body weight or improved physical activity had contributed increased Facebook interactions, though this relationship neared but did not surpass the threshold for significance. Nevertheless, when participants posted about their personal successes and challenges, it generated significantly more platform interactions in comparison to motivational content, health information, and program reminders. This study exemplifies the impact that social media can have on patients' medical health outside of psychiatric care.

On a similar note, social media can be used to identify habits detrimental to health, such as smoking. Hswen *et al*[21] found that Twitter users with schizophrenia had significantly more posts containing tobacco-related keywords, which parallels the reality that smoking is more common in the schizophrenia community relative to the general population. Thus, these two studies demonstrate the capability of social media to not only identify areas to improve physical health, but also provide a reasonable intervention buffered by social support. Apart from physical health benefits, Sangeorzan *et al*[22] found that patients with SMI who vlog through YouTube receive peer support, increased self-efficacy, and diminished self-stigma. These benefits are likely to contribute to an improved sense of well-being, as would reducing overall stigma through public health education.

Public Health Education

While not a directly clinical application, it is worthwhile to briefly note the impact of social media in removing stigma through educational efforts targeting the general population. Robinson *et al*[23] examined over one million tweets and found

schizophrenia to be the most stigmatized condition among mental health illnesses. Likewise, 68.3% of Turkish Twitter posts containing schizophrenia were deemed stigmatizing[24]. Several efforts have been made to assess public perception and improve awareness through Twitter[23-25], YouTube[26-28], Facebook[29-30], Instagram[30-31] and Weibo[32] (a Chinese social media platform). Social media has demonstrated potential to reduce stigma of schizophrenia, which may indirectly benefit patients' daily interactions and sense of well-being.

FUTURE DIRECTIONS

Although the above results are undoubtedly promising, one concern that must be addressed is whether these benefits apply to all age groups. Rekhi *et al*[33] reported the results of a survey of 265 individuals with schizophrenia to determine the characteristics of social media users. 52% of individuals used social media in the past week. However, patients that more frequently used social media were of younger age, higher family income, decreased symptom severity, and education above secondary school. Similarly, in a survey of patients from early psychosis and recovery units, age accounted for differences in use and access of technology[34]. The use of technology and interest in internet-based interventions were nevertheless primarily positive, suggesting that with improvements, the interventions can become even more appealing to the broader population. These statistics are also improved compared to a 2015 survey that reported on 80 patients of ages 18-70 with schizophrenia, in which only 27% of individuals used social media[35]. At that time, participants reported that social media assisted them in increasing socialization, further supporting that the underlying interest is present and growing, but peak usage may depend on improvements in appeal and functionality.

To better understand what these improvements may be, a suitable starting point is patient feedback. Twelve participants with a mean age of 23 years were interviewed from the original Horyzons study. While some participants reported that the strengths

of the intervention were on-demand support and flexibility, others felt overwhelmed by the options available to them that resulted in decreased motivation to engage with the platform[36]. Additional feedback was given by 26 participants involved in an open trial of the Horyzons platform in the United States. These users recommended the development of a smartphone application, the functionality to allow users to send private messages to each other, and the expansion of the Horyzons community to incorporate a greater number of users[15]. Integrating user suggestions such as simplifying the users' choices and increasing ease of use with a smartphone application may increase motivation to engage with the platform and ultimately expand the diversity of the userbase. Lastly, future updates to the Horyzons platform may benefit from employing artificial intelligence to automate delivery of therapy content tailored to users by analysis of individual data, further streamlining the user experience[37].

The negative effects of platforms such as Horyzons should also be taken into consideration for future research. Social media users with SMI report various concerns about privacy vulnerabilities. Specifically, these concerns involve the fear of stigma and judgment by others, impact on personal relationships, hostility towards participants, being hurt, and endangering employment. In a survey of 90 social media users with SMI, approximately one-third reported being concerned about privacy[38]. These concerns are legitimate, and platform developers should continue to involve participants in the development of their systems and ensure that privacy is prioritized. Likewise, enrolled participants should be educated on how to protect themselves from the potential risks related to stigma, self-disclosure, and other related concerns. These platforms must also take precautions to prevent spreading misinformation, worsening participant symptoms, and delaying professional help when necessary[38]. Lastly, the aforementioned improvement in vocational and educational outcomes seems to be dependent on user engagement, as those in the top quartile of logins (greater than 77 times over the course of the study) demonstrated significantly greater effects compared to those in the bottom quartile of logins (less than 9 times)[14]. Since these improvements

seem to follow a dose-response relationship, platforms should screen for participants in this lower quartile of engagement, as they are not receiving the intended intervention effects, but may benefit from additional one-on-one time with moderators or specifically designed interventions.

CONCLUSION

Social media has transformed daily life and is on the cusp of extending an equal impact to psychiatric diagnosis and management. Studies have consistently shown the capability of machine learning to distinguish users with schizophrenia through social media data, whether it be typed language or visual content. These technologies showcase the emerging predictive value in first-episode psychosis and episodes of symptom exacerbation. Novel platforms such as Horyzons improve social functioning and increase timely access to resources such as peer support and psychotherapy. With platform improvements that streamline the user experience and augment patient engagement, all users stand to benefit from the contribution of social media to a multifaceted digital phenotype.

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