



Review

Online, social media and mobile technologies for psychosis treatment: A systematic review on novel user-led interventions



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ABSTRACT

Background: Internet and mobile-based interventions provide a unique opportunity to deliver cost-effective, accessible, time-unlimited support to people with psychosis. The aims of this study were to systematically compile and analyze the evidence on the acceptability, feasibility, safety and benefits of online and mobile-based interventions for psychosis.

Methods: Systematic review of peer-reviewed studies examining the usability, acceptability, feasibility, safety or efficacy of user-led, Internet or mobile-based interventions, with at least 80% of participants diagnosed with schizophrenia-spectrum disorders.

Results: Of 38 potentially relevant articles, 12 were eligible for inclusion. Interventions included web-based psycho-education; web-based psycho-education plus moderated forums for patients and supporters; integrated web-based therapy, social networking and peer and expert moderation; web-based CBT; personalized advice based on clinical monitoring; and text messaging interventions. Results showed that 74–86% of patients used the web-based interventions efficiently, 75–92% perceived them as positive and useful, and 70–86% completed or were engaged with the interventions over the follow-up. Preliminary evidence indicated that online and mobile-based interventions show promise in improving positive psychotic symptoms, hospital admissions, socialization, social connectedness, depression and medication adherence.

Conclusions: Internet and mobile-based interventions for psychosis seem to be acceptable and feasible and have the potential to improve clinical and social outcomes. The heterogeneity, poor quality and early state of current research precludes any definite conclusions. Future research should investigate the efficacy of online and mobile interventions through controlled, well-powered studies, which investigate intervention and patient factors associated with take-up and intervention effects.

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1. Introduction

Advances in the treatment of psychosis have led to an improved prognosis in relation to symptom management (van Os and Kapur, 2009). However, relapse rates after initial response to acute pharmacological treatment are stubbornly high (Alvarez-Jimenez et al., 2012c) and clinically meaningful improvements in functional outcomes remain elusive (Alvarez-Jimenez et al., 2012b).

Novel concomitant psychosocial interventions targeting relapse prevention, symptom management and functional recovery have demonstrated effectiveness above and beyond that of pharmacotherapy alone (Mueser et al., 2013). Unfortunately, studies uniformly point to penetration rates for psychosocial interventions of less than 10%, leaving many patients with limited or no access to evidence-based psychological support (Lehman and Steinwachs, 1998; Lehman et al., 2004). Reasons for poor accessibility include costly delivery and dissemination of specialized interventions, geographic barriers and transportation costs, and the stigma associated with mental health treatment, which limits help seeking and treatment attendance among people with severe mental disorders (Corrigan, 2004; Alvarez-Jimenez et al., 2012a).

The rapid development of novel information and communication technologies (ICTs) has dramatically transformed the way in which

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people interact with one another and the wider community. Never before have information and communication been so accessible to so many. The Internet has also become a powerful source of information and support for patients with psychosis (Haker et al., 2005), with the potential to significantly influence health related behaviors and decisions as well as the clinician–patient relationship (Schrank et al., 2010). Emerging evidence indicates that the use of the Internet by people with psychosis resembles that of individuals not affected by mental illness (Haker et al., 2005; Schrank et al., 2010). People with psychosis use the Internet effectively to create social connections enabling the development of both virtual and face-to-face relationships (Spinzy et al., 2012). In addition to the general advantages such as accessibility and the capacity to access a wide array of resources (Fox and Rainie, 2000), people with psychosis resort to the Internet because of the anonymity and absence of a hierarchy on the Web and its potential to assist in overcoming difficulties with social interaction (Schrank et al., 2010).

Given the acceptability and accessibility of novel ICTs, Internet and mobile-based interventions provide an unprecedented opportunity to overcome existing barriers by delivering cost-effective, non-stigmatizing, time-unlimited support to people with psychosis. However, while several meta-analyses have shown that online interventions are effective for treating depression and anxiety (Spek et al., 2007; Van't Hof et al., 2009; Andrews et al., 2010), the use of the Internet and mobile technologies has been rarely applied to the treatment of psychotic disorders. Recent reviews examined online interventions for people with psychosis, but these either focused on telepsychiatry (Kasckow et al., 2013) (i.e., traditional therapy delivered via mobile phones or videoconference) or were not systematic (Alvarez-Jimenez et al., 2012a), thus omitting relevant studies. A rigorous examination of the emerging evidence on the potential of these technologies to support psychosis treatment will help identify promising treatment opportunities and inform further research. The aims of this study were to systematically compile and analyze the current evidence on the acceptability, feasibility, safety and benefits of Internet and mobile-based interventions for people suffering from psychosis.

2. Method

This review was carried out in line with the PRISMA statement for reporting systematic reviews (Liberati et al., 2009).

2.1. Data sources

Systematic bibliographic searches were performed to find relevant English and non-English language, peer-reviewed, studies from the following databases: the Cochrane Central Register of Controlled Trials (CENTRAL), Medline, CINAHL, EMBASE, PsycINFO, Scopus, Information Science Citation Index Expanded (SCI-EXPANDED), Information Social Sciences Citation Index (SSCI), and Information Arts and Humanities Citation Index (A&HCI), all from inception to August 2013. Conference abstracts were searched from Conference Proceedings Citation Index-Science (CPCI-S) and Conference Proceedings Citation Index-Social Science & Humanities (CPCI-SSH). The abstracts, titles and keywords of studies were searched using combinations of the following terms: (PSYCHOSIS or SCHIZOPHR* or PSYCHOTIC) and (INTERNET or ONLINE or WEB-BASED or WEBSITE or MOBILE). Additional articles were identified by hand-searching the references of retrieved articles and previous reviews. Finally, authors and other experts were contacted for unpublished studies.

2.2. Study selection

Considered for inclusion were studies examining the usability, acceptability, feasibility, safety or efficacy of user-led, Internet or mobile-based interventions, with at least 80% of participants diagnosed with schizophrenia-spectrum disorders using either DSM or ICD criteria.

Internet interventions were defined as web-based interventions enabling peer-to-peer contact, patient-to-expert communication or interactive psycho-education/therapy. Mobile-based interventions were defined as interventions delivered via mobile phones using SMS, MSS, mobile or web-applications. User-led support was defined as interventions in which participants led or directed the timing, content or interaction with the web or mobile-based intervention. Studies investigating traditional face-to-face therapy delivered via teleconference of mobile phones and studies recruiting less than 10 participants were excluded (Fig. 1).

Two reviewers (M.A.-J. and M.A.-C.) independently assessed all potentially relevant articles for inclusion. Any disagreements were resolved through discussion. If necessary, authors were contacted to determine eligibility against inclusion criteria.

2.3. Data extraction and analysis

Two reviewers (M.A.-J. and M.A.-C.) independently extracted relevant data from selected studies including: (1) the characteristics of the study (i.e., study design, study aims, year of publication, country of origin, sample characteristics and follow-up time in weeks); (2) characteristics, nature and purpose of the online or mobile-based intervention and comparison groups (if applicable); (3) intervention setting (i.e., hospital-based/controlled environment vs. real-world); and (4) research findings in relation to study aims. Specifically, data pertaining to the following domains was extracted and analyzed: (1) users' engagement with, and use of, the online or mobile-based intervention; (2) drop-out rates; (3) users' evaluation of usability, attractiveness and helpfulness of the intervention; (4) variables associated with use of, and engagement with, the intervention; (5) adverse events and safety of the intervention; (6) challenges in implementing and using the online or mobile-based intervention; (7) clinical outcomes (i.e., symptom-based outcomes); and (8) psychosocial outcomes (i.e., social and functional outcomes). Interventions were categorized according to delivery format into either web-based interventions (i.e., designed to be accessed mainly via computers) or mobile-based interventions (designed to be accessed through mobile devices, e.g., SMS-based interventions). Web-based interventions were further categorized according to intervention approach (online therapy (e.g., psycho-education, CBT) vs. online therapy in tandem with online social networking), and target group (i.e., patients, carers or both patients and carers). This category system was informed by previous literature indicating that delivery format, user group, and online social networking are likely to influence both take-up and efficacy (Alvarez-Jimenez et al., 2012a). To minimize the risk of reporting bias, efforts were made to extract and report positive and negative findings from the included studies. Any discrepancies were resolved by consensus.

2.4. Assessment of methodological quality and procedures

For controlled studies methodological quality was assessed by means of the Cochrane Collaboration 'risk of bias' tool. This measure is a 2-part tool that addresses 6 different domains of methodological quality, namely, sequence generation, allocation concealment, blinding, incomplete outcome data, selective outcome reporting, and other biases. The 'other bias' domain was assessed through the following criteria: (1) balance/imbalance of baseline characteristics across study groups; (2) acceptability of and retention in the intervention assessed against a priori criteria; (3) patients in both groups spending an equivalent amount of time in treatment; (4) statistical power to detect moderate effect sizes. Two reviewers (M.A.-J., C.G.-B) independently assessed the methodological quality. Any disagreements were resolved through discussion. For uncontrolled studies we assessed the following criteria: (1) blinding to study design or purpose; (2) incomplete

outcome data; and (3) acceptability and completion of the intervention assessed against a priori criteria.

3. Results

Of 38 studies retrieved, 12 were eligible for inclusion. Two of the included studies examined the acceptability/use of online-based interventions and 9 provided data on intervention effects. The interventions evaluated consisted of web-based psycho-education (Valimaki et al., 2008; Yakirevitch et al., 2010; Steinwachs et al., 2011; Anttila et al., 2012); web-based psycho-education plus moderated forums for patients and supporters (Glynn et al., 2010; Rotondi et al., 2010); integrated web-based therapy, social networking and peer and expert moderation (Alvarez-Jimenez et al., 2013); web-based CBT (Gottlieb et al., 2013); personalized advice based on routine clinical monitoring (van der Krieke et al., 2012), and mobile-based interventions (Spaniel et al., 2008a; Granholm et al., 2012; Spaniel et al., 2012). Six interventions were evaluated in admission units or controlled environments (Valimaki et al., 2008; Yakirevitch et al., 2010; Steinwachs et al., 2011; Anttila et al., 2012; van der Krieke et al., 2012; Gottlieb et al., 2013) and 6 were delivered remotely in real world settings via Internet enabled or mobile devices (Spaniel et al., 2008a; Glynn et al., 2010; Rotondi et al., 2010; Granholm et al., 2012; Spaniel et al., 2012; Alvarez-Jimenez et al., 2013).

Table 1 depicts the characteristics of the selected studies. Twelve studies involving 617 patients and 106 supporters/relatives were included. Patients' mean age ranged from 20.3 to 50 years and supporters' mean age varied from 47 to 57 years. Seven studies recruited patients with chronic schizophrenia (Valimaki et al., 2008; Yakirevitch et al., 2010; Steinwachs et al., 2011; Anttila et al., 2012; Granholm et al., 2012; van der Krieke et al., 2012; Gottlieb et al., 2013), 4 studies recruited patients with chronic schizophrenia and their relatives/supporters (Spaniel et al., 2008a; Glynn et al., 2010; Rotondi et al., 2010; Spaniel et al., 2012), and 1 recruited young people with first-episode psychosis (FEP) (Alvarez-Jimenez et al., 2013). Four studies employed a randomized controlled design (Rotondi et al., 2010; Yakirevitch et al., 2010;

Steinwachs et al., 2011; Spaniel et al., 2012), 2 studies included non-randomized comparison groups (Glynn et al., 1990; Spaniel et al., 2008a), 4 used uncontrolled single-group pre-post designs (Anttila et al., 2012; Granholm et al., 2012; Alvarez-Jimenez et al., 2013; Gottlieb et al., 2013), and 2 tested the acceptability/usability of an online intervention in a single session (Valimaki et al., 2008; van der Krieke et al., 2012). For prospective studies follow-up periods ranged from 10 days to 52 weeks. For those studies including comparison groups control interventions comprised treatment as usual (TAU) (Glynn et al., 1990; Spaniel et al., 2008a; Rotondi et al., 2010; Yakirevitch et al., 2010; Spaniel et al., 2012) and videos and information about schizophrenia treatment (Steinwachs et al., 2011). Five studies were conducted in the United States (Han et al., 2008; Glynn et al., 2010; Rotondi et al., 2010; Steinwachs et al., 2011; Granholm et al., 2012; Gottlieb et al., 2013), 5 in Europe (Spaniel et al., 2008a; Anttila et al., 2012; Spaniel et al., 2012; Välimäki et al., 2012; van der Krieke et al., 2012), 1 in Australia (Alvarez-Jimenez et al., 2013) and 1 in Israel (Yakirevitch et al., 2010).

3.1. Acceptability, usability and safety of online and mobile-based interventions

3.1.1. Web-based psycho-education and CBT

Three pilot studies provided data on the usability and acceptability of web-based psycho-education (Valimaki et al., 2008; Anttila et al., 2012) and interactive CBT (Gottlieb et al., 2013) for patients with chronic schizophrenia delivered in hospital-based settings (Table 1). Overall patients considered the web-based interventions to be usable (Valimaki et al., 2008) and helpful (Gottlieb et al., 2013). One study reported that 73 (79%) patients attended all 6 programmed psycho-education sessions, with 69 (74%) successfully completing the set tasks (Anttila et al., 2012). Conversely, 24 (26%) experienced clear difficulties including the lack of motivation, poor engagement and understanding. Higher symptom severity and lower level of functioning were significantly associated with required time to complete the sessions (Anttila et al., 2012). Online-based CBT for auditory hallucinations

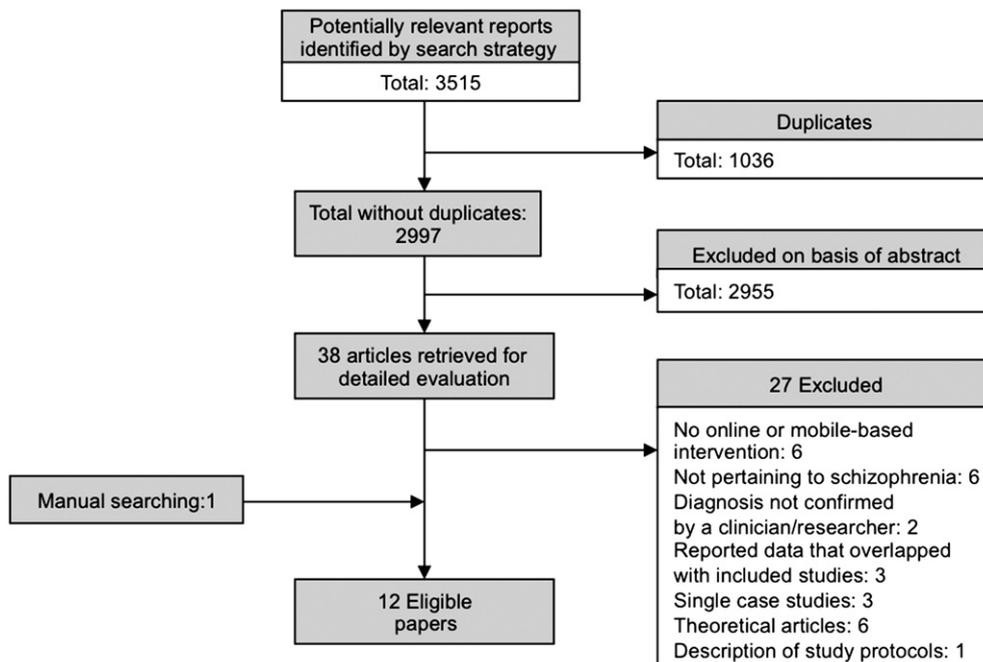


Fig. 1. Study selection.

was rated to be very good/helpful by 82.4% of patients, with 17 (81%) finishing at least 6 sessions and an average of 9.7 lessons being completed (Gottlieb et al., 2013). By contrast, 11.8% considered the intervention not to be useful and helpful to manage psychotic symptoms and 75% reported not following through on homework assignments. Although the latter study included a newsfeed for participants to share experiences, it did not provide data on either level of use or acceptability of the social networking feature.

3.1.2. Web-based psycho-education plus moderated forums for patients and supporters

Two 12-month studies provided data on the usability and acceptability of online psycho-education in conjunction with moderated forums for patients with schizophrenia and their supporters (Rotondi et al., 2010), or relatives of patients with schizophrenia only (Glynn et al., 2010) delivered in real world settings (Table 1). One RCT reported that patients and their supporters spent a median of 971 min (range = 162–11,796) and 372 min (range = 19–2498), respectively, on the website. Patients' baseline symptom severity was positively correlated with time using the website. Both patients and their supporters spent more time on therapy forums as opposed to psycho-educational activities over the course of the study (Rotondi et al., 2010). Another quasi-experimental study evaluated the feasibility of an online-based intervention for relatives of patients with schizophrenia (Glynn et al., 2010). Twenty (79%) participants completed the 12-month intervention, with a mean attendance to core real-time online sessions of 52.6%. In addition, 92% were satisfied with the intervention and 84% used the online forum. By contrast, attendance to optional real-time sessions was only 30% and activity on the online forum was low (overall less than 1 post per week) (Glynn et al., 2010).

3.1.3. Integrated web-based therapy, social networking and peer and expert moderation for FEP patients

One 4-week pilot study evaluated the use, acceptability and safety of an online platform integrating strength-based interactive interventions, psycho-education, social networking and expert and peer moderation for 20 FEP patients delivered in a real world setting (Alvarez-Jimenez et al., 2013) (Table 1). Results showed that 15 (75%) patients reported they had a positive and constructive experience using the online platform, 18 (90%) would recommend it to others, and 16 (70%) considered the system to be a useful long-term option. Usage data showed 70% used the system at least 3 of 4 weeks, 95% used the social network (with a total of 371 postings) and 60% completed at least 3 therapy modules. No adverse events were reported during the study and 100% reported the intervention to be safe and confidential. Conversely, 30% did not actively engage with the online intervention, and only 20% completed at least 5 (out of 7) therapy modules during the study (Alvarez-Jimenez et al., 2013).

3.1.4. Personalized advice based on routine clinical monitoring

One study examined the usability of a web-based system integrating routine care monitoring and personalized advice for treatment management and recovery in patients with chronic schizophrenia in a controlled environment (van der Krieke et al., 2012) (Table 1). Results showed that all participants were able to complete the usability test although 3 (of 15) needed assistance. The overall satisfaction with the website was 74 (maximum being 90).

3.1.5. Mobile-based interventions

One 12-week pilot study examined the feasibility of a mobile-based SMS intervention targeting auditory hallucinations, medication adherence and socialization for patients with chronic schizophrenia delivered in a real world setting (Granholtm et al., 2012). Forty-two participants (76%) completed the intervention and 13 (26%) were considered non-completers (i.e., did not send any valid messages or stop sending

messages within 2 weeks despite repeated reminders). The average valid response rate for completers was 86%. Non-completers had comparably more severe negative symptoms, lower premorbid IQ as well as poorer self-reported living skills (Granholtm et al., 2012).

3.1.6. Summary of results

The extant research showed that web-based psycho-education and CBT delivered in controlled environments were feasible and acceptable to patients with schizophrenia, with 79–81% completing the majority of planned sessions. By contrast, 26% experienced clear difficulties with online psycho-education while 12% considered online CBT not to be helpful. Online psycho-education in conjunction with social networking delivered in real world settings was also shown to be feasible and acceptable to patients with schizophrenia and their carers as well as FEP patients. However, actual usage and engagement with the interventions over the long-term were unclear. Finally, one study showed that a mobile-based SMS intervention was again feasible and acceptable, with 76% of patients with schizophrenia completing the intervention.

3.2. Treatment effects of online and mobile-based interventions

3.2.1. Web-based psycho-education and CBT

Three studies examined the effects of either web-based psycho-education (Yakirevitch et al., 2010; Steinwachs et al., 2011) or CBT (Gottlieb et al., 2013) for people suffering from chronic schizophrenia delivered in hospital-based environments (Table 1). One small RCT reported that online psycho-education improved treatment satisfaction and compliance to pharmacological treatment compared with the control group. No data was reported on symptom outcomes (Yakirevitch et al., 2010). Another small controlled study evaluated the efficacy of web-based intervention designed to enhance patients' communication with clinicians about evidence-based interventions (Steinwachs et al., 2011). Study results showed that patients assigned to the intervention contributed more actively to the interactions with clinicians compared with their counterparts in the control group. Moreover, treatment sessions in the intervention group had a stronger focus on psychosocial and lifestyle aspects as opposed to biological themes (Steinwachs et al., 2011). Finally, web-based CBT for persistent auditory hallucinations was associated with significant improvements in hallucination severity and general psychopathology in an uncontrolled single group pilot study (Gottlieb et al., 2013).

3.2.2. Web-based psycho-education plus moderated forums for patients and supporters

One 12-month RCT evaluated the effects of web-based psycho-education in combination with moderated online forums for patients with schizophrenia and their supporters (Rotondi et al., 2010) (Table 1). Study results showed significant improvements in perceived social support and stress at 3-month follow up for patients allocated to the intervention group compared with treatment as usual (TAU). Similarly, there was a significant reduction in positive psychotic symptoms in the intervention group at 12-month follow up (Rotondi et al., 2010). By contrast, there were no significant benefits for supporters in terms of perceived stress and social support at 3-month follow up (Rotondi et al., 2005) and these outcomes were not reported at 12-month follow up (Rotondi et al., 2010). Another 12-month study with historical control investigated the effects of online-based psycho-education, online forums and real-time online sessions for relatives of patients with schizophrenia compared with a historical cohort of relatives receiving TAU (Glynn et al., 2010). Study results revealed reduced family stress and a trend to a significantly reduced rate of hospital admissions in the intervention group compared with the TAU group. Conversely, perceived social support for relatives and patients' symptoms did not improve over the course of the study.

Table 1
Characteristics of included studies.

Study	Study aim and origin	Study design and sample size	N	Age mean (SD)	Gender (male)	F-U	Online and mobile-based interventions
Rotondi et al., 2005, 2010	To evaluate the use and efficacy of a web-based intervention for people with schizophrenia or schizoaffective disorders and their supporters USA	Randomized controlled trial comparing a website intervention (SOAR) vs. treatment as usual (TAU)	31 patients: SOAR = 16 TAU = 15 24 supporters: SOAR = 13 TAU = 11	Patients SOAR = 38 (11) TAU = 38 (11) Supporters SOAR = 47 (14) TAU = 53 (13)	Patients SOAR = 38% TAU = 27% Supporters SOAR = 31% TAU = 45%	12 months	Schizophrenia Online Access to Resources (SOAR) included family psychoeducation (e.g., empathy skills, coping strategies, promotion of self-efficacy and problem solving skills) and moderated supporter and peer discussion forums (one for patients, one for supporters and one for both) Delivery: Users could use the website at their own discretion from any Internet-enabled device ITAPERS: Patients and family members (if available) were sent a weekly 10-item EWS Questionnaire delivered via SMS. A given threshold number of EWS triggered an alert to the treating psychiatrist leading to a 20% increase in antipsychotic dose within 24 h (if clinically appropriate) Delivery: SMS was delivered to the community Website providing psychoeducation on 5 domains: illness, treatment, well-being, daily activities and patients' rights. Delivery: Usability test in laboratory-based environment
Spaniel et al., 2008a, 2008b	To test the feasibility and efficacy of a text-messaging intervention designed to identify early warning signs (EWS) of relapse in patients with schizophrenia Czech Republic	Quasi-experimental study (historical comparison)	73 patients 56 relatives	Male = 29.9 (6.7) Female = 29.5 (9.4)	55%	24 months	The Online Relative Support Program included: 1) a discussion board for participants and staff; 2) links to relevant agencies and websites; 3) written and video educational presentations on behavioral family therapy; 4) real time chat (60 minute sessions with 5–6 relatives held weekly for the first 6 months and biweekly for the second 6 months facilitated by a psychologist); and 5) 2 optional real time chats/groups focused on medication and treatment issues or social support Delivery: Families could use the website at their discretion
Valimaki et al., 2008	To develop a web-based patient support system for people with schizophrenia spectrum disorders and to examine users' views on the system Finland	Four phases: Analysis of users' needs; development of informational areas; development of prototype; and piloting of the website with patients	21	N/R	N/R	N/A	Website including information on pharmacotherapy, symptoms management and patients' rights Delivery: Website intervention was delivered at the inpatient unit (25 of 28 participants were hospitalized)
Glynn et al., 2010	To evaluate the feasibility of an online multifamily group program for relatives of patients with schizophrenia USA	Quasi-experimental study comparing patients and relatives receiving the online intervention with a cohort of patients and relatives that had previously received TAU	Online = 26 TAU = 16	Online = 57 (10.7) TAU = 53.8 (10.3)	Online = 23% TAU = 6%	12 months	Intervention: Interactive website with information on 6 domains: medications, side effects, referrals, family support, employment and quality of life. Individualised feedback was provided to patients based on their responses to questions on each domain. Feedback was supplemented with video-clips with actors modelling communication strategies. Control group: 22-minute video about schizophrenia treatment and a brochure including 5 treatment recommendations included by the website Delivery: N/R Intervention took 20 min on average
Yakirevitch et al., 2010	To study the effects of a psychoeducational website for patients with schizophrenia (mostly hospitalized) Israel	Patients were randomized into 4 groups receiving different information through the website (i.e., pharmacological treatment, symptom management, patients' rights, and control)	28	N/R	N/R	2 weeks	Intervention: Interactive website with information on 6 domains: medications, side effects, referrals, family support, employment and quality of life. Individualised feedback was provided to patients based on their responses to questions on each domain. Feedback was supplemented with video-clips with actors modelling communication strategies. Control group: 22-minute video about schizophrenia treatment and a brochure including 5 treatment recommendations included by the website Delivery: N/R Intervention took 20 min on average
Steinwachs et al., 2011	To evaluate a web-based tool to support patients with schizophrenia in communicating with clinicians about evidence-based interventions USA	Patients were randomized to the web-based intervention or to a control group. Subsequent visits to clinicians were audiorecorded, analyzed and compared across groups	Intervention = 24 Control = 26	Intervention = 49 (12) Control = 50 (11)	Intervention = 63% Control = 69%	N/R	Website including information on pharmacotherapy, symptoms management and patients' rights Delivery: Website intervention was delivered at the inpatient unit (25 of 28 participants were hospitalized)

Anttila et al., 2012	To evaluate the use of web-based patient psychoeducation in inpatient care for patients with schizophrenia <i>Finland</i>	Web-based psychoeducation sessions conducted by nurses in 9 inpatient units in Finland	93	37.2 (12.2)	62%	Mdn = 10 days	5 psychoeducation sessions delivered daily or every 2 days on the following topics: (1) mental illness, (2) treatment, (3) well-being, (4) patients' rights, (5) daily life, plus peer support for patients and e-support through which patients could send questions to the psychiatric nurses Delivery: Inpatient units
Granholtm et al., 2012	To assess the feasibility and efficacy of a text-messaging intervention in patients with schizophrenia or schizoaffective disorder <i>USA</i>	Single group uncontrolled pilot study	55	Completers: 48.7 (9.1)	Completers: 69%	12 weeks	Mobile Assessment and Treatment for Schizophrenia (MATS): Participants were sent 3 sets of 4 interactive text exchanges each day, 6 days per week for 12 weeks. Each set targeted 1 of 3 intervention domains (i.e., medication adherence, socialization, and auditory hallucinations) through personalized CBT-based text messages based on information collected at baseline interview Delivery: Participants could be living independently or in an assisted living facility (57%)
Spaniel et al., 2012	To test the efficacy of a PC-to phone SMS platform designed to EWS of relapse in patients with schizophrenia at increased risk for relapse <i>Czech Republic</i>	Double-blind randomized controlled trial	ITAREPS = 75 Control = 71	ITAREPS = 32.4 (9.8) Control = 33.7 (10.4)	ITAREPS = 58.7% Control = 53.5%	12 months	ITAPERS (same as Spaniel et al., 2008a, 2008b) Control: ITAPERS but the email notification to the treating team was disabled
Van der Krieke et al., 2012	To develop and evaluate the usability of a web-based system integrating Routine Outcome Monitoring (ROM) and personalized advise in patients with schizophrenia spectrum disorders <i>The Netherlands</i>	Cross-sectional evaluation of the usability of the website including quantitative and qualitative methods	15	42 (23–61)	67%	N/A	The WEGWEIS support system provided patients with personalized advise on treatment, rehabilitation and personal recovery based on the patient's ROM assessment results Delivery: Usability test in laboratory-based environment
Alvarez-Jimenez et al., 2013	To evaluate the feasibility, acceptability, safety and initial clinical benefits of a novel online-based intervention specifically designed for young people with first episode psychosis <i>Australia</i>	Single group uncontrolled pilot study	20	20.3 (2.7)	50%	1 month	Horyzons adopted the MOST (Moderated Online Social Therapy Model) which integrated: i) peer-to-peer social networking, ii) individually tailored interactive psychosocial interventions, and iii) expert interdisciplinary and peer-moderation in a coherent platform designed to improve long-term outcomes in FEP Delivery: Patients using the system at their own discretion from any internet-enabled device
Gottlieb et al., 2013	To evaluate the feasibility, acceptability and impact on hallucinations of a web-based CBT intervention in patients with schizophrenia spectrum disorders and auditory hallucinations <i>USA</i>	Uncontrolled single group pilot study	21	40.1 (13.9)	62%	N/R	The Coping with voices intervention consisted of ten 45 to 80 min interactive lessons including exercises and games to exemplify CBT principles as well as behavioral and cognitive coping strategies aimed at reducing the severity, distress, and functional impairment caused by auditory hallucinations. It used video tutorials, interactive games and quizzes to enhance engagement and an anonymous social feed or forum Delivery: Sessions took place in offices at the mental health centers

3.2.3. Integrated web-based therapy, social networking and peer and expert moderation for FEP patients

A 1-month uncontrolled pilot study showed that integrated online therapy, social networking and peer and expert moderation in a real world setting were associated with moderate to large reductions in depression in FEP patients (Alvarez-Jimenez et al., 2013) (Table 1). Additionally, 60% of patients reported increased perceived social connectedness and 55% felt empowerment in their recovery process after 1-month using the online platform. On the other hand, there were no statistically significant improvements in anxiety levels at 1-month follow up.

3.2.4. Mobile-based interventions

A 2-year open trial with patients with schizophrenia and their carers evaluated the efficacy of weekly monitoring of early warning signs of relapse via a mobile phone (Spaniel et al., 2008a, 2008b) (Table 1). Responses were collected using SMS, and, if the total score exceeded a given threshold, an alert was declared and the treating psychiatrist is notified by an e-mail message. Compared with the 2 years before the intervention, there was a 77% reduction in the number of hospital admissions (Spaniel et al., 2008b). A subsequent 1-year RCT examining the efficacy of this intervention found no significant differences in hospital admission across treatment groups (Spaniel et al., 2012). However, this study was limited by the low adherence by treating psychiatrists to the treatment protocol, with only 39% of triggered alerts being followed by an increase in dose of antipsychotic medication (Spaniel et al., 2012). Further analysis showed a significant reduction in hospital admissions when the pharmacological protocol was closely followed (compared with declared alerts not leading to an increase in antipsychotic medication). Finally, a 12-week, uncontrolled, single-group study tested the clinical effects of an SMS-based intervention purposely designed to foster medication adherence and improve social outcomes and auditory hallucinations in patients with schizophrenia or schizoaffective disorders (Granholm et al., 2012). Study results revealed an increased number of social contacts, decreased hallucination severity and improved medication adherence (for those living independently) in real-time ecological momentary assessments. Conversely, no significant improvements were detected in psychotic symptoms, depression and independent living skills through validated measures at follow-up.

3.2.5. Summary of results. Preliminary research showed that web-based CBT may improve hallucination severity in patients with schizophrenia and persistent auditory hallucinations. Web-based psycho-education in combination with social networking for patients with schizophrenia and their carers yielded conflicting results regarding carers' perceived stress and social support, although it may improve positive psychotic symptoms when both patients and their carers are targeted by the intervention. Integrated online therapy, social networking and expert and peer support moderation showed promise in improving social connectedness and depression in patients with FEP. Finally, mobile-based interventions may provide a useful medium to monitor EWS of relapse and possibly prevent hospital admissions, while a tailored SMS-based intervention showed encouraging results in improving social contacts and hallucination severity. Conversely, no study provided positive findings in fostering functional outcomes using validated or objective measures.

3.3. Methodological quality

The quality of the included studies is summarized in Table 2. Description of methodology and results was poor in many studies, making it difficult to ascertain methodological quality. Only one randomized controlled trial reported adequate randomization procedures, blinding

of study-group assignments and had sufficient statistical power to detect moderate effects. For uncontrolled studies, only 3 measured acceptability and completion of the intervention against a priori criteria, and no study included assessors blind to study purpose and/or methodology.

4. Discussion

This systematic review examined 12 recent studies evaluating the acceptability, feasibility, safety or effects of user-led online or mobile-based interventions in patients with psychosis. Results showed that 74–86% of patients used the interventions effectively, 75–92% perceived them as positive and useful, and 70–86% completed or were engaged with the interventions over the follow-up. Likewise, online and mobile-based interventions showed promise in improving a number of outcomes including positive psychotic symptoms, hospital admissions, socialization, social connectedness, depression and medication adherence.

4.1. Feasibility and acceptability vs. engagement

Overall the extant research supports the acceptability and efficient use of web or mobile interventions by people suffering from psychosis. These results are consistent with recent studies showing that patients with schizophrenia participate in specialized online forums using equivalent communications skills and discussing the same topics as do relatives and caregivers (Haker et al., 2005). Similarly, patients with psychosis have been shown to utilize the Internet skillfully to form social connections that carry over to real life relationships just as frequently as healthy controls (Spinzy et al., 2012).

There is little evidence, however, on the ongoing engagement of patients with psychosis with Internet or mobile-based interventions. With the exception of two 12-month trials (Glynn et al., 2010; Rotondi et al., 2010), all the included studies had intervention periods ranging from 4 to 8 weeks, which precluded the analysis of long-term engagement with Internet or mobile-delivered interventions. In addition, several studies tested these novel interventions in controlled or hospital-based settings, limiting their ability to determine the spontaneous engagement of patients with psychosis with online or mobile interventions in the community. The limited available data suggests a marked variability in the use of, and engagement with, online and mobile-based interventions over time, with some patients showing regular or intermittent use and others (approximately 25–30%) not engaging or dropping or during the follow-up (Rotondi et al., 2010).

Only 4 studies provided data on patient attributes or intervention characteristics associated with the use of online or mobile intervention in patients with psychosis. Specifically, poorer functioning and more severe psychotic symptoms were associated with more difficulties completing online psycho-education sessions (Anttila et al., 2012), while those dropping out of a text-messaging intervention had more negative symptoms, lower premorbid IQ and poorer self-reported living skills (Granholm et al., 2012). With respect to intervention features, one study incorporating online psycho-education and discussion forums for people with schizophrenia and their carers found that the time spent on forums was significantly higher compared with the time spent on psycho-educational activities (Rotondi et al., 2005, 2010). Alvarez-Jimenez et al. (2013) reported a high level of use and interest in online social networking by many young people with FEP, whereas some patients preferred undertaking interactive psycho-educational modules (Alvarez-Jimenez et al., 2013). Taken together these findings indicate that both patient attributes (e.g., cognitive variables, level of functioning, and age) and characteristics of the interventions (i.e., different features, content and their integration) have

Table 2
Methodological quality of included studies.

Randomized controlled trials									
Study	Sequence generation	Allocation concealment	Blinding	Incomplete outcome data addressed	Selective outcome reporting	Balance of baseline characteristics	Acceptability of the intervention assessed against a priori criteria	Equivalent amount of time in treatment	Statistical power to detect moderate effects
Rotondi et al., 2005, 2010	Unclear	Unclear	Unclear	Yes	Unclear	Unclear	Yes	No	No
Yakirevitch et al., 2010	Unclear	Unclear	Unclear	Unclear	No	Unclear	Unclear	Unclear	No
Steinwachs et al., 2011	Unclear	Unclear	Unclear	Unclear	Unclear	Yes	No	Yes	No
Spaniel et al., 2012	Yes	Yes	Yes	Unclear	Unclear	Yes	Yes	Yes	Yes
Uncontrolled studies reporting on intervention effects									
Study	Assessors blind to study design or purpose		Incomplete outcome data addressed			Acceptability and completion of the intervention assessed against a priori criteria			
Glynn et al., 2010	No		Unclear			No			
Anttila et al., 2012	No		Unclear			No			
Granhölm et al., 2012	Unclear		No			No			
Gottlieb et al., 2013	No		No			Yes			
Alvarez-Jimenez et al., 2013	No		Yes			Yes			
Spaniel et al., 2008a, 2008b	No		Unclear			Yes			

important effects on the take-up of online and mobile-based interventions. Similarly, it is likely that there are distinct user profiles (i.e., ‘social networkers’ vs. ‘therapy readers’) and user needs which influence patients’ usage of, and benefit from, these interventions. Flexible interventions that account for potential cognitive deficits and integrate different technologies (e.g. mobile phones and computer-based), evidence-based therapy and online social networking are more likely to cater for different patients’ needs and preferences producing more acceptable and engaging online environments.

4.2. Effects of online and mobile-based interventions for psychosis

Preliminary evidence shows that online and mobile-delivered interventions offer promise in improving several outcomes in psychosis such as psychotic symptoms, socialization, perceived social connectedness, depression and medication adherence. A recent study reported that web-based CBT focused on reducing the distress and functional impairment caused by persistent auditory hallucinations was associated with improved symptom severity (Gottlieb et al., 2013). That being said, the intervention was evaluated in a controlled environment and there was no control group, limiting both causal attributions and the external validity of the intervention effects.

Two 12-month studies investigated the effects of Internet-based family interventions for patients with psychosis and their carers (Rotondi et al., 2010), or carers only (Glynn et al., 2010). Rotondi et al. (2010) conducted a RCT assessing the efficacy of an online psycho-education program in tandem with professionally moderated patient and carer forums (i.e., separate and joint forums) compared with treatment as usual. The online intervention improved positive psychotic symptoms, but there were no significant effects on other clinical, social or family related variables. Glynn et al. (2010) conducted a quasi-experimental study evaluating the efficacy of an online multifamily intervention for relatives of patients with schizophrenia. The intervention comprised a real-time, professionally moderated chat program for anonymous groups of 5 to 6 relatives, a discussion board, and educational material on behavioral family interventions. In contrast with the results of Rotondi and colleagues, this study showed the online intervention did not have a significant effect on patients’ clinical status, while relatives’ stress levels improved over time (Glynn et al., 2010).

When taken together, these findings indicate that it may be necessary to involve patients in online family interventions to realize positive clinical results. Alternatively, it may be that Glynn’s study was underpowered to detect clinical improvements in patients. On the other hand, in order for online interventions to bring about improved family outcomes they may need to specifically address carers’ needs, distress and burden as opposed to focusing solely on the carer role or the management of psychosis. This is supported by the finding that patients had up to 7 times as much activity on the website as did their relatives in an online intervention focused on improving patient’s clinical outcomes (Rotondi et al., 2005, 2010).

A single-group pilot study examined the effects of online social networking in conjunction with interactive therapy plus professional and peer moderation in FEP (Alvarez-Jimenez et al., 2013). Social networking and online therapy were fully integrated, with users’ therapy-related activity being displayed in the social network. Likewise, online therapy modules incorporated ‘talking points’, prompting participants to discuss therapy themes and practice therapeutic techniques within the social network (i.e. the MOST model (Alvarez-Jimenez and Gleeson, 2012; Gleeson et al., 2012)). Results from this study provided preliminary support for the safety and benefits of online social networking in FEP, suggesting that social media may empower young people and foster social connectedness in this group. Further, the study showed a statistical reduction in depression scores at 1-month follow-up, particularly in those with more frequent use of the website (Alvarez-Jimenez et al., 2013). While encouraging, these findings need to be validated via a well-powered RCT with a significantly longer follow-up period. This study is currently underway.

Finally, three studies have shown that interventions delivered through mobile phones may bring about improved outcomes in psychosis. Firstly, Spaniel and colleagues showed that weekly monitoring of early warning signs of relapse via SMS followed by early evaluation and intervention strategies (i.e., increase of antipsychotic dose) may prevent hospital admissions (Spaniel et al., 2008a, 2008b). A subsequent RCT testing this intervention showed that the reductions in hospital admissions were only achieved if the pharmacological protocol was closely followed, casting some doubts on the acceptability of the intervention to the clinicians (Spaniel et al., 2012). Interestingly, Granhölm et al. (2012) administered personalized cognitive behavioral interventions in real time through text messaging. Daily text messages assessed thoughts and behaviors and subsequently delivered pre-elicited thought-

challenging messages and personalized behavioral coping strategies. The intervention was associated with a significant improvement in auditory hallucinations and number of social interactions, with medication adherence improving for those living independently (Granhölm et al., 2012). Taken as a whole, these preliminary findings indicate the mobile technology has the potential to measure clinically meaningful variables and deliver effective around-the-clock interventions for patients with psychosis. As mobile technology progresses and new generations of smartphones become widespread, unique opportunities will arise to deliver and evaluate context-dependent, real-time, fully personalized support.

4.3. Challenges ahead

This review highlighted significant challenges in the field. First, data on long-term use of online and mobile-based interventions was very limited, with some indication that ongoing use varied markedly among users and a significant proportion did not actively use the interventions on an ongoing basis. Just as long-term engagement in effective face-to-face interventions poses a major challenge in psychosis treatment, it is likely that keeping patients involved in online and mobile-based interventions will also constitute a challenge in this emerging field. Novel online social media-based technologies will provide an attractive avenue to develop flexible interventions that cater for different user's needs and preferences. As information technologies advance rapidly, new interventions will need to offer current, cutting edge technology with end-users being involved in the design and delivery of the interventions (Alvarez-Jimenez et al., 2013). In addition, it is likely that interventions focused on positive constructs such as personal strengths, positive affect and self-efficacy maximize users' engagement while reducing the reported risks of over-exposure to negative, deficit-focused content (Alvarez-Jimenez et al., 2012a). Secondly, no study demonstrated improved psychosocial outcomes as measured through validated or objective instruments. For example, one study showed only a marginal proportion of participants followed through with homework, despite completing the online sessions (Gottlieb et al., 2013). In order for online interventions to have an impact on patients' level of functioning, they need to provide creative solutions that bridge the gap between the online world and real recovery. Mobile, in-real-time interventions delivering action-focused, context-relevant therapeutic strategies will become the obvious candidates to bring about real word changes.

4.4. Methodological issues and future research

A number of important methodological limitations were identified in the emerging literature on Internet and mobile-based interventions for psychosis. First, the majority of the included studies used uncontrolled designs, providing only preliminary evaluations of the acceptability, feasibility, safety and effects of these novel interventions. Only 4 studies employed randomized controlled designs, but trial reporting was generally poor, making it difficult to ascertain methodological quality. In addition, with one exception (Spaniel et al., 2012), all studies were underpowered to detect moderate treatment effects. Finally, there was significant variation in the type of interventions and outcomes evaluated, with no findings being replicated across 2 or more studies. Future studies should investigate the effects of these novel interventions through well-conducted, properly powered, clinical trials.

Second, as noted above, the extant research reveals a marked heterogeneity in the take-up and use of these interventions by people with psychosis. This issue is of clinical relevance as research on eHealth interventions has consistently demonstrated high attrition rates (Eysenbach, 2005). Future studies should report on the proportion of, and degree to which, patients engage with different

aspects of online or mobile interventions over time, as opposed to providing mean use of these interventions across the sample. Further, non-completion and good engagement with the interventions should be measured according with a priori-established criterion. Likewise, design, content and interface aspects of online and mobile-based interventions should be carefully analyzed to tease out their potential differential effects. This will enable us to identify different user profiles as well as patient and intervention variables associated with take-up and treatment effects. Importantly, this will inform the next generation of Internet-based interventions for psychosis and pave the way for a better understanding of what works and for whom in this rapidly expanding field.

Third, although a number of studies provided details on the procedures employed to develop the interventions, only four intervention studies reported involving end-users at some point in the design process (Rotondi et al., 2007, 2010; Anttila et al., 2012; Granhölm et al., 2012; Alvarez-Jimenez et al., 2013). These findings are at odds with general calls to involve patients in all stages of the design process in order to develop engaging, meaningful and clinically relevant interventions (Hagen et al., 2012). Patients' involvement should include both generation of ideas and providing feedback on existing designs (Hagen et al., 2012). Finally, the development of future online interventions should follow theory-driven models and testable hypothesis on potential variables influencing engagement and treatment effects (e.g., automated vs. human supported systems, type of human moderation (Mohr et al., 2011), level of intrinsic motivation, insight, cognitive deficits).

Lastly, only 2 studies described safety protocols and reported on adverse events and perceived safety of the online interventions (Glynn et al., 2010; Alvarez-Jimenez et al., 2013). Although online social networking and around-the-clock interventions provide a unique opportunity for improving social functioning and preventing relapse and even suicide, it also introduces practical and ethical dilemmas. To address this issue, rigorous protocols for safety need to be devised. Recommendations to optimize safety in Internet-delivered interventions for patients with psychosis include: enclosed online environments (Valimäki et al., 2008) with exclusion of high-risk patients (e.g., participants with significant paranoid ideation or antisocial personality traits), regular monitoring and moderation of online interactions (Sharkey et al., 2011; Gleeson et al., 2014), visible emergency guidelines and contact information for users (Glynn et al., 2010; Sharkey et al., 2011), a report button for users (Gleeson et al., 2014), computerized monitoring of self-harm-related terms (Goh, 2009; Gleeson et al., 2014), clear forum guidelines (Sharkey et al., 2011), and a detailed emergency response protocol (Depp et al., 2010; Alvarez-Jimenez et al., 2012a).

4.5. Conclusions

Recent studies support the acceptability and feasibility of Internet and mobile-based interventions for psychosis and provide encouraging preliminary results regarding their clinical and psychosocial potential. However, the marked diversity and early state of current research preclude any definite conclusions. New interventions should be evaluated through controlled, well-powered studies. These studies should carefully examine rates of engagement as well as intervention and patient factors associated with take-up and intervention effects. The development of novel interventions should actively involve end-users and be built on testable theory-driven models and hypotheses on variables affecting engagement and effectiveness.

Importantly, new interventions should provide flexible and enriching online environments, which maximize engagement opportunities and treatment benefits and cater for different user's profiles and needs. Ultimately, the Internet has the potential to foster recovery in people with psychosis beyond what is possible in traditional

interventions. Internet-based support can be empowering, enabling consumers to link up, and even shape the nature of the services, support, and care they are receiving in line with the main principles of the recovery framework.

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Contributors

M.A.-J., M.A.-C and C.G.-B. performed the literature search and extracted data from the selected articles. M.A.-J wrote the first draft of the manuscript. S.B., P.D.M. and J.F.G. contributed to the design of the study, participated in the consensus process, and critically revised the manuscript. All authors contributed to and have approved the final manuscript.

Conflict of interest

The authors report no additional financial or other affiliation relevant to the subject of this article.

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