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Technology-Delivered Mental Health Interventions for People Living with HIV/AIDS (PLWHA): a Review of Recent Advances

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Abstract

HIV/AIDS infection and psychiatric diagnoses are closely linked, with an estimated 50 % of HIV-infected individuals diagnosed with co-occurring mental health disorders. Mental health disorders have been shown to be associated with HIV acquisition as well as poor treatment outcomes for those infected with HIV. Therefore, behavioral interventions to improve HIV/AIDS health outcomes have included interventions addressing mental health co-morbidities, such as depression and anxiety, and the use of technology to facilitate such intervention is growing. The current review focuses on research published between January 2011 and April 2015, exploring technology-based interventions aimed to improve health outcomes among HIV/AIDS individuals with co-occurring mental health symptoms. Technologies identified in this review included telephone-delivered and computer-delivered interventions. Despite rapid advances in technology use in the medical professions, particularly in the area of psychiatric treatment, little has been translated into the area of mental health research in the context of HIV disease. This review reveals that the widespread dissemination of various technologies, especially technologies facilitating access to care among vulnerable and marginalized populations, may be a necessary way to offer evidence-based mental health interventions to HIV/AIDS populations in need.

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Human and Animal Rights and Informed Consent With regard to the author's research cited in this paper, all procedures were followed in accordance with the ethical standards of the responsible committee on human experimentation and with the Helsinki Declaration of 1975, as revised in 2000 and 2008.

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Keywords

Mental health; HIV/AIDS; Technology-based intervention; Telepsychiatry; Telemedicine; People living with HIV/AIDS (PLWHA)

Introduction

Behavioral intervention technologies and telemedicine have a documented history of being used to screen, treat, monitor, and communicate with patients with mental health disorders [1••]. Initial reports of telepsychiatry date to 1959, when Dr. Cecil Wittson was the first to demonstrate that using two-way black and white television to deliver group therapy was not only acceptable to patients but also was as effective in therapeutic outcomes as face-to-face sessions [2]. Technologies used in the context of telemedicine have been advancing rapidly since Dr. Wittson's groundbreaking work. An increasing selection of technologies have been integrated into mental health interventions, including telephones, instant messaging, videoconferencing, web-based interventions, computer programs, mobile technologies, virtual reality, conversation agents/virtual humans, and gaming [1••, 2, 3]. However, while an estimated 50 % of HIV/AIDS patients have been diagnosed with mental health co-morbidities affecting HIV treatment outcomes, little is known about the use of behavioral intervention technologies aiming to improve mental health outcomes among people living with HIV/AIDS (PLWHA) [4].

Behavioral interventions have been effectively used to improve mental health outcomes among PLWHA in traditional clinic settings, but few have capitalized on the increased utility of technology to disseminate interventions across marginalized and hard to reach populations and remote geographic areas [5, 6]. However, with the increasing and widespread uptake of mobile phones and smartphones, telephone-based interventions have been effective in communicating, monitoring, and providing therapy to PLWHA [7–12]. One of the main uses of the cell phone, besides sending text messages, remains voice calling. In the context of mental health, teletherapy is defined as the use of telecommunication devices (e.g., traditional landline or cellular phones) to deliver psychological services [13, 14]. Several advantages of using telephone-based technology for psychotherapy among PLWHA have been reported, most notably ease of scheduling and flexibility in selecting location of therapy, which may help overcome barriers of HIV- and mental health-related stigmas as well as transportation costs [15–17].

Based on a report by the Pew Research Center in 2012, the majority of adults in the USA who own a cell phone (ca. 85 %) use their phone mainly to make regular voice calls. However, the use of text messaging as a means of communication has increased significantly among adults 18 and older, with 80 % reporting they send or receive text messages [18]. Contrary to the belief that most technologies are not available to minority populations, minority adults living in the USA (i.e., African Americans and English-speaking Hispanics) are not only more likely than Caucasians to own a cell phone (87 vs. 80 %), they are also more likely to send or receive text messages throughout the day, with a median of ten texts a day for African Americans and Hispanics and five texts a day for Caucasians [7].

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Despite demonstrated advantages of using telephone-based interventions, its implementation within the field of mental health and HIV disease has been limited. While mental health co-morbidities among HIV-infected populations represent a wide array of psychiatric disorders, depressive symptoms seem to be the most prevalent and showing the most consistent and perhaps strongest association with adverse clinical outcomes among PLWH, such as non-adherence to antiretroviral therapy, increase of HIV-related morbidity, and higher overall mortality [4, 19–23]. Therefore, it is not surprising that the majority of the studies testing telephone-based interventions among HIV-infected populations suffering from co-morbid mental health conditions include therapeutic approaches aiming to decrease depression symptoms directly or indirectly [24••, 25••, 26].

Computerized interventions due to its potential for widespread dissemination—similar to mobile health technologies—provide the opportunity to deliver behavioral interventions and health-related knowledge and education more rapidly and potentially more effectively to hard-to-reach populations. Several advantages of computer-delivered interventions have been noted such as 24-h access, uniformity of intervention and knowledge delivery, anonymity and privacy of access, and the ability to tailor and adapt computer-delivered interventions to various populations and individuals [27, 28]. Therefore, computer-delivered interventions have been increasingly used to effectively deliver behavioral interventions addressing various health behaviors such as nutrition, tobacco use, substance use, safe sexual behavior, as well as general health maintenance [29]. More specifically, computer-delivered cognitive behavioral therapy has shown to be effective in improving depression and/or anxiety outcomes [30–33]. Computer packages available suggested to impact mental health outcomes include *Beating the Blues*, *MoodGYM*, *Living Life to the Full*, *COPE*, and *Color Your Life* and have recently been reviewed among others in a meta-analysis by Grist et al. [32]. The review evaluates the effectiveness of computerized cognitive behavioral therapy (cCBT) for common mental health disorders (CMHD) among 49 selected trials. Results indicated an overall mean effect size of g=0.77 (95 % CI 0.59–0.95) in favor of the cCBT trial arms in comparison to other control interventions or waitlist controls. An analysis of moderating factors revealed that mean participant age (i.e., younger age vs. older age) and type of control group (i.e., wait list control vs. other therapy) significantly moderated effect sizes among the studies reviewed. Type and frequency of therapeutic support accompanying the intervention did not moderate effect sizes. While this review indicates great promise regarding computerized delivered CBT, little is known regarding its efficacy among PLWHA diagnosed with mental health disorders.

In this review, we summarize recent evidence and advances in technology use within the context of HIV infection and mental health co-morbidities.

Methods

Literature Search

A two-phase search strategy was employed to identify articles that were published within the past five years (January 2011–April 2015). The initial search phase focused on identifying the full range of articles that may potentially be related to the topic of interest. The search phrase paired terms related to technology-based interventions with terms related to mental

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health conditions and HIV/AIDS were submitted to the following online databases: MEDLINE, PubMed, PsycINFO, Cochrane Central Register of Controlled Trials, Cochrane Database of Systematic Review, and Health Technology Assessments. To capture relevant studies, a combination of the following search terms were used: ((technolog* OR telepsychiatry OR tele-mental health OR teletherapy OR e-mental health OR e-therapy OR telemedicine OR teleconferencing OR videoconferencing OR telephone OR phone OR text* OR computer* OR computer-based OR internet-based OR web-based OR virtual reality OR gaming) AND (HIV OR AIDS OR HIV/AIDS) AND (mental health OR depression OR anxiety OR bipolar OR *stress)). Similar search terms and prominent authors (for example, Heckman et al.) were also entered in online search engine such as Google Scholar to identify related articles. The initial search (April 2015) yielded a total of 1,056 abstracts or titles. After excluding (a) duplicated articles, (b) non-technology-based interventions, and (c) non-mental health-specific findings, a total of 45 potential articles were identified.

Inclusion Criteria

The abstracts of the 45 articles identified in the initial search were reviewed by two authors (MK and RS) to determine whether a study met the following inclusion criteria: (a) published in peer-reviewed articles within the past 5 years (January 2011–April 2015); (b) mental health outcomes were addressed using behavioral intervention technologies; (c) the population of interest was defined as PLWHA with any mental health symptoms; and (d) a randomized controlled trial design (RCT) was employed to examine the effect of intervention on study outcomes.

Results

A total of six studies that met the inclusion criteria are highlighted in the current review. Technologies identified include telephone-delivered interventions (n=4) and computer-delivered interventions (n=2) aiming to improve adherence to psychotropic and antiretroviral medicines and effectively deliver psychotherapies for depression and anxiety disorders among PLWHA (Table 1). The review is structured by describing the type of technology used to deliver the mental health intervention, followed by a detailed description on study populations and clinical outcomes.

Telephone-Based Interventions

Voice Calling Interventions—Given the high prevalence of depression co-morbidity in PLWHA and its strong association with adverse clinical outcomes among PLWHA, it is not surprising that the majority of the studies testing telephone-based interventions among HIV-infected populations suffering from co-morbid mental health conditions include therapeutic approaches aiming to decrease depression symptomatology directly or indirectly [24••, 25••, 26].

Heckman and colleagues effectively used empirically validated group psychotherapy administered via telephone-conference technology to reduce depression symptoms in HIV-infected middle-aged and older adults [24••]. The study utilized supportive-expressive group therapy, which allows patients with life-threatening conditions to discuss their existential

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concerns regarding their disease, express and manage disease-related emotions, increase social support, enhance relationships with family and physicians, and improve symptom control [38]. Supportive-expressive group therapy in comparison to coping effectiveness training or a standard of care control group (i.e., access to community-based services) was demonstrated to be effective in reducing depressive symptoms among HIV-infected older adults at post-intervention and 4- and 8-month follow-up visits. Each therapy arm consisted of 12 therapy sessions—all conducted via group conference calls. Secondary analysis indicated a dose–response relationship for therapy sessions attended for supportive-expressive group therapy, as well as an increased benefit for those entering the study at baseline with elevated depression symptoms. Furthermore, older heterosexual PLWHA in particular seemed to benefit from supportive-expressive group therapy, while older men who have sex with men (MSM) who participated in supportive-expressive group therapy did not demonstrate any significant differences in depression symptomatology in comparison to those receiving standard of care [34].

While several studies, as the one by Heckman et al. [24••], have shown that telephone-delivered interventions can effectively decrease depressive symptoms, the question whether telephone-delivered interventions are as effective as face-to-face interventions remains unanswered. Recently, Himelhoch et al. demonstrated in a pilot randomized trial that telephone-based cognitive behavioral therapy (CBT) is efficacious in treating major depression among low income, urban-dwelling minority patients [25••]. Depressive symptoms, measured by using the Hamilton rating scale for depression (HAM-D), were significantly reduced in the face-to-face therapy arm (HAM-D, effect size=−1.2) and the telephone-delivered therapy arm (HAM-D, effect size=−0.90). The investigators were able to show that delivering telephone-based CBT among economically disadvantaged individuals was feasible and therapy satisfaction did not differ from the face-to-face CBT intervention.

In addition to interventions aimed to directly decrease depressive symptoms among HIV-infected patients, indirect intervention effects on depression symptoms have been described. A study conducted by Lovejoy demonstrated that telephone-delivered motivational interviewing aimed to reduce risky sexual behavior in HIV-infected middle-aged (i.e., >45 years of age), and older adults demonstrated secondary benefits of reducing depression, anxiety, and stress at 6-month follow-up, relative to a standard of care control, with consistently moderate to large effect size with Cohen's *d* scores ranging from 0.54 to 0.90 [26]. While study participants (n=100) had non-clinical levels of psychological distress at the initiation of the study when compared to mean Depression Anxiety Stress Scale (DASS) scores from normative community samples [39] and thus had little room for improvement, significant improvements in depression scores were still evident [26].

Text Messaging Interventions—Accordingly, various telephone-delivered interventions, utilizing text messaging, have been evaluated for their impact on the health of socioeconomically disadvantaged minority populations [40]. Interventions involving automated and individualized text messaging systems have been shown to improve knowledge and health outcomes in a variety of health areas, domestically and internationally [41–48]. The accessibility and widespread use of cell phones underscore the utility and potential of text messaging to improve people's health and change people's behavior.

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Studies using text messaging to improve health outcomes within the context of HIVand mental health co-morbidities are very limited, especially given the accelerating use of texting within the public and the health professions more specifically. Moore et al., in a recently published randomized control trial, demonstrated the feasibility of implementing a personalized two-way adherence text messaging intervention among HIV-infected individuals with co-occurring bipolar disorder (HIV+/BD+) [35]. Participants in the intervention arm (i.e., iTAB) received personalized medication adherence reminders daily for both antiretroviral (ARV) and psychotropic medications, whereas both groups received daily text messages to assess mood. While overall daily adherence to ARV and psychotropic medications did not differ between participants in the iTAB group vs. control arm, ARV dose timing was significantly improved in the iTAB group (Cliff's d=0.37) as measured by electronic monitoring caps (i.e., Medication Event Monitoring System Track Caps (MEMS caps)). The authors note that overall adherence was high in all participants regardless of intervention arm, with ~85 % adherence to ARVs and ~78 % adherence to psychotropic medications over the 30-day study period. However, no baseline adherence assessment was reported, nor was medication non-adherence an entry criteria into the study, potentially leaving little room for improvement. Yet, intervention responsiveness was extremely high with a >90 % response rate to study text messages, indicating participant engagement. Furthermore, the study does indicate differential medication intake behavior, with higher adherence levels for ARVs than psychotropic medications. Additional studies need to evaluate the utility of text messaging in multi-co-morbid PLWHA recognizing the need to effectively manage and monitor multiple health issues to improve overall clinical outcomes.

Computerized Interventions

Very little has been reported on the utility of computer-delivered interventions among HIV-infected populations in the context of mental health disorders or the reductions of mental health symptomatology [49]. Brown et al. [36] pilot-tested a brief, theory-guided, computer-delivered, stress management intervention for HIV-infected women that demonstrated improved stress management knowledge among study participants. HIV-infected women (n=60) were randomized to an immediate or delayed intervention condition, with psychological functioning, perceived stress, coping self-efficacy, and stress management knowledge being assessed at baseline and 1-month follow-up visits. The computerized stress management training was administered in one session (ca. 90 min duration) and was adapted based on a previously validated coping effectiveness training intervention for PLWHA [50]. The investigators hypothesized that the computerized stress management intervention would increase coping self-efficacy to manage stressors, decrease levels of perceived stress, improve positive affect and global psychological functioning, reduce self-reported psychological symptom, and increase stress management knowledge. However, stress management knowledge was the only outcome significantly improved in the immediate vs. the delayed control intervention arm (effect size: η^2=0.12). Various reasons are suggested for the unexpected negative results on health outcomes, such as intervention duration (i.e., single session lasting 90 min), small sample size (i.e., 60 HIV-infected women), and single follow-up at only 1-month post-intervention. Furthermore, while participants' psychological symptoms and distress levels varied across the study sample, the sample was too small to

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allow for analyses providing information whether effects of the intervention may vary by symptom and distress level experienced.

Hersch et al. evaluated the effectiveness of a web-based adaptation of the Life-Steps intervention (i.e., single-session cognitive behavioral HIV medication adherence intervention [51–55]) in combination with an evidence-based stress reduction and mood management program to improve medication adherence among PLWHA [37]. While the study showed a significant increase in ARV adherence and better viral load outcomes among participants randomized to the Life-Steps intervention as measured by MEMS caps, no significant effects of the web-based intervention were found on stress reduction or mood management. However, completion of stress reduction and mood management modules was low, with less than half of intervention participants accessing the modules dedicated to these topics.

Discussion

Advances of Technology-Based Interventions

Studies conducted by Heckman et al. demonstrate the feasibility and acceptability of telephone-based delivered CBT to reduce depression in PLWHA [24••, 34]. Their findings laid the foundation for the development and implementation of future group interventions delivered via phone. However, findings that group-level interventions may not be the ideal intervention format for MSM as they may benefit more from a one-on-one intervention format suggest that specific tailoring to the individual needs of MSM may be necessary, given the numerous issues they may be facing in their lives, such as continuing discrimination despite some gains, alienation by family members, and ongoing stigmatization enacted through society and policies [56]. On the contrary, heterosexual HIV-infected older adults may welcome the community of a group therapy session given that they may be fewer networks of people living with HIV they may easily identify with. However, given the pilot nature of studies conducted so far, it is still too premature to draw any conclusions regarding the equivalence of face-to-face and telephone-delivered psychotherapy interventions.

While the majority of telephone-based intervention studies attempt to directly decrease depressive symptoms among HIV-infected patients, indirect intervention effects on depression symptoms have been described. Lovejoy et al. demonstrated that evaluations of combined mental health and risk reduction interventions are needed, potentially providing an additive effect on reducing sexual risk behavior and psychological distress, relative to singly targeted interventions [26, 34]. Studies like this are needed with a focus on HIV-infected persons to better understand the interrelation of risk behaviors, structural and socioeconomic disparities, and psychological distress.

Findings from Brown et al. [36] provide preliminary data suggesting its efficacy in promoting health-related knowledge in PLWHA. This study also highlights the limited evidence base regarding the utility of computer-delivered health behavior interventions among HIV-infected populations. Evidence for these approaches has only been gathered using pilot studies and thus warrants larger, full-scale efficacy trials in the future.

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In addition to integrating technology with mental health and/or behavioral interventions, there are many different ways to maximize the use of technology-based approaches. Computer tablets are currently used in a multi-center cohort study applying computerized adaptive tests (CATs) integrated within the Patient-Reported Outcomes Measurement Information System (PROMIS) to routinely collect patient-reported outcomes during routine clinic visits. Mental health outcomes assessed include depression and anxiety symptomatology, for real-time clinical assessment among PLWHA [57]. Broader emphasis in the future should be given to integrate a wide array of technologies in all aspects of health care delivery, communication, and monitoring.

Emerging Technologies

The majority of interventions identified in this review focused on the delivery of technology-adapted psychotherapies, with only a few evaluating the use of mobile technologies to monitor mental health status or symptoms in PLWHA. However, recent research studies have used wireless technologies to monitor health status, symptoms, and behavior in real time longitudinally. For example, real-time adherence-monitoring has been described and successfully used in PLWHA in the context of antiretroviral therapy intake; however, it has not been implemented for the intake of psychotropic medicines [58, 59]. Similarly, t-shirts with embedded sensors (i.e., textile electrodes) that monitor electrocardiogram heart rate variability (HRV), piezoresistive sensors measuring respiration activity, and triaxial accelerometers for activity recognition, when combined with smartphone technology, could provide critical information on the association of medication intake behavior and psychological and physiological distress over time [60••]. Electronic monitoring systems, embedded in wearable textiles, will present new opportunities to support clinical decision-making and disease management. Besides the advantage of wireless technology to assess patients remotely in their everyday lives, studies need to capitalize on the increasing demand and dissemination of wireless technology into remote areas, providing access to mental health and HIV care to populations living in rural and geographically remote areas. Videoconferencing has been effectively used in the area of psychiatry and the criminal justice system to deliver therapy and medical care across various disadvantaged populations [61–64]. However, while HIV infection in particular is highly prevalent in minority and socioeconomically disadvantaged populations, who are often hard to reach and suffer from various forms of stigma and discrimination, the use of wireless technologies would offer new avenues and opportunities to overcome psychosocial and structural barriers to access health care and promote adherence to care. Despite the remaining challenges of internet connectivity in some rural areas of the USA, persons from minority or disadvantaged communities have been shown to have high rates of mobile phone and text messaging use, and therefore leveraging these technologies in these populations is an important area for continued research.

Last but not least, social media technology could provide opportunities to create virtual communities of social support that are urgently needed for those isolated by HIV disease and co-occurring mental health disorders. However, while none of these approaches will fit all, as demonstrated by Heckman and colleagues, who demonstrated that phone-delivered group therapy sessions were more effective among heterosexual older age PLWHA than

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homosexual PLWHA, careful evaluation of the appropriateness of technologies used for intervention delivery in various populations is needed [34]. Furthermore, dissemination and uptake of technologies domestically and globally will develop rapidly; therefore, interventions need to be flexible and adaptable over time to accommodate changes and upgrades in technology to not become obsolete when new technologies emerge.

Conclusion

Our review on technology-based interventions, which aim to promote behavior change in HIV-infected patients with cooccurring mental health symptomatology, revealed evidence for the utility and potential of technologies to improve mental health outcomes in PLWHA. Technologies currently used and evaluated in the context of mental health and HIV disease include phone-delivered interventions, using voice and texting modalities to communicate with or alert patients via messages, and computer-delivered interventions. Phone interventions in particular seem to be acceptable and effective in improving psychological outcomes when used for the delivery of psychotherapy individually or via group sessions. While studies identified in this review provide evidence for intervention efficacy, especially those using cognitive behavioral therapy-based interventions, significant gaps in technology use in PLWHA with psychological distress were evident.

Future studies need to assess the utility of computer-delivered interventions in PLWHA with co-morbid mental health disorders more broadly, evaluating various content and delivery modalities across different populations. Comparative effectiveness studies using face-to-face comparisons will provide additional information needed on the value of intervention/therapy components most acceptable and feasible to be implemented via computers. Furthermore, it is critical to assess psychological symptom patterns and disorders at baseline using diagnostic instruments to more rigorously assess the effect of interventions evaluated. Studies of current and emerging technologies can benefit from the use of established diagnostic instruments and symptom severity rating scales. Along with this, the routine use of consensus diagnosis conferences, ideally employing experienced doctoral level clinicians to clearly establish mental health diagnoses, can only enhance this important knowledge base.

Despite the growing use and effectiveness of new and emerging technologies outlined in this review, in the USA, many state licensing boards and practice laws have failed to keep pace with changing practice patterns and opportunities. For example, only a limited number of states allow mental health clinicians to practice across state lines or provide licensing reciprocity, as a result states vary considerably regarding how they approach the use of telemental health and broad uptake of new treatment approaches may be hindered in many jurisdictions [65]. In large part, this is related to the many new ethical and privacy challenges that new technologies present, which state and national practice organizations may be struggling to keep up with. Therefore, evidence-based technology-based interventions may yet face dissemination and implementation barriers unrelated to intervention content and its associated costs.

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Table 1

Technology-based mental health interventions for people living with HIV/AIDS (searched conducted on May 28, 2015)

Author, year	Targeted MH condition and health behavior	MH intervention	Duration of intervention	Sample	Results
I. Telephone-based interventions (*n*=5)					
Heckman et al., 2013 [24••]	Depression	11: Supportive-expressive group therapy (tele-SEGT) 12: Coping effectiveness training (tele-CET) C: Standard of Care (SOC)	12 weekly sessions (90 min per session, 6-8 people per group)	HIV+ older adults; 11: *n*=122; 12: *n*=118; C: *n*=121	Participants in the tele-SEGT group reported fewer depressive symptoms compared to the tele-CET group at post-intervention and 8-month follow-up as well as to the SOC controls at post-intervention, 4-, and 8-month follow-up
		11: Supportive-expressive group therapy (tele-SEGT) 12: Coping effectiveness training (tele-CET) C: Standard of Care (SOC)	12 weekly sessions (90 min per session, 6-8 people per group)	HIV+ older men who have sex with men (MSM): *n*=149; heterosexual: *n*=212	MSM and heterosexual participants attended comparable numbers of group sessions. Heterosexual participants received t-SEGT had significantly greater reductions in depressive symptoms compared to SOC controls
Himelhoch et al., 2013 [25••]	Major depression and HAART adherence	I: Telephone-based Cognitive behavioral therapy (T-CBT) C: face-to-face (f2f) therapy	11-session	Low-income, urban-dwelling people with HIV/AIDS; I: *n*=16; C: *n*=18	Significant differences in depression treatment outcomes were found for within group but not for between group. Participants in the T-CBT group were significantly more likely to maintain HAART adherence compared to the f2f group
Lovejoy, 2012 [26]	Depression, anxiety, stress, and sexual risk behavior	Telephone-delivered motivational interviewing (MI) 11: One-session MI 12: Four-session MI C: Stand of Care (SOC)	One- or four-session	HIV+ adults 45+years old: 11: *n*=39; 12: *n*=38; C: *n*=23	Participants in 11 and 12 reported lower levels of depression, anxiety, and stress at 6-month follow-up compared to the SOC group
Moore et al., 2015 [35]	Bipolar disorder, ARV, and PSY adherence	I: Medication adherence psychoeducation and daily texts assessing mood, plus personalized medication reminder texts C: Active comparison (CTRL)	30-day	HIV+ with co-occurring bipolar disorder (HIV+/BD+); I: *n*=25; C: *n*=25	Mean adherence was high and comparable between groups for both ARV and PSY medications among HIV+/BD+. iTAB participants took ARV significantly closer to intended dosing time compared to CTRL (p=0.002, Cliff's d=0.37)
II. Computer-based interventions (*n*=2)					
Brown et al., 2011 [36]	Psychosocial stress	Computerized stress management training (CSMT) 11: Immediate intervention 12: Delayed intervention	One single session (~90 min)	60 HIV+ female (70 % African American)	Participants in the immediate intervention group demonstrated improved stress management knowledge compared to delayed treatment control at the follow-up (p<0.01). No between-group difference was found for depressive symptoms, psychological distress, perceived stress, and coping self-efficacy (p>0.05)
Hersch et al., 2013 [37]	Psychosocial stress, mood management, and ARV adherence	11: Web-based adapted Life-Steps + evidence-based web-based stress and mood management program	10 Life-Steps medication adherence modules; 9 stress management modules	HIV+, on ARVs, detectable viral load (>48 copies/ml) no dx of mental disorder	Patients in the web-based Life-Steps condition had significantly higher ARV adherence rates than patients in the control group after 9-month follow-up as measured

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Author, year	Targeted MH condition and health behavior	MH intervention	Duration of intervention	Sample	Results
		C: Waitlist control condition			by MEMS. No significant effects were found on psychosocial stress and mood management

Abbreviations not described in the table are listed in alphabetical order as follows: *ARV* antiretroviral, *C* control, *I* intervention, *HARRT* highly active antiretroviral therapy, *MH* mental health, *OR* odds ratio, *PSY* psychotropic

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