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Short communication

A novel *m*Health application for improving HIV and Hepatitis C knowledge in individuals with opioid use disorder: A pilot study

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ABSTRACT

Aims: There is a critical need to reduce infectious disease transmission among individuals with opioid use disorder (OUD). Here we examine the ability of a novel, automated educational intervention, delivered via iPad in a single visit, to improve human immunodeficiency virus (HIV) and Hepatitis C (HCV) knowledge among adults with OUD.

Methods: Participants were 25 adults enrolled in a 12-week trial evaluating the efficacy of an Interim Buprenorphine Treatment for reducing illicit opioid use and other risk behaviors during delays to opioid treatment. Participants completed baseline HIV and HCV knowledge assessments with corrective feedback. They then completed an interactive HIV flipbook and HCV video followed by a second administration of the knowledge assessments. The knowledge assessments were repeated at post-intake Weeks 4 and 12.

Results: At baseline, participants answered 69% and 65% of items correctly on the HIV and HCV assessments, respectively. The educational intervention was associated with significant increases in knowledge (86% and 86% correct on the HIV and HCV assessments, respectively; *p's* < .001). These improvements persisted throughout the study, with scores at Week 4 and 12 significantly greater than baseline (*p's* < .001).

Conclusion: This HIV + Hepatitis Education intervention was associated with significant and sustained improvements in knowledge of HIV + HCV transmission and risk behaviors in this vulnerable group of individuals with OUD. Given the continuing opioid epidemic, efforts are urgently needed to reduce HIV and HCV contraction and transmission among individuals with OUD. Mobile health educational interventions may offer a time- and cost-effective approach for addressing these risks.

1. Introduction

Rates of opioid use disorder (OUD) have reached epidemic proportions in the US (Birnbaum et al., 2011; Clausen et al., 2009; Rudd et al., 2016). Of particular concern is the disproportionate prevalence of human immunodeficiency virus (HIV) and Hepatitis C (HCV) among individuals with OUD. Untreated OUD has been associated with unprecedented recent outbreaks of HIV and HCV (CDC, 2015, 2016; Dunn et al., 2016; Wang et al., 2011). Infectious disease risks among individuals with OUD and other substance use disorders stems from engaging in risky drug use and sexual behaviors (e.g., sharing injection equipment, having unprotected sex, trading sex for drugs). Efforts to improve HIV and HCV knowledge in this population are critical for reducing the individual and societal consequences associated with infectious disease. Educational interventions are a widely-used approach and have been associated with improvements in HIV- and HCV-related knowledge (Arain et al., 2016), decreasing self-reported risk behaviors (Copenhaver et al., 2006; Meader et al., 2010), and improved utilization of HIV and HCV screening and treatment services (Lubega et al., 2013; Marinho et al., 2016). Despite this, several features have limited their widespread use. The interventions have often been delivered across multiple lengthy sessions and relied on delivery by trained peer, staff, or health care professionals (Shah and Abu-Amara, 2013). These factors can increase cost and time burdens associated with education delivery. Staff-delivered assessments and interventions may also be less appealing to some individuals due to potential concerns regarding

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confidentiality or perceived judgment around the sensitive behaviors being assessed.

The recent development of mobile health (*m*Health) platforms may hold promise for overcoming this limitation. *m*Health interventions use portable computerized devices to extend the reach of health care by permitting delivery of monitoring, education, point-of-care diagnostics and treatment beyond the confines of the medical office (Boyer et al., 2010). The limited studies to date examining the utility of *m*Health approaches for improving HIV and HCV knowledge suggest this approach may be promising (Aronson et al., 2017; Catalani et al., 2013; Festinger et al., 2016; Niakan et al., 2017). We recently adapted a single-visit, therapist-delivered educational intervention, which was developed and shown by our group in prior studies to improve HIV and HCV knowledge in illicit drug abusers (Dunn et al., 2013; Heil et al., 2005; Herrmann et al., 2013), for automated delivery using an iPad platform. We report here on our initial examination of this novel *m*Health application for improving HIV and HCV knowledge among individuals seeking but waitlisted for opioid agonist maintenance.

2. Methods

2.1. Parent study

The HIV + HCV educational intervention was delivered as part of a 12-week randomized trial investigating the initial efficacy of interim buprenorphine dosing for reducing illicit opioid use and other risk behaviors during delays to community treatment. To be eligible for the study, participants had to be > 18 years old, meet Diagnostic and Statistical Manual criteria for OUD, provide an opioid-positive urine specimen, and be waitlisted for opioid agonist treatment. The study was approved by the University of Vermont Institutional Review Board and all participants provided written informed consent prior to participating.

Participants were randomized 1:1 using a balanced allocation procedure to Interim Buprenorphine Treatment (IBT; n = 25) or a continued waitlist control condition (WLC; n = 25), while stratifying on variables that may be associated with treatment outcome (e.g., duration on waiting list, primary opioid, amount of opioids used per day, past-month cocaine use, lifetime IV use). IBT participants visited the clinic bimonthly for staff-observed medication ingestion and urinalysis, with the remaining doses dispensed via computerized device (Med-O-Wheel Secure; Addoz, Finland). They also received daily calls assessing drug use, craving and withdrawal via an Interactive Voice Response (IVR) phone system, as well as IVR-generated random callbacks and HIV + HCV Education. Waitlist control participants remained on the waitlist of their local clinic and did not receive these services. The primary outcomes from this study demonstrated the efficacy of IBT and have been reported previously (Sigmon et al., 2016). As only IBT participants received the HIV + HCV education described below, our analyses focused on those individuals.

2.2. HIV + HCV educational intervention

During Week 1, participants completed a baseline assessment (Pre-Test) of HIV and HCV knowledge and perceived risk using an interactive iPad application developed by us (below), after which the application provided immediate corrective feedback and explanations for any incorrect items. Participants then reviewed an interactive flipbook ("HIV/AIDS Basics," Aids.gov) and watched a 15-minute video ("What is Hepatitis C and how is it diagnosed?", amfAR: The Foundation for AIDS Research), both administered via iPad and monitored by study staff. The HIV + HCV knowledge assessment was then administered immediately following delivery of the educational content (Post-Test), with feedback provided for any incorrect answers. At the end of the session, a staff member offered condoms, as well as contact information for free HIV and HCV testing resources. The intervention took approximately an hour to complete. To examine the extent to which changes in HIV and HCV knowledge persisted following the single-visit intervention, participants repeated the Post-Test knowledge assessment at Weeks 4 and 12.

2.3. Measures

The knowledge assessment consisted of a modified version of the HIV/AIDS Knowledge Test (Marsch et al., 2005), a 50-item assessment of HIV knowledge in three areas (i.e., general knowledge, sexual risk behaviors, drug risk behaviors; see supplemental material). Also included was a 17-item HCV knowledge assessment (Dunn et al., 2013; Supplemental material). Both were administered via iPad and included "True," "False," or "Don't know" response options (Herrmann et al., 2013), with correct responses summed to obtain an overall accuracy score (i.e., percent correct) for each questionnaire.

Participants also completed visual analog scale (VAS) items evaluating their perceived risk of infection and disease knowledge, as well as HIV and HCV risk behaviors (Supplemental material). On three additional VAS items, participants rated the helpfulness of the HIV iPad flipbook, the helpfulness of the HCV video, and their comfort with the iPad application more generally. Scores for each VAS item ranged from 0 (Not at all) to 100 (Extremely).

2.4. Data analyses

Descriptive statistics were used to characterize participants' baseline demographics and drug use history. The percentage of items correct on the HIV and HCV assessments were calculated for each participant at the Pre-Test, Post-Test, and Week 4 and 12 follow-up assessments, with higher scores indicating greater knowledge accuracy. The significance associated with temporal changes in mean scores was evaluated using a linear mixed model for repeated measures data (SAS, PROC MIXED). Pairwise comparisons among timepoints were performed using a Fisher's LSD procedure. McNemar's tests were used to evaluate changes in accuracy on individual items. Analyses of temporal changes on the VAS items paralleled those described above, with the exception of the three VAS items assessing the perceived helpfulness of the intervention components which were descriptively examined at Post-Test. Statistical analyses were performed using SAS 9.4 (SAS Institute, Cary, NC), with significance determined based on $\alpha = .05$.

3. Results

3.1. Participant characteristics

At study intake, 64% and 36% of participants reported heroin or prescription opioids as their primary opioid of abuse, respectively (see supplementary material). Fifty-six percent of participants endorsed the intravenous (IV) route as their primary route of opioid administration, 80% endorsed a lifetime history of IV drug use, and 40% reported a history of opioid overdose. Of those reporting a lifetime history of overdose, 89% had experienced multiple overdoses. Among participants with a history of IV drug use, 30% reported using a syringe or needle after someone, and 15% had used an unsterilized syringe or needle (see supplementary material[2]). Twelve percent of participants' partners were also opioid users, and 67% of those partners were IV drug users. Twenty-two percent of participants had received a diagnosis of HCV, and 14%, 6%, 2%, and 2% had been previously diagnosed with chlamydia, gonorrhea, herpes, and viral warts, respectively.

3.2. HIV knowledge

On the baseline (Pre-test) HIV knowledge assessment, participants answered an average of 69% of items correctly (Table 1). Following delivery of the intervention, this increased to 86% ($t(66) = -9.49$,