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Research paper

Realising the technological promise of smartphones in addiction research and treatment: An ethical review

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ABSTRACT

Background: Smartphone technologies and mHealth applications (or apps) promise unprecedented scope for data collection, treatment intervention, and relapse prevention when used in the field of substance abuse and addiction. This potential also raises new ethical challenges that researchers, clinicians, and software developers must address.
Aims: This paper aims to identify ethical issues in the current uses of smartphones in addiction research and treatment.
Methods: A search of three databases (PubMed, Web of Science and PsycInfo) identified 33 studies involving smartphones or mHealth applications for use in the research and treatment of substance abuse and addiction. A content analysis was conducted to identify how smartphones are being used in these fields and to highlight the ethical issues raised by these studies.
Results: Smartphones are being used to collect large amounts of sensitive information, including personal information, geo-location, physiological activity, self-reports of mood and cravings, and the consumption of illicit drugs, alcohol and nicotine. Given that detailed information is being collected about potentially illegal behaviour, we identified the following ethical considerations: protecting user privacy, maximising equity in access, ensuring informed consent, providing participants with adequate clinical resources, communicating clinically relevant results to individuals, and the urgent need to demonstrate evidence of safety and efficacy of the technologies.
Conclusions: mHealth technology offers the possibility to collect large amounts of valuable personal information that may enhance research and treatment of substance abuse and addiction. To realise this potential researchers, clinicians and app-developers must address these ethical concerns to maximise the benefits and minimise risks of harm to users.

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Introduction

Smartphones are a powerful and ubiquitous technology that combines mobile computing with telecommunication capabilities (Mosa, Yoo, & Sheets, 2012). In 2011, there were over 6 billion phone subscriptions reaching 87% of the world's population (ITU, 2011). A recent survey found that 43% of global respondents have a smartphone (Poushter, 2016). For countries such as Australia or the United States, this figure approaches three-quarters (Poushter, 2016). There is growing interest in the use of smartphones and other mobile technologies for conducting research on drug use and addiction and intervening to reduce drug use and its harmful effects (Kuntsche & Labhart, 2014; Meurk, Hall, Carter, & Chenery, 2014).

The ability of smartphones to run third party software applications (or apps) has generated interest in their use for research in substance abuse and addiction. Smartphones overcome many of the traditional limitations of addiction research that rely upon pen and paper surveys or diaries and retrospective recall. Although gathering retrospective self-report may be cost-efficient and convenient, it has been found to underestimate substance abuse (Kuntsche & Labhart, 2014). Self-reported drug use can be under-reported if participants are unwilling to reveal the true amount consumed. It may also be subject to recall bias when users only remember some of their total drug consumption (Kuntsche & Labhart, 2014). Surveys of drug use generally underrepresent heavy substance abusers in the population (Kuntsche & Labhart, 2014). Less intrusive smartphone technologies can encourage a wider section of the population to participate in surveys. Less time is taken to fill out lengthy questionnaires and diaries, and prompts can be sent throughout the day to collect a greater range of data at more regular intervals (Kuntsche & Labhart, 2014).

Smartphones are also being looked at for use in healthcare settings to improve diagnosis and personalise treatment (Mosa et al., 2012). Smartphones may enable clinicians and other health care professionals to deliver clinically important information in a uniquely timely way. For example, data collected by a smartphone could trigger clinically relevant messages to the user prior to any drug use (Luxton, McCann, Bush, Mishkind, & Reger, 2011). The use of smartphone technologies for this purpose has been termed *mHealth* (Tamony, Holt, & Barnard, 2015). mHealth falls within the broader field of electronic research or *e-research* (Kypri & Lee, 2009; Miller & Sønderlund, 2010). E-research is commonly used to study human participants from populations difficult to identify, recruit and retain in research and treatment. Advantages of mHealth and e-research in non-therapeutic research (e.g. epidemiological, social and behavioural, humanities research) (Barratt, 2012; Meurk et al., 2014; Miller, Johnston, McElwee, & Noble, 2007; Shearer et al., 2007), include: increased participant comfort and perceived anonymity that encourages more honest disclosure; improved consent processes (Ford Ii et al., 2015; Monney, Penzenstadler, Dupraz, Etter, & Khazaal, 2015; Patel et al., 2015); reduced research costs; and fewer data errors (Miller et al., 2007; Monney et al., 2015). These approaches have also proven beneficial with human participants in therapeutic research domains (i.e. prevention, treatment and other interventions). Advantages include greater capacity to recruit participants for clinical studies, more efficient intervention delivery, improved monitoring of adherence to treatment protocols (Vahabzadeh & Lin, 2009), and capacity to produce significant intervention effects (Amstadter, Broman-Fulks, Zinzow, Ruggiero, & Cercone, 2009; Neil, Batterham, Christensen, Bennett, & Griffiths, 2009).

For both research and treatment of addiction, smartphone monitoring of substance use or treatment is possible through passive data collection or via direct input from patients. Smartphone apps can prompt and record a patient's self-reported drug consumption and cravings, commonly referred to as Ecological Momentary Assessment (EMA) (Serre, Fatseas, Swendsen, & Auriacombe, 2015). Smartphone technologies may passively record patterns of movement within the environment, for example, via global positioning systems (GPS), wireless local area networks (or Wi-Fi), Bluetooth, accelerometers, gyroscopes, pressure-sensors, proximity-sensing magnetometers, barometers, humidity sensors, temperature sensors, and ambient light sensors (Luxton et al., 2011). Microphones and cameras are able to record images and sounds, including personal conversations, in the vicinity of the phone (Pei et al., 2013). From these data it is possible to deduce rich social information about an individual, including their identity, gender, age, marital status, social status, where they live, where their children go to school, health, sex life, religion, mood, and whether they visit a therapist, and if so how often, or how regularly they visit drinking or gambling establishments (Carter, Liddle, Hall, & Chenery, 2015a, 2015b; Gasson, Warwick, Kosta, Royer, & Meints, 2011; King, 2011; Pei et al., 2013; Shilton, 2009).

Physiological information such as heart rate, blood pressure and substance concentration levels may be measured using additional sensors. Remote monitoring devices, for example, are being

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