



Perceived Confidentiality Risks of Mobile Technology-Based Ecologic Momentary Assessment to Assess High-Risk Behaviors Among Rural Men Who Have Sex with Men

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Abstract

Although men who have sex with men (MSM) within rural communities are disproportionately impacted by HIV, limited HIV research and programmatic resources are directed to these communities within the U.S. There is a need for improved behavioral data collection methods to obtain more detailed information on the relationship between rural environments, sexual behavior, and substance use. Utilization of mobile health (mHealth) technologies, such as ecologic momentary assessment (EMA), has been advocated for; however, limited research has evaluated its utility among rural MSM. Forty MSM residing in rural Oklahoma were recruited to complete in-depth interviews related to participating online/mobile-based HIV prevention research. Men described a willingness to participate in HIV and substance use studies that use EMA methodologies for data collection; however, they raised various research-related concerns. In particular, participants indicated potential privacy and confidentiality concerns related to the use of the mobile technology-based EMA in public and the storage of data by researchers. Given the varying degree of sexual orientation and substance use disclosure by participants, rural MSM were largely concerned with being inadvertently “outed” within their communities. Men described the various strategies they could employ to protect private information and methods to minimize research risk. Study findings suggest that EMA is an acceptable research methodology for use among rural MSM in the context of HIV and sexual health information, when privacy and confidentiality concerns are adequately addressed. Input from community members and stakeholders is necessary to identify potential areas of concerns for participants prior to data collection.

Keywords Mobile research · Men who have sex with men · Rural · Data privacy · Sexual orientation · Ecologic momentary assessment

Introduction

The nature of the HIV epidemic in the U.S. has changed with a shift toward rural areas, where populations are dispersed and health care resources are limited (Pitasi et al., 2019; Schafer et al., 2017). Men who have sex with men (MSM) within these communities are disproportionately impacted;

yet, limited HIV research and programmatic resources are directed to rural communities within the U.S. (Pitasi et al., 2019; Schafer et al., 2017). Social, structural, and environmental factors coalesce within rural communities in a unique manner that places MSM at increased risk of HIV acquisition and transmission. In light of this circumstance, research with rural, at-risk communities has been advocated for in an effort to enhance the HIV care continuum.

These unique factors in a rural context can act syndemically, where multiple epidemics and risk factors interact and connect with one another. Specifically within rural communities, syndemic conditions such as substance use, stigma, and minority stress have a multiplicative effect on sexual risk behavior and the rural HIV epidemic (Horvath, Bowen, & Williams, 2006; Hubach et al., 2015, 2019; Parsons et al., 2017). The 2011–2014 outbreak of HIV infections within rural Indiana underscores the overlap of syndemic conditions within a rural context, where

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HIV prevention resources are limited and inhibited by a dominant socially conservative environment (Conrad et al., 2015; Preston, D'Augelli, Cain, & Schulze, 2002; Rich & Adashi, 2015; Rosser & Horvath, 2008; Strathdee & Beyrer, 2015; Taylor, Croff, Story, & Hubach, 2019).

The nascent literature indicates that community-level factors influence the diffusion and uptake of public health programming within rural communities (Fisher, Irwin, & Coleman, 2013; Giano et al., 2019; Williams, Bowen, & Horvath, 2005). For example, rural communities are typically more socially conservative and therefore may be less welcoming to openly lesbian, gay, bisexual, and transgender individuals (LGBT; Sherkat, Powell-Williams, Maddox, & De Vries, 2011; Swank, Fahs, & Frost, 2013; Swank, Frost, & Fahs, 2012). Concurrently, rural MSM are geographically estranged from other MSM and venues such as community centers, restaurants, and businesses that cater to gay and bisexual men (Li, Hubach, & Dodge, 2015; Rosenberger, Schick, Schnarrs, Novak, & Reece, 2014).

Most research with rural MSM has relied on cross-sectional data in which there is an extended period of time from the event to the data collection point. A major limitation of this method of measurement is that it is affected by recall bias and may not be context specific. For example, condom use may be assessed for the last sexual event or over a predetermined span of time; however, necessary contextual elements around the sexual event (e.g., current substance use, mood, partner-seeking behaviors) may not be evaluated. To address these limitations, utilizing mobile health (mHealth) technologies, such as an ecological momentary assessment (EMA), would allow researchers to collect behavioral activities in real time while providing tailored public health messaging (Duncan et al., 2017; Wray, Kahler, & Monti, 2016). For example, EMA would enable the immediate collection of condom use data following time periods in which individuals typically attend social events (e.g., parties, bars/clubs). Further, EMA could allow for public health messaging, such as information about post-exposure prophylaxis, to be delivered based on a participant's response.

The ubiquity of smartphones and related devices allows participants to provide behavioral data on devices they carry with them as they go about their daily lives. Use of these technologies in longitudinal research can allow researchers to assess experiences more frequently, providing valuable information about dynamic and proximal influences on decision-making that occur throughout each day (Epstein et al., 2014; Furnari et al., 2015; Kennedy, Epstein, Phillips, & Preston, 2013). Previous research has demonstrated the feasibility and acceptability of mobile technology-based EMA among various subgroups of MSM (Duncan et al., 2017; Wray et al., 2016; Yang et al., 2015); however, to date, little research has been conducted on rural samples. This dearth of research may be in part due to the relatively hidden nature of this population and the unique needs of this group of men residing in socially conservative environments.

Research Risks of Rural Men Who Have Sex with Men

While research on marginalized, hard-to-reach populations such as rural MSM often provides participants a direct benefit, it also necessitates special attention to minimizing research-related risks—particularly concerning invasions of privacy or breaches of confidentiality. Sexual and substance use behavior, particularly in a socially conservative environment, carries social stigma or in the instance of substance use involves criminal behaviors (Hubach et al., 2015; Preston, D'Augelli, Kassab, & Starks, 2007; Zukoski & Thorburn, 2009). There is a critical need to evaluate how the use of mobile technology-based EMA with rural MSM samples might exacerbate preexisting risks or introduce new risks among this highly stigmatized population.

Privacy and confidentiality risks remain critical concerns for sexual and gender minorities participating in research studies (Bonar et al., 2018; Broaddus et al., 2015a; Broaddus, Marsch, & Fisher, 2015b; Fisher & Jaber, 2019; Yang et al., 2015). The use of mobile technology-based EMA to continually collect behavioral data may be viewed by some as a potential violation of privacy and thus enhances data security concerns (Heron & Smyth, 2010; Labrique, Kirk, Westergaard, & Merritt, 2013; Rudolph, Young, & Havens, 2017). EMA data collection often includes socially sensitive information (e.g., risk-taking behaviors including sexual behavior and substance use) in an effort to reduce perceived potential negative outcomes (Pequegnat et al., 2007; Rudolph et al., 2017). Privacy concerns regarding the collection of such information extend beyond the data collection procedures to areas such as data transfer and storage (Heron & Smyth, 2010; Pequegnat et al., 2007). Methods commonly used within EMA research protocols typically include some form of daily reminder via email or text message (SMS) to complete data collection activities. Without appropriate encryption, these uncontrolled messages can be read by another person other than the intended recipient and often remain on unsecured devices for extended time periods.

Overall, protecting the rights and well-being of marginalized populations requires empirical data on protocol strengths and vulnerabilities as perceived by research participants. Such approaches are advocated for within research with sexual and gender minorities, adolescents, and persons who use drugs (Fisher, Arbeit, Dumont, Macapagal, & Mustanski, 2016; Labrique et al., 2013; Rudolph et al., 2017). Research is needed to determine the extent to which previous findings based on survey data or interviews with those living in urban environments transfer to MSM living in rural communities. As part of the intervention development process and to gain a deeper understanding of the acceptability of EMA for the collection of behavioral and psychosocial data, within the context of HIV risk behaviors and substance use, individual qualitative interviews were conducted with a sample of MSM residing in rural Oklahoma during 2019.

Method

Participants

Incorporating the principles of community-based participatory research (CBPR), interview data were collected from rural MSM ($N=40$) in Oklahoma to (1) assess amenability to and concerns with participating in EMA studies related to HIV risk behavior and substance use and (2) evaluate the role of factors, such as interpersonal relationships, community and social norms, and stigma on privacy and confidentiality concerns. Oklahoma contains two designated metropolitan areas, Oklahoma City and Tulsa; however, over half of the State's population resides in designated rural and mixed rural areas (United States Department of Agriculture, 2011). Oklahoma, along with six other states, has been noted by the CDC as having a disproportionate HIV burden within rural communities (Pitasi et al., 2019). Over the last 5 years, there has been an overall upward trend in newly diagnosed HIV cases in Oklahoma among MSM. Concurrently, racial/ethnic minorities are disproportionately affected by HIV in Oklahoma as evidenced by disease prevalence. Of the estimated 6163 persons in Oklahoma living with HIV or AIDS (PLWHA) in 2017, 25.6% of cases were African-American, 9.4% of cases were Hispanic, and 6.1% of cases were American Indian or Alaskan Native (Oklahoma State Department of Health, 2019).

Utilizing the core concepts of purposive sampling, participants were identified and recruited to form a more homogenous sample. This type of sampling is useful when the research question being addressed is specific to the characteristics of a particular group and is examined in detail (Bryman, 2006; Kemper, Stringfield, & Teddlie, 2003). In conjunction with traditional methodologies employed to recruit LGBT samples, participants were also recruited through Internet-based direct marketing (e.g., advertisements placed on social media sites, sexual networking applications; Li et al., 2015; Raymond et al., 2010). In a few instances, participants were referred to the study via their social networks.

Participants eligible for the interview were proficient English speakers, between 18 and 40 years of age, identifying as a man who has sex with men, and residing in a rural classified county in Oklahoma. The Index of Relative Rurality was utilized to determine the rurality of a participant's residence, with all participants residing in counties with an IRR score greater than 0.45 (Waldorf, 2006). Eligible participants were invited to complete a one-on-one semi-structured interview with a trained interviewer lasting approximately 1 h. Interviews were conducted by the first author, a white gay male, who has engaged with the rural MSM community in Oklahoma over the past 5 years and is trained in qualitative inquiry. After providing informed consent, participants completed the interview process and were compensated with a \$30 retail store gift card for their participation. The

institutional review board at the primary author's home institution approved the study, and each study participant completed an informed consent process.

Measures

To gain a deeper understanding of participants' experiences, a semi-structured interview guide was designed to elicit narratives from participants regarding: (1) previous research experiences, e.g., What kind of commitments/expectations do you have as a participant in a research study? (2) perceived risks associated with participating online/mobile-based health studies, e.g., What type of risk would you expect to encounter by participating in an online/mobile-based sexual health and substance use study? And (3) security preferences for mobile technology-based EMA, e.g., Given the concerns you discussed related to this mobile technology-based EMA, what type of features would you as a community member like to see added? The interview was based on findings from previous studies (Giano et al., 2019; Hubach et al., 2017, 2019) and feedback from a community advisory board (CAB) comprised of rural MSM, community public health practitioners, and other stakeholders.

Data Analysis

The interview audio was digitally recorded, transcribed, and reviewed for accuracy against the recordings. Resulting data were analyzed using a qualitative grounded theory approach to inductively identify and interpret concepts and themes that emerged from the interview transcripts (Corbin & Strauss, 2008). This method involved multiple readings of transcripts and interview notes, and analytic induction via open and axial coding of data using NVivo software (Version 11) to thematically organize transcripts. A codebook was developed by the research team using mutually agreed upon codes derived from five interview transcripts. Coding was completed by two researchers independently and compared for agreement. Cohen's kappa was calculated with all codes having a $k \geq 0.80$. Open coding involved assigning conceptual codes to small sections of words, phrases, and sentences in transcripts. This was followed by axial coding—whereby relationships among similar concepts and categories were identified and then combined into themes. Wherever necessary, descriptive analyses were conducted using SPSS statistical software (Version 21).

Results

Participant Demographics

Table 1 shows the demographics of the sample ($n=40$). Participants ranged in age from 18 to 36 years (mean = 25.78, SD = 5.34) and 75.5% of them identified as white, not of

Hispanic origin. The majority of participants identified as single (67.5%). Overall, 35% of the sample reported having completed an undergraduate and/or graduate degree. Similarly, 35% of the sample indicated their personal yearly income to be \$30,000 or less.

Qualitative Data

Three main levels emerged in our evaluation of amenability of mobile technology-based EMA among MSM in rural Oklahoma: (1) confidentiality risks of participation, (2) methods to confidentiality participation risks, and (3) a need for culturally responsive research. Pseudonyms are used to maintain participant anonymity.

Confidentiality Risks of Participation

Participants noted how the current cultural environment in their state and local rural areas shaped their risk perceptions. A lack of identified social resources, nondiscrimination policies, and inclusive faith communities within rural Oklahoma were indicative of an environment which was not conducive to rural men being open about their sexuality. In particular,

men were concerned that completing daily questionnaires (EMA) on a smartphone within public settings could lead to unwanted “outing” within their community. Such disclosure of sexual orientation was viewed as being associated with perceived social risks—such as becoming socially isolated within their community. Fewer participants were concerned that such disclosures could lead to their own physical harm by members of their community. Kyle noted this relationship when he stated:

This is a good ole boy town—you do things at your own risk. Most of us [rural MSM] aren’t out around here...if people find out, you never know who you may lose or what may happen to you. (23, Native American, Gay).

Almost all respondents identified unknowing disclosure of identifiable data by the research team as a participation risk. Of particular concern were unintentional disclosures related to participants’ sexual behavior and substance use compared to the diligent efforts made by rural MSM to hide their sexual orientation. As Sam describes:

I keep things close to my chest...no one needs to know my business—especially about personal stuff. Who is going to make sure my business doesn’t get aired out?...that type of stuff can come back to bite you and ruin you. (27, Black/African American, Bisexual)

Similarly, among those engaged in regular substance use, participants expressed concern over the potential legal ramifications in small rural communities if their use was unknowingly disclosed: “They [local law enforcement] will find a way to use that information against me...They’ll put me under a microscope. I can’t end up in prison” (Jacob, 24, White, Bisexual). For example, participants engaged in regular substance use expressed they would be concerned to provide geographic or other forms of data which describe locations they engage in drug use and/or purchase drugs. Trevor stated:

Every place can be easily found here, you don’t need much information to figure it out where we are shooting up or scoring [buying drugs]...a little bit of information goes a long way, especially if cops get it. (28, White, Gay)

Overall, location-specific data were viewed as “sensitive” in that unwanted disclosure would also breach the confidentiality of individuals they purchase drugs from and others they use drugs with.

Role of Outness The extent to which men report they had disclosed their sexual orientation to others influences their risk determination. Participants reported various levels of outness within their respective communities—with the majority being out in a limited scope, such as being out to a selected group of family and/or friends, whereas fewer

Table 1 Demographic characteristics of the sample ($n=40$)

	<i>N</i>	%	<i>M</i>	<i>SD</i>
Age			25.78	5.34
Race/ethnicity	2	5.0		
Black/African-American	31	77.5		
White, non-Hispanic	4	10.0		
Native American/Alaskan	3	7.5		
Hispanic/Latino				
Education	10	25.0		
High school graduate	16	40.0		
Some college or technical school	10	25.0		
Undergraduate degree	4	10.0		
Graduate degree				
Personal income	14	35.0		
\$30,000 or less	16	40.0		
\$30,001 to \$50,000	8	20.0		
\$50,001 to \$80,000	2	5.0		
More than \$80,000				
Employment status	24	60.0		
Full time (35+ hours per week)	5	12.5		
Part time	6	15.0		
Full-time student	5	12.5		
Not in workforce				
Relationship status	27	67.5		
Single	6	15.0		
In a domestic partnership	6	15.0		
Married	1	2.5		
Divorced				
Sexual orientation	32	80.0		
Gay/homosexual	5	12.5		
Bisexual	3	7.5		
Straight				

participants indicated either being completely out or not at all out in their community. Mike (36, White, Straight), who had not disclosed his same-sex behavior to others, perceived increased risks associated with study participation: “I don’t even identify as gay, it is not who I am. No one needs to know...if folks find out, it would change everything for me...it is not worth it, if I can stop it.” Conversely, men who reported being relatively out in their community perceived fewer study-related risks: “People tend to know about me, so I’m not worried. If they are looking at my phone they should know what they are in for! Just like if Grindr popped up—that is what you get for being nosey” (Mitch, 26, White, Gay). For those out in a limited scope, there was a desire to control disclosures to select individuals within their social networks.

Overcoming Confidentiality Risks

All respondents indicated the need to minimize potential participation risks, particularly through the development of security features within EMA-related technology. Participants were familiar with various common features traditionally available within other mobile applications and used that knowledge to inform their technological preferences for study implemented protections.

Regarding preferences for daily reminder messages to complete time-sensitive EMA prompts, participants desired the ability to tailor the form in which messages are received (e.g., text message, email, application notification) and timing of the reminder (e.g., afternoon vs. evening). Affording participants this flexibility in their message delivery would allow them to receive reminders that would be conducive to their schedule and location during EMA completion. For example, Chad (24, White, Gay) noted “there are times that are best for me...at night is when I know I’m not usually around people and there’d be no reason why I couldn’t fill things out.” Most participants preferred text message reminders compared to other reminder formats; however, several participants discussed their preference for email reminders associated with greater confidentiality: “I have a special email account...I use it for apps and meeting guys, only I know about it and no one else could get into it...that would be the safest for me” (Mike, 36, White, Gay).

When discussing potential security features, 75% of participants wanted the ability to enable two-factor identification to access study-related materials. Men described social settings in which they felt information on their phones was most vulnerable and perceived two-factor identification as a method to decrease their study-related anxiety. Brad provided the example of Sunday dinners when family gathered at his parent’s house:

All my younger nieces and nephews are over, it can be chaotic and we give them our phones to keep them busy...

They are smart and get into some of my apps...I deleted Grindr because of it. I need to make sure they can’t get into that stuff. (31, White, Bisexual)

Community Engaged Research

All participants alluded to the expectation that research protocols need to be responsive to the unique environments in which these men reside. In particular, men perceived the need for research teams to be familiar with not only the rural context but specifically LGBT-related concerns within rural communities: “Not many folks understand living out here. It is a way of life for us...it feels different and is different. There is no question about it...out here the rainbow has mud on it” (Chris, 20, Hispanic/Latino, Gay). To build community rapport, to establish trust, and to demonstrate the ability to maintain privacy and confidentiality, participants outlined a three-step process they viewed as necessary for implementation of mobile technology-based EMA among rural MSM: (1) engagement of rural MSM to assess confidentiality concerns within study protocols and identify potentially sensitive areas within questionnaire development; (2) detailing within recruitment materials and the informed consent process how community members have been part of the process to identify privacy and confidentiality concerns; and (3) describing efforts completed at the design stage of the project to embed participant and data confidentiality protections into the study design. Nearly all participants indicated these processes as necessary to not only recruit but also to receive buy-in from rural MSM community members. Carlos (34, Black/African-American, Gay) indicated the building of trust relationships as a foundational step for researchers: “It is all about trust for me. Why should I trust you and why should you trust me... how have rural and gay folks been involved? They know what is at stake for us...they know our experiences.”

Participant–Researcher Relationship To enhance the building of trust between participant and researcher, respondents expressed an interest in the ability to retain regular contact with the research team via phone or computer-based teleconference technology:

...sometimes you just want to know who is getting your information—who are they and why are they interested? Why should I trust them?...just like when I see a new doctor, I want to learn about them and see if they should be trusted...Research should be a two-way street. (Scott, 22, White, Gay)

Regular contact was viewed as an opportunity to provide experiential feedback to the research team, ask emergent questions related to privacy concerns, and retain study buy-in. For those who had participated in previous research studies, a significant barrier to being retained in the study was

the one-sided nature: “I feel like we are giving out a lot about ourselves and our lives...are we just being watched? I feel like researchers should be giving too during the study” (Sean, 27, White, Gay). Participants observed that in studies where there was more interaction with the study team they were more likely to remain engaged and active.

Research Benefits Interwoven within participant narratives related to community research were descriptions of how the collection of condom use, substance use, mental health, and other forms of data within their communities would be of social and personal benefit. In particular, participants noted a lack of public health programming within their communities and the role participating in research could be of benefit: “There is nothing out here for us [rural MSM]...it is hard to get care...this research could start something, something to help us” (Sean, 27, White, Gay). Among substance users, participants indicated that most prevention, treatment, and sober living facilities near their communities were religiously affiliated and often were not affirming toward or willing to serve MSM. Participants understood research participation would lead to long-term benefits within the community, such as development of public health programming or increased access to medical care, instead of receiving an individual immediate benefit. At the individual level, the majority of participants indicated they would like to see and would benefit from HIV and STI testing as part of a study utilizing mobile technology-based EMA: “...it is hard to get tested [HIV and STIs]. I am limited to where I can go... or really on who will see me... If there was free testing in studies, I’d do it—it would just be easier” (Trevor, 28, White, Gay). Ultimately, although participants identified numerous privacy and confidentiality concerns, they recognized the potential for improvements within public health to meet the needs of peers within rural communities.

Discussion

Our findings indicate that mobile technology-based EMA is an amenable research methodology for use among rural MSM, when privacy and confidentiality concerns are addressed at all stages of the research process. As ownership of smart phones has become increasingly common over the last decade (Ryan & Lewis, 2017), it provides a promising platform among rural MSM who are often under sampled within research and have limited access to HIV and substance use programming (Giano et al., 2019; Hubach et al., 2019; Sullivan et al., 2017; Ventuneac, John, Whitfield, Mustanski, & Parsons, 2018). In particular, rural MSM have indicated a desire for increased phone and online-based programming focused on sexual health and HIV risk reduction (Ventuneac et al., 2018).

In light of the need for the development of phone and online-based programming, rural MSM are acutely aware of the potential risks associated with participating in research studies, particularly those that incorporate the use of technology to collect behavioral data on potentially sensitive topics. Interviews provided perspectives on how rural MSM may construct personalized strategies for risk mitigation—which included, but were not limited to: the time and location of their access of research-related items, the personal information that they disclosed to research teams, and the way in which they communicated their personal information to research teams. Congruent with other studies, we found that input from community members and stakeholders is necessary to ensure research protocols are culturally relevant and potential areas of concerns for participants are identified prior to data collection (Fisher, 2004; Reback, Ling, Shoptaw, & Rohde, 2010; Rendina & Mustanski, 2018; Rhodes & Wong, 2016; Roth et al., 2017). Use of Community Advisory Boards (CAB) allows for the development of a community perspective at key points throughout a study (Rhodes et al., 2014; Rhodes & Wong, 2016; Sun, Stowers, Miller, Bachmann, & Rhodes, 2015). Given the sensitivity of the issues that are discussed within HIV and substance use behavior studies, and the relatively hidden nature of same-sex behavior among rural adult men, engaging community members who can provide insight into local, social, and cultural norms is essential to help guide and shape the research process.

Given the relatively hidden nature of rural MSM and substance users within communities, the sociocultural environment in which these men reside is not always conducive to the collection of behavioral and psychosocial data. Sociocultural factors may operate independently or together in a dynamic fashion to create a context in which rural MSM, including those who engage in substance use, experience challenges or inability to engage in research or programming. As such, an understanding of the social contexts that surround participants is necessary for the development and implementation of EMA research designs and the future implementation of mHealth (Burns, Montague, & Mohr, 2013; Shiffman, 2009; Smiley et al., 2017). For example, Lauckner et al. (2019) explored risks associated with dating app use among rural MSM and found potential risks associated with use such as cyberbullying and coercion. Rural men adapted strategies to navigate these risks and protect themselves. Such experiences within these technological social spheres may impact willingness to engage in mHealth programming, especially for those who feel their sexual orientation or substance use history could be disclosed without consent. Rudolph et al. (2017) found substance using rural MSM were specifically concerned that data could be accessed by or inadvertently disclosed to local law enforcement. Perceiving that geographic location data tied to their cell phone could be collected, participants indicated decreased willingness to carry their phone or complete brief questionnaires while engaging in substance use. Acquisition of a NIH-issued Certificate of Confidentiality may alleviate concerns among rural substance using MSM; however, this approach requires the

research team to thoroughly describe the protections afforded by it. Furthermore, given that rural MSM participants may be of varying stages of sexual identity development and disclosure, researchers could implement privacy protections to minimize the risk of confidentiality breaches that may place rural MSM at risk of harm or inadvertently out these men within their social or community networks (Macapagal, Coventry, Arbeit, Fisher, & Mustanski, 2017; Rudolph et al., 2017).

Implications

Study findings have implications for future public health research and for health promotion interventions for MSM residing in rural areas. The findings of this study point to the value of utilizing EMA as a methodological approach for research with rural MSM. EMA allows for the collection of behavioral data in real time, which limits potential recall bias and provides the ability to assess behavior change over time (Shiffman, Stone, & Hufford, 2008). Reactivity bias—when participants' responses may be affected by their awareness of being part of a study—is a concern when collecting risk behavior data such as substance use and condomless sex (French & Sutton, 2010; Newcomb & Mustanski, 2013). Behavior reporting may be altered as an artifact of study participation as well as a means of controlling data subjected to potential unwanted disclosure. Addressing potential confidentiality, privacy, and data management concerns before data collection and relaying these safeguards to participants could lead to more accurate data reporting from participants. With the ongoing development of mHealth care and public health programming for rural MSM, current findings indicate the need to assess participant preferences across technological platforms. Utility of these programs is premised on the belief that rural MSM will adopt these technologies. However, as indicated within these results, rural MSM assess programmatic utility based on numerous individual, interpersonal, and community-level factors. Future research is warranted on rural MSM related to their amenability to telemedicine and other aspects of mHealth for the provision of care-related services.

Limitations

This study and the conclusions drawn are not without limitations. As the interview participants were recruited only from Oklahoma, we cannot assume that our results are representative of the larger population of MSM residing in other relatively rural states with differing cultural contexts. In addition, the size of our sample limited our ability to observe potential pattern differences among subpopulations of MSM in Oklahoma, specifically by age group and race/ethnicity. Future research is warranted to explore potential privacy concerns based age group and race/ethnicity. Our sample was comprised of educated individuals, with 75% of participants having at least some technical school or college training. Higher educational attainment, combined

with increased personal income, could inform a participant's risk determination. For example, these participants may engage more frequently with newer mobile technology and thus have a better understanding of technological safeguards embedded within devices. Finally, we relied on self-reported perceptions and experiences provided by participants in response to questions raised during the interview process. Self-report can reflect potential biases inherent in the use of interviews for data collection. Despite these potential limitations, our data provide much needed formative information that can be immediately applied to the development of mobile technology-based EMA with rural MSM. It is noteworthy that our sample was comprised of only adults over the age of 18. Because research has documented the unique needs and experiences of adolescent MSM, future research should investigate potential confidentiality concerns regarding mobile technology-based EMA with rural adolescent MSM.

Conclusions

Taken together, the present study augments the growing literature on rural MSM, their healthcare needs, and best practices for engaging this hard-to-reach population in public health research and programming. This study suggests a relatively favorable view of mobile technology-based EMA research among rural MSM with few privacy and confidentiality concerns. Rural MSM perceive there to be both social and personal benefits from participating in research studies which could inform the development of public health programming or that may include ancillary services, such as HIV or STI testing, as part of data collection. Researchers should consider utilizing community informants, such as a CAB, to address emergent privacy and confidentiality concerns related to the use of EMA within rural settings. Future research should engage rural MSM in the development of mHealth and telemedicine prevention efforts and assessment of their use.

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Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

References

- Bonar, E. E., Koocher, G. P., Benoit, M. F., Collins, R. L., Cranford, J. A., & Walton, M. A. (2018). Perceived risks and benefits in a text message study of substance abuse and sexual behavior. *Ethics and Behavior, 28*, 218–234.
- Broaddus, M. R., DiFranceisco, W. J., Kelly, J. A., Lawrence, J. S. S., Amirkhani, Y. A., & Dickson-Gomez, J. D. (2015a). Social media use and high-risk sexual behavior among black men who have sex with men: A three-city study. *AIDS and Behavior, 19*, 90–97.
- Broaddus, M. R., Marsch, L. A., & Fisher, C. B. (2015b). Risks and benefits of text-message-delivered and small-group-delivered sexual health interventions among African American women in the midwestern United States. *Ethics and Behavior, 25*, 146–168.
- Bryman, A. (2006). Integrating quantitative and qualitative research: How is it done? *Qualitative Research, 6*, 97–113.
- Burns, M. N., Montague, E., & Mohr, D. C. (2013). Initial design of culturally informed behavioral intervention technologies: Developing an mHealth intervention for young sexual minority men with generalized anxiety disorder and major depression. *Journal of Medical Internet Research, 15*, e271. <https://doi.org/10.2196/jmir.2826>.
- Conrad, C., Bradley, H. M., Broz, D., Buddha, S., Chapman, E. L., Galang, R. R., ... Patel, M. R. (2015). Community outbreak of HIV infection linked to injection drug use of oxycodone—Indiana, 2015. *Morbidity and Mortality Weekly Report, 64*, 433–434.
- Corbin, J., & Strauss, A. (2008). *Basics of qualitative research: Techniques and procedures for developing grounded theory* (3rd ed.). Los Angeles: Sage.
- Duncan, D. T., Kapadia, F., Kirchner, T. R., Goedel, W. C., Brady, W. J., & Halkitis, P. N. (2017). Acceptability of ecological momentary assessment among young men who have sex with men. *Journal of LGBT Youth, 14*, 436–444.
- Epstein, D. H., Tyburski, M., Craig, I. M., Phillips, K. A., Jobes, M. L., Vahabzadeh, M., ... Preston, K. L. (2014). Real-time tracking of neighborhood surroundings and mood in urban drug misusers: application of a new method to study behavior in its geographical context. *Drug and Alcohol Dependence, 134*, 22–29.
- Fisher, C. B. (2004). Ethics in drug abuse and related HIV risk research. *Applied Developmental Science, 8*, 91–103.
- Fisher, C. B., Arbeit, M. R., Dumont, M. S., Macapagal, K., & Mustanski, B. (2016). Self-consent for HIV prevention research involving sexual and gender minority youth: reducing barriers through evidence-based ethics. *Journal of Empirical Research on Human Research Ethics, 11*, 3–14.
- Fisher, C. B., & Jaber, R. (2019). Ethical issues in substance-use prevention research. In Z. Sloboda, H. Petras, E. Robertson, & R. Hingson (Eds.), *Prevention of substance use* (pp. 281–299). New York: Springer.
- Fisher, C. M., Irwin, J. A., & Coleman, J. D. (2013). LGBT health in the midlands: A rural/urban comparison of basic health indicators. *Journal of Homosexuality, 61*, 1062–1090. <https://doi.org/10.1080/00918369.2014.872487>.
- French, D. P., & Sutton, S. (2010). Reactivity of measurement in health psychology: How much of a problem is it? What can be done about it? *British Journal of Health Psychology, 15*, 453–468.
- Furnari, M., Epstein, D. H., Phillips, K. A., Jobes, M. L., Kowalczyk, W. J., Vahabzadeh, M., ... Preston, K. L. (2015). Some of the people, some of the time: Field evidence for associations and dissociations between stress and drug use. *Psychopharmacology, 232*, 3529–3537.
- Giano, Z., Hubach, R. D., Meyers, H. J., DeBoy, K. R., Currin, J. M., Wheeler, D. L., & Croff, J. M. (2019). Rural men who have sex with men's (MSM) experiences and preferences for outreach health programming. *Journal of HIV/AIDS & Social Services, 18*, 80–89.
- Heron, K. E., & Smyth, J. M. (2010). Ecological momentary interventions: incorporating mobile technology into psychosocial and health behaviour treatments. *British Journal of Health Psychology, 15*, 1–39.
- Horvath, K. J., Bowen, A. M., & Williams, M. L. (2006). Virtual and physical venues as contexts for HIV risk among rural men who have sex with men. *Health Psychology, 25*, 237–242.
- Hubach, R. D., Currin, J. M., Giano, Z., Meyers, H. J., DeBoy, K. R., Wheeler, D. L., & Croff, J. M. (2019). Experiences of stigma by gay and bisexual men in rural Oklahoma. *Health Equity, 3*, 231–237.
- Hubach, R. D., Currin, J. M., Sanders, C. A., Durham, A. R., Kavanaugh, K. E., Wheeler, D. L., & Croff, J. M. (2017). Barriers to access and adoption of pre-exposure prophylaxis for the prevention of HIV among men who have sex with men (MSM) in a relatively rural state. *AIDS Education and Prevention, 29*, 315–329.
- Hubach, R. D., Dodge, B., Li, M. J., Schick, V., Herbenick, D., Ramos, W. D., ... Reece, M. (2015). Loneliness, HIV-related stigma, and condom use among a predominantly rural sample of HIV-positive men who have sex with men (MSM). *AIDS Education and Prevention, 27*, 72–83.
- Kemper, E. A., Stringfield, S., & Teddlie, C. (2003). Mixed methods sampling strategies in social science research. In C. Teddlie & A. Tashakkori (Eds.), *Handbook of mixed methods in social and behavioral research*. Thousand Oaks, CA: Sage.
- Kennedy, A. P., Epstein, D. H., Phillips, K. A., & Preston, K. L. (2013). Sex differences in cocaine/heroin users: Drug-use triggers and craving in daily life. *Drug and Alcohol Dependence, 132*, 29–37.
- Labrique, A. B., Kirk, G. D., Westergaard, R. P., & Merritt, M. W. (2013). Ethical issues in mHealth research involving persons living with HIV/AIDS and substance abuse. *AIDS Research and Treatment, 2013*, 189645.
- Lauckner, C., Truszczynski, N., Lambert, D., Kottamasu, V., Meherally, S., Schipani-McLaughlin, A. M., ... Hansen, N. (2019). “Catfishing,” cyberbullying, and coercion: An exploration of the risks associated with dating app use among rural sexual minority males. *Journal of Gay & Lesbian Mental Health, 23*, 289–306.
- Li, M. J., Hubach, R. D., & Dodge, B. (2015). Social milieu and mediators of loneliness among gay and bisexual men in rural Indiana. *Journal of Gay & Lesbian Mental Health, 19*, 331–346. <https://doi.org/10.1080/19359705.2015.1033798>.
- Macapagal, K., Coventry, R., Arbeit, M. R., Fisher, C. B., & Mustanski, B. (2017). “I won’t out myself just to do a survey”: Sexual and gender minority adolescents’ perspectives on the risks and benefits of sex research. *Archives of Sexual Behavior, 46*, 1393–1409.
- Newcomb, M. E., & Mustanski, B. (2013). Diaries for observation or intervention of health behaviors: Factors that predict reactivity in a sexual diary study of men who have sex with men. *Annals of Behavioral Medicine, 47*, 325–334.
- Oklahoma State Department of Health. (2019). *Oklahoma HIV/AIDS summary statistics: Newly diagnosed HIV and newly diagnosed AIDS in Oklahoma 2017*. Retrieved October 1, 2019 from <https://www.digitalprairie.ok.gov/digital/collection/stgovpub>.
- Parsons, J. T., Millar, B. M., Moody, R. L., Starks, T. J., Rendina, H. J., & Grov, C. (2017). Syndemic conditions and HIV transmission risk behavior among HIV-negative gay and bisexual men in a US national sample. *Health Psychology, 36*, 695–703.

- Pequegnat, W., Rosser, B. S., Bowen, A. M., Bull, S. S., DiClemente, R. J., Bockting, W. O., ... Horvath, K. (2007). Conducting Internet-based HIV/STD prevention survey research: Considerations in design and evaluation. *AIDS and Behavior, 11*, 505–521.
- Pitasi, M. A., Delaney, K. P., Brooks, J. T., DiNenno, E. A., Johnson, S. D., & Prejean, J. (2019). HIV testing in 50 local jurisdictions accounting for the majority of new HIV diagnoses and seven states with disproportionate occurrence of HIV in rural areas, 2016–2017. *Morbidity and Mortality Weekly Report, 68*, 561–567.
- Preston, D. B., D'Augelli, A. R., Cain, R. E., & Schulze, F. W. (2002). Issues in the development of HIV-preventive interventions for men who have sex with men (MSM) in rural areas. *Journal of Primary Prevention, 23*, 199–214.
- Preston, D. B., D'Augelli, A. R., Kassab, C. D., & Starks, M. T. (2007). The relationship of stigma to the sexual risk behavior of rural men who have sex with men. *AIDS Education and Prevention, 19*, 218–230.
- Raymond, H. F., Rebchook, G., Curotto, A., Vaudrey, J., Amsden, M., Levine, D., & McFarland, W. (2010). Comparing internet-based and venue-based methods to sample MSM in the San Francisco Bay Area. *AIDS and Behavior, 14*, 218–224.
- Reback, C. J., Ling, D., Shoptaw, S., & Rohde, J. (2010). Developing a text messaging risk reduction intervention for methamphetamine-using MSM: Research note. *The Open AIDS Journal, 4*, 116–122. <https://doi.org/10.2174/1874613601004030116>.
- Rendina, H. J., & Mustanski, B. (2018). Privacy, trust, and data sharing in web-based and mobile research: Participant perspectives in a large nationwide sample of men who have sex with men in the United States. *Journal of Medical Internet Research, 20*, e233. <https://doi.org/10.2196/jmir.9019>.
- Rhodes, S. D., Mann, L., Alonzo, J., Downs, M., Abraham, C., Miller, C., ... Song, E. (2014). CBPR to prevent HIV within racial/ethnic, sexual, and gender minority communities: Successes with long-term sustainability. In S. D. Rhodes (Ed.), *Innovations in HIV prevention research and practice through community engagement* (pp. 135–160). New York: Springer.
- Rhodes, S. D., & Wong, F. Y. (2016). HIV prevention among diverse young MSM: Research needs, priorities, and opportunities. *AIDS Education and Prevention, 28*, 191–201.
- Rich, J. D., & Adashi, E. Y. (2015). Ideological anachronism involving needle and syringe exchange programs: Lessons from the Indiana HIV outbreak. *Journal of the American Medical Association, 314*, 23–24.
- Rosenberger, J. G., Schick, V., Schnarrs, P., Novak, D. S., & Reece, M. (2014). Sexual behaviors, sexual health practices, and community engagement among gay and bisexually identified men living in rural areas of the United States. *Journal of Homosexuality, 61*, 1192–1207. <https://doi.org/10.1080/00918369.2014.872525>.
- Rosser, B. S., & Horvath, K. J. (2008). Predictors of success in implementing HIV prevention in rural America: A state-level structural factor analysis of HIV prevention targeting men who have sex with men. *AIDS and Behavior, 12*, 159–168.
- Roth, A. M., Felsher, M., Reed, M., Goldshear, J. L., Truong, Q., Garfein, R. S., & Simmons, J. (2017). Potential benefits of using ecological momentary assessment to study high-risk polydrug use. *mHealth, 3*, 46. <https://doi.org/10.21037/mhealth.2017.10.01>.
- Rudolph, A. E., Young, A. M., & Havens, J. R. (2017). A rural/urban comparison of privacy and confidentiality concerns associated with providing sensitive location information in epidemiologic research involving persons who use drugs. *Addictive Behaviors, 74*, 106–111.
- Ryan, C. L., & Lewis, J. M. (2017). *Computer and internet use in the United States: 2015: US Department of Commerce*. Washington, DC: Economics and Statistics Administration, US Census Bureau.
- Schafer, K. R., Albrecht, H., Dillingham, R., Hogg, R. S., Jaworsky, D., Kasper, K., ... Oursler, K. A. K. (2017). The continuum of HIV care in rural communities in the United States and Canada: What is known and future research directions. *Journal of Acquired Immune Deficiency Syndromes, 75*, 35–44. <https://doi.org/10.1097/QAI.0000000000001329>.
- Sherkat, D. E., Powell-Williams, M., Maddox, G., & De Vries, K. M. (2011). Religion, politics, and support for same-sex marriage in the United States, 1988–2008. *Social Science Research, 40*, 167–180.
- Shiffman, S. (2009). Ecological momentary assessment (EMA) in studies of substance use. *Psychological Assessment, 21*, 486–497.
- Shiffman, S., Stone, A. A., & Hufford, M. R. (2008). Ecological momentary assessment. *Annual Review of Clinical Psychology, 4*, 1–32.
- Smiley, S. L., Elmasry, H., Hooper, M. W., Niaura, R. S., Hamilton, A. B., & Milburn, N. G. (2017). Feasibility of ecological momentary assessment of daily sexting and substance use among young adult African American gay and bisexual men: A pilot study. *JMIR Research Protocols, 6*, e9. <https://doi.org/10.2196/resprot.6520>.
- Strathdee, S. A., & Beyrer, C. (2015). Threading the needle—how to stop the HIV outbreak in rural Indiana. *New England Journal of Medicine, 373*, 397–399.
- Sullivan, P. S., Driggers, R., Stekler, J. D., Siegler, A., Goldenberg, T., McDougal, S. J., ... Stephenson, R. (2017). Usability and acceptability of a mobile comprehensive HIV prevention app for men who have sex with men: A pilot study. *JMIR mHealth and uHealth, 5*, e26. <https://doi.org/10.2196/mhealth.7199>.
- Sun, C. J., Stowers, J., Miller, C., Bachmann, L. H., & Rhodes, S. D. (2015). Acceptability and feasibility of using established geosocial and sexual networking mobile applications to promote HIV and STD testing among men who have sex with men. *AIDS and Behavior, 19*, 543–552.
- Swank, E., Fahs, B., & Frost, D. M. (2013). Region, social identities, and disclosure practices as predictors of heterosexist discrimination against sexual minorities in the United States. *Sociological Inquiry, 83*, 238–258.
- Swank, E., Frost, D. M., & Fahs, B. (2012). Rural location and exposure to minority stress among sexual minorities in the United States. *Psychology & Sexuality, 3*, 226–243.
- Taylor, B., Croff, J. M., Story, C. R., & Hubach, R. D. (2019). Recovering from an epidemic of teen pregnancy: The role of rural faith leaders in building community resilience. *Journal of Religion and Health. https://doi.org/10.1007/s10943-019-00863-1*.
- United States Department of Agriculture. (2011). *Oklahoma-rural definitions: State-level maps*. Retrieved October 1, 2019 from https://www.ers.usda.gov/webdocs/DataFiles/Rural_Definitions__18009/25591_OK.pdf?v=39329.
- Ventuneac, A., John, S. A., Whitfield, T. H., Mustanski, B., & Parsons, J. T. (2018). Preferences for sexual health smartphone app features among gay and bisexual men. *AIDS and Behavior, 22*, 3384–3394.
- Waldorf, B. (2006). *A continuous multi-dimensional measure of rurality: Moving beyond threshold measures*. Paper presented at the meeting of the Association of Agricultural Economics, Long Beach, CA.
- Williams, M. L., Bowen, A. M., & Horvath, K. J. (2005). The social/sexual environment of gay men residing in a rural frontier state: Implications for the development of HIV prevention programs. *Journal of Rural Health, 21*, 48–55.
- Wray, T. B., Kahler, C. W., & Monti, P. M. (2016). Using ecological momentary assessment (EMA) to study sex events among very high-risk men who have sex with men (MSM). *AIDS and Behavior, 20*, 2231–2242.
- Yang, C., Linas, B., Kirk, G., Bollinger, R., Chang, L., Chander, G., ... Latkin, C. (2015). Feasibility and acceptability of smartphone-based ecological momentary assessment of alcohol use among African American men who have sex with men in Baltimore.

JMIR mHealth and uHealth, 3, e67. <https://doi.org/10.2196/mhealth.4344>.

Zukoski, A. P., & Thorburn, S. (2009). Experiences of stigma and discrimination among adults living with HIV in a low HIV-prevalence context: A qualitative analysis. *AIDS Patient Care & STDs*, 23, 267–276. <https://doi.org/10.1089/apc.2008.0168>.

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