Digital Crowdsourcing in Promoting HIV testing Among MSM in China: Study Protocol for A Cluster-Randomized Controlled Trial

Ci Ren
Shandong University School of Public Health  https://orcid.org/0000-0003-3686-1147

Joseph David Tucker
University of North Carolina at Chapel Hill

Weiming Tang
University of North Carolina at Chapel Hill

Xiaorun Tao
Shandong Center for Disease Control and Prevention

Meizhen Liao
Shandong Center for Disease Control and Prevention

Guoyong Wang
Shandong Center for Disease Control and Prevention

Kedi Jiao
Shandong University School of Public Health

Zece Xu
Shandong University School of Public Health

Zhe Zhao
Shandong University School of Public Health

Yu Yan
Shandong University School of Public Health

Yuxi Lin
Shandong University School of Public Health

Chuanxi Li
Shandong University School of Public Health

Lin Wang
Shandong University School of Public Health

Yijun Li
Shandong University School of Public Health

Dianmin Kang
Shandong Center for Disease Control and Prevention

Wei Ma  (weima@sdu.edu.cn)
Study protocol

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Abstract

**Background:** Men who have sex with men (MSM) are an important key population in China. However, HIV testing rates among MSM remain suboptimal. Digital crowdsourcing may be a useful tool to reach this marginalized population. The proposed cluster randomized controlled trial (RCT) study aims to assess the effectiveness of digital crowdsourcing in improving HIV testing and sexual behaviors change among Chinese MSM.

**Methods:** A two-arm, cluster-randomized controlled trial will be implemented in eleven cities (ten clusters) in Shandong Province, China. Target study enrollment will be 250 participants per arm and 50 participants per cluster. MSM who are 18 years old or above, live in the study city, have not been tested for HIV in the past 3 months, are not living with HIV or have never been tested for HIV, and are willing to provide informed consent, will be enrolled. MSM will be recruited through banner advertisements on Blued, the largest gay dating app in China, and in-person at community-based organizations (CBOs). Participants will be followed-up quarterly during the 12-month period. The primary outcome will be the self-reported uptake of HIV testing. Secondary outcomes will include change in condomless sex, self-test efficacy, social network engagement, HIV testing social norms, and testing stigma.

**Discussion:** Innovative approaches to HIV testing among marginalized population are urgently needed. Through this cluster randomized controlled trial, we expected that we can evaluate effectiveness of a digital crowdsourcing approach, improve the HIV testing rate among MSM and provide a resource in related public health fields.

**Trial Registration:** ChiCTR1900024350. Registered on 6 July 2019, identifier http://chictr.org.cn/.

Background

The growing epidemic among MSM has become the gravest challenge in fighting against HIV/AIDS in China. As of October 31, 2019, MSM accounted for 23.0% of newly reported HIV/AIDS cases in China, whereas the proportion was only 14.7% in 2011[1, 2]. Although the Chinese government and health facilities have adopted various measures such as providing free HIV testing and condoms, some systematic reviews showed the HIV testing rate among MSM in China remains low [3, 4]. In order for improving the HIV testing rate and reach the first 90 target of the 90-90-90 UNAIDS goals [5], innovative approaches are urgent needed. Digital crowdsourcing approaches may be a powerful tool. We define digital as social media, mobile phone applications, internet, or other approaches that use digital connections.

Digital approaches have been used to promote HIV prevention, especially for key populations like MSM [6–9]. Digital approaches can transcend the limits of space, limit stigma, provide a platform for anonymity and privacy, and increase community engagement [7, 9–11]. Previous surveys suggested that digital interventions can promote HIV testing and safe sexual behaviors through providing information related to HIV, offering HIV testing services, collecting different creative ideas to design intervention and
linking people to the community [10, 12]. In China, the internet has become a major way to find gay partners among MSM [15, 16]. A cross-sectional survey of 61 cities in China showed that 73.5% of MSM had found recent sex partners online [17], providing a strong foundation for digital interventions. According to the data of MSM national sentinel surveillance in China, only 26.3% men have received HIV test and known for the results in the last one year [18]. The high rates of internet usage and low HIV testing rate among MSM in China make digital approaches a useful tool in reaching high-risk populations and building low-cost HIV prevention interventions to promote HIV testing [19, 20].

Crowdsourcing represents a great opportunity to develop HIV testing services based on the community and improve HIV/sexual health outcomes in low- and middle-income countries (LMIC) [21, 22]. It can involve a group of experts and non-experts working together to solve a common problem and sharing solutions with the public [21, 23]. Crowdsourcing can be a promising tool in health, and it has been used in a number of medical studies such as cancer, malaria, HIV testing, etc. [24–27]. It has several advantages. First, it provides a specific platform for the people who have no formal training to share their thoughts with others to solve the common problems so that it can be used to enhance community engagement and speed up innovations [22, 28–30]. Second, by using crowdsourcing, researchers may conduct public contests, which have generated effective programs that may be more appropriate to implement for the specific population [26, 31]. Third, it can provide easy access to engage hard-to-reach populations for a research, especially via the social media [29, 32]. In this respect, crowdsourcing is a rapid and low-cost way to collect information from a great number of people [22, 26, 30, 33]. However, most crowdsourcing interventions have been conducted in large cities with few in smaller cities and less developed areas [31, 34]. Digital crowdsourcing may be a good way in promoting HIV testing and healthy sexual behaviors.

This study proposal aims to describe the designing of the cluster RCT and to evaluate the efficacy of digital crowdsourcing in improving the HIV testing rate among MSM in China.

**Trial Aims**

The first aim of this trial is to improve HIV testing rate among MSM in eleven target cities, testing the effectiveness of a digital crowdsourced intervention compared to the current HIV intervention conducted by local centers for disease control (CDCs). We hypothesize that the digital crowdsourced intervention will be superior in improving HIV testing rate. The second aim is to compare secondary outcomes (including condom use, social networking, HIV stigma, etc.) in digital crowdsourced intervention with the current HIV intervention. We hypothesize that the digital crowdsourced intervention will be superior in promoting safe sexual behaviors.

**Methods**

**Design**
As the intervention in our study will involve two levels—the community level and the individual level, and MSM in the same city often communicate with each other, we adopt a cluster-randomized controlled trial with one intervention arm and one control arm (Fig. 1). The cluster unit will be city. Surveys will be conducted at baseline and every three months thereafter (Fig. 2). A total of ten clusters, including Weifang, Zibo, Jining, Liaocheng, Jinan, Dezhou, Weihai, Binzhou, Qingdao, Heze, and Zaozhuang from Shandong Province are chosen by the following criteria: (1) with CDC MSM sentinel surveillance sites; (2) capacity for recruiting sufficient MSM. Heze and a nearby city Zaozhuang are in the same cluster considering the number of estimated MSM in both cities are small.

| STUDY PERIOD          | Enrollment | Allocation | Post-allocation | Close-out |
|-----------------------|------------|------------|-----------------|-----------|
| TIMEPOINT             | Aug-Jan 2019–2020 | Aug-Sep 2019 | March-May 2020 | Dec-Feb 2020–2021 | Mar-Apr 2021 |
| ENROLLMENT:           | ×          |            |                 |           |
| Online recruitment    | ×          |            |                 |           |
| Eligibility screen    | ×          |            |                 |           |
| Informed consent      | ×          |            |                 |           |
| Allocation            | ×          |            |                 |           |
| INTERVENTIONS:        | ×          | ×          | ×               | ×         |
| Intervention          | ×          | ×          | ×               | ×         |
| Control               | ×          | ×          | ×               | ×         |
| ASSESSMENTS:          | ×          | ×          | ×               | ×         |
| Online survey         | ×          | ×          | ×               | ×         |
| CDC Surveillance survey |            |            |                 | ×         |

Randomization

We randomly assigned cities (1:1) to either the intervention group or the control group with a block design, stratified by the city's number of HIV-positive in 2018, average GDP in 2017, cumulative number of
HIV-positive from 2012–2018 and year’s population at the end of 2017. We have a total of five blocks involving ten clusters: Block 1 consists of Dezhou and Weifang; Block 2 consists of Binzhou and Jining; Block 3 consists of Liaocheng, Heze and Zaozhuang; Block 4 consists of Zibo and Weihai; Block 5 consists of Jinan and Qingdao. Then the ten clusters were randomized with five (Binzhou, Dezhou, Weihai, Heze, Zaozhuang, Qingdao) in the intervention arm and five (Weifang, Zibo, Jining, Liaocheng, Jinan) in the control arm. Random numbers were generated using SAS 9.4 software. Cities in intervention arm will implement the digital crowdsourced intervention while cities in control arm will implement the current intervention conducted by local CDCs. Participants will be blinded in this trial, they will not know the city assignment.

Participants and eligibility criteria

Eligibility criteria for participants were: (1) aged at least 18 years; (2) had anal sex with men in the past one year; (3) currently living and planning to live in the eleven cities for the next 12 months; (4) born biologically male; (5) agree to provide phone number (just for follow up); (6) willing to participate in the follow-up survey every 3 months; (7) fully understand the facts about the trial and agree with the informed consent. The informed consent form will be shown to the potential participants at the beginning of the online questionnaire. Only those who clicked the “agree” option may be included in the study. Participants living with HIV will be invited to complete the baseline survey but will not be followed.

Study measures and Recruitment

We have built an online questionnaire (see Additional file 1) using Sojump Survey Software. The questionnaire was divided into two part. Part 1 includes the informed consent form and six questions for screening. Part 2 includes the main questions of this trial. MSM who pass through the screening in part 1 will jump to part 2 to answer the rest of questions, and they will be required to add us as contacts on WeChat (the largest social App in China) so that we can establish an online cohort. Participants who are not meet all requirements can scan the QR codes to get 0.14USD (1RMB) on WeChat for thanks. MSM will be recruited through banner advertisements on Blued (the largest gay dating app in China). CBOs in each study city will also assist with recruitment. In addition to direct recruitment through digital approaches, eligible participants will be invited to refer no more than five friends from their social networks of MSM and can receive a 1.44USD (10RMB) per person as incentive if their friends meet the requirements of this trial. All participants who enroll in the trial will receive a 7.22USD (50RMB) incentive for baseline survey and 7.22USD (50RMB) for each follow-up. Surveys will be conducted at baseline and every 3 months thereafter. Those who complete all five surveys will have an opportunity to win an iPad mini.

All the information in the questionnaire is self-reported. The questionnaire used in MSM surveillance sites run by local CDCs in each city will include additional questions about sexual partners, social media engagement, HIV/syphilis testing and HIV/syphilis test results (see Additional file 2). Cell phone numbers
will be used to link CDC and online survey data sets so the self-report data can be triangulated with CDC surveillance data during the same period.

**Intervention**

The intervention which includes 24 images and 4 short videos about HIV testing and safe sexual behaviors was developed through a series of participatory crowdsourcing contests. These included a sprint-like designathon that identified digital HIV self-testing as a priority [35] and an open call for images and videos [31]. The 24 images aim to address the importance of HIV testing, so as to improve HIV testing rate. The purpose of the 4 short videos of 50 s-1 min in duration is to enhance the awareness of safe sexual behaviors like condom use among MSM and encourage them to take regular HIV testing. The images and videos can be found in Additional file 3. The intervention will be implemented at the individual level through “WeChat”, and at community level through WeChat-group and WeChat-moments (a function on WeChat that people can share their life with friends).

The intervention will be implemented in five clusters (Binzhou, Dezhou, Weihai, Heze, Zaozhuang, Qingdao). For individual-level implementation, the images will first be shown at the end of the baseline questionnaire, and then we will send one different image every 2 weeks and one video every 3 months to the participants via WeChat messages. We will send self-test kit to the participants in intervention group at the 2nd and 3rd follow-up. For community-level implementation, we will set up several WeChat groups in each city and invited 30–40 participants in each group. Messages about HIV testing and safe sexual behavior from authority facilities (hospital, CDCS, CBOs, etc.) will be distributed to these groups and WeChat-moments every 2 weeks. We encourage members in these groups to talk about HIV. We will invite volunteers from local CBOs to join the groups. Team members of this study will participate in discussion if the participants have any question. Participants in other five cities (Weifang, Zibo, Jining, Liaocheng, Jinan) will receive routine intervention by local CDCs.

**Follow up**

All the participants will receive an online survey at baseline and the follow-up will be conducted every 3 months. Each participant will participate in a total of five surveys. At the 2nd and 3rd follow-up, we will send self-test kits to the participants in intervention group with their consent to evaluate the effectiveness of self-test kit in improving HIV testing rate.

**Outcomes**

The primary outcome of this study will be the uptake of self-reported HIV testing rate. We have set ten monitoring sentinels in the eleven cities so that the self-reported HIV testing rate can be triangulated with the rate from surveillance data during the same period. In addition, participants who receive the self-test kit are required to send their results to us on WeChat so that we can verify that the self-reported results are consistent with the self-test results. An increase of 20% in testing rate (assuming a proportion of HIV testing of 70% in intervention arm and 50% in control arm) was chosen as the superiority margin. This choice was based on the data of MSM sentinel surveillance collected by CDC of Shandong Province in
last one year. Secondary outcomes include, condom use, syphilis testing, social networking and others (see Additional file 4).

## Sample Size

A two-arm, cluster-randomized controlled trial will be used to this study. The sample size was calculated based on the primary outcome. We assumed that a digital crowdsourced intervention will be superior to a CDC routine intervention in promoting HIV testing rate among MSM who have not been tested in the past 3 months. Assuming the HIV testing rate is 70% in intervention cities and 50% in the control cities, a total of ten clusters, five in intervention group, others in control group, an intraclass correlation coefficient of 0.02 (usually between 0.01 to 0.03), two-sided $\alpha = 0.05$, power = 0.85, and the loss of follow-up is 30%, the total sample size is 500 men (50 to each cluster). The calculation was made using the software PASS 15.

## Timeline

This study will last 17 months. The first 5 months will be the baseline survey. Because the total population and the numbers of MSM are small in some cities, we budget ample time for the recruitment. CDC surveillance surveys will also be conducted in the target cities. The following 12 months will be the intervention phase. The intervention will be implemented in Binzhou, Dezhou, Weihai, Qingdao Heze and Zaozhuang following the cluster RCT design outlined in Fig. 2. All the participants in the eleven cities will be surveyed at baseline and every 3 months thereafter. In the 17th month, the last follow-up survey will be implemented.

## Data Collection and Management

The Sojump Survey Software will be used for data collection. In this study, we will collect information about socio-demographics, sexual behaviors, HIV and syphilis testing behaviors, social networking and psychological characteristics through an online questionnaire. The online tool and questionnaire have been used in our original stepped wedge cluster randomized controlled trial [31]. Socio-demographic characteristics include age, occupation, education level, annual income, marital status, sexual orientation, and sexual orientation disclosure. Behavioral variables consist of sex partners, frequency of sex, condom use, self-reported HIV testing (including both facility-based and self-testing), syphilis testing and social networking. Psychological characteristics include HIV testing self-efficacy and HIV stigma.

Survey data completed by all participants will be saved in a secured computer only used for saving data, discarding other privacy issues such as open network environments. Passwords and firewalls will also be used to protect the data.

An independent external advisory committee composed of STI experts has been established. The committee will meet regularly to review and assess progress in data collection and research.
Analysis

The sociodemographic characteristics will be analyzed using descriptive statistics. Comparison in baseline characteristics between the intervention and control arm will be conducted using a chi-squared test adjusted for clustering. The primary outcome of this trial will be the uptake of self-reported HIV testing rate. Generalized linear mixed models (GLMM) will be used for the analysis. Intervention status and time will be considered fixed effects, while sites and individual participants with multiple measurements across the four follow-ups will be considered random effects. The secondary outcomes will include a series of binary variables (continuous variables will be categorized into binary variables), such as number of sexual partners, frequency of anal sex, sex without condoms, frequency of HIV testing (including both facility-based and self-testing), awareness of syphilis status, social network engagement and others. These will be analyzed similar with the primary outcomes. Furthermore, the interaction effect of intervention between individual level and community level will also be analyzed. Participants who miss the follow-up will be included and assumed not achieved the primary and secondary outcomes during the missed follow-up period. If an outcome is missing for < 15% of participants, analyses will use a complete-case approach. Otherwise, multiple imputation will be used.

We will also carry out a subgroup analysis based on age (≤ 30 years old versus > 30 years old) and way of HIV testing (facility-based versus self-testing).

Results of this study will be distributed to target cities and national stakeholders.

Discussion

Digital crowdsourcing approach has the potential to reach marginalized populations who face multi-level barriers to care, lower the cost of intervention, aggregate community wisdom and solicit images and videos to promote HIV testing and health outcomes [22, 28, 31, 33]. Several studies and reviews showed that the digital crowdsourcing can improve HIV services for MSM, promote the HIV testing and link them to the HIV cascade [21, 26, 31]. It can be a powerful vehicle for increasing HIV testing rate and making messages more feasible to implement among MSM. The effectiveness of digital crowdsourcing has been examined in few randomized controlled trials, more rigorous evaluation is needed. We believe that a large-scale, multi-site cluster RCT is needed to evaluate the effectiveness of digital crowdsourcing.

There are several limitations that should be considered in this study. First, digital approaches may not be able to reach people who do not use online tools often. The CBOs in eleven target cities will also help us for the recruitment, which may alleviate this problem to some extent. Second, all the information will be self-reported, some participants may report a change in HIV testing and sexual behaviors because of the social expectation or sensitivity on data privacy for taking part in the study. However, our online survey allows a high degree of anonymity, we will not collect personal information like name or address, and we will highlight the information of privacy protection in the informed consent. In this way, this bias may be reduced. Third, MSM will receive 50 RMB when they finished one online questionnaire. Part of them may deliberately falsify their answers just for obtaining the incentive. To reduce this bias, we have established
a strict review mechanism. When a questionnaire has been completed, we will check for it first. If it has only one logical error, we will verify with the participant. When there is more than one logical error in the questionnaire, the participant will no longer be included in the study. Furthermore, we have an administrator for each city to ensure that recruitment and review work is done in an orderly manner. Triangulation with CDC surveillance site data can facilitate validation. Forth, participants from the intervention and control cities may potentially communicate with each other, which may cause study contamination. Although the randomization of this trial is at city level, participants will not be aware of whether they are in the intervention group or the control group. Participants will also be asked whether they have seen the pictures or words which should only been sent to intervention group in the last follow-up questionnaire.

We anticipate that this digital crowdsourcing will increase HIV testing rate and promote safe sexual behaviors among MSM in China. The study outcomes will help to identify the effectiveness of the intervention. The intervention content can be accessed for free to the public. If successful, we hope that the health institutions will utilize this program as a resource and applied to the HIV prevention or to solve other health issues.

**Trial Status**

This protocol was registered in chictr.org.cn with ID ChiCTR1900024350. At the time of this draft, the recruitment has done.

**Abbreviations**

AIDS
Acquired Immune Deficiency Syndrome; CBO:Community-based organization; CDC:Chinese Center for Disease Control and Prevention; GLMM:Generalized linear mixed models; HIV:Human Immunodeficiency Virus; LMIC:Low-income and middle-income countries; MSM:Men who have sex with men; QR codes:Quick Response Code; RCT:Randomized controlled trial; STI:Sexually Transmitted Infection; UNAIDS:The Joint United Nations Programme on HIV and AIDS

**Declarations**

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Availability of data and materials

Data is not applicable now. Materials can be found in Additional file 3.

Authors’ contributions

WM, JT, WT and CR conceived the study. DK, XT, ML, GW participated in building the surveillance sentinel. ML, CR, KJ, ZX, ZZ, YL, CL, LW, YY, YL participated in MSM recruitment. The manuscript was prepared by CR and was carefully revised and edited by WM, DK, JT and WT. All authors read and approved the final manuscript.

Ethics approval and consent to participate

This protocol has been developed in accordance to the SPIRIT Checklist (see Additional file 5). Institutional Review Board (IRB) approval has been obtained from School of Public Health, Shandong University on 6 March 2019 (20190210). All participants will provide consent prior to taking part in the study.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

Author details

1 Department of Epidemiology, School of Public Health, Shandong University, Jinan, Shandong 250012, China.

2 University of North Carolina Chapel Hill Project-China, No. 2 Lujing Road, Guangzhou 510095, China.

3 Department of Epidemiology and Biostatistics, University of California San Francisco, 550 16th Street, San Francisco, CA 94158, USA.

4 Institution for AIDS/STD Control and Prevention, Shandong Center for Disease
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Figures
Figure 1

Schematic of crowdsourced intervention implementation

| TIMEPOINT | STUDY PERIOD |
|-----------|--------------|
|            | Enrollment | Allocation | Post-allocation | Follow-up |
|            | March 2019-March 2020 | March 2019-May 2020 | March 2020-May 2021 | March 2021 |
| ENROLLMENT | x            | x           | x                | x |
| Online recruitment | x            | x           | x                | x |
| Eligibility criteria | x            | x           | x                | x |
| Informed consent | x            | x           | x                | x |
| Allocation | x            | x           | x                | x |
| INTERVENTIONS | x            | x           | x                | x |
| Intervention | x            | x           | x                | x |
| Control | x            | x           | x                | x |
| ASSESSMENTS | x            | x           | x                | x |
| Outcome survey | x            | x           | x                | x |
| CDC Surveillance survey | x            | x           | x                | x |

Figure 2

Spirit figure of study timeline
Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- AdditionalFiles.rar