Pay-it-forward gonorrhea and chlamydia testing among men in China: The PIONEER pragmatic randomized controlled trial

Study Protocol Version 6.0

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Background: Gonorrhea is one of the most common sexually transmitted diseases (STDs) among men who have sex with men in China. Past studies have shown that pay-it-forward (PIF) approaches premised on upstream reciprocity theory have been associated with a substantial increase in gonorrhea test uptake compared to standard of care. We propose the Pay-It-forward gONorrhEa tEsting randomized controlled trial (PIONEER) to examine the effectiveness of two implementation strategies involving different levels of community engagement to translate the generosity created by the pay-it-forward approach into test-taking action.

Methods: PIONEER will be a three-arm, programmatic cluster randomized controlled trial (RCT) to compare the effectiveness of the three implementation strategies, followed by a mixed-methods implementation evaluation study guided by a transformative paradigm. For the cluster RCT, we will enroll 12 diverse clinics, which will be randomly assigned to one of the intervention arms for delivering gonorrhea testing: a standard pay-it-forward implementation strategy with minimal encouragement to get tested, a community-engaged pay-it-forward strategy, and a control arm in which men pay for their own STD test. The public and MSM-led clinics in the same city will be randomized to the same study group to prevent contamination. The primary outcome of the RCT will be gonorrhea test uptake, and secondary outcomes will include chlamydia testing, STD treatment among those with infection, amount donated, 100% condom use, and antimicrobial resistance. A sequential explanatory mixed methods design will be used to evaluate the implementation process. Data sources will include survey data on the acceptability of the intervention, intervention appropriateness, feelings and attitudes towards the interventions among participants, administrative data about test uptake, treatment rate, and donations, as well as qualitative data to gain insights about men's perceptions and attitudes towards the pay-it-forward interventions strategies, mechanisms driving uptake and donating behaviors. Both survey and qualitative interviews with implementers and organizers about fidelity and adherence to protocol, intention to continue and maintain a pay-it-forward intervention, and barriers and facilitators of implementing the intervention will be conducted.

Discussion: PIONEER will substantially increase gonorrhea testing among MSM in China, providing an innovative new financial mechanism to sustain STD screening among sexual minorities in low- and middle-income countries. This study will answer compelling scientific questions about how best to implement pay-it-forward and the individual and organizational characteristics that moderate it.

Contributions to the literature

- This cluster randomized controlled trial aims to examine the effectiveness of two implementation strategies involving different levels of community engagement to translate the generosity created by the pay-it-forward approach into test-taking action.
- A sequential explanatory mixed methods design will be used to evaluate the implementation process to determine mechanisms by which pay-it-forward motivates testing and donations across the two intervention arms, and how individual and organizational characteristics moderate these individual and organizational characteristics moderate these.
- This study will answer compelling scientific questions about how best to implement pay-it-forward and the individual and organizational characteristics that moderate it.

Background

Gonorrhea is common among MSM in China. Gonorrhea is one of the most common sexually transmitted diseases (STDs) worldwide and in China. The World Health Organization estimated 87 million new cases of gonorrhea among people 15-49 years old based on a 2016 global systematic review[5]. The prevalence of gonorrhea among MSM in southern China has been reported as high as 12.5%[6-7]. Gonorrhea is known to increase the risk of HIV acquisition and transmission but is often asymptomatic at extragenital sites.

Gonorrhea testing rates among MSM are low. World Health Organization[9] and United States Centers for Disease Control and Prevention guidelines[10] recommend routine gonorrhea testing for sexually active MSM. Studies in different provinces of China consistently report that less than half of MSM have ever been tested for gonorrhea[11-12]. Low testing rates are problematic because this allows onward gonorrhea transmission.

Low testing rates are likely related to fees and minimal community engagement. User fees are common in many low and middle-income countries for STD testing and discourage test uptake[12], decreasing opportunities for prompt treatment and public health interventions[11,13]. Gonorrhea testing in China is expensive, not covered by health insurance, and not covered by other social support systems. This decreases access to routine gonorrhea testing[14]. Some young MSM may opt to self-pay for STD services in order to decrease the risk of parents, insurance providers, or others knowing about their need for services[15]. In addition to financing problems, community engagement in STD testing is often weak. Many MSM campaigns for STD testing are driven by public health authorities and have limited authentic input from local end-users[16]. This limited participation may then diminish STD test uptake. In response to these financial and community barriers to STD testing, our team developed a pay-it-forward approach to gonorrhea testing for MSM.

Pay-it-forward has a person receive a gonorrhea test as a gift from the local community and then decide to donate money to support subsequent testers (**Figure 1**)[17,18]. Pay-it-forward fits within the broader field of behavioral economics, which uses multiple disciplines to understand human decision-making. Pay-it-forward chains of giving are sometimes driven by unconnected generous individuals[18], but more often organized by a group with a common purpose[19,20]. Studies have shown that pay-it-forward can be sustainable and promote generosity[21].

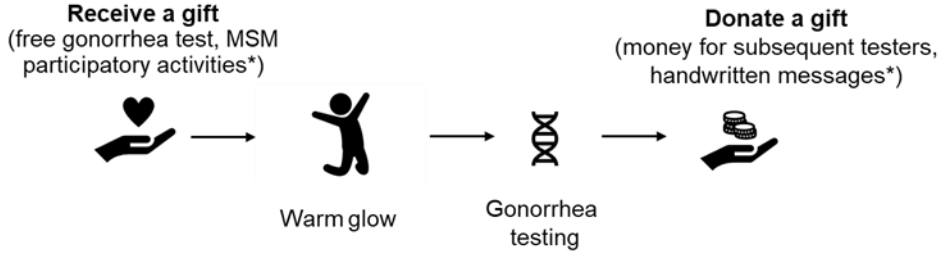

Figure 1. Overview of pay-it-forward. *Participatory activities such as open calls to create handwritten messages in the community-engaged implementation strategy. A warm glow refers to a positive feeling after receiving a gift.

Our previous pay-it-forward research showed that it was associated with a substantial increase in gonorrhea test uptake compared to standard of care[22,23]. However, these studies have several limitations. First, the projects were mostly, although not entirely, implemented at MSM-led clinics. These clinics serve MSM who are more likely to disclose their sexual orientation compared to MSM who present to public clinics. Alongside the MSM volunteers at MSM-led clinics, these sites are likely in a better position to organize MSM community engagement activities[15]. In addition to MSM-led clinics, public clinics also provide gonorrhea testing and treatment for MSM. Public clinics include HIV testing sites and STD clinics that receive support from public health authorities. Public clinics have higher rates of linkage to care and are more likely to have antibiotic therapy on-site. Second, MSM included in these two studies were mostly younger, better educated, higher income, and more willing to donate. The pay-it-forward intervention needs to be evaluated in additional cities and different types of clinics (i.e., both MSM-led and public clinics). Last, the previous study showed that pay-it-forward was effective compared to the standard of care, but explicit and intentional support for implementation is needed for scale-up. Lack of implementation evaluation limits our understanding of the implementation process, and community-engaged strategies are needed to maximize efficiency and effectiveness. These underscore the importance of implementation research to inform contextually appropriate strategies to implement pay-it-forward most effectively at scale.

We propose the Pay-It-forward gONorrhEa tEsting randomized controlled trial (PIONEER) to examine the effectiveness of two implementation strategies involving different levels of community engagement to translate the generosity created by the pay-it-forward approach into test-taking action. In the standard approach, men receive the gift of a free test and view messages promoting testing. In the community-engaged approach, men receive gifts, view tailored messages, are encouraged to create tailored messages of their own and are invited to become part of a community of collaborators engaged in promoting gonorrhea testing. Community-engaged approaches are important for enhancing the contextual appropriateness of public health interventions and the possibility of success.[1] The objectives of the study are threefold:

1) To compare point-of-care gonorrhea test uptake in a standard pay-it-forward implementation strategy arm, a community-engaged pay-it-forward implementation strategy arm, and a control arm using a three-arm cluster randomized controlled trial.
2) To determine mechanisms by which pay-it-forward motivates testing and donations

across the two intervention arms and how these are moderated by individual and organizational characteristics.

Theories informing the PIONEER intervention.

Our trial design and pay-it-forward strategies were informed by two theories/principles. First, the pay-it-forward is a novel concept embedded in upstream reciprocity theory. Upstream reciprocity is defined as individuals helped by someone who is more likely to help other unspecified people.

Upstream reciprocity theory has been used to understand the pay-it-forward mechanism within a community. The idea is that if someone is generous to you, it generates a "warm glow" that encourages you to be generous to others. In the context of pay-it-forward, the hypothesis is that someone receiving a gift feels an obligation to be generous to the community by getting tested and contributing a gift in return.

Principles guiding the design of community engagement elements.

Our implementation strategies were developed based on community-based participatory research (CBPR)[26.] Community participation is essential to the acceptance and contextual appropriateness of an intervention strategy.[1] This is especially important for hard-to-reach sexual minority groups. CBPR involves having the target community participate in several phases of the research process to address a health research question[26]. CBPR is appealing as it generates community engagement and amplifies the voices of neglected populations in service delivery strategy designs. It is a bottom-up, user-centered approach that leads to the development of culturally appropriate intervention strategies. Evidence has shown that community engagement in developing intervention strategies is associated with better acceptance, adherence, and effectiveness of the interventions in changing behaviors in a favorable way. We will use CBPR to guide the following activities: 1) organizing a co-creation group to co-create the community-engaged pay-it-forward strategy and forming shared leadership; 2) guiding the design of community engagement elements of the community-engaged strategy; 3) involving key stakeholders in various stages of the project to enhance appropriateness, acceptability, and feasibility.

Effectiveness-implementation (EI) hybrid trial design

Hybrid effective-implementation study designs are emerging as a useful research method to examine not only the intervention outcomes but also the implementation process that may affect the intervention effectiveness to various degrees. Evaluating the implementation outcomes collects evidence about the intervention delivery process, which can inform future evidence-based practices, facilitate replication or scale-up, and translate research findings to routine practices. We define our trial as a hybrid implementation-effectiveness design in which we aim to identify an optimal pay-it-forward delivery strategy (i.e., community-

engaged pay-it-forward versus standard pay-it-forward strategies and a control arm without pay-it-forward components) by comparing the effectiveness of these three strategies, and in the meantime, examine the implementation process of the two pay-it-forward strategies guided by RE-AIM framework.

Implementation evaluation framework

Finally, we used the RE-AIM evaluation framework to define outcomes in the five key domains for evaluating the implementation process and how different factors may affect intervention effectiveness. The RE-AIM framework is one of the most commonly used frameworks to evaluate the implementation of an intervention. It guides the development of implementation-focused outcomes to better understand mechanisms and factors influencing behavioral changes as a result of the interventions. Evaluation of the five key domains of the implementation process will provide evidence for future scale-up of the intervention and facilitate evidence-based practices. These domains are the reach of the three implementation strategies within the target MSM population, the effectiveness of the intervention itself and of the strategies that aim to enhance and optimize intervention delivery, factors affecting the adoption of the implementation strategies, fidelity and adherence to standard operation protocol for implementation, maintenance and sustainability.

Transformative Mixed Methods Paradigm

A transformative paradigm was chosen to address issues of social justice and inform the methodological decisions of this study in ways that eventually ensure a strong link between the research and advancing a social justice agenda[27,28]. In the context of this hybrid trial, the transformative paradigm has informed our research in several ways. First, acknowledging that there are multiple realities shaped by political, social, cultural, economic, gender, and sexual identities, we ensured that a participatory co-creation process involving diverse partners were adopted to develop trial components, lead implementation of the research, and provide input into the analysis and interpretation of our data. Second, beyond centering community voices in our research, a transformative paradigm will inform our qualitative implementation research with its focus on structural inequities and power structures that lead to the marginalization of MSM and limit access to healthcare in the population[29]. Third, the research adopts a hybrid effectiveness-implementation trial design as its commitment to ensuring that effective, community-led solutions are scaled up and sustained in local health systems. This research ultimately hopes to bridge inequities in gonorrhea testing and treatment for the MSM population in China.

Methods

Design overview

Our trial will use a hybrid effectiveness-implementation study design which values both

intervention effectiveness and implementation process. Specifically, the PIONEER trial will be a three-arm, programmatic cluster randomized controlled trial (RCT), followed by a mixed-methods implementation evaluation study. The cluster RCT aims to compare the effectiveness of the three implementation strategies, and the implementation evaluation will look into other domains of the implementation process guided by the RE-AIM framework.

For the cluster RCT, we will enroll 12 diverse clinics (i.e., MSM-led and public sexual health clinics), and the clinics will be randomly assigned to one of the intervention arms for delivering gonorrhea testing: a standard pay-it-forward implementation strategy with minimal encouragement to get tested, a community-engaged pay-it-forward strategy, and a control arm in which men pay for their own STD test. Randomization will be based city economic status and stratified by clinic type. The standard strategy, which was developed through our previous pay-it-forward research, will have men who enter the clinic be provided with a free gonorrhea test and shown handwritten postcards from other MSM in the local community. The community-engaged strategy will include all elements of the standard strategy, in addition to the following key community-engaging activities: the gift recipients will be invited to choose and keep one anonymously donated postcard, submit handwritten postcards of their own, draw on plain fans, and decorate with stickers, send out messages that encourage testing on social media platforms or create videos promoting gonorrhea testing (to be viewed at the same clinic). Men who agree to participate in the community engagement activities will be invited to a hybrid digital and in-person pay-it-forward event where they meet other people who have donated and to related participatory activities organized by the local clinic to promote gonorrhea testing.

Data collection

Mixed methods will be used to evaluate the implementation process with project implementers, organizers, and participants. Data sources will be multiple, which will include survey data on the acceptability of the intervention, intervention appropriateness, feelings and attitudes towards interventions among participants, administrative data about test uptake, treatment rate, and donations, as well as qualitative data to gain insights about men's perceptions and attitudes towards the pay-it-forward interventions strategies, mechanisms driving uptake and donating behaviors. Both survey and qualitative interviews with implementers and organizers about fidelity and adherence to protocol, intention to continue and maintain a pay-it-forward intervention, and barriers and facilitators of implementing the intervention will be conducted.

Study setting and population

We will implement the study in Guangdong cities with either (or both) public STD and MSM-led clinics. Examples include Zhuhai, Foshan, Jiangmen, Zhanjiang, Zhanjiang, Dongguan, and Huizhou. These clinics were chosen because respective cities have a higher burden of STDs, and findings would be potentially relevant in many cities. In MSM-led clinic, only MSM who

meet eligibility criteria will be included. In public STI clinics, all men will be recruited. The rationale for this is that many MSM do not identify as being attracted to other men.

The study settings between public clinics and MSM-led clinics would be different. One key obstacle to recruiting MSM at public STD clinics is that MSM usually may not want to disclose their sexual identities due to justifiable fears about risks of stigma and discrimination from other men and health workers. Therefore, to avoid indirect sexual orientation disclosure and feelings of discrimination, public STD clinic recruitment will be extended to include all men visiting the public clinic setting regardless of sexual orientation. This will lower the risk of being unnecessarily 'targeted' and accidental sexual orientation disclosure.

The inclusion criteria at public clinics include men who are at least 18 years old; have had sex over the past year; have not been tested for gonorrhea and chlamydia in the past year; reside in the city in the past three months; speak Mandarin Chinese or Cantonese; mentally capable of providing informed consent to test for gonorrhea and chlamydia; and owning a mobile phone.

The inclusion criteria at MSM-led clinics include men who had anal sex with another man; are at least 18 years old; have had anal sex over the past year; have not been tested for gonorrhea and chlamydia in the past year; reside in the city in the past three months; speak Mandarin Chinese or Cantonese; mentally capable of providing informed consent to test for gonorrhea and chlamydia; and owning a mobile phone. In China, over 95% of MSM own a mobile phone.

Development of intervention and formative research

Approach and study team

A key innovation of this trial study, relative to past pay-it-forward research, is developing and evaluating the community-engaged approach as an additional intervention arm. While upstream reciprocity is hypothesized to promote the pay-it-forward mechanism in our proposed trial, simulation models of the upstream reciprocity process show that the "warm glow" does not guarantee sustainability. In contrast, evidence shows that the probability of cooperation increases when combined with network reciprocity where a community of collaborators reinforces acts of altruism.72 The two arms of our trial are designed to test these two hypotheses. The standard pay-it-forward arm evaluates the hypothesis that the upstream reciprocity created by a pay-it-forward approach will increase testing adoption with minimal implementation support, while the community-engaged arm tests the hypothesis that pay-it-forward needs to be reinforced by an implementation strategy based on network reciprocity to enhance its effectiveness.

The study will be managed through a consortium involving two academic centers, the University of North Carolina in Chapel Hill and the Southern Medical University Dermatology Hospital in Guangzhou, as well as a non-profit community-based organization that will

organize community engagement activities, the Social Entrepreneurship to Spur Health (SESH). The SESH team has a strong track record of community engagement and organizing research studies focused on sexual health, including pay-it-forward programs in Beijing and Guangzhou. The study team comprises representatives from the academic centers and SESH who have complementary expertise in community mobilization, implementation science, epidemiology, health economics, biostatistics, and social science.

A co-creation group will be appointed and will comprise MSM representatives, clinicians and nurses, communication officers, and co-chaired by members of SESH and a local MSM community-based organization. Co-creation groups serve as a source of shared leadership in CBPR-premised research, and its members typically reflect the community of interest. This co-creation group will be consulted on a quarterly basis to provide input on the study design, implementation, and dissemination activities.

Site selection, training, and trial registration

We will implement the study in Guangdong cities with MSM-led clinics: Huizhou, Zhuhai, Jiangmen, Foshan, Zhanjiang, and Dongguan. These clinics were chosen because respective cities have a higher burden of STDs, they include the two major service delivery approaches (MSM-led clinics and public clinics) in China, and findings would be potentially relevant in many cities that have chlamydia/gonorrhea point-of-care testing available.

Each of the clinical sites will receive Good Clinical Practice (GCP) training for new personnel, regulatory assessment, and related trial requirements. Representatives from each of the participating clinics will be invited to attend a single training workshop in Guangzhou to introduce the study protocol, local implementation workflows, sample collection and testing, gonorrhea and chlamydia treatment, and the resistance testing processes. We registered the RCT on ClinicalTrials.gov (registration id: NCT05723263) prior to the commencement of the trial.

Developing standard strategy and the community-engaged strategy

This three-arm cluster randomized controlled trial will compare gonorrhea test uptake in a standard pay-it-forward implementation strategy arm, a community-engaged pay-it-forward implementation strategy arm, and a control arm. Our implementation strategies are summarized in Table 1.

Table 1. Overview of the three study arms.

Trial Arm	Financial Component of Gonorrhea Testing*	Community Engagement
Standard Pay-it-forwardarm	Free gonorrhea/ chlamydia testing	Passive: viewing postcards and materials written by others encouraging gonorrhea/ chlamydia testing Active: an opportunity

		to donate to support others.
Community-engaged Pay-it-forward arm	Free gonorrhea/ chlamydia testing	Active: multi-stakeholder co-creation activities to develop essential components of the intervention and implementation strategies; writing postcards; designing fans with stickers,; sending out testing promotion messages on social media; an opportunity to donate to support others.
Control arm	Fee-based gonorrhea/ chlamydia testing (approximately 20 USD	None

*Note: All participants who test positive for gonorrhea will receive a referral for AMR testing and treatment at the local public STD clinic.

In the standard strategy/arm, MSM who enter the clinic will be provided with a free gonorrhea test alongside handwritten postcards from other MSM in the local community. Our previous RCT has already created standard operating procedures, survey instruments, and educational materials for this intervention. The initial postcards were generated through an open call for suggestions about tailored, handwritten messages that are clinic-specific and locally appropriate. We used the standardized methods developed by the World Health Organization to design the open call. Briefly, this will involve creating a steering committee, promoting the open call, judging submissions, recognizing excellent submissions, and implementing selected ideas.

In contrast, the community-engaged strategy/arm will include all elements of the standard strategy, in addition to the following key components: gift recipients will be invited to select a handwritten postcard for keepsakes, submit handwritten postcards of their own, draw on and decorate plain hand fans with stickers, send out messages promoting gonorrhea/chlamydia testing on social media platforms, or create videos promoting gonorrhea testing (to be viewed at the same clinic). Men who agree to participate in the community-engagement activities will be invited to a pay-it-forward event where they will meet other people who have donated, and will also be invited to related participatory activities organized by the local clinic to promote gonorrhea testing.

In the control arm, MSM will be informed about the importance of gonorrhea testing but will not receive handwritten postcards or other community engagement activities. Among men who choose to receive gonorrhea testing, they will have access to the same diagnostics,

treatment, and follow-up provided in the other two arms. Donations in the two pay-it-forward arms will be organized using WeChat, a hybrid between Twitter and Facebook that allows micro-payments.

We will use intervention mapping[30], a method used in public health, to design these components in a way that is tailored to the local context of each site and facilitates their implementation. We will be guided by several behavior change taxonomies developed by implementation scientists to assist in the designing of implementation interventions[2,3]. Briefly, examples include categories of behavioral change techniques that focus on changes to increase knowledge, changes to awareness and risk perception, and changes to social influence.

Formative testing, finalization of interventions, and development of instruments

Formative Digital Qualitative (n=50)

To further develop and fine-tune our implementation strategies in preparation for the RCT, we will conduct a series of digital qualitative research activities. These activities will explore the perceptions of men who have sex with men (MSM) in Huizhou, Zhanjiang, Zhuhai, Jiangmen, Foshan, and Dongguan on HIV and other STI testing, with a focus on barriers and facilitators to testing for HIV and other STI (especially Gonorrhea and Chlamydia), perceptions of public STI clinics, perceptions of MSM-led clinics, as well as perceptions of community-engagement in the MSM community. First, we will recruit up to 50 people to participate in an online chat-based focus group discussion (FGD) on WeChat. The SESH team will disseminate a call for participation over social media. Participants who are interested in participating will be provided with a link to the participant information sheet and consent form, and will be directed to an enrollment survey after they provide informed consent. Personal identifiers will never be shared with anyone outside of the research team.

There will be no more than eight participants per FGD. In order to participate in this focus group discussion (FGD), individuals must meet the following criteria: Age 18 years or older (Age of majority in China); Sex assigned male at birth; Have had anal sex with a man at least once; Speaks Mandarin Chinese or Cantonese; and currently living in Huizhou, Zhanjiang, Zhuhai, Jiangmen, Foshan, and Dongguan. Second, we may follow up with no more than 25 participants for further in-depth interviews conducted over voice call on WeChat. Third, we will conduct digital ethnographic activities on digital spaces and sites mentioned by participants throughout the course of the study to articulate stakeholders associated with such spaces and describe how community identities, interactions, and engagement occur in these spaces.

Formative Quantitative (n = 350)

We will field test our two implementation strategies at selected MSM-led clinics and public STD clinics in Guangdong province, China. We will recruit a total of 350 participants. The

eligibility criteria include at least 18 years old and mentally capable of providing informed consent to test for gonorrhea; men who have had anal sex with another man over the past year; have not been tested for gonorrhea in the past year; reside in the city in the past three months; speak Mandarin Chinese or Cantonese; and owning a mobile phone. This will allow us to improve the strategies using learning evaluation methods[31] that involve iterative Plan-Do-Study-Act cycles based on user feedback. We will also develop and fine-tune our process evaluation instruments for fidelity assessment[32], gratitude assessment[33, 34], and organizational readiness[35] at this stage of research.

Formative Qualitative (n = 50)

We have developed an interview guide as part of formative testing. The main topics in the interview guide will include the following: (1) reasons for getting tested; (2) understanding and perception of the pay-it-forward concept; (3) specific questions about emotions of gratitude after receiving a test that is supported by another community member; and (4) self-identity in the MSM community and level of integration within a community; (5) intention and motivation to initiating and mediating helping behaviors within the community. We will obtain recorded verbal informed consent from all interviewees before the commencement of the interview. Interviews will last about one hour and will take place either in person or over the phone-based on participant preference.

Interviews will be audio-recorded, and personal information will not be recorded. Unintentional recording of personal information will otherwise be redacted before transcription. Each participant will receive a small monetary incentive of ¥50 (7.50 USD) for their participation. All recorded interviews will be transcribed, and the transcripts will be checked by one research staff member. Summaries of interviews will be written up for preliminary data analysis. In addition, we will collect anonymized text from handwritten postcards and other community engagement activities.

Pragmatic cluster RCT

Sample size and power considerations

We used a binary outcome cluster RCT design for sample size calculation where the unit of randomization is the clinic. In order to achieve a 90% power and allow for 0.05 type-I error, 12 overall clusters (4 in each arm) are needed. Thus, the sample size includes a total of 12 clusters and 1200 participants (100 per cluster) based on cluster randomized trial sample size calculation principles. We expect this study will have 85% power to detect a 10% difference in azithromycin resistance between intervention arms and routine gonorrhea antibiotic surveillance data from other cities in the same province. Nevertheless, further calculations will be made following formative research endeavors that will estimate the prevalence of these outcomes. The calculation would be performed using the software PASS (version 15) with the formulas developed by Hussey and colleagues.[36]

Randomization

Figure 2 shows the cluster RCT design flowchart. We will assign clinics to study arms on a 1:1:1 basis using covariate-constrained randomization. We will use covariate-constrained randomization to decrease potential bias associated with unbalanced study arms. We will balance the number of MSM-led and public clinics in each arm because these are unique implementation structures. All men recruited via one clinic will be assigned to one arm. We will recruit and screen men until we meet our sample size of 1200 men.

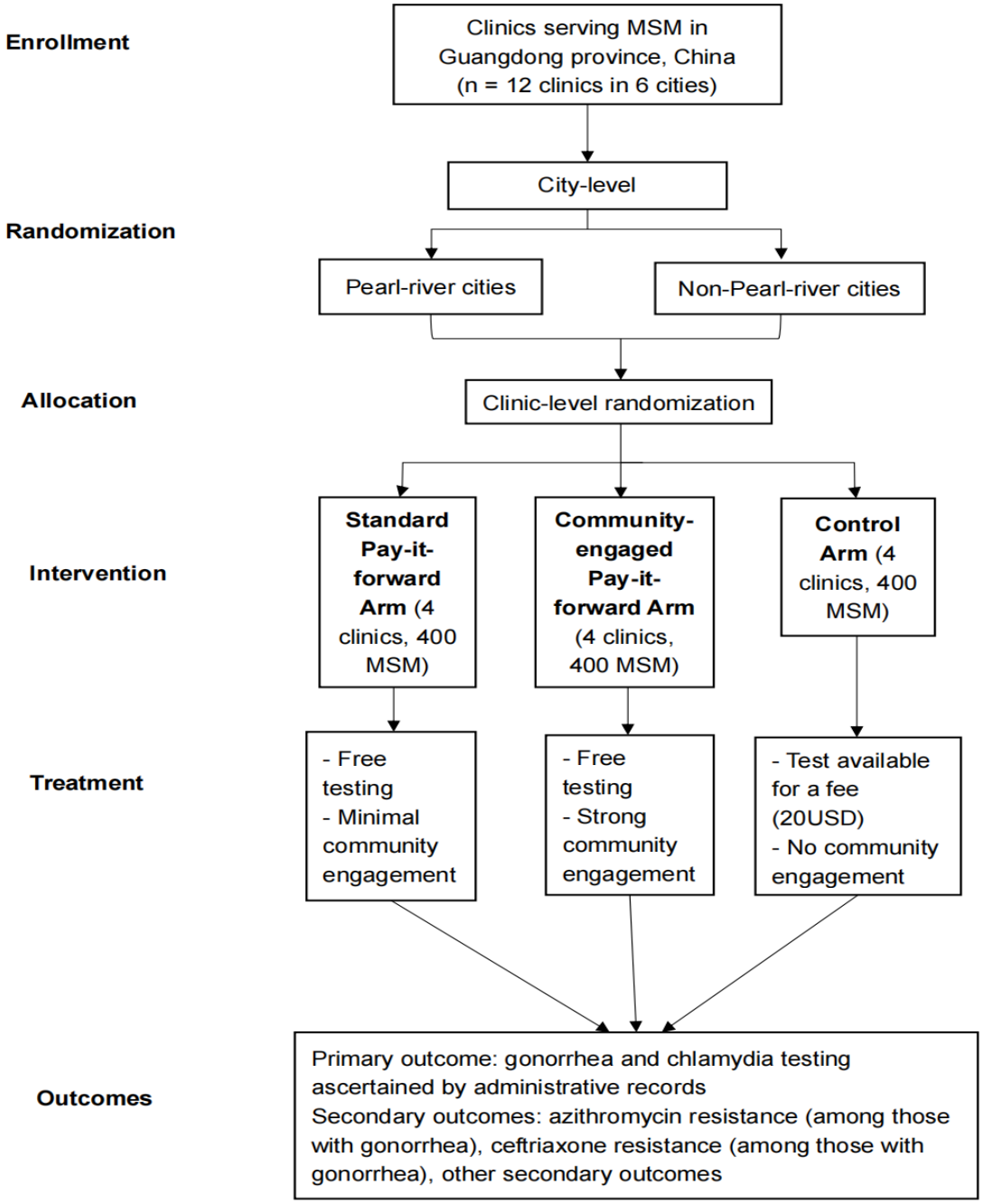

Figure 2. Pragmatic RCT flowchart. Each city will have one MSM-led clinic andone public clinic participating.

Intervention delivery strategies

The duration of the intervention is one year at each clinic, with the potential to continue based on local commitments. All patients who accept testing will receive gonorrhea/ chlamydia PCR testing. This diagnostic is approved by the US FDA and the Chinese national regulatory authority. Men who agree to be tested will have specimens collected from

pharyngeal, rectal, and urethral sites. Specimens will be pooled based on excellent sensitivity and specificity. Turnaround time for test results will depend on the local clinic. Surveys will be done online in order to facilitate implementation. All participants diagnosed with gonorrhea will receive ceftriaxone and azithromycin in accordance with WHO recommendations for first-line gonorrhea therapy.

Outcome measures

The primary outcome of the RCT will be gonorrhea test uptake ascertained by administrative review from participating clinics. We used this same primary outcome in previous quasi-experimental and RCT trials evaluating pay-it-forward. Secondary outcomes will include syphilis testing, amount donated towards pay-it-forward, antimicrobial resistance measures, positive tests for gonorrhea and chlamydia, measures of gratitude and community solidarity, and per unit costs associated with the intervention (Table 2).

Table 2. Secondary outcomes of the cluster RCT

Outcome	Time Frame	Ascertainment	Data Analysis
Primary			
Gonorrhoea and Chlamydia test uptake		Clinic administrative data	Generalized mixed effects models (compare control arm to pay-it-forward intervention)
Secondary			
Amount donated	During enrollment visit	Administrative data	Descriptive analysis
The number of participants who tested positive for Gonorrhea	During enrollment visit	Laboratory result	Descriptive analysis
The number of participants tested positive for chlamydia	During enrollment visit	Laboratory result	Descriptive analysis
The proportion of those who tested positive for Gonorrhea or Chlamydia who returned for referral treatment	One month after receiving the results	Self-reported follow-up survey (linkage to care, treatment)	Descriptive analysis
Cost per test[1]	During enrollment visit	Costing data collection	Micro-costing approach

Adapted gratitude scale	During enrollment visit	Self-report	T-test
Community solidarity scale[4]	During enrollment visit	Self-report[2]	T-test
Community cohesion	During enrollment visit	Self-report	T-test
Internalized homophobia	During enrollment visit	Self-report	T-test
Subgroup analysis			
Gonorrhea and chlamydia testing uptake by clinic type	During enrollment visit	Administrative data at study site	MSM-led clinic vs. public STD clinic
Gonorrhea and chlamydia testing uptake by sexual orientation	During enrollment visit	Self-reported sexual orientation data from baseline survey	Self-identified sexual minority vs. not
Gonorrhea and chlamydia testing uptake by age group	During enrollment visit	Self-reported socio-demographic data from baseline survey	≤30years vs. >30years
Gonorrhea and chlamydia testing uptake by PrEP eligibility	During enrollment visit	Self-reported frequency of condom use in during sexual intercourse in the past 3 months data from baseline survey	Condom use vs. Condomless sex.

[1]Cost per test is defined as the cost associated with respective interventions (development, start-up, implementation, intervention) per individual who reported testing for gonorrhea and chlamydia following the intervention; economic test and financial cost are reported separately.
[2]Community solidarity involves engagement, social network support, and a sense of belonging. These items were used in our previous pay-it-forward research study..

Data analysis

Data will be analyzed using a transformative mixed method research approach. The primary outcome will be gonorrhea and chlamydia test uptake among MSM. Quantitative and qualitative data will be analyzed using a convergent parallel design (i.e., analyze quantitative

and qualitative data separately) and the results were interpreted together. Generalized mixed-effects models will be used to examine two main hypotheses: one comparing the superiority of the community-engaged strategy compared to the standard pay-it-forward strategy; and another comparing the superiority of the standard pay-it-forward strategy to the control arm. The estimated intervention effects will be reported with 95% C.Is and p-values. Descriptive analysis will be used to summarize the characteristics and behaviors of the participants in each arm.

Implementation evaluation

The RE-AIM framework has been extensively used in implementation research to evaluate the implementation of evidence-based interventions. At this stage, we will evaluate the other dimensions of the implementation of the standard pay-it-forward and the community-engaged pay-it-forward arms with a view to understand both the factors that influence men to get tested and those that motivate men to donate. Given the novelty of pay-it-forward to raise funds, its sustainability partly depends on men willing to donate. Understanding the drivers of financial sustainability across individuals and clinics may help inform policymakers and interested researchers in resource-limited settings about the potential of using the strategy to promote underfunded public health services.

We will use a sequential explanatory mixed methods design.93 In this design, quantitative data is followed up with qualitative methods to expand or explain the quantitative results. The quantitative component of our design will measure reach, implementation, adoption and maintenance by adapting validated implementation research instruments to assess acceptability and appropriateness at the individual level (related to adoption) and fidelity and organizational readiness at the clinic level (related to implementation. Details of these instruments are provided in Table 3 below. The qualitative data will use in-depth interviews grounded in upstream and social reciprocity theories to explore the processes and mechanisms that affect the results, and how these differ by individual (geography and socioeconomics) and organizational (geography and readiness) characteristics. Our mixed methods study will be conducted during and after the RCT.

Quantitative surveys

Surveys with clinics, project implementers and participants will be conducted. We will administer an organizational readiness survey in all clinics in the standard and community-engaged arms. All clinic staff involved in the implementation of the pay-it-forward intervention will be encouraged to take the survey which will assess the motivation and capabilities of their clinic. Every month, at each site in the standard and community-engaged arms, a member of the research staff will assess the extent to which pay-it-forward is implemented in accordance with the protocol using a fidelity checklist. This checklist will document how often each step of the Pay-it-forward protocol (including screening, consent, explanation of study procedures and Pay-it-forward, sample collection, donation, and

community engagement activities) is implemented. Research staff will also document the sequence of the study procedures, site-specific adaptations, and any implementation challenges that occur at each site visit.

Qualitative interviews

MSM, healthcare providers, and PIONEER organizers will be recruited for in-depth interviews. We will recruit MSM in the clinic, immediately following participation in the RCT. We will also recruit, and interview selected health professionals to explore their perspectives about generosity in clinical settings to contribute to the development of more generous health services and inform clinical innovations. Purposive sampling strategies will be used to recruit MSM involved in each implementation strategy arm, those who participate and those who do not, those who provide a higher donation and lower donation, and healthcare providers. Among organizers, we will recruit them by sending a text message to a purposive sampling of organizers. This will include those at MSM-led clinics and public clinics, organizers who identify as gay and those who do not, and other key characteristics. We will develop a topic guide to guide the MSM and healthcare provider interviews based on the literature review, fieldnotes and reflections during the implementation of RCT. Main topics will include the following: (1) reasons for getting tested; (2) understanding and perception of the pay-it-forward concept; (3) specific questions about emotions of gratitude after receiving a test that is supported by another community member; and (4) self-identity in the MSM community and level of integration within a community; (5) intention and motivation to initiating and mediating helping behaviors within the community. The healthcare provider interviews will explore their perceptions of the factors affecting generosity will be explored at both individual and collective levels, particularly in terms of cynicism and gratitude within the practitioner-patient relationship. Analysis will focus on how generosity may be demonstrated and received, expanded and restricted, and its impact on patient recipients, colleagues and the clinical settings, and implications for the wider social community beyond the clinic space. We will obtain a recorded verbal informed consent from all interviewees before the commencement of the interview. Interviews will last about one hour and will take place either in person or over the phone-based on participant preference.

Interviews will be audio-recorded and personal information will not be recorded. Unintentional recording of personal information will otherwise be redacted before transcription. Each participant will receive a small monetary incentive of ¥50 (7.50 USD) for their participation. All recorded interviews will be transcribed, and transcripts will be checked by one research staff member. Summaries of interviews will be written up for preliminary data analysis. In addition, we will collect anonymized text from handwritten postcards and other community engagement activities.

Sample size and power considerations

A total of 25 MSM participants, 27 healthcare providers, and 25 PIONEER organizers will be

recruited for individual interviews. Enrollment will cease when no new themes and sub-themes emerge, inferring data saturation. All eight participating clinics that are implementing the pay-it-forward intervention (both standard strategy and community-engaged strategy) will be invited to respond to questions related to implementing the intervention (see Table 3). All participating clinics will be invited to answer questions related to organizational implementation and maintenance. Operational definitions and example measures of the five dimensions of RE-AIM adapted for the study are shown in Table 3.

Outcome measures

The outcomes will include (1) primary RE-AIM data comparing differences between the community-engaged pay-it-forward strategy and the standard pay-it-forward strategy; and (2) qualitative data describing mechanisms related to test uptake and donation decisions, respectively.

Data analysis

Thematic analysis will be used to analyze qualitative data. A codebook will be developed by a senior qualitative researcher. Two research assistants will then code the transcripts based on the codebook. NVivo version 12 (NVivo, Columbus, OH) will be used for qualitative data analysis. Descriptive data analyses, independent sample t-tests and chi-square tests will be used to compare differences in RE-AIM measures between pay-it-forward and standard-of-care arms. We will generate a global implementation score and scores of separate dimensions and convert them to a z-score. Correlates of global implementation and implementation dimensions will be examined using general linear mixed models (GLMM). In addition, qualitative data on social networks will be applied to disentangle the connection between an individual's gratitude and position within a network comprised of helping relationships (both direct and indirect relationships). Finally, we will use linguistic inquiry word count to analyze textual information gathered as part of community engagement activities.

Safety management plan

Criteria for withdrawal: if participants want to quit the study for any reason. Project implementers will do data and safety monitoring.

Data management information

For the surveys and demographic questionnaires, all data are directly entered into computers at the UNC Project China office as participants complete the surveys. Programs to ensure accuracy, completeness, and internal consistency are automated. Data can be readily downloaded and converted to the format of commercially available statistical software. During the collection of the online portion of the study, all data will be transmitted securely using SSL (TLS) 128-bit encryption across the Internet (HTTP). SSL provides users with the assurance of access to a valid, "non-spoofed" site, and prevents data interception or tampering with sensitive information. The SSL certificate that will be used for this project will

use 128-bit encryption, the preferred security level of government and financial institutions. 128-bit encryption offers protection that is virtually unbreakable. For example, if a hacker could crack a standard 40-bit SSL session in a day, it is estimated that it would take well beyond a trillion years to accomplish the same thing against a 128-bit SSL session. A dedicated server, which eliminates security issues involved with shared hosting environments where hundreds of websites and users reside on one shared web server as well as ensuring both physical and network security, will be used to house the data. Data will then be stored in a secured server at Dermatology Hospital, Southern Medical University. The server will be configured with a redundant hard drive array to ensure reliability. Access to the data will be password-protected within the server's firewall. Only the PI and a designated senior staff member will have the password to access the "key" that links the non-descript identifier to personally identifiable information. IP addresses of participant's computers will not be collected at any time. Cookies will not be used in any way to track participant activity. A quick link will exist on each survey page to provide participants with a rapid way to switch to an innocuous website if their privacy is interrupted while completing the survey.

For participants' urine testing results and clinical outcomes, the data will be recorded directly and input into the Health Information System (HIS) at the public STD clinic. Data will be downloaded and stored the same way as the survey data.

Table 3. Dimensions of RE-AIM in implementation research adapted for pay-it-forward.31

Dimensions	**Level**	**Operational definitions**	**Measurement method**	**Analysis**
Reach	Individual	• Proportion of MSM who enter the clinic and are screened for eligibility • Percent of MSMs who visit the clinic compared to the MSM in the catchment area	RCT data Local CDC data	Descriptive analysis
Effectiveness	Individual	• How effective are the two implementation strategies in promoting gonorrhea test uptake? • Does pay-it-forward influence secondary outcomes (chlamydia testing, treatment and prevention outcomes)?	RCT data	Covered in RCT analyses above
Adoption	Organizational	• Is the organization ready to adopt pay-it-forward?	ORIC survey – administer after piloting and again early during RCT Qualitative interviews	Descriptive analysis Rapid or content analysis
Implementation	Organizational	• Fidelity: what is the extent to which local staff implement the pay-it-forward according to the SOP and how does this	Fidelity checklist filled out by research staff member observing intervention	Descriptive analysis T-test/regression for fidelity score and/or adaptations vs intervention effectiveness Time series of adaptation

		impact effectiveness? • Adaptations: what adaptions are implemented and how do they impact effectiveness?	Documentation of adaptation content and timing Interviews with clinic staff	implementation Rapid or content analysis
Maintenance	Organizational	• Donations over time during the intervention • Cost-effectiveness • What are the barriers and facilitators of maintenance? What do implementing partners need to sustain Pay-it-forward?	Donation and costing data Qualitative interviews	Descriptive analysis Time series Cost-effectiveness analysis Rapid or content analysis

Discussion

Pay-it-forward is a novel behavioral and financial model. Our previous studies showed that it is cost-effective, but the study findings have limited representativeness due to the primary involvement of MSM-led clinics but an exclusion of public clinics, which are the major provider of STD testing and treatment services in the Chinese setting. There is also a lack of understanding of the implementation process and a missed opportunity to optimize the implementation strategy. By enhancing the community engagement components of the strategy, our trial aims to test the effectiveness of an enhanced pay-it-forward implementation strategy in comparison to the standard pay-it-forward approach and a control arm. We propose a programmatic cluster RCT to document high-quality evidence on the effectiveness of different pay-it-forward implementation strategies and to better understand the real-world practices. The proposed study will provide an evidence base on whether community-engaged pay-it-forward implementation can strengthen the effectiveness and inform future expansion of pay-it-forward intervention strategies to improve gonorrhea testing and treatment for MSM in diverse clinic settings in China.

This study has important implications for evidence-based practices for delivering important but underfunded public health services in a novel and efficient way. Hybrid implementation study designs focus not only on effectiveness but also on assessing implementation outcomes. Generating evidence on the implementation itself will inform evidence-based practices and enable us to tap into the potential of normalizing or integrating the pay-it-forward interventions into existing programs to promote gonorrhea testing among a key community. Our hybrid implementation-effectiveness design has a primary focus on testing two pay-it-forward implementation strategies as well as evaluating other domains, including reach, adoption, implementation, and maintenance. These will help inform what is possible in routine practices, translate research findings into practices and scale up the strategy in gonorrhea testing service delivery and beyond.

Our trial will also have added value to the current body of literature on altruism and generosity research in changing behaviors. Our implementation evaluation will underscore the individual and organizational-level mechanisms affecting test uptake and donating behaviors in the pay-it-forward arms. We will test against the upstream reciprocity theory and measure whether generosity is associated with uptake and donating behaviors. This evidence will be relevant to interested health researchers, program implementers and public health authorities to leverage human kindness and warm glow to promote healthy behaviors, and engage key stakeholders.

We anticipate that this novel financing model may also have policy implications for transitioning

from fee-based to subsidized health services in China and beyond. Pay-it-forward is effective in pooling small funds for essential services to support other service users in the community. Such pro-social behaviors could potentially be contagious when managed well. In addition, if proven practically more cost-effective, it is also possible to use pay-it-forward strategies to mobilize microdonations from economically better-off areas to cover essential health services in places that are underdeveloped.

Organizational structure/Study team

Principal Investigator (PI)	Dr. Joseph D. Tucker *Email:* jdtucker@med.unc.edu
Co-PI	Dr Weiming Tang
Co-investigators (CIs)	Dr Ramaswamy Rohit; Dr Wang Cheng; Dr Kurt Gray; Dr Sean S, Sylvia; Dr David Van Duin; Dr Zheng Heping; Dr Dan Wu; Dr Ligang Yang; Dr Bin Yang *Post-docs:* Dr Rayner K.J. Tan; Dr Gifty Marley; Dr Katherine Li; Dr Meredith Wang
Research Assistants	Zixuan Zhu Liyuan Zhang Danyang Luo Ye Liu Zhou Ke Ruby Wang
Interns	Dorian Ho,

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