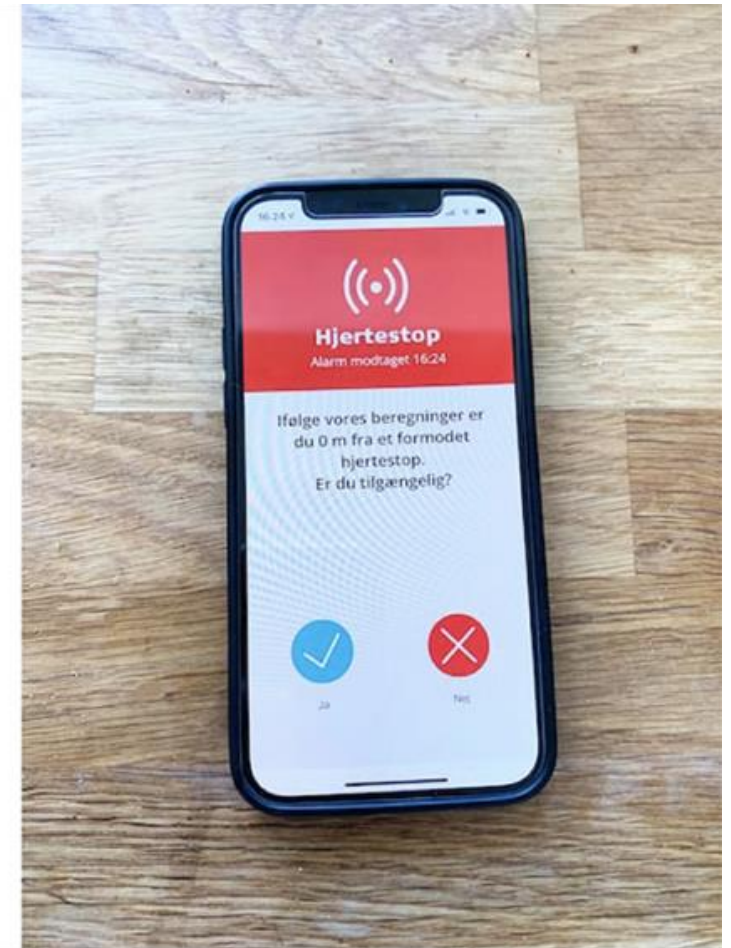


Crowdsourcing: An Introduction

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Professor of Medicine, UNC
Professor of Global Health,
LSHTM



Crowdsourcing in Sweden: Heartrunner and out-of-hospital cardiac arrest volunteering

Science: Ringh et al., NEJM, 2015; Photo: Washington Post, 2021

Outline

- Crowdsourcing defined
- Crowdsourcing in public health
- Crowdsourcing for pay-it-forward



Power of collaboration

Source: Consumption re-imagined

Outline

- **Crowdsourcing defined**
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Power of collaboration

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Summary

- **Crowdsourcing** has a group of people solve all or part of a problem, then share back selected solutions with the community
- Data from randomized controlled trials demonstrates that **crowdsourcing is effective** in increasing diagnostic test uptake and other public health outcomes
- **Pay-it-forward** was developed through a crowdsourced process; the approach includes both financial and social nudges

Crowdsourcing – a group of people solves all or part of a problem, then shares solutions

1) Collective intelligence:

Group of people attempts to solve all or part of a problem



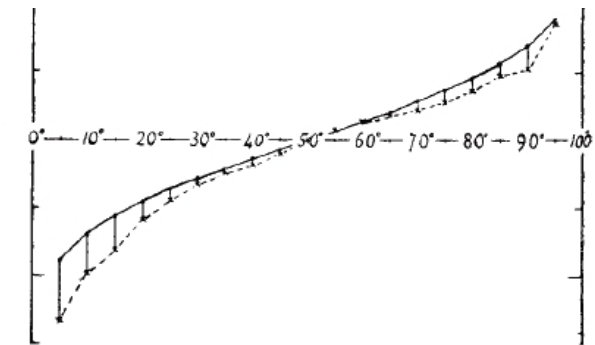
2) Open science:

Selected ideas are implemented or widely shared with others



Power of crowd wisdom

- At a 1906 county fair in England, a group of individuals was asked to guess the weight of an ox
- The median estimate of the crowd (1207 pounds) was accurate to within one percent of the actual weight (1198 pounds) and better than any estimate from agricultural experts



The continuous line is the normal curve with p.e.=37.
The broken line is drawn from the observations.
The lines connecting them show the differences between the observed and the normal.

Above: Image: Tow Times

Below: *Nature* 75: 450-451. 1907

Crowdsourcing typologies



Crowdsourcing activity

Open call (contest, competition, innovation challenge)

Structure

Open solicitation and promotion to the public for challenge submissions; evaluation, celebration, and sharing of challenge submissions

Function

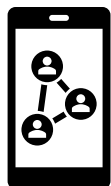
Generate innovative ideas, logos, images, or videos (e.g., images to increase HIV testing, strategies to promote hepatitis testing); accelerate pharmaceutical drug development



Designathon (sprint, hackfest, hackathon)

Design-thinking and three stages: preparation; intensive collaboration; follow-up

Design a clinical algorithm, prevention service (e.g., design an HIV testing service), or new technology



Digital systems

Websites or portals that allow individuals to solve a problem

Mobile phone system to optimize out-of-hospital CPR (Ringh et al., NEJM, 2015); Foldit (Cooper et al., Nature, 2020)

Definitions: Tucker et al., *PeerJ*, 2019

Systematic Review: Wang et al., *Infectious Diseases of Poverty*, 2020

Crowdsourcing Key Elements

Criteria	Description
Diversity of opinion	Each person should have private information even if it's just an eccentric interpretation of the known facts.
Independence	People's opinions aren't determined by the opinions of those around them.
Decentralization	People are able to specialize and draw on local knowledge.
Aggregation	Some mechanism exists for turning private judgments into a collective decision.

Source: *Wisdom of Crowds*, Surowiecki J, Doubleday, 2005



Eight Immortals Crossing the Sea

Examples of Crowdsourcing during COVID-19



Mutual aid: members of a local community work together to help each other, solving problems directly and generating community resources. Many mutual aid groups established during COVID-19 lockdowns to help older adults, build support for marginalized groups, and allow people to directly help each other.

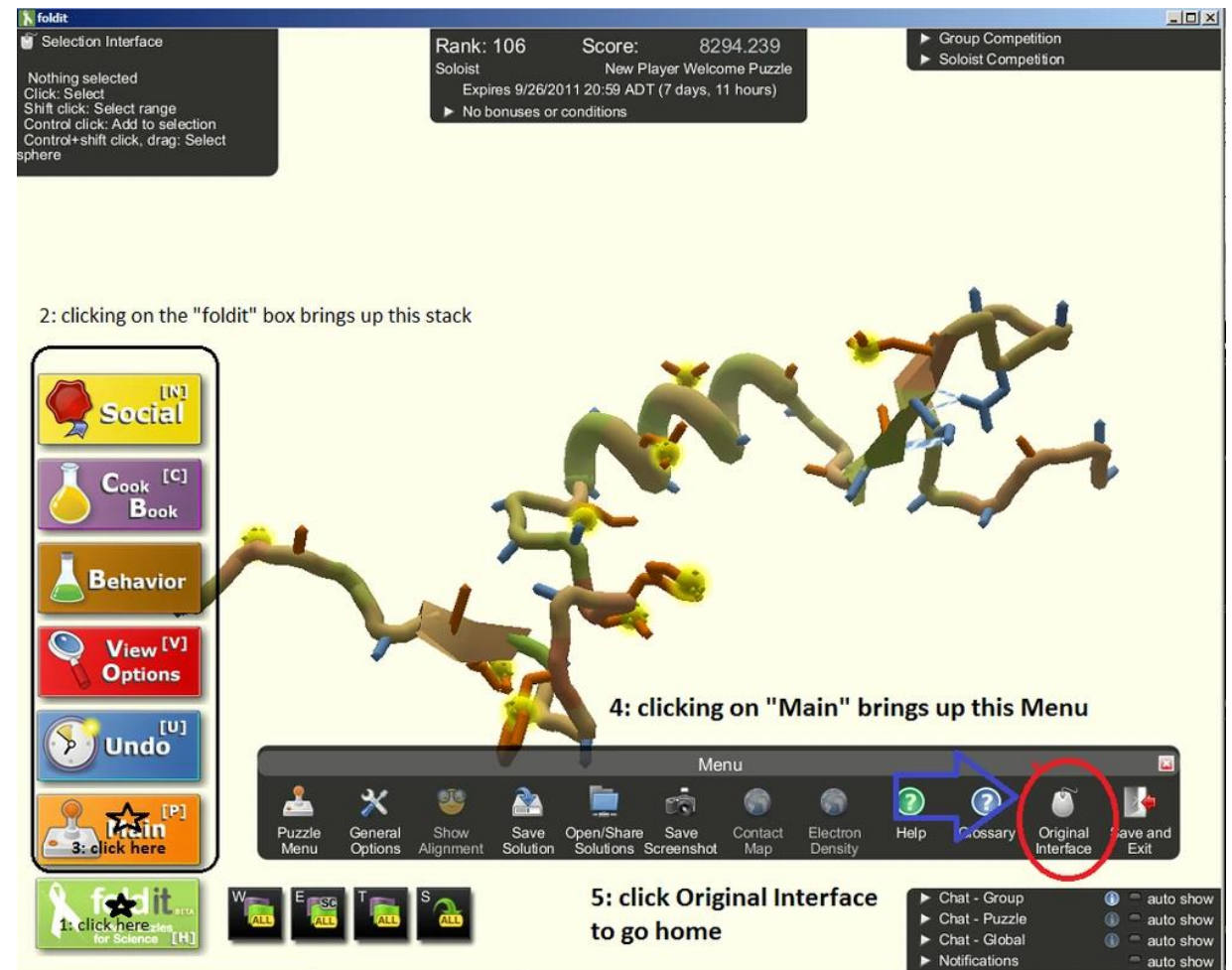


We Vs Virus: Online hackathon in Germany included 26,000 people who created a total of 1,492 project ideas focused on the COVID-19 response. Increased trust in the government response and several ideas were implemented by the government.

Crowdsourcing to solve protein structures

- Online player game video to help solve protein structures¹
- Developed by David Baker at UW
- Nature paper with 57,000 acknowledgements to all the gamers who contributed

¹Cooper et al., Nature, 2020

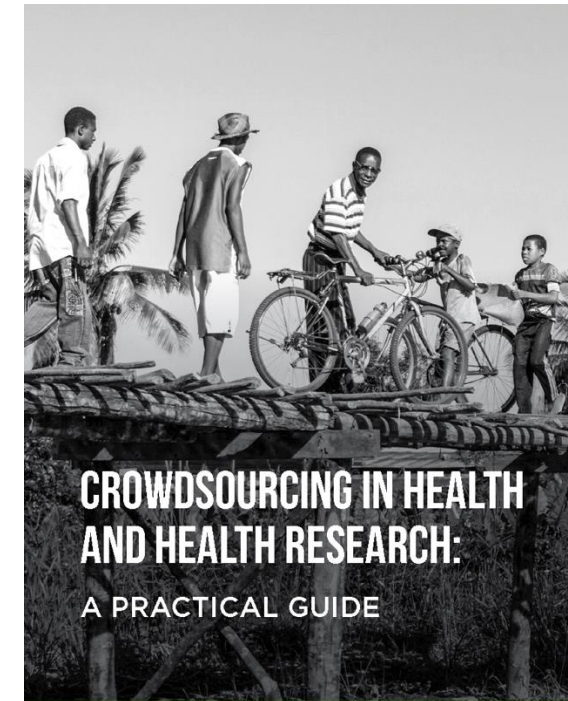
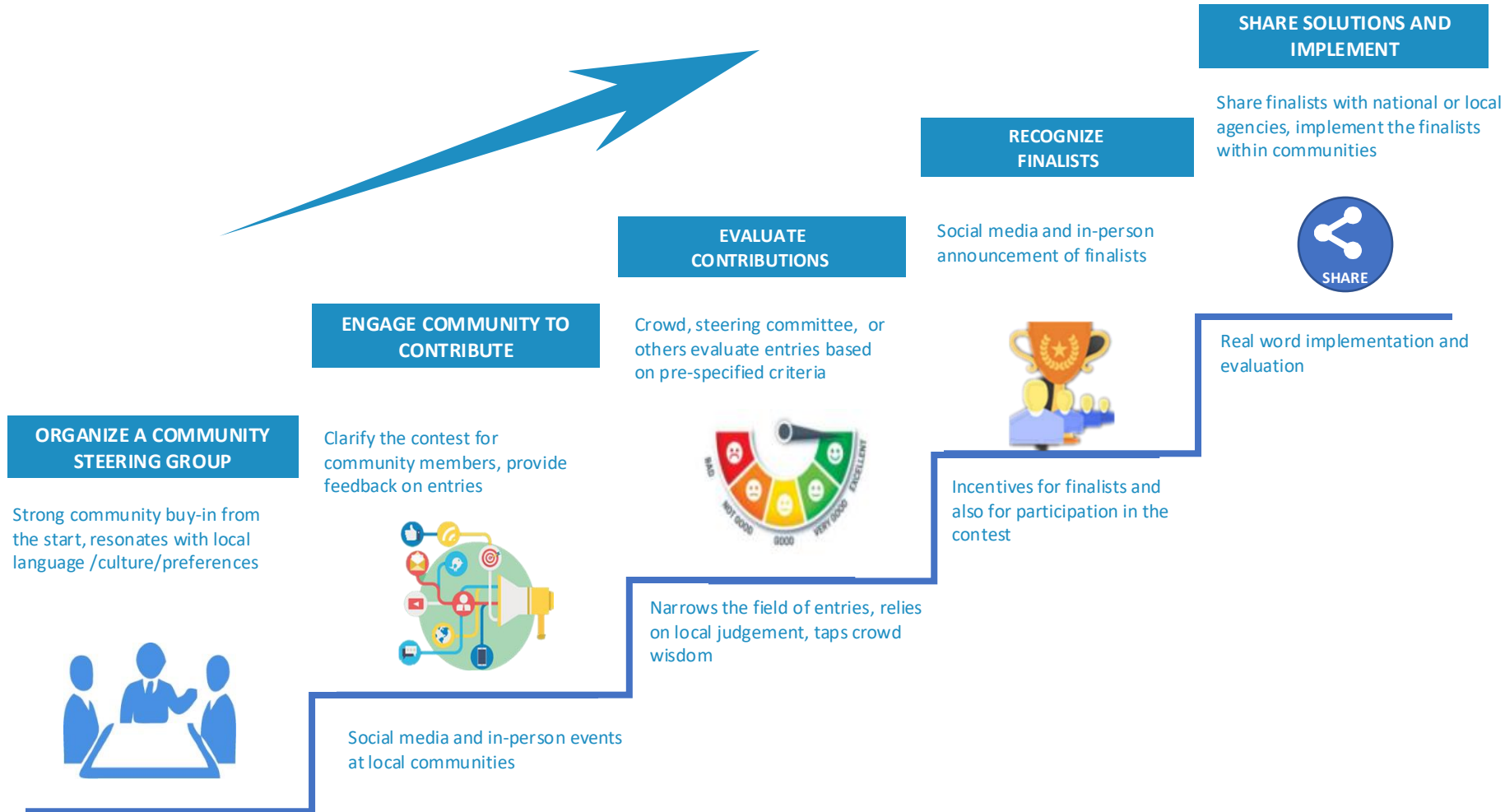


Foldit game that also solves protein structures.
Source: Foldit

Question

What are examples of crowdsourcing in public health from your local context?

Crowdsourcing Open Call



Outline

- Crowdsourcing defined
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Power of collaboration

Source: Consumption re-imagined

Crowdsourcing can be used in several ways

- Engage the community
- Develop public health interventions
- Reach consensus in a more equitable manner



Crowdsourcing for community engagement

**Community engagement:
Iterative bidirectional dialogue between
researchers and community members**



Why crowdsourcing for community engagement?

- “Grounds-up approach”¹ building solutions from the ground
- Inclusive process can engage marginalized groups
- Distribute power more broadly within communities, instead of relying on experts alone
- Crowdsourcing can enhance trust and strengthen relationships between researchers and community members



**Community research sharing workshop in Guangzhou
October 2023**

Source: SESH Global, CC-BY

¹For the Future: WHO Western Pacific Regional Report, April 2019

Crowdsourcing for community engagement

- Crowdsourcing has been used to listen to community perspectives prior to clinical trials¹
- Crowdsourcing has been used to enhance participant recruitment and refine survey instruments²
- Youth open calls and designathons as part of ITEST³



Crowdsourcing activity in Lagos, Nigeria
Source: 4YBY (<https://4yby.org/>)

¹Zhao et al., BMC Public Health; ²Day et al., AIDS, 2020; Day et al., Clinical Trials, 2020; ³Iwelunmor et al, AIDS Patient Care

Co-creation groups to engage communities

- Co-creation has researchers and communities work together
- Small groups of end-users, health professionals, and others who solve problems¹
- Inspired by participatory approaches (e.g., CBPR, YPAR)
- Inform clinical trials, study design, consent procedures

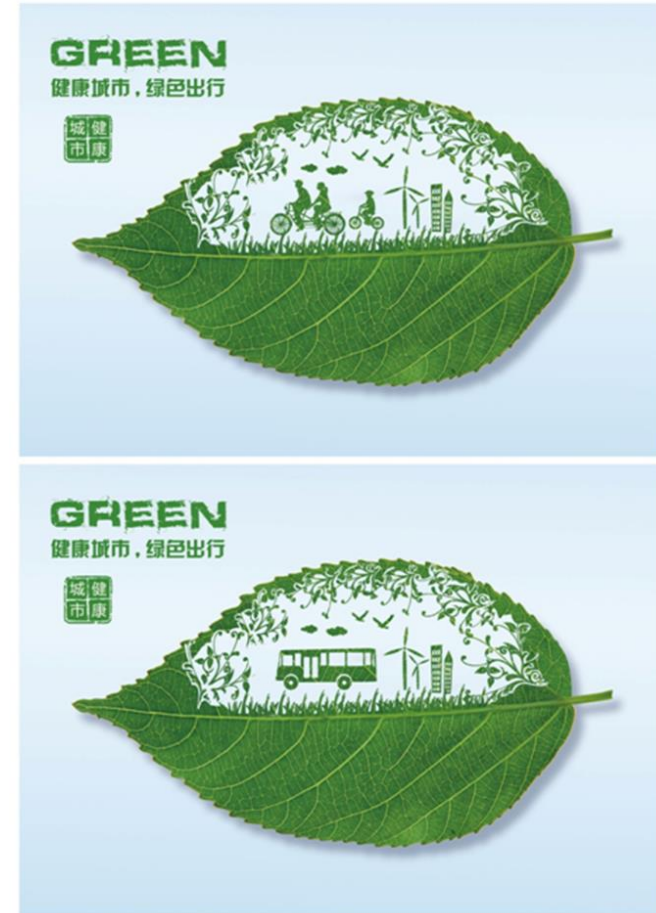
¹Sha et al., BMC Public Health, 2022



In-person meeting of a co-creation group in Guangzhou, China

Why crowdsourcing for intervention development?

- Incorporates end user preferences, style, and culture
- “Nothing about us without us”
- Builds local horizontal partnerships that increase the likelihood of sustainability
- Low cost compared to conventional processes
- More community-engaged



Lancet Health Cities crowdsourced image
(Wu et al., Lancet Planetary Health, 2018)

Designathons to inform PrEP interventions

- Designathons are a multi-step process that include preparation, intensive collaboration, and follow-up¹
- Encourage multi-disciplinary collaboration
- Designathons have been used to co-create mobile phone applications for gay men²



Hackathon to develop a mobile app for gay men

Image: SESH, CC-BY

¹Tieosapjaroein et al. BMJ Global Health, 2023

²Li et al., JMIR Mhealth Uhealth, 2020

Evidence Supporting Crowdsourcing Open Calls

Year	Scope	Crowd Contribution	Purpose	Evaluation
2013-2014	China	Images from youth	Promote sexual health	RCT, ¹ qual research ²
2015	China	Videos from public	↑condom use	RCT in MSM ³
2016	NC Triangle (US region)	Images/videos from public	Meaning of HIV cure	Social media analysis ⁴
2016-2017	10 contests in 8 cities	Concepts, slogans, strategies	↑HIV testing	Stepped wedge RCT ⁶
2018-2019	China	Images, concepts	↑STD testing	Qualitative ⁷ , RCT ⁸
2018-2022	Nigeria	Images, texts, videos	↑HIV ST	Pilot trial ⁹
2021-2022	LMICs	Research mentorship	WHO guide	Mixed methods ¹⁰
2023-2024	China	Design, images, texts, study design	↑STD testing	SW RCT ¹¹

¹Tang et al., *Clin Infect. Dis.*, 2016; Zhang et al., *Sex Trans Dis*, 2015; ²Zhang et al., *Sex Trans Dis*, 2015; Zhang et al., *BMC Public Health* 2017; ³Tang et al., *STD*, 2018; ⁴Mathews et al., *Journal of Virus Eradication*, 2017 ⁵Zhang et al., *AIDS Research and Human Retroviruses*, 2017 ⁶SESH Study Group, *Trials*, 2017; ⁶Tang et al., *Plos Medicine*, 2018; ⁷Li et al, *JMIR mHealth*, 2020; ⁸Yang, *TLID*, 2020; ⁹Iwelunmor et al, *AIDS Patient Care*, 2022; ¹⁰ Kpokiri et al., *PLoS ONE*, 2023; ¹¹ Marley, *BMC PH*, 2023

Why crowdsourcing for consensus development?

- Incorporate larger number of perspectives, including from non-experts, people living with disease, and others
- More inclusive approach than conventional guideline development
- Structured pathway to aggregate wisdom from multiple individuals
- Transparent, fair, open science way to achieve consensus



Photo: Melissa Askew, CC-BY

Crowdsourcing approaches for consensus development

Area of focus	Crowdsourcing approaches	Consensus output (policy or guideline)	Publications
Sexual and reproductive health	Global open call, in-person hackathon in Kenya	WHO/HRP brief survey	Kpokiri, Wu, Srinivas et al., STI, 2021
Social innovation monitoring and evaluation (SIHI)	Global open call, digital designathon	WHO/TDR research checklist, statement	Research checklist manuscript and TDR/SIHI guide
Crowdsourcing open calls in health and health research	Global open call	TDR/SIHI/SESH practical guide on crowdsourcing	TDR/SIHI/SESH Practical Guide 2018
Hepatitis testing	Global open call	WHO Hepatitis Testing Guidelines	WHO Hepatitis Testing Guidelines

SIHI: social innovation in health initiative; TDR: Special Programme on Research and Training in Infectious Diseases; SESH: social entrepreneurship to spur health

Outline

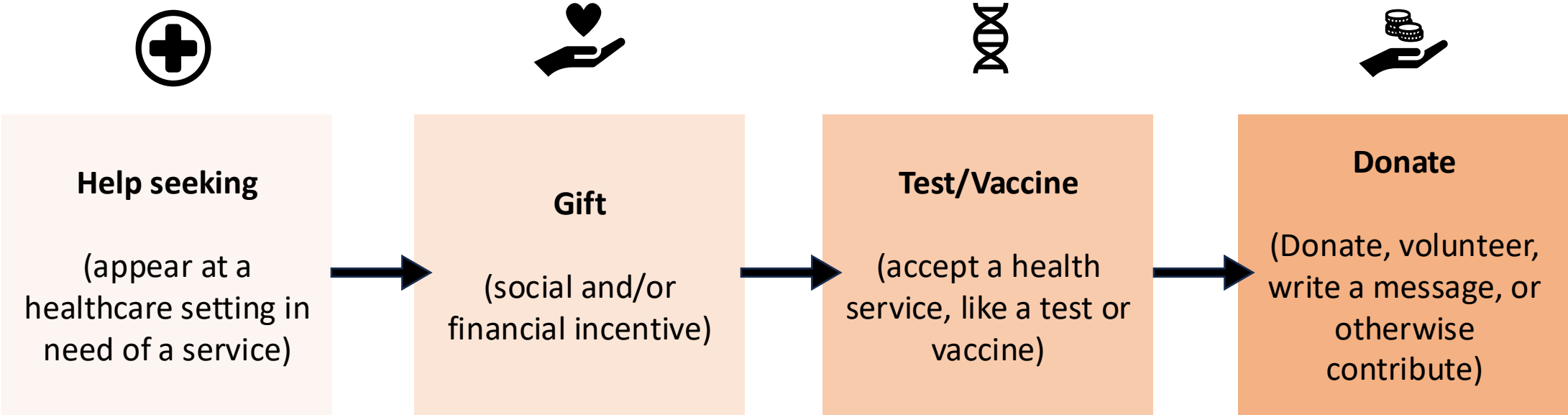
- Crowdsourcing defined
- Crowdsourcing in public health
- **Crowdsourcing for pay-it-forward**



Power of collaboration

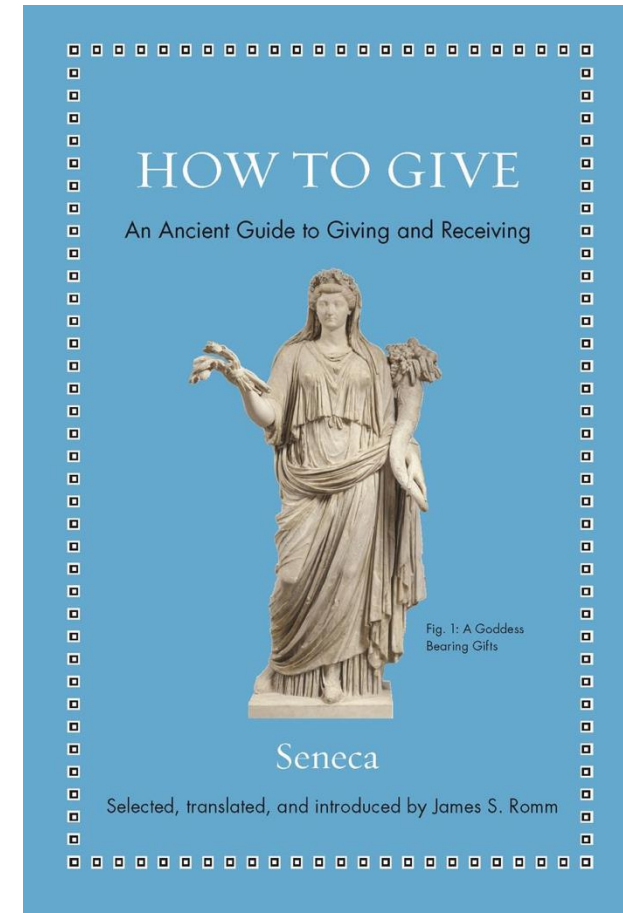
Source: Consumption re-imagined

Pay-it-forward: Receive a gift (financial/social nudge) and then choose whether to give a gift to others



Evidence supporting pay-it-forward

- *Religious* – all religions have some variation on the axiom to be kind to other people
- *Psychology* – Social and peer influences can powerfully influence behavior
- *Non-profit sector* – giving is hard-wired into human behavior
- *Business* – teams that use pay-it-forward principles have a competitive advantage
- *Public health* – Pro-social interventions increase uptake of diagnostic tests and vaccines



Sargeant et al., *Int J Nonprofit Volunt Sect Mark*, 2007; Allen, *Science of Generosity*, Greater Good Science Center, 2018; Byrne et al., *JAMA Network Open*, 2023; Mauss, *The Gift*, 1950; Eriksson et al., *Business Horizons*, 2023; Cialdini et al., *Annu Rev. Psychol*, 2004

Framing Emotional Context of STD testing

Conventional context:

Individual stigma (“I’m bad”)

Social stigma (“friends bad”)

Expect the worst

Pay-it-forward:

Individual generosity (“I am good”)

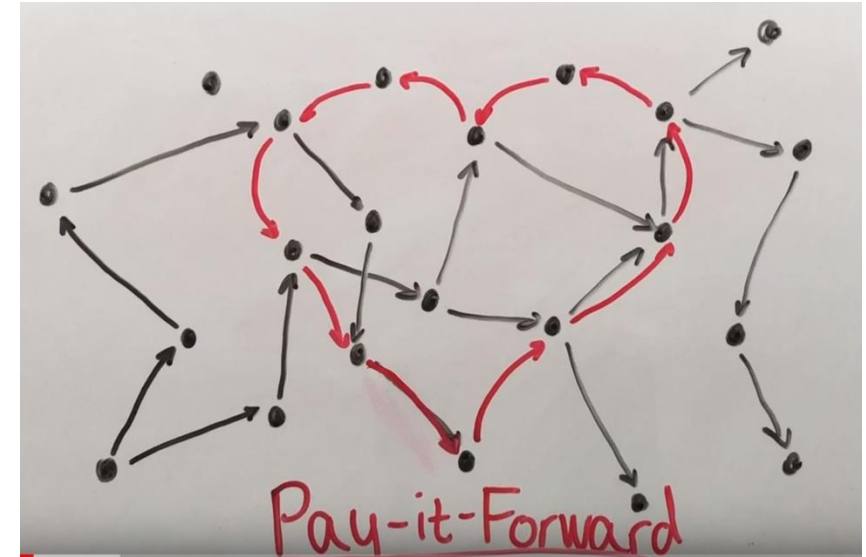
Pro-social (“friends are good”)

Anticipate the best

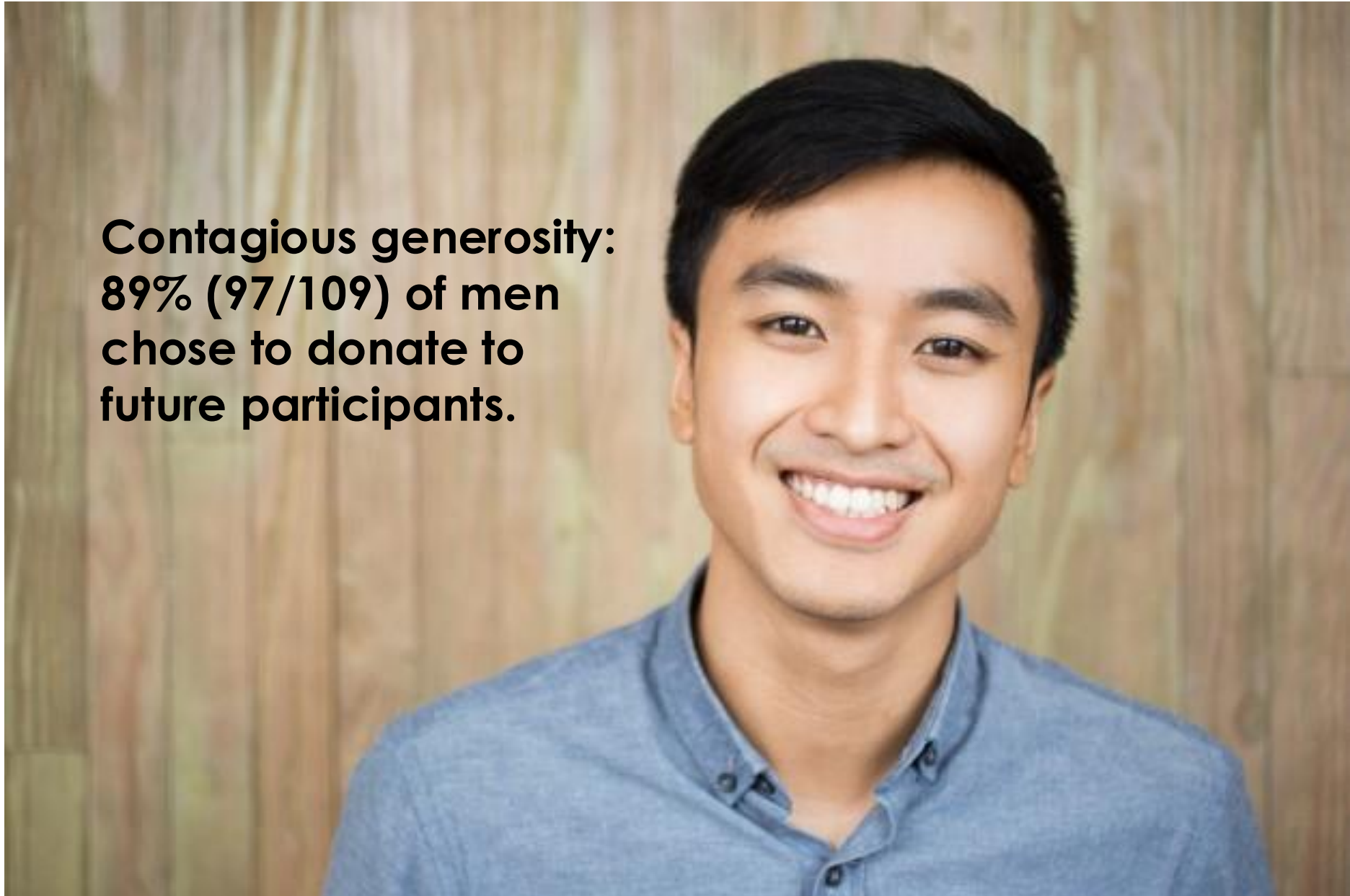
Crowdsourcing Pay-It-Forward



- Open contest used to choose a name of the project in Mandarin Chinese
- Designathon to develop the project logo
- Postcards designed by men who participate to future men
- Strong gay community ownership at all stages



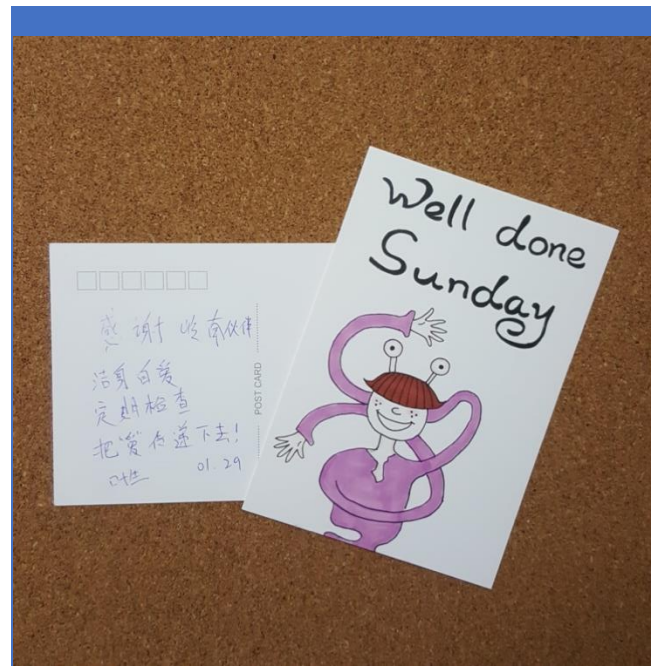
**Contagious generosity:
89% (97/109) of men
chose to donate to
future participants.**



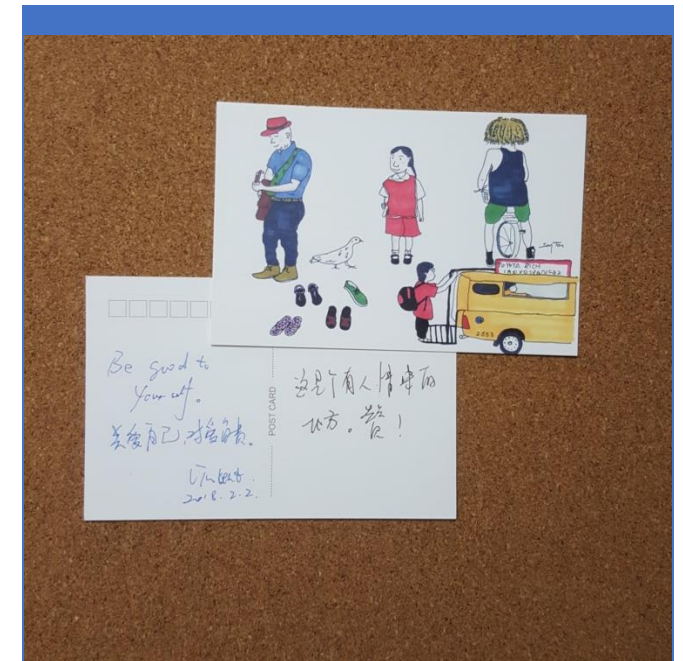
The pay-it-forward program revealed *substantial generosity* among gay Chinese men



“It is a great project. Give more sunshine to LGBT.”



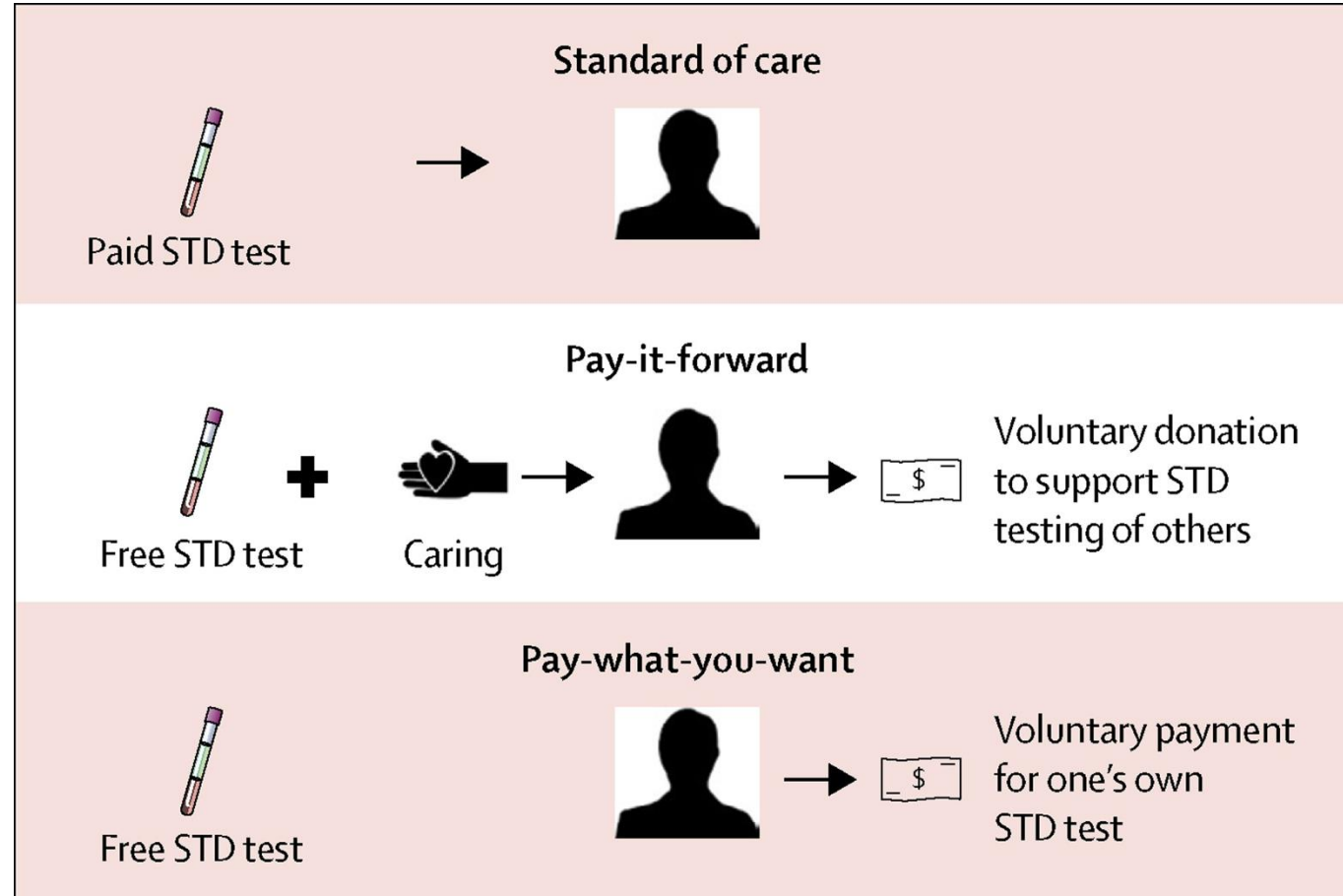
“Take regular STD testing. Pass the love.”



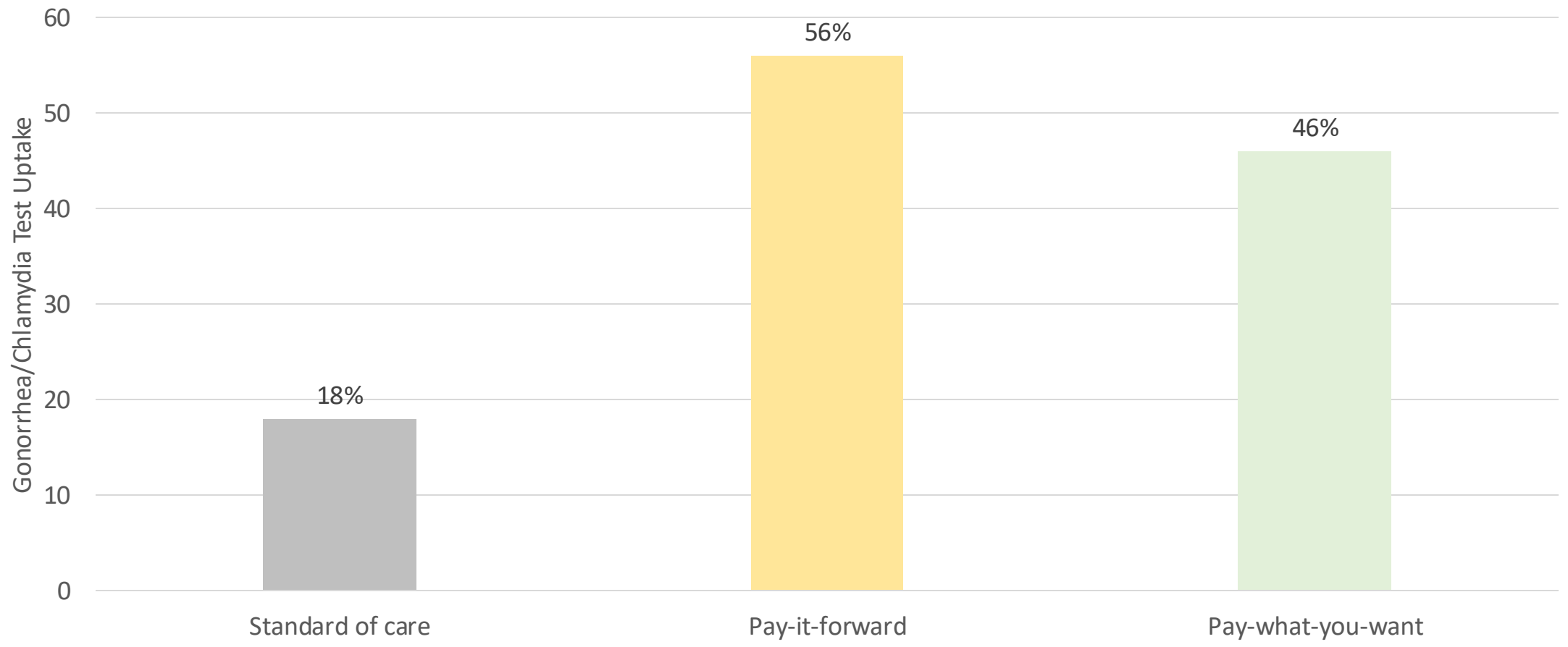
“Be good to yourself and take care of your lover.”



Pay-it-forward RCT



RCT Main Outcome – Gonorrhoea/Chlamydia Testing Increased in Pay-it-forward Arm

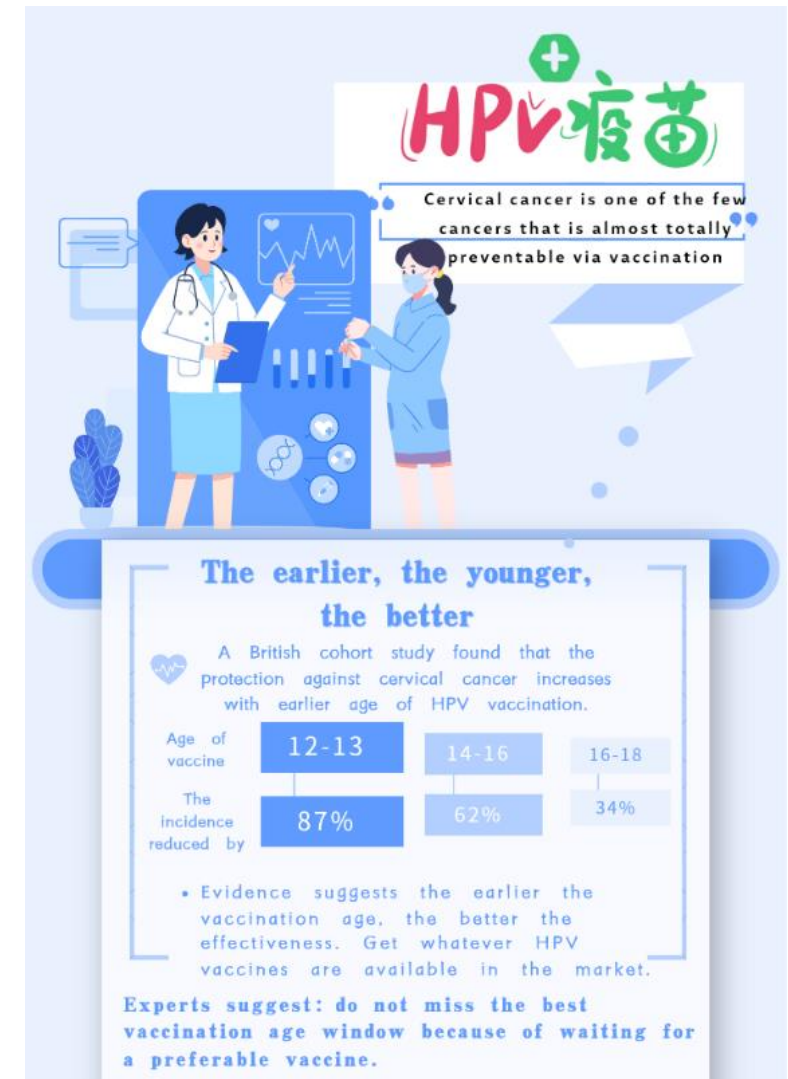


Yang F et al., Lancet ID, 2020

HPV Vaccine Pay-it-forward

- Project iteratively developed with end-users, physicians, and others¹
- Caregivers of girls offered a single free HPV vaccine alongside community-engaged messages¹
- If they decide to receive a vaccine, we asked them if they would like to donate to support subsequent people

¹Qin et al., Res Square, 2023; Li et al., BMC PH, 2023



Crowdsourced image promoting HPV vaccination

Pay-it-forward increased HPV vaccination

- A pilot in China (n = 321) using a population-based sample found that pay-it-forward increased HPV vaccination (34% pay-it-forward, 18% in the standard of care).
- Among 55 girls who received the vaccine, 71% donated money and 67% wrote a postcard
- Further piloting ongoing in China now



Pay-it-forward Research Expands

- Mixed methods research suggests that pay-it-forward increases community connectedness¹
- From an economic perspective, pay-it-forward generates 20-60% of the costs associated with STD testing
- Effective in promoting HPV vaccination, influenza vaccination, and hepatitis testing²
- Recognized by the World Health Summit, UNAIDS, and World Youth Day



¹Li et al., STD, 2020; Byrne et al., SSM Qual, 2024

²Wu et al., Lancet ID, 2022; Qin et al., Res Square, 2023; Zhang et al., Nature Medicine, 2023

Evidence supporting pay-it-forward approaches

Diseases	Location	Outcomes	Study design	References
Gonorrhea/chlamydia	Urban China	Test uptake in MSM	Observational	Li et al, Lancet ID, 2019
Gonorrhea/chlamydia	Community outreach services in China	Test uptake in FSW	RCT	Tang W et al, JMIR Public Health Surveillance, 2023
Gonorrhea/chlamydia	Urban and rural China	Test uptake in MSM	RCT x 2	Yang F, Lancet ID, 2020; Marley et al., BMC Public Health, 2024
Hepatitis B and C	Community Clinics in China	Test uptake, stigma in MSM	RCT	Zhang Y et al, Nature Medicine, 2023
Influenza	Rural, suburban, urban China	Vaccine uptake, confidence, CEA in children and adults	Observational	Wu et al, Lancet ID, 2022
HPV	Population-based in China	Vaccine uptake, confidence in girls	Observational	Qin et al, Res Square, 2023
HPV	Population-based in China	Vaccine uptake, confidence in girls	RCT	Protocol: Wu et al, BMC Public Health, 2023; Li et al., SSRN Pre-Print, 2023
Malaria	Private drug shops in Uganda	Testing and treatment	RCT	Unpublished report

Open access resources

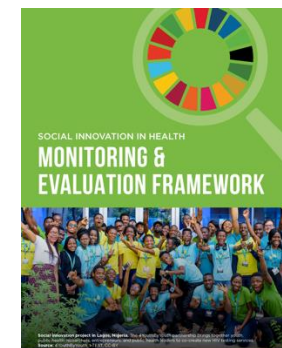
- Crowdsourcing in Health and Health Research Guide (WHO/TDR/SIHI/SESH) and crowdsourcing systematic reviews^{2,3}
- Consensus on Open Calls (WHO/TDR/SIHI)
- Participatory Health Research Guide on Designathons (WHO/TDR/SESH)
- Crowdfunding and Public Engagement in Research (WHO/TDR)

¹Kpokiri et al., PLoS Medicine, 2021

²Wang et al., Infectious Diseases of Poverty, 2020

³Wu et al., JAIDS, 2019; Tang et al., Curr HIV/AIDS Rep, 2019

⁴Han et al., BMJ Open, 2021



Summary

- **Crowdsourcing** has a group of people solve all or part of a problem, then share back selected solutions with the community
- Data from randomized controlled trials demonstrates that **crowdsourcing is effective** in increasing diagnostic test uptake and other public health outcomes
- **Pay-it-forward** was developed through a crowdsourced process; the approach includes both financial and social nudges



Thank you

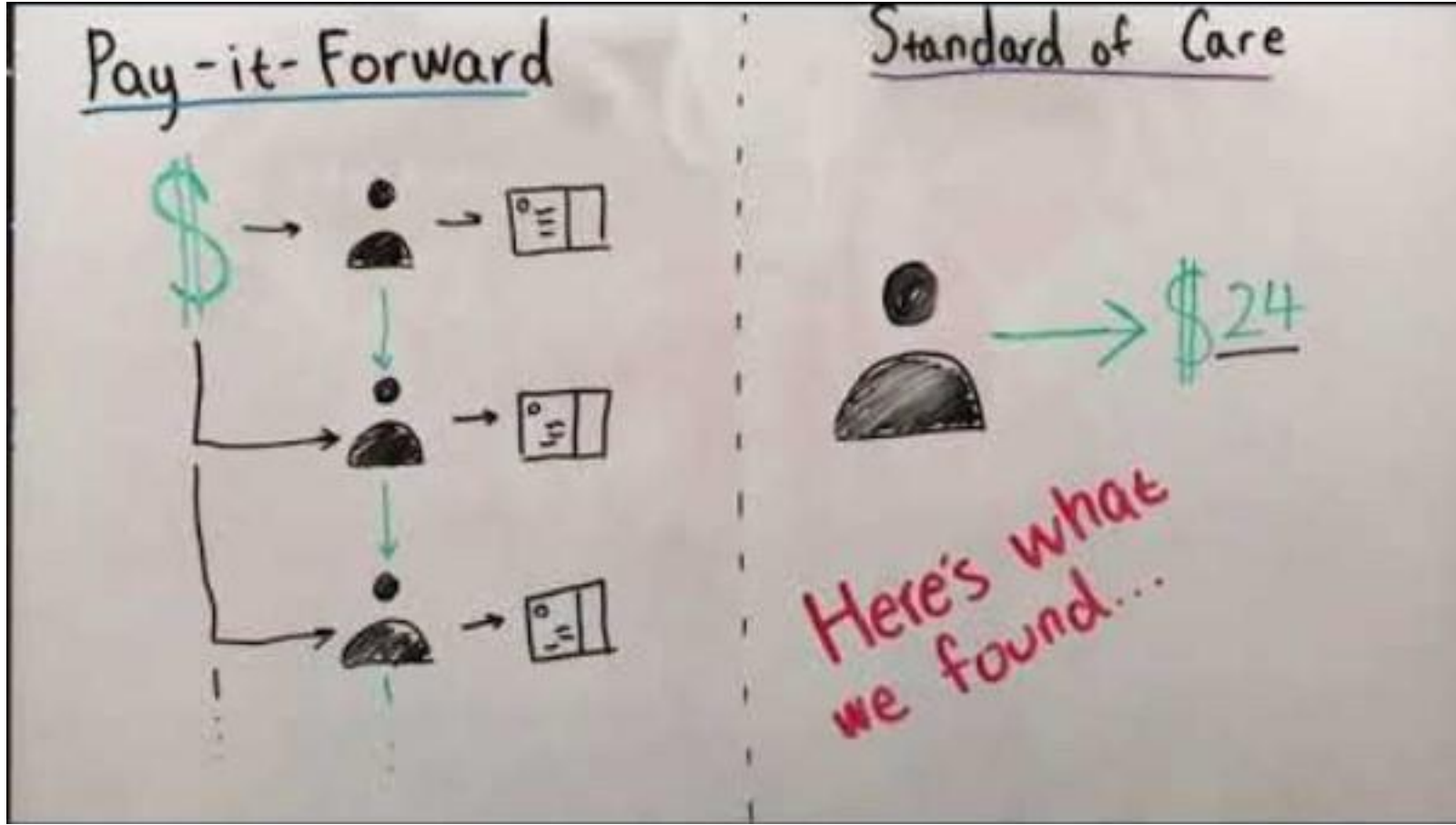
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Mats Målqvist
Eneyi Kpokiri and Ruby Wang
SIHI Sweden team and organizers



Funders: US National Institutes of Health, BMGF, TDR, Sida
jdtucker@med.unc.edu







https://www.youtube.com/watch?v=a7-XsfUV_I0