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Preferences and cost-effectiveness of case detection and management strategies for chlamydia control in Hong Kong
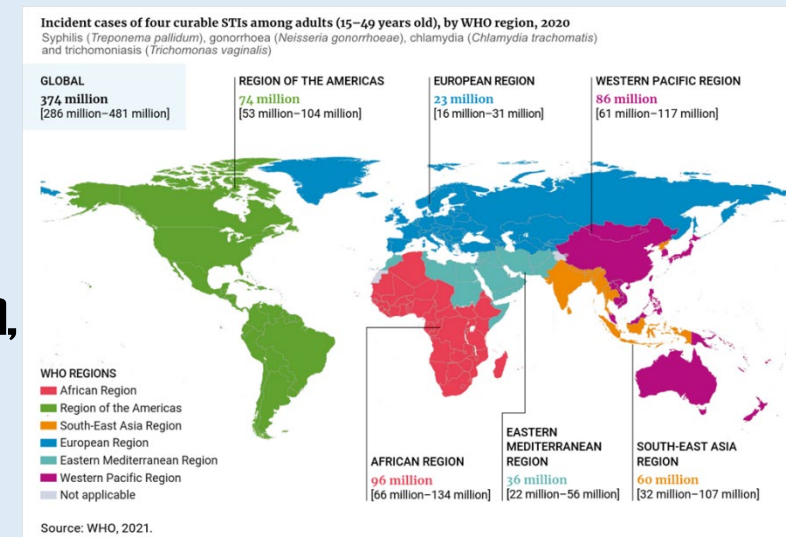
Speaker: Professor William Chi-Wai Wong

Introduction

- **Chlamydia trachomatis is the most common curable sexually transmitted infection (STI) globally.**

- **In people aged 15 to 49 years,**
  - **Globally: Estimated 128.5 million cases (2020). Prevalence is 3.8% in women, 2.7% in men (2016)[1].**
  - **Hong Kong: Prevalence is 1.4% overall but can be as high as 5.8% in women and 4.8% in men aged 18 to 26 years (2017)[2].**

Incident cases of four curable STIs among adults (15–49 years old), by WHO region, 2020
Syphilis (*Treponema pallidum*), gonorrhoea (*Neisseria gonorrhoeae*), chlamydia (*Chlamydia trachomatis*) and trichomoniasis (*Trichomonas vaginalis*)

GLOBAL
374 million
[286 million–481 million]

REGION OF THE AMERICAS
74 million
[53 million–104 million]

EUROPEAN REGION
23 million
[16 million–31 million]

WESTERN PACIFIC REGION
86 million
[61 million–117 million]

WHO REGIONS
- African Region
- Region of the Americas
- South-East Asia Region
- European Region
- Eastern Mediterranean Region
- Western Pacific Region
- Not applicable

AFRICAN REGION
96 million
[66 million–134 million]

EASTERN MEDITERRANEAN REGION
36 million
[22 million–56 million]

SOUTH-EAST ASIA REGION
60 million
[32 million–107 million]

Source: WHO, 2021.

1. World Health Organization (17 July 2023). "Chlamydia."

2. **Wong, W. C.,** et al. (2017). "Prevalence and risk factors of chlamydia infection in Hong Kong: A population-based geospatial household survey and testing." PLoS One **12**(2): e0172561

Introduction

- Complications include pelvic inflammatory disease (PID), ectopic pregnancy, infertility and neonatal blindness, pneumonia or death for newborns[3, 4].

- In most cases, people with chlamydia are asymptomatic

  or have mild symptoms:
  - Control of the disease is a significant challenge, even though it can be cured with a course of antibiotics.

- 80% of chlamydia testing is conducted in Hong Kong's private sector[5].

3. Adachi KN, Nielsen-Saines K, Klausner JD. Chlamydia trachomatis screening and treatment in pregnancy to reduce adverse pregnancy and neonatal outcomes: a review. *Front Public Health* (2021) 9:531073. doi: 10.3389/fpubh.2021.531073

4. Worboys M. *Wellcome Trust – Funded Monographs and Book Chapters.* Chlamydia: A Disease without a History. In: Szreter S, editor. *The Hidden Affliction: Sexually Transmitted Infections and Infertility in History.* Rochester (NY): University of Rochester Press Copyright 2019 by the Editors and Contributors. (2019).

5. Yue XL, Gong XD, Li J, Zhang JH, Gu H. Epidemiology of Genital Chlamydial Infection in China in 2019. *International Journal of Dermatology and* Venereology. 2020;3(2):86-90. DOI: 10.1097/JD9.0000000000000099

Our study

Global Trend: Recent discussions have shifted the focus from population-based screening towards improving case detection among high-risk populations and strengthening case management.

We aimed to identify patient preferences and optimal strategies of case detection and management for chlamydia control in Hong Kong. Specifically,

- To find out the age and number of partners and condom use in the general population in Hong Kong;
- To determine the preferences of people living in Hong Kong for chlamydia testing and management services; and
- To illustrate the epidemiologic and cost-effectiveness impact of shifting the focus from population-based screening toward a targeted management approach for genital chlamydia infection.
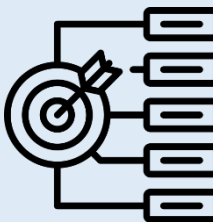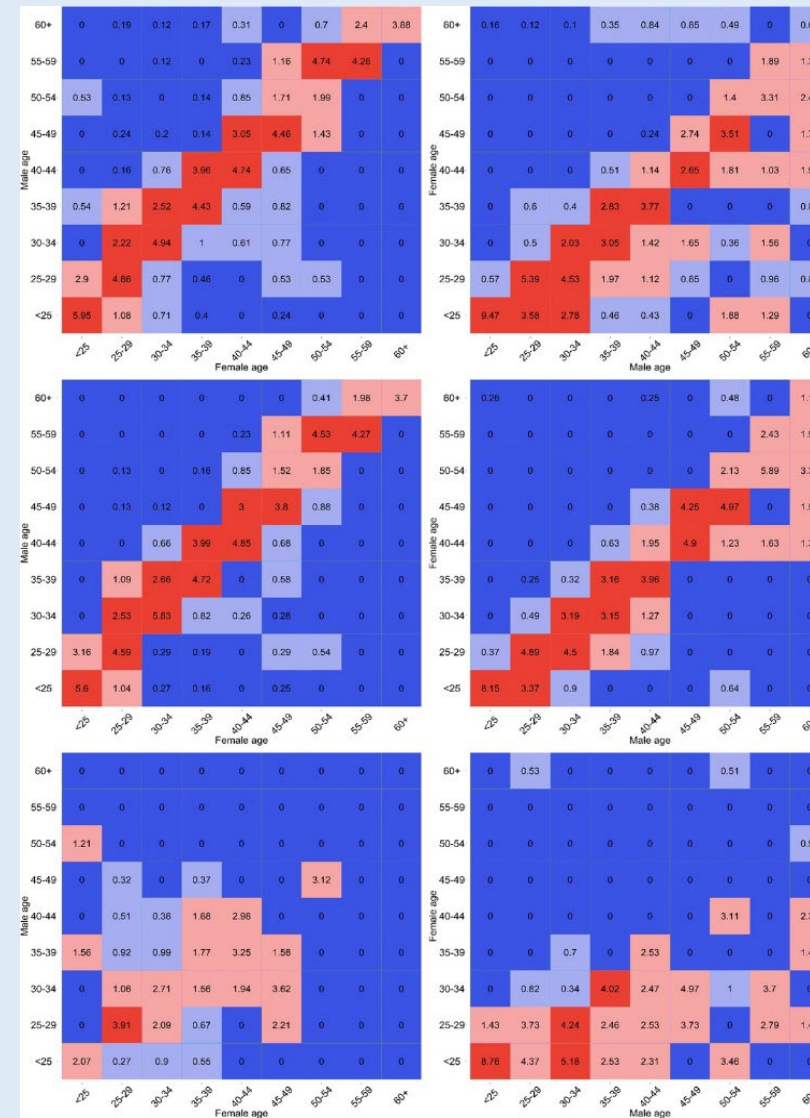
Methodology

- We conducted a discrete choice experiment (DCE) (*n* = 520).

- The development of choice tasks, attributes and levels was based on:
  - Literature review of 21 papers on the effectiveness of chlamydia screening programs that examined the failure or success of their individual elements; and
  - Individual in-depth interviews with 16 patients recently infected with chlamydia in Hong Kong.

- Recruitment was conducted through *Toluna*, an online survey platform that invited account holders (>18; living in HK; admitted sex) to participate in specific surveys.
  - Using a sampling quota that ensured a population-representative age and gender distribution according to the Hong Kong census.

- Participants were invited to join via email including a link directing interested respondents to participate a self-administered survey.

- *Toluna* participants are compensated for taking surveys by amassing points on the online platform, which can be redeemed in the form of gift cards or sweepstake entries.
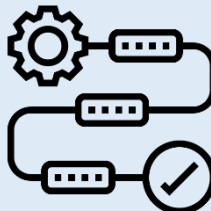
Age-based mixing and condom use patterns[6]

Figure 1. A total of 1090 partnerships were reported, for an overall mean 2.1 partners per person (2.3 for men, 2.1 for women). As compared to women, a higher proportion of partnerships reported by men were with casual (11.2% vs. 7.8%) or commercial partners (5.9% vs. 2.5%) as opposed to with regular partners.

Overall mixing patterns for both men and women were highly assortative: Men were more likely to report younger female (~3.6 years partners and women to report older male partners (~2 years). Age-based mixing was far more disassortative, however, when partnerships were restricted to casual and commercial ones.
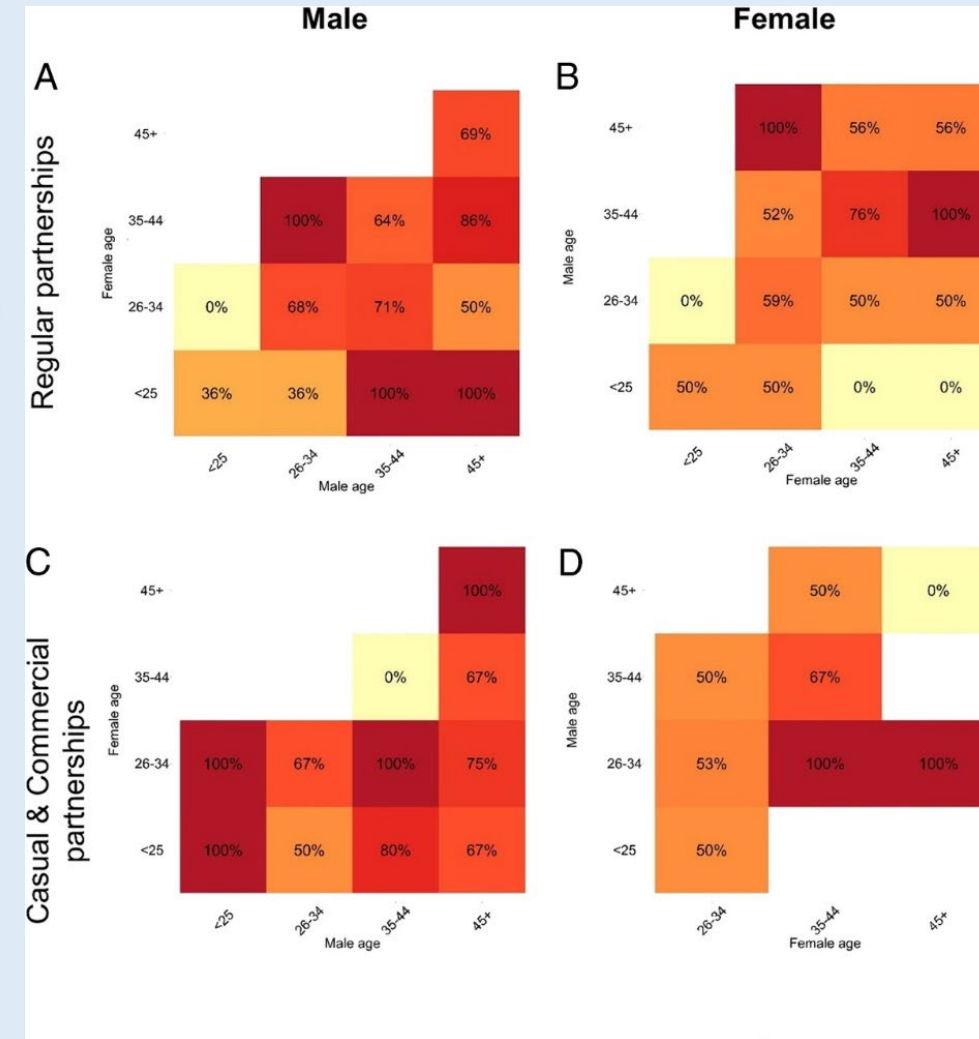
6. Smith MK, Graham M, Ong JJ, Tse D, **Wong WCW**. Age-based mixing and condom use patterns in opposite-sex adult partnerships in Hong Kong. *Sexually Transmitted Diseases*. 2023;50(1):28-33. DOI: 10.1097/OLQ.0000000000001703. PMID: 36098566

Age-based mixing and condom use patterns[6]

Figure 2. When reporting on condom use with regular partners, male respondents in the youngest age group (<25) reported the lowest condom use rates. Older men reported a greater diversity of condom use patterns, and it appeared that use was least consistent when the partnership was with the youngest age group of women. Condom use reported by women in regards to their regular male partners was slightly more consistent, though we noted that it was most so when pertaining to male partners aged 35 or older. When reporting on condom use with casual and commercial partners, this time men aged less than 25 years reported the most inconsistent condom use. Patterns across all other age groups further indicated that consistency of condom use may be better with younger rather than older female partners.

6. Smith MK, Graham M, Ong JJ, Tse D, Wong WCW. Age-based mixing and condom use patterns in opposite-sex adult partnerships in Hong Kong. *Sexually Transmitted Diseases*. 2023;50(1):28-33. DOI: 10.1097/OLQ.0000000000001703. PMID: 36098566

Preferences for chlamydia testing and management[7]

Table 1. The most influential attribute for chlamydia testing was <u>cost</u>, followed by <u>speed of results, delivery of results, extra STI testing, when testing is available</u>, and the least important was the <u>location of testing</u>. The most preferred chlamydia testing service is one that provides: free testing, results in 14 days, results delivered via SMS, extra STI testing, same-day appointment and testing in a private hospital. The least preferred chlamydia testing service: testing that costs $600 HKD (uS$1=7.8 HKD), results in 21 days, results delivered via WeChat, no other STI testing available, appointment in 14 days and testing in a public hospital.

Attribute	Level	Coefficient (SE)	SD (SE)
Cost	Free (ref)	2.15 (0.25)*	0.82 (0.24)*
	$300 HKD	−0.30 (0.27)	0.12 (0.21)
	$600 HKD	−2.23 (0.31)*	0.78 (0.10)*
	$1000 HKD	0.38 (0.26)	0.23 (0.13)*
Location	Private clinic or general practice (ref)	−0.1 (0.1)	0.54 (0.31)*
	Public/government hospital	−0.12 (0.12)	0.02 (0.16)
	Social hygiene clinic	−0.08 (0.08)	0.07 (0.17)
	Non-government organisation	−0.11 (0.09)	0.53 (0.09)*
	Private hospital	0.41 (0.13)*	0.05 (0.16)
When testing is available	Same day (ref)	0.36 (0.1)*	0.29 (0.26)
	Appointment in 3 days	0.09 (0.07)	<0.01 (0.18)
	Appointment in 7 days	−0.19 (0.07)*	0.29 (0.10)*
	Appointment in 14 days	−0.26 (0.08)*	0.03 (0.15)
Speed of results	Same day (ref)	0.14 (0.07)*	0.21 (0.52)
	3 days	−0.31 (0.13)**	0.02 (0.16)
	7 days	0.21 (0.09)**	0.02 (0.33)
	14 days	0.32 (0.15)**	0.15 (0.13)
	21 days	−0.36 (0.08)*	0.15 (0.21)
Delivery of results	Must return to the testing site to discuss results (ref)	0.08 (0.14)	0.09 (0.25)
	Phone call	−0.02 (0.08)	0.03 (0.15)
	SMS	0.39 (0.13)*	0.01 (0.10)
	Email	−0.18 (0.14)	0.08 (0.13)
	Whatsapp/ Wechat	−0.27 (0.15)*	0.01 (0.10)
Extra tests offered	Only test for chlamydia (ref)	−0.33 (0.04)*	0.22 (0.05)*
	Can test for other STIs (gonorrhoea, HIV and syphilis)	0.33 (0.04)*	0.22 (0.05)*
Opt-out		−3.47 (0.24)*	

Akaike Information Criterion (AIC)/N=1.18, log likelihood=−1493.70.
This table is not reproduced from another source and has been created by the research team for the current publication.
*P value <0.01, **p value <0.05, *p value <0.10.
HKD, Hong Kong dollars; Ref, reference level.; .

7. Ong JJ, Fairley CK, Hocking J, Turner K, Booton R, Tse D, Wong WCW. Preferences for chlamydia testing and management in Hong Kong: A discreet choice experiment. *Sexually Transmitted Infections*. 2022;98(6):408-413. DOI: 10.1136/sextrans-2021-055182

Preferences for chlamydia testing and management[7]

Table 2. The most important attribute for chlamydia management was staff's attitude, followed by cost, who they consult with, availability of PDPT and travel time, and the least important was treatment location. The most preferred chlamydia management service is one that provides: staff who are not rude, free service, consultation with a specialist, PDPT, travel time less than 30 min and antibiotics sent to their home. The least preferred service is one that provides: rude staff, service that cost HK$400, consultation with a nurse, no PDPT, travel time more than 90 min and service managed in an non-governmental organization (NGO).

Attribute	Level	Coefficient (SE)	SD (SE)
Cost	Free	0.43 (0.09)*	0.47 (0.18)*
	$100 HKD	0.23 (0.09)**	0.03 (0.16)
	$200 HKD	−0.06 (0.10)	0.38 (0.09)*
	$400 HKD	−0.60 (0.10)*	0.28 (0.07)*
PDPT	No	−0.20 (0.03)*	0.19 (0.04)*
	Yes	0.20 (0.03)*	0.19 (0.04)*
Treatment location	Private clinic or general practice	0.13 (0.08)	0.07 (0.25)
	Social hygiene clinic	−0.11 (0.08)	0.06 (0.20)
	Non-Government organisation	−0.17 (0.07)**	0.01 (0.10)
	Hospital	0.08 (0.08)	0.01 (0.11)
	Pharmacy	−0.09 (0.08)	0.01 (0.12)
	Sent to home	0.16 (0.07)**	0.03 (0.11)
Travel time	Less than 30 min	0.18 (0.06)*	0.18 (0.21)
	30–60 min	0.02 (0.06)	0.02 (0.18)
	60–90 min	0.01 (0.05)	0.01 (0.08)
	More than 90 min	−0.21 (0.06)*	0.18 (0.10)*
Consultation with	General practitioner	0.07 (0.05)	0.18 (0.12)
	Specialist	0.21 (0.04)*	0.02 (0.09)
	Nurse	−0.28 (0.05)*	0.18 (0.07)**
Attitude of staff	Not rude	0.65 (0.04)*	0.25 (0.04)*
	Rude	−0.65 (0.04)*	0.25 (0.04)*
Opt-out		−1.88 (0.08)*	

AIC/n=1.41, Log likelihood=−3421.08.
This table is not reproduced from another source and has been created by the research team for the current publication.
*P value <0.01, **p value <0.05, *p value <0.10.
HKD, Hong Kong dollars; PDPT, patient-delivered partner therapy; Ref, reference level.

7. Ong JJ, Fairley CK, Hocking J, Turner K, Booton R, Tse D, **Wong WCW.** Preferences for chlamydia testing and management in Hong Kong: A discreet choice experiment. *Sexually Transmitted Infections*. 2022;98(6):408-413. DOI: 10.1136/sextrans-2021-055182

Methodology

- We adapted an individual-based, stochastic, dynamic network model on gonorrhea, previously developed and parameterised among men who have sex with men (MSM) in the UK.

  - We have modified the partnership network to generate a bipartite network that only allows heterosexual partnerships using our age-based mixing and condom use study.

- The baseline scenario was obtained according to chlamydia prevalence and treatment statistics on 18-49 years old sexually active adults in Hong Kong[2].

  - A sample size network of 10,000 people was selected to efficiently run the scenarios presented in this study

2. **Wong, W. C.,** et al. (2017). "Prevalence and risk factors of chlamydia infection in Hong Kong: A population-based geospatial household survey and testing." PLoS One **12**(2): e0172561
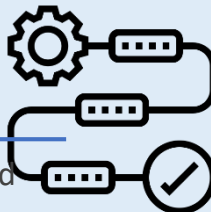
Methodology

- All intervention scenarios started in endemic equilibrium, in which we had a mean prevalence value in the range of 3–4% in a year.

- The scenarios present different implementations of three main programs:
    1. Screening only with no contact tracing;
    2. Screening plus contact tracing, with treatment of all successfully traced contacts; and,
    3. Screening plus contact tracing, with testing before treatment of successfully traced contacts

- A cost-effectiveness model was constructed, which takes the outputs of the dynamic transmission model, and uses them to estimate the costs and benefits associated with each scenario.
    - The individual-based model returns a time-series of each infection, clinic attendance, treatment, contact tracing, and testing event.
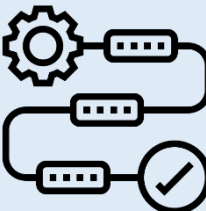
Impact and cost-effectiveness of chlamydia management strategies[8]

Table 3. Summary of the strategies and relevant parameter values. The scenarios present different implementations of three main programs: (1) screening only with no contact tracing; (2) screening plus contact tracing, with treatment of all successfully traced contacts; and (3) screening plus contact tracing, with testing before treatment of successfully traced contacts

Scenario	Programs				Variables			
	Universal screening	Targeted screening						
	Only screening	Only screening	Screening plus partner tracing		Fraction symptomatic	Follow-up period	Screened population proportion in a year	Partner trace efficiency
			Treatment to all partners	Testing partners before treatment				
Non-targeted								
Ai	X				10%	-	≈10%	-
Aii	X				10%	-	≈30%	-
Targeted: Follow-up testing of patients seeking treatment								
Bi		X			10%	3 months	-	-
Bii		X				6 months	-	-
Biii		X				12 months	-	-
Biv			X			3 months	-	40%
Bv				X			-	
Ci		X			30%		-	-
Cii			X				-	40%
Ciii			X				-	
Targeted: Population with two partners or more								
Di		X			10%	-	≈10%	-
Dii			X			-	-	2%
Diii			X			-	-	10%
Div			X			-	-	20%
Dv			X			-	-	40%
Ei				X		-	-	2%
Eii				X		-	-	10%
Eiii				X		-	-	20%
Eiv				X		-	-	40%

Scenarios A implements non-targeted screening programs. Scenarios B/C target the symptomatic population seeking treatment by performing follow-up testing. Scenarios D/ E target the population with two or more partners.

8. Montes-Olivas S, Homer M, Turner K, Fairley CK, Hocking JS, Tse D, van Rees NV, Wong WCW(equal last author and corresponding author), Ong JJ. Evaluating the impact and cost-effectiveness of chlamydia management strategies in Hong Kong: a modelling study. *Frontiers in Public Health*. 2022. https://doi.org/10.3389/fpubh.2022.932096

Impact and cost-effectiveness of chlamydia management strategies[8]

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Table 4. The most cost-effective scenarios are those for which the intervention was focused on the higher-risk population defined by the <u>number of partners, with contact tracing included</u> (Dii-Dv). Reasonable-to-good cost-effectiveness can also be obtained in some targeted scenarios in which there was a <u>follow-up screening for those patients seeking attention</u> (Bii, Cii). In scenarios where there is contact tracing with treatment to all such traced partners (Biv, Cii, and Dii-Dv), there is <u>extensive over-treatment</u> (i.e., treatment of un-infected traced individuals) which would potentially be a driver of antimicrobial resistance. Scenarios where <u>testing precedes treatment for traced individuals</u> (Bv, Cii, and Ei-Eiv) almost eliminate the over-treatment problem but are less cost-effective due to the high testing costs.

Scenario	Newly incurred direct cost/QALY gain		Net cost/QALY gain	
	Year 1	Year 10	Year 1	Year 10
Non-targeted				
Ai	$512,499	$343,590	$487,348	$318,438
Aii	$596,685	$423,059	$571,533	$397,907
Targeted: Follow-up testing of patients seeking treatment				
Bi	−$110,978	$54,265	−$136,130	$29,113
Bii	$55,798	$67,573	$30,646	$42,421
Biii	−$1,978	$19,254	−$27,130	−$5,898
Biv	$40,943	−$87,493	$15,791	−$112,645
Bv	$90,293	$219,212	$65,142	$194,060
Ci	$115,551	$125,699	$90,399	$100,547
Cii	$79,901	$100,692	$54,749	$75,540
Ciii	$354,610	$255,767	$329,458	$230,615
Targeted: Population with two partners or more				
Di	$362,043	$185,584	$336,891	$160,432
Dii	$45,335	$49,740	$20,183	$24,588
Diii	$29,622	$31,921	$4,470	$6,769
Div	$28,511	$30,398	$3,359	$5,246
Dv	$28,845	$30,612	$3,693	$5,460
Ei	$356,063	$200,862	$330,911	$175,710
Eii	$521,497	$322,297	$496,345	$297,145
Eiii	$593,423	$422,323	$568,271	$397,171
Eiv	$634,844	$540,549	$609,692	$515,397

For each scenario (labels as defined in Table 2), the newly incurred direct costs in HKD per QALY gained are shown in columns 2–3 (years 1 and 10 of the control period respectively), and the net change in costs in HKD per QALY gained are shown in columns 3–4 (years 1 10 of the control period respectively). The color scale is from 0 (green) to 3 (red) times HK GDP per capita (HK$357,076 in 2020) (30); negative results are uncolored. Direct costs (columns 2–3) include clinic attendance, treatment, tracing and testing costs as appropriate for each scenario. Net costs (columns 3–4) additionally include the (reduction in) costs due to averted complications; see the text for details.

8. Montes-Olivas S, Homer M, Turner K, Fairley CK, Hocking JS, Tse D, van Rees NV, Wong WCW(equal last author and corresponding author), Ong JJ. Evaluating the impact and cost-effectiveness of chlamydia management strategies in Hong Kong: a modelling study. *Frontiers in Public Health*. 2022. https://doi.org/10.3389/fpubh.2022.932096
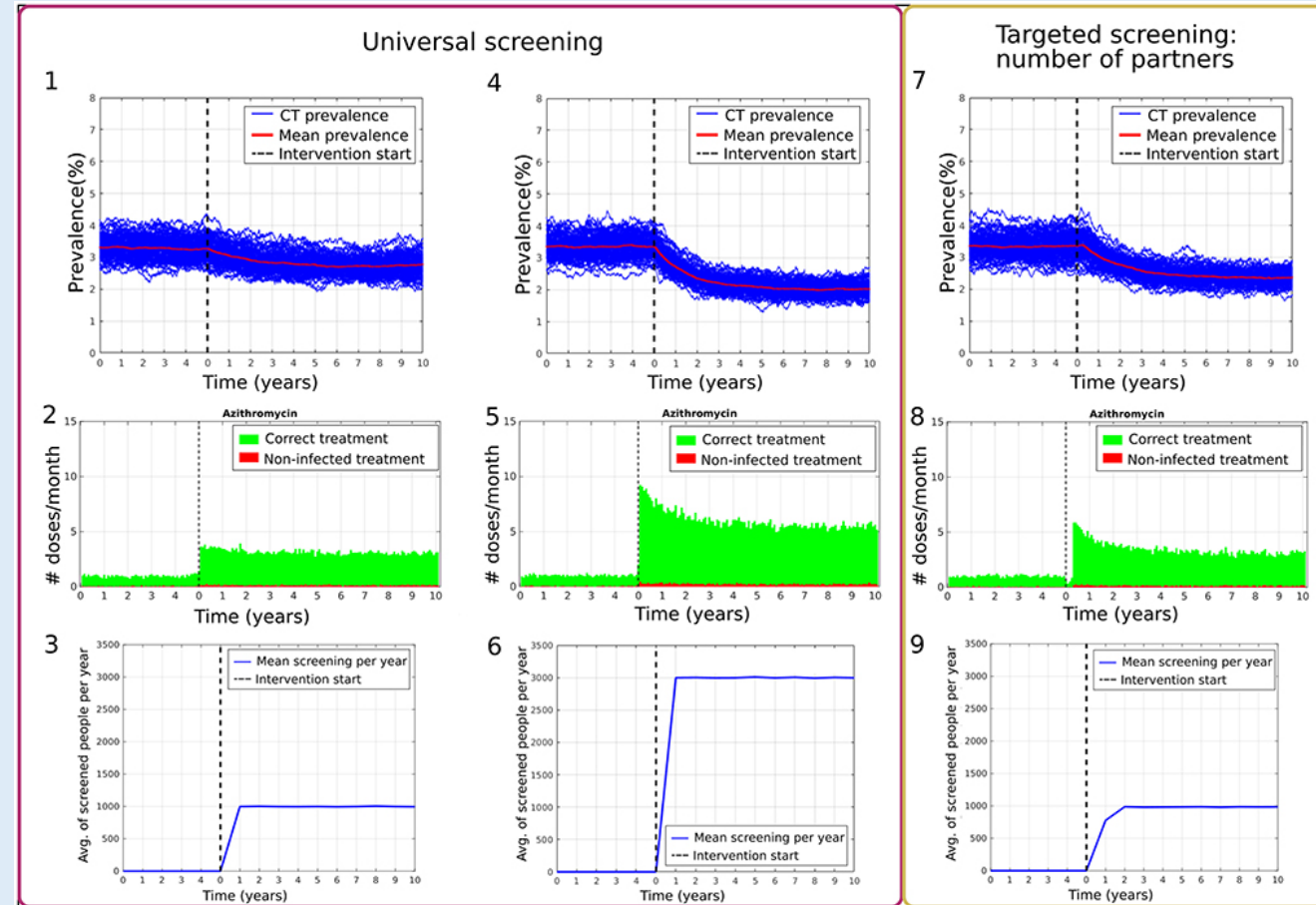
Impact and cost-effectiveness of chlamydia management strategies[8]

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Figure 3. The main difference between the effect of both approaches shown here is that the targeted approach can reach a higher number of <u>infected individuals at the beginning when reaching a similar number of screenings per year</u>. This means that more treatment is provided during the first months, further decreasing the prevalence before reaching a steady state again. Here we observe that, even when the average number of people being screened a year was similar (see Figures 3.3,9), the prevalence could be reduced further by <u>targeting a specific higher-risk subpopulation of the network</u>.
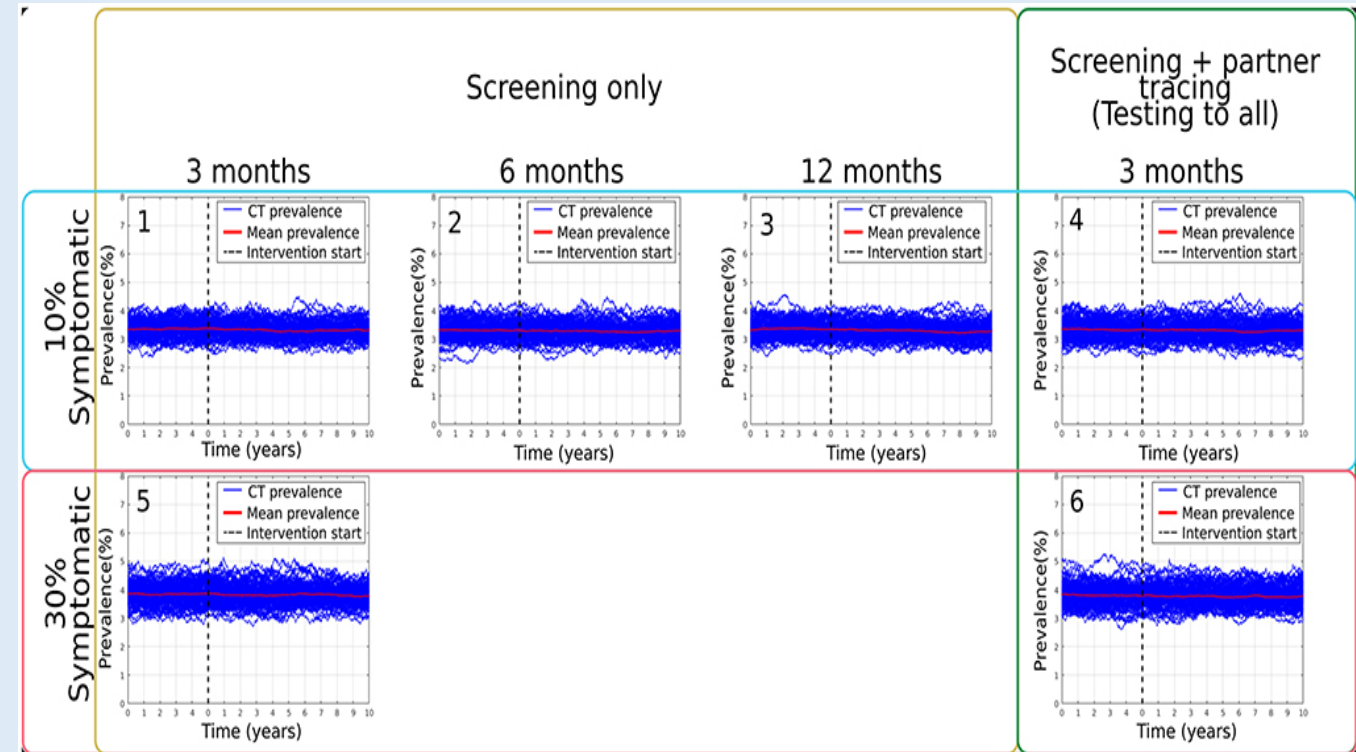
8. Montes-Olivas S, Homer M, Turner K, Fairley CK, Hocking JS, Tse D, van Rees NV, **Wong WCW**(equal last author and corresponding author), Ong JJ. Evaluating the impact and cost-effectiveness of chlamydia management strategies in Hong Kong: a modelling study. *Frontiers in Public Health*. 2022. https://doi.org/10.3389/fpubh.2022.932096

Impact and cost-effectiveness of chlamydia management strategies[8]

Figure 4. We did not observe a significant change in the overall prevalence due to the limited population who presented with symptoms and sought attention. It is important to highlight that this targeted intervention was analyzed by increasing the percentage of the population presenting with symptoms from 10% (Figures 4.1–4) to 30% (Figures 4.5,6) and by changing the follow-up periods on the population of 3 months (Figure 4.1), six months Figure 4.2) and a year (Figure 4.3).
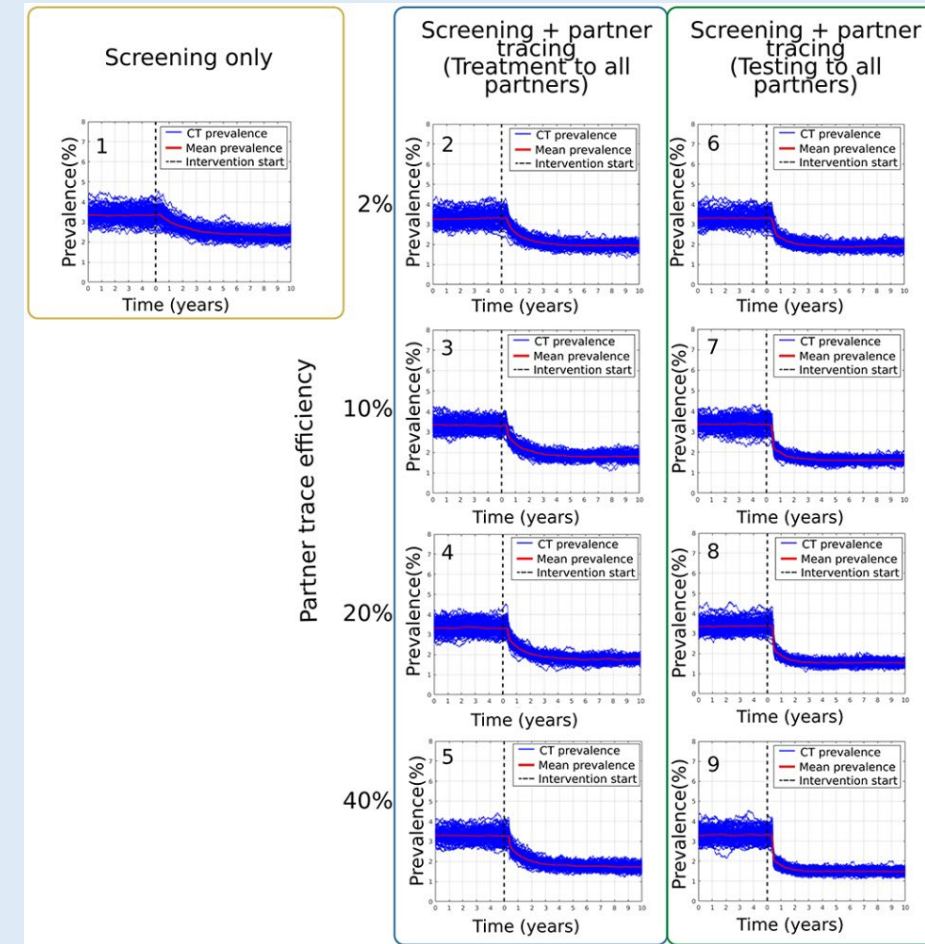
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Impact and cost-effectiveness of chlamydia management strategies[8]

Figure 5. The targeted scenarios in which the intervention was focused on the higher-risk population defined by the number of partners provided a more significant reduction of the mean chlamydia prevalence in the sample network. For scenario Di, in which screening only was applied as an intervention, the mean prevalence at equilibrium was 3.35 ± 0.38% (see Figure 5.1). After the intervention, this mean prevalence was reduced to 2.35 ± 0.21%. For the best-case scenario of screening plus contact tracing with an effectiveness of 40%, Dv, the mean prevalence changed from 3.27 ± 0.34% to 1.73 ± 0.17% (see Figure 5.5). For comparison, scenario Eiv, which is similar but without over-treating all the traced partners, has a mean prevalence of 3.31 ± 0.33% that was reduced to 1.48 ± 0.13% after the intervention period (see Figure 5.9).

8. Montes-Olivas S, Homer M, Turner K, Fairley CK, Hocking JS, Tse D, van Rees NV, Wong WCW(equal last author and corresponding author), Ong JJ. Evaluating the impact and cost-effectiveness of chlamydia management strategies in Hong Kong: a modelling study. *Frontiers in Public Health*. 2022. https://doi.org/10.3389/fpubh.2022.932096

Conclusion

- Regarding condom use, older age groups of both sexes reported less consistent use with all partner types. Casual and commercial partners had larger age discrepancies but less condom use pattern

- Choosing to test was most influenced by cost, followed by speed of results, delivery of results, extra STI testing, appointment available and the least important was the location of testing. Choosing to attend for management was most influenced by staff's attitude, followed by cost, who they consult, access to patient-delivered partner therapy, travel time and the least important was treatment location.

- Targeted screening with strengthened contact tracing efforts is the most cost-effective strategy to reduce the prevalence of chlamydia in Hong Kong.

Conclusion: Targeted screening with strengthened contact tracing efforts is more cost-effective than universal screening to reduce the prevalence of chlamydia in the local context.

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