Network modeling the impact of community-based male-screeing on the Chlamydia prevalence in women

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Outlines

Chlamydia - most commnly reported sexually transmitted disease (STD)

- Chlamydia is an infection with *Chlamydia trachomatis* bacteria.
- Ct is the most commonly reported STD in the U.S.
  - 1.7 million cases, CDC 2017 Surveillance
  - 2.9 million cases, estimated, under-reporting
  - 22% increase since 2013

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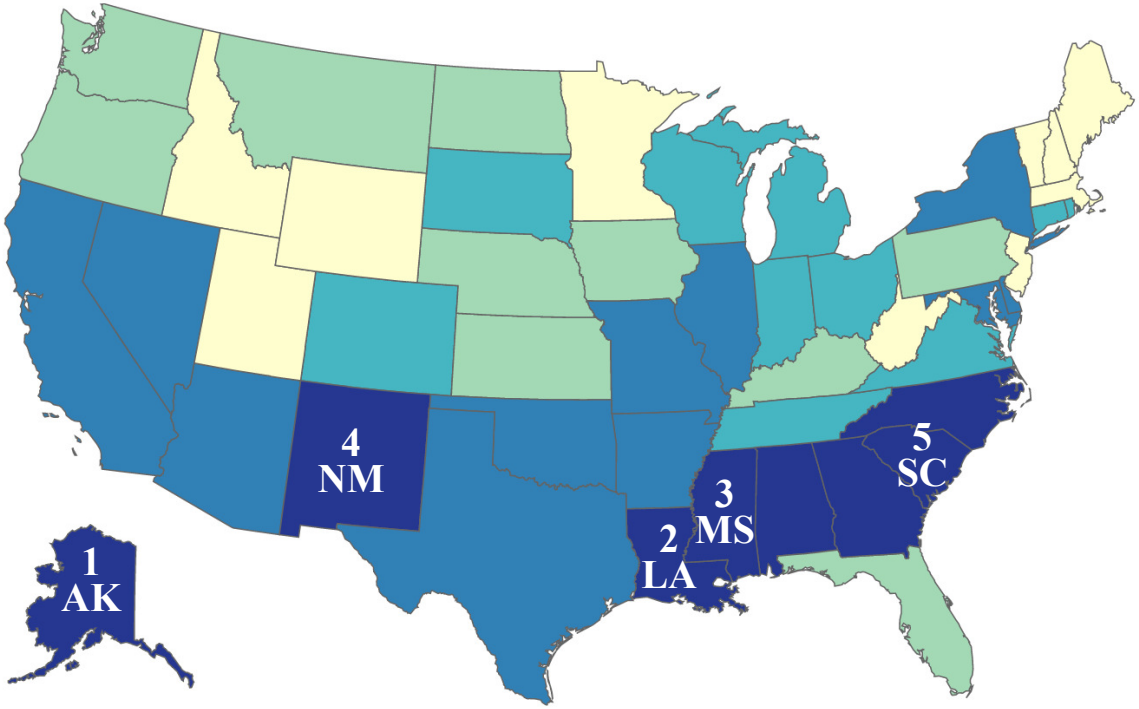

Cases per 100,000 population (2017) both sexes, all races/ethnicities

Chlamydia - LA, 742
- black/AA, 1595
  - age 15-24, 7153
    - female, 10323 (~1/10)

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- cause serious, permanent damage to a womans reproductive system
  - infertility, pelvic inflammatory disease
  - ectopic pregnancy
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- Chlamydia can be easily cured with antibiotics
- Repeat infection with chlamydia is common

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Screening is necessary to identify most infections.

CDC: routine screening policy for women, but not for men

Annual screening is recommended for high-risk women

- sexually active women $<$25 years old
- older women with risk factors (new or multiple partners)

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- Men could be an important reservoir of infection for women

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"Check It", a male-screening based program, targets

- African American men
- age 15-24, live in New Orleans
- sexually active (at least one sexual contact in the past two months)

Goal: model and quantify the impacts of male-screening strategy

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We create a mathematical model for Chlamydia epidemic:

- stochastic, heterosexual, individual-based
- simulates Chlamydia transmission over sexual networks
- describes the interventions for the epidemic

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Network modeling to describe hetersexual partnership

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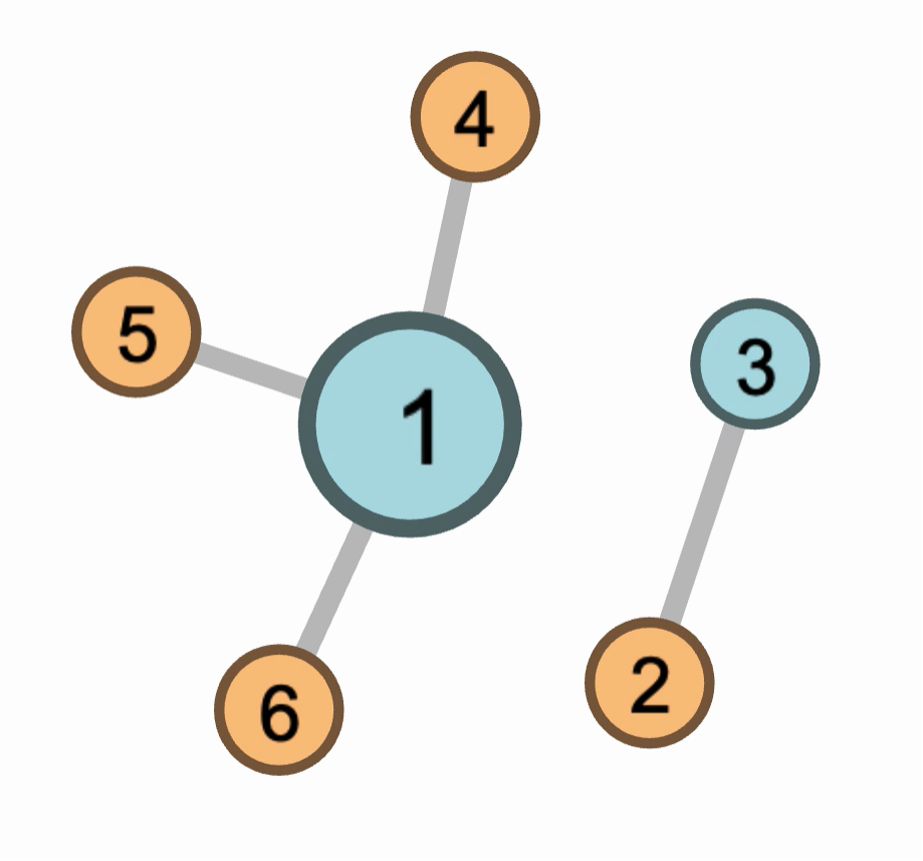

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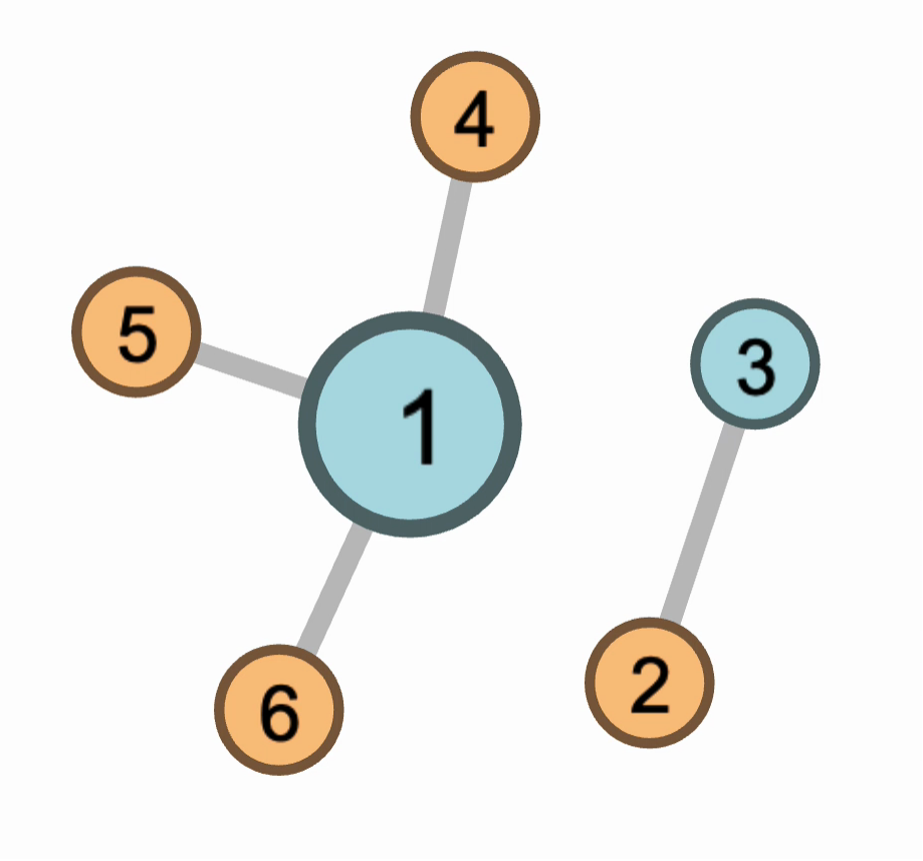
- dynamic sexual networks, partner changes in time



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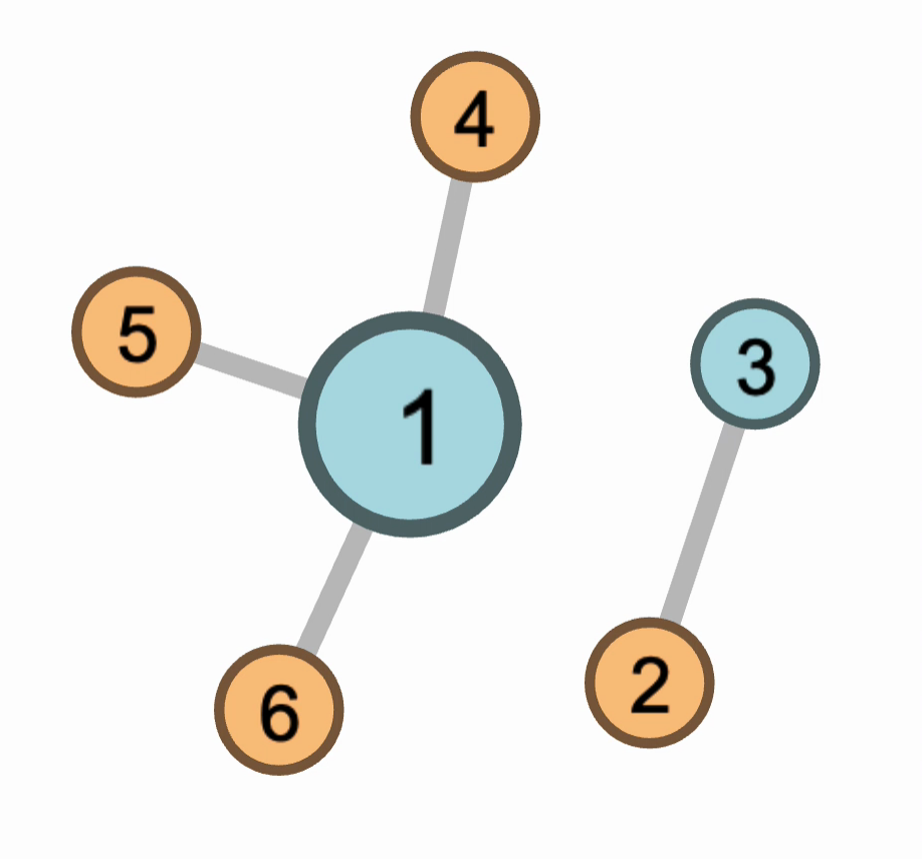

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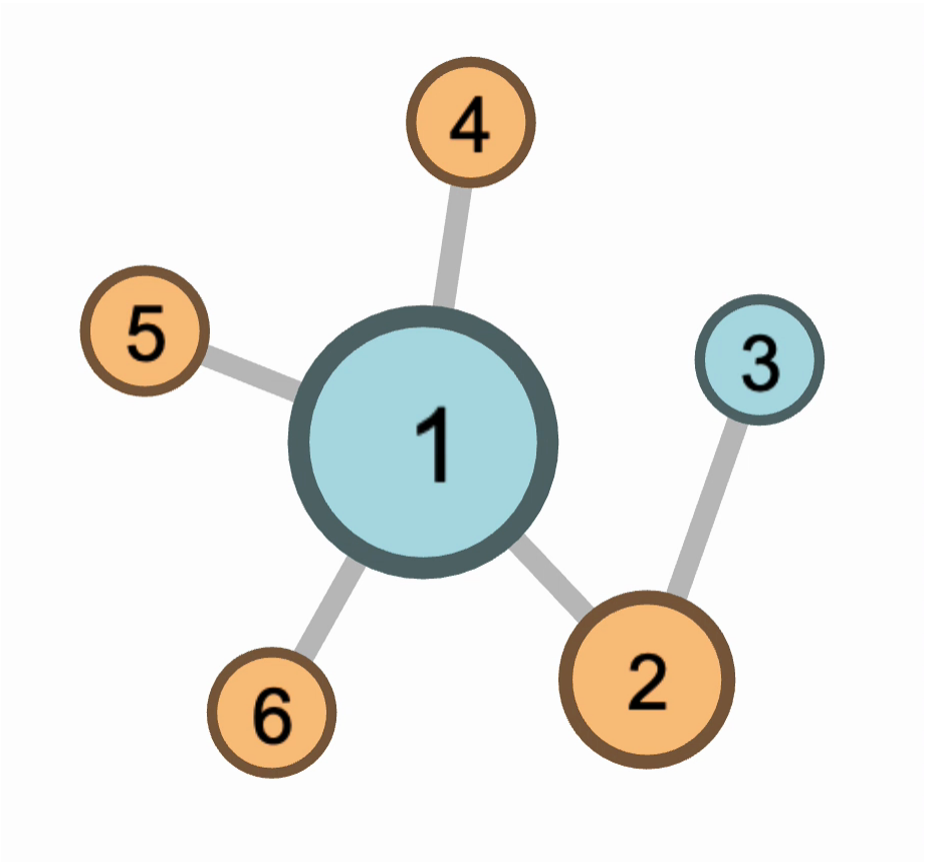

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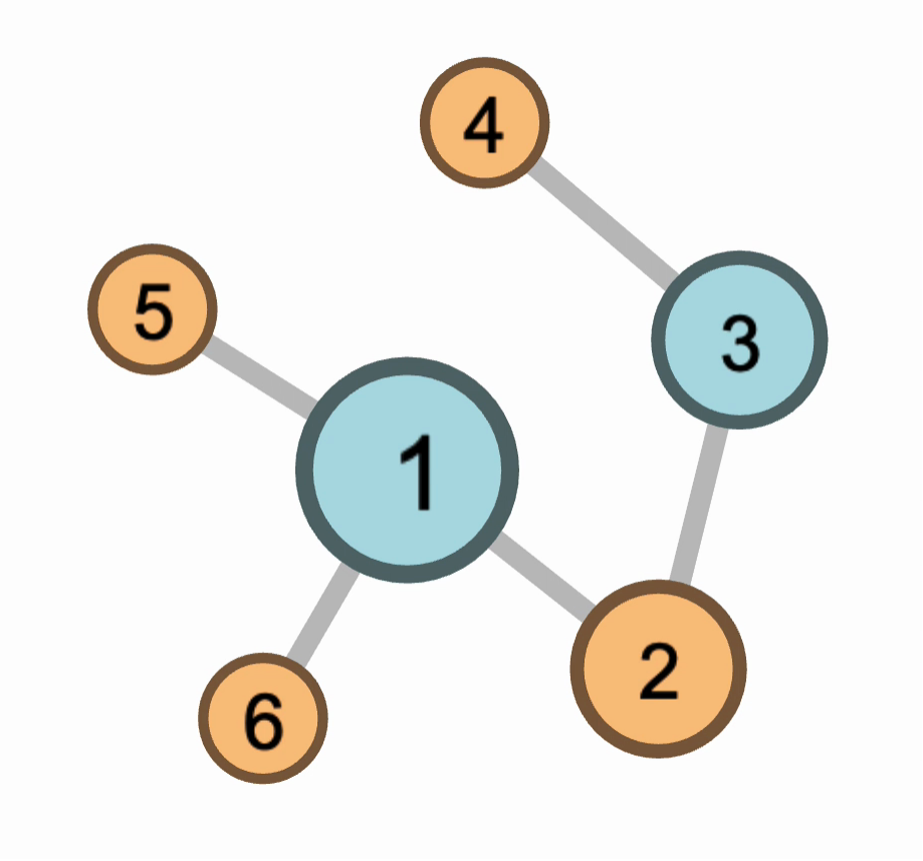

Network modeling to describe hetersexual partnership

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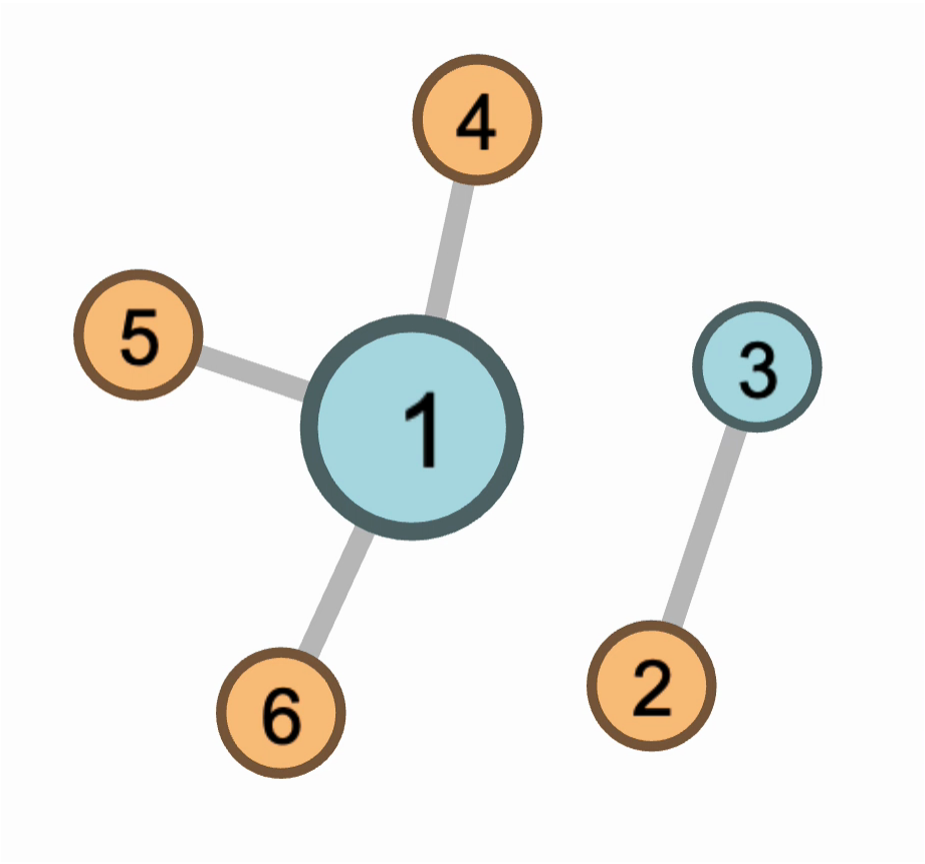
- primary (long-term) vs. casual (short-term)



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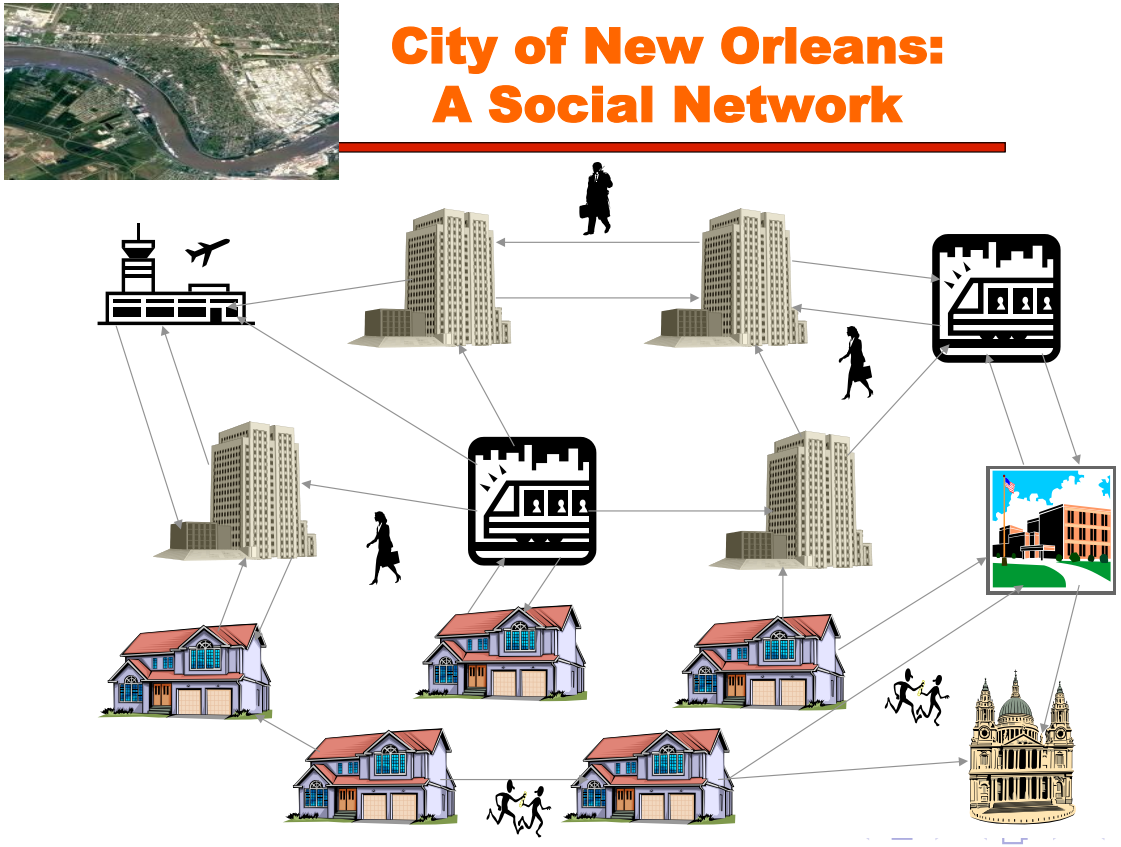
   - TRANSIMS infrastructure, tracks social activities, 150K population, New Orleans (Bryan Lewis, Achla Marathe, U Virginia)



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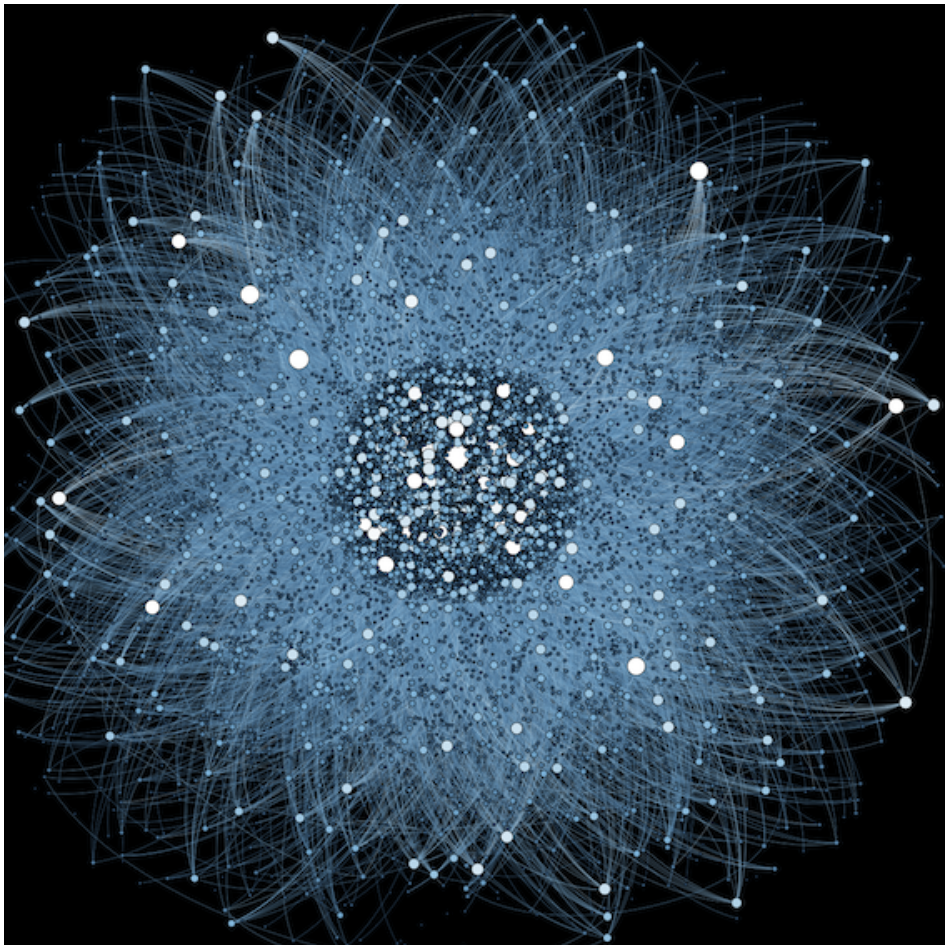

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- data from "Check It" and "You Geaux Girl!"

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Check It, men's perspective

- enrolled 1318 AA men (ongoing, as of April 2019)
- survey questionnaire on
  - sexual behavior
  - partner demographics

https://gocheckit.net/

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You Geaux Girl!, women's perspective (Jakevia L. Green, 2014, Tulane)

- enrolled 649 AA women
- survey questionnaire on
  - sexual behavior
  - partner information

YGG!

Pregnancy prevention intervention for young AA women

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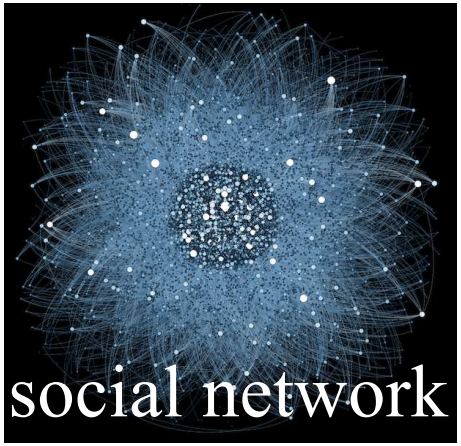

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sexual behavior survey

dynamic sexual networks

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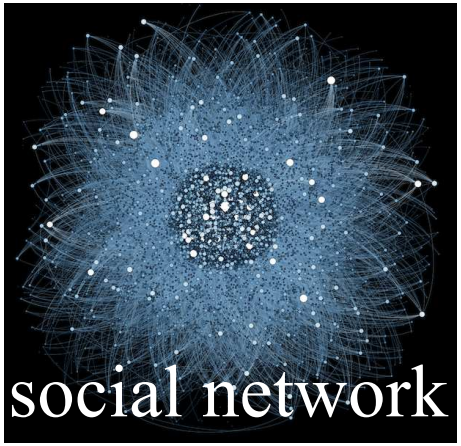

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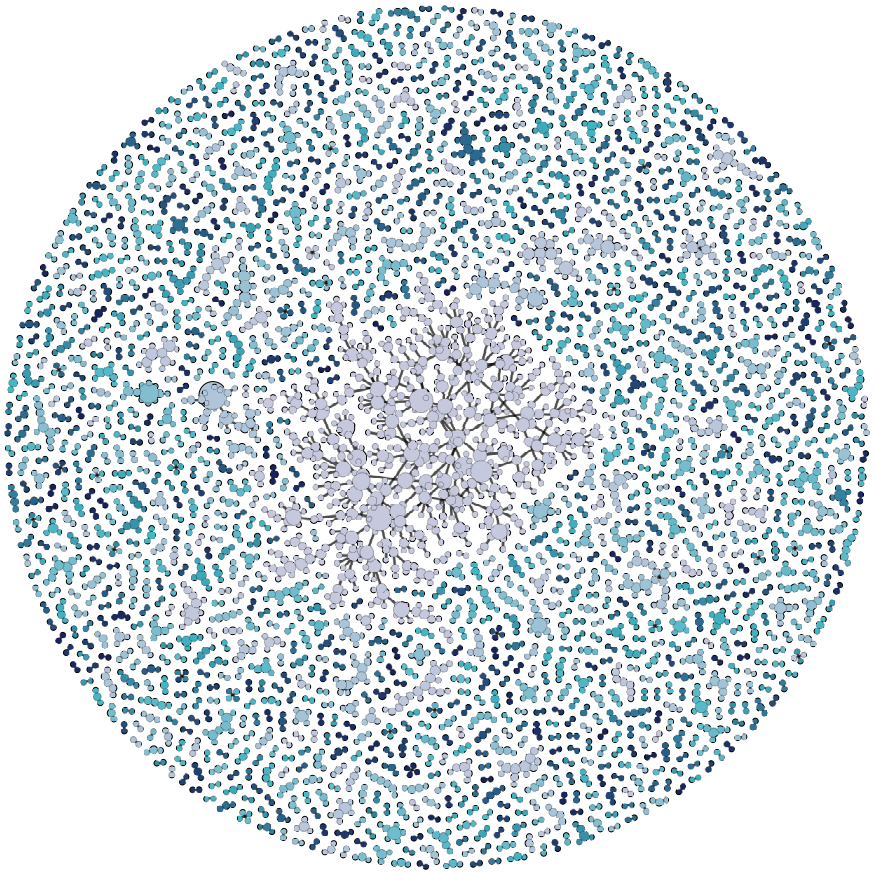
sexual behavior survey

dynamic sexual networks

- $\sim$ 80% of partnerships from one's heterosexual social network

Realistic sexual networks need biased mixing (population = 5000)



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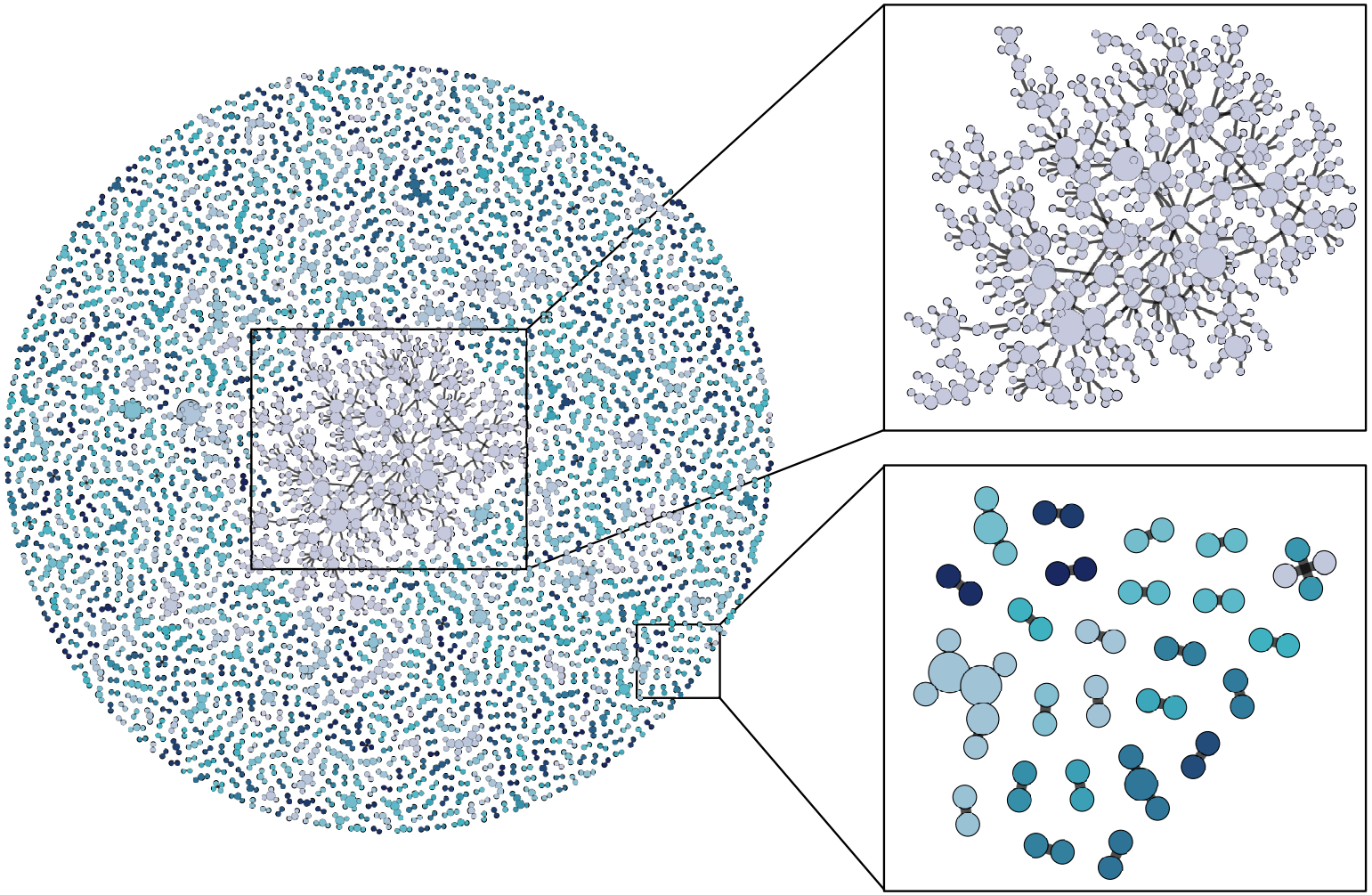
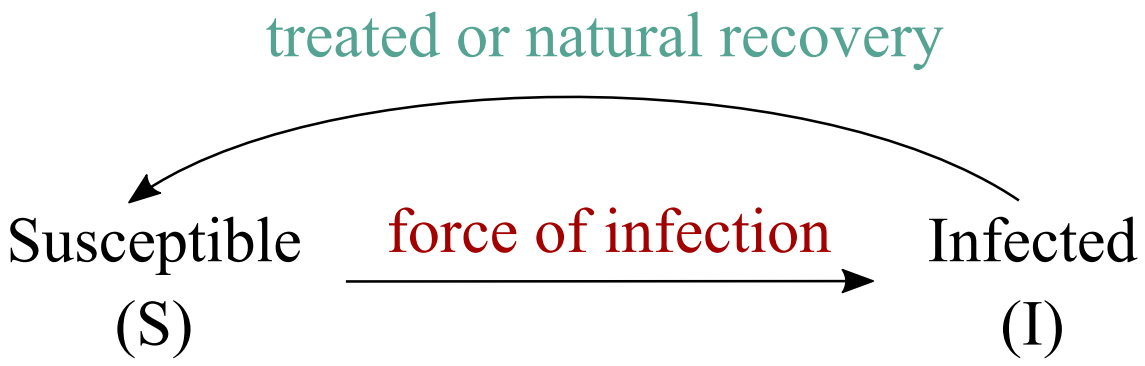


Chlamydia transmission on sexual network - SIS model



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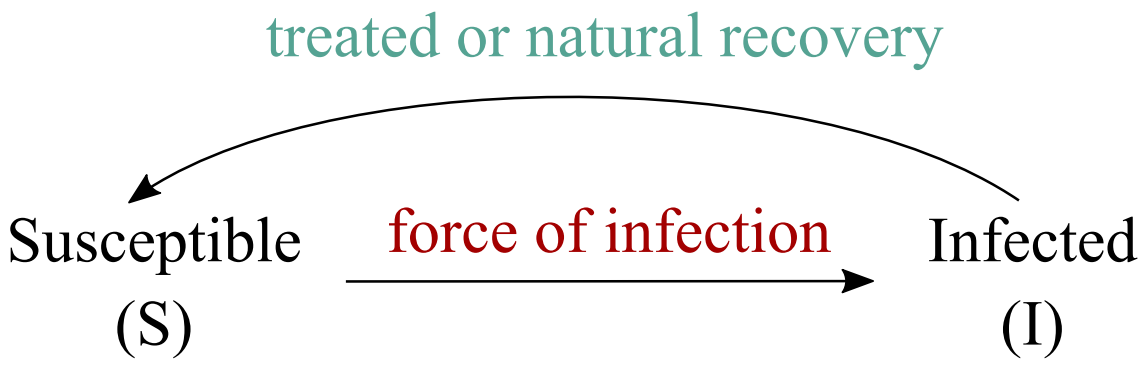

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  - number of partners
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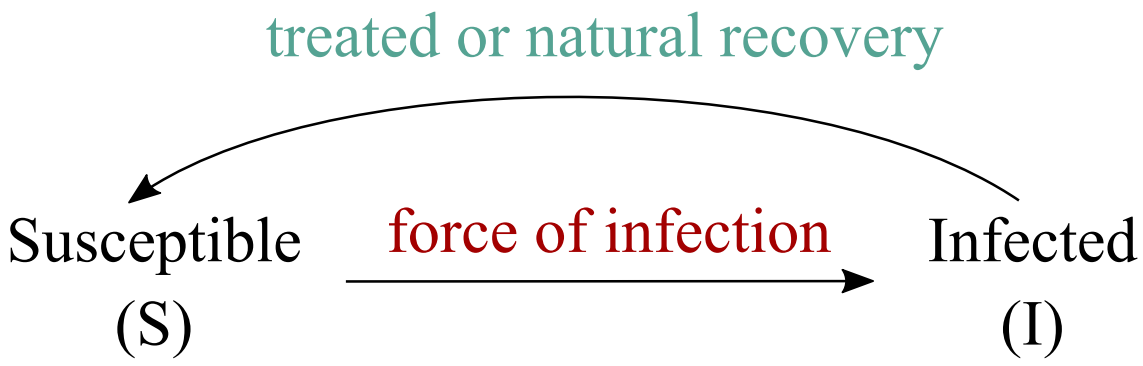

- $S \to I$: force of infection combining risk factors
  - number of partners
  - probability of having a sexual contact
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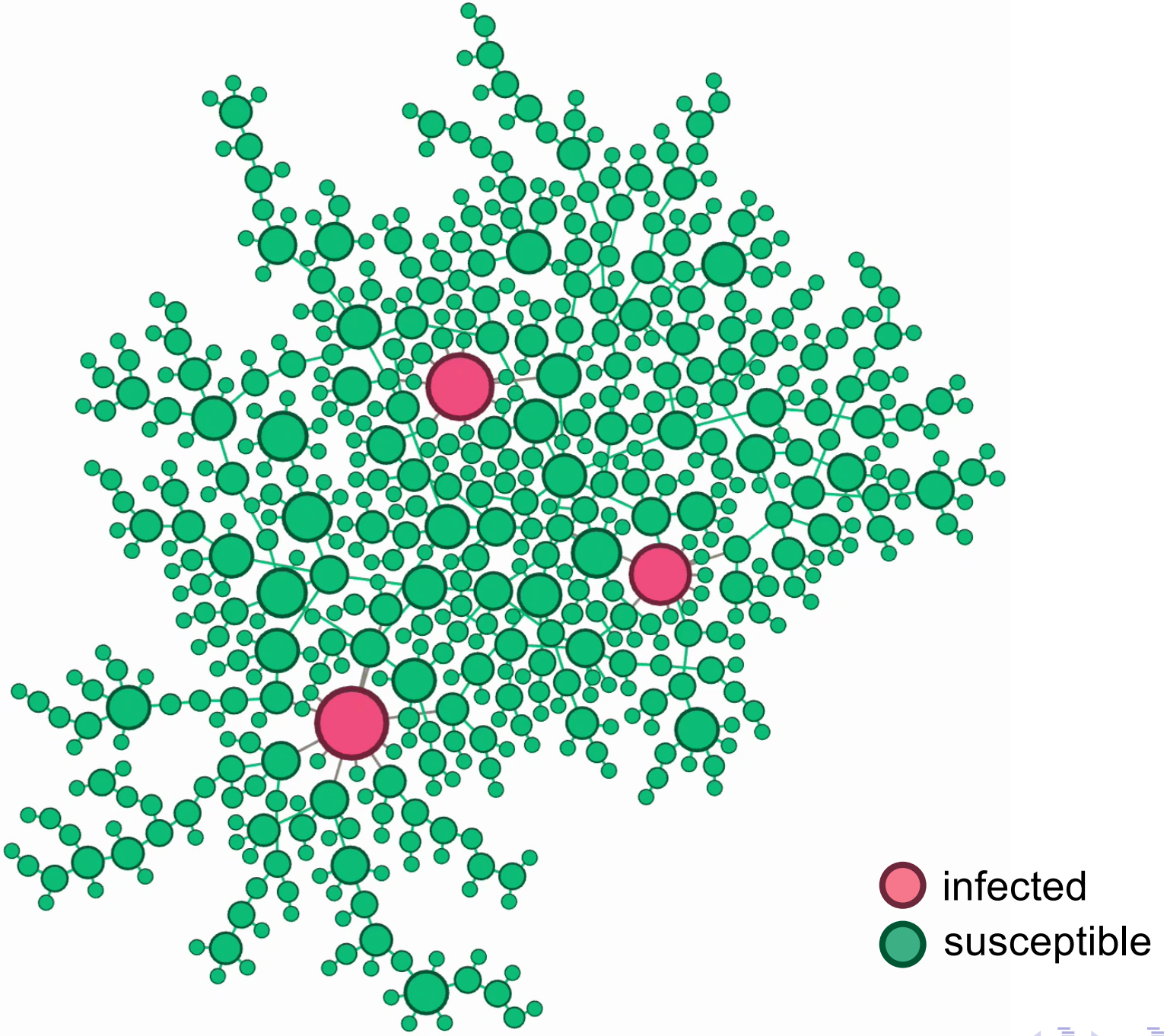
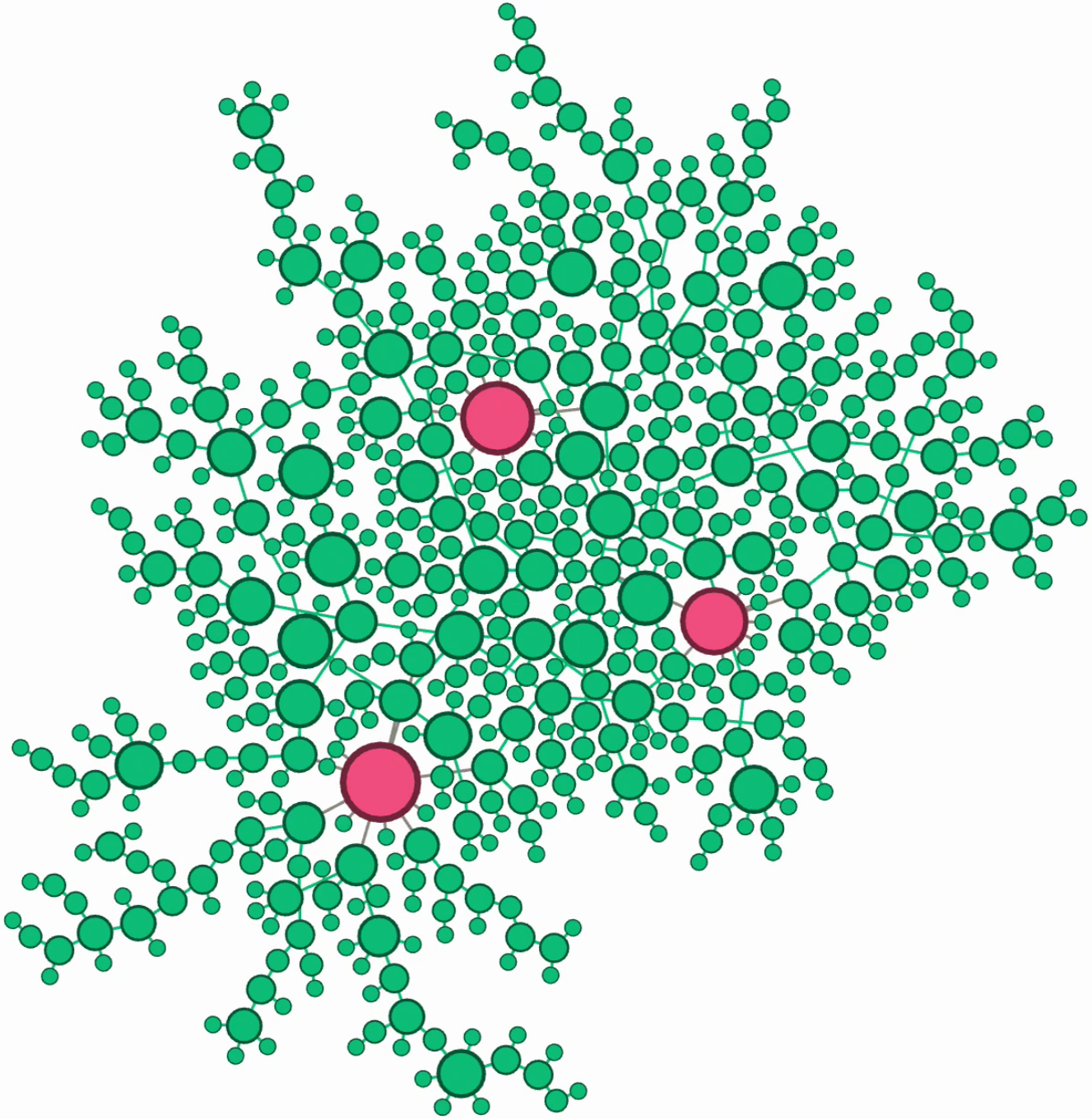
  - type of partnership (primary or casual)
- $I \to S$: Chlamydia infection does not confer lasting immunity after treatment or natural clearance
- individual may have repeat infections once susceptible


infected
susceptible



Investigate the effectiveness of male-screening strategy

We need to a have a comprehensive description for

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- Check It male-screening intervention program

to study the *net* impact of male-screening strategy given the existing policy

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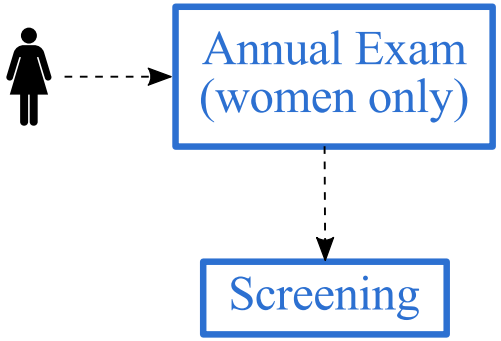
Baseline intervention strategies

- **women annual screening**
  as regular preventive healthcare



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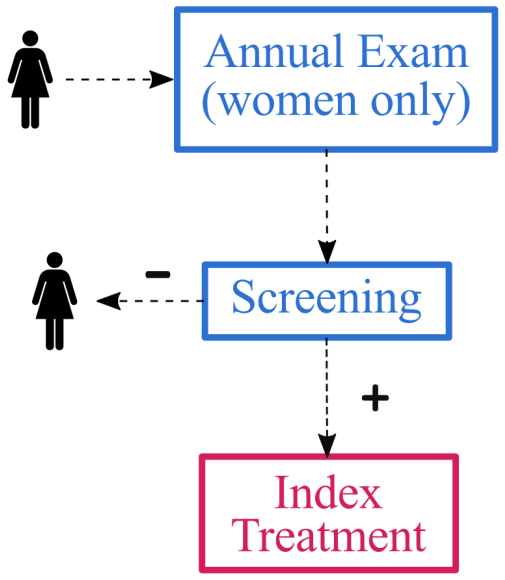

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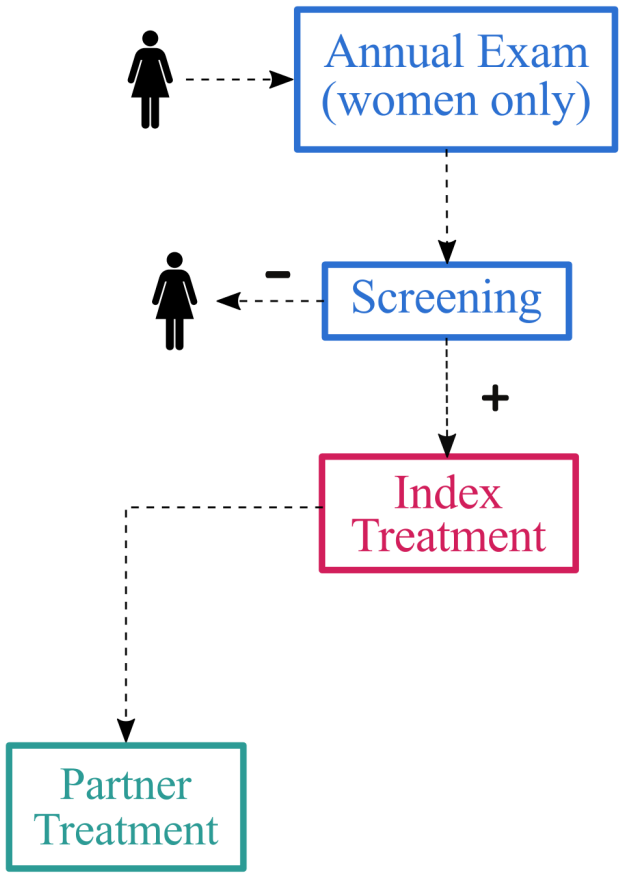

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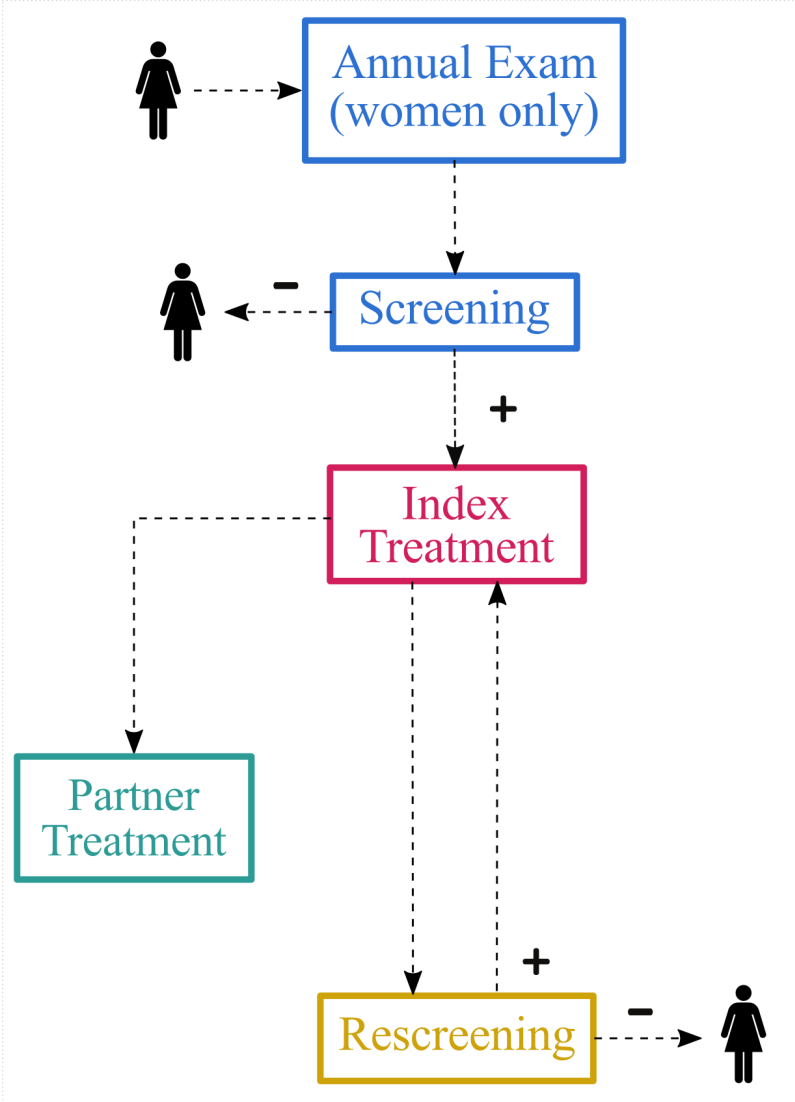

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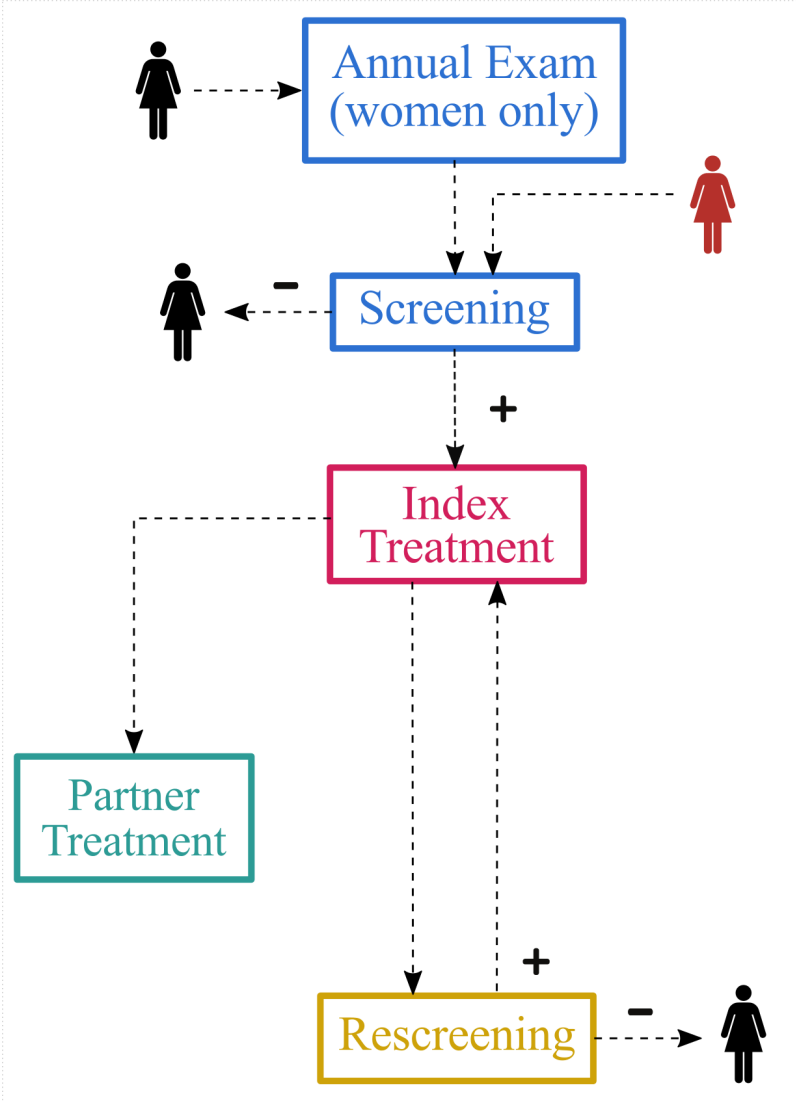
  for symptomatic infection
  - about 30% cases in women
  - same procedure if infected



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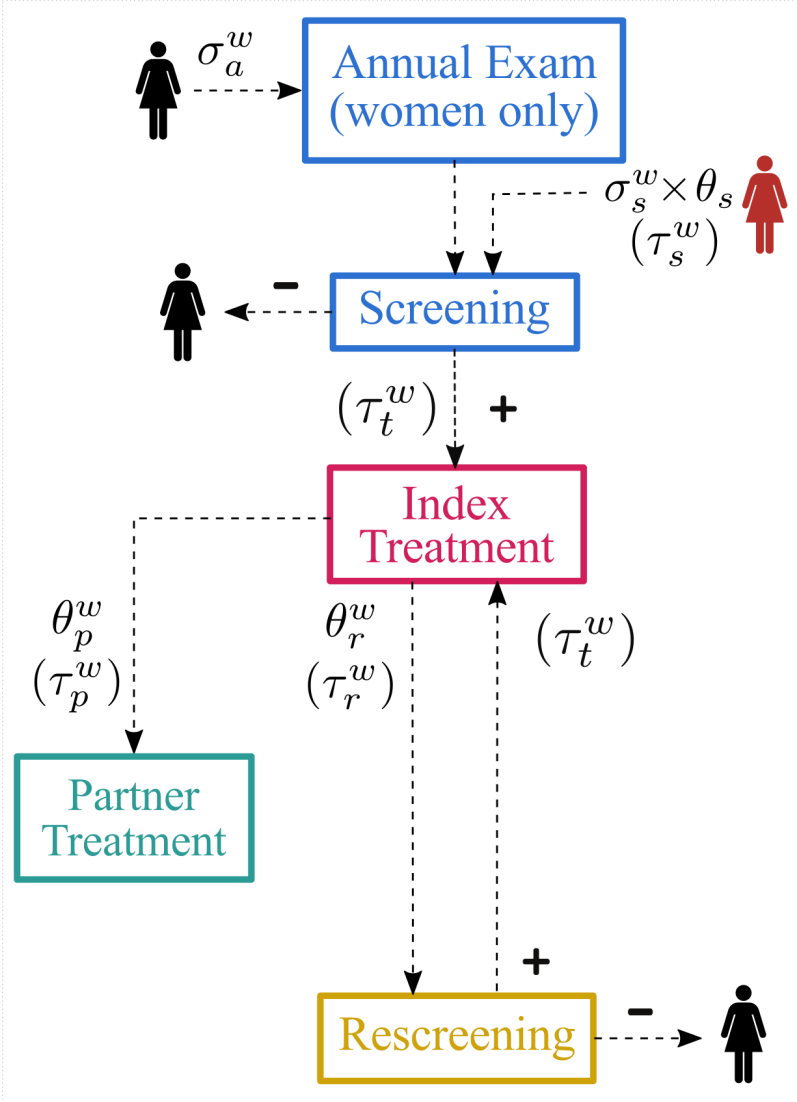

Baseline intervention strategies

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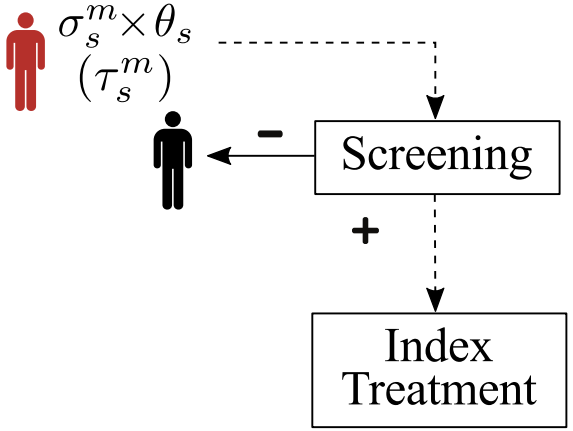
- **women clinic visit**
- **men clinic visit**
  for symptomatic infection
  - about $\sim 10\%$ cases in men
  - index treatment



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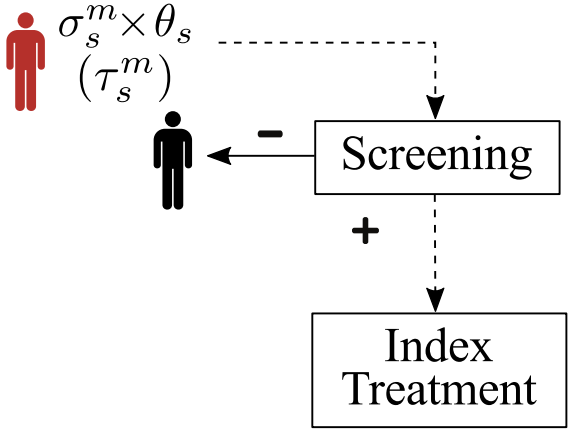

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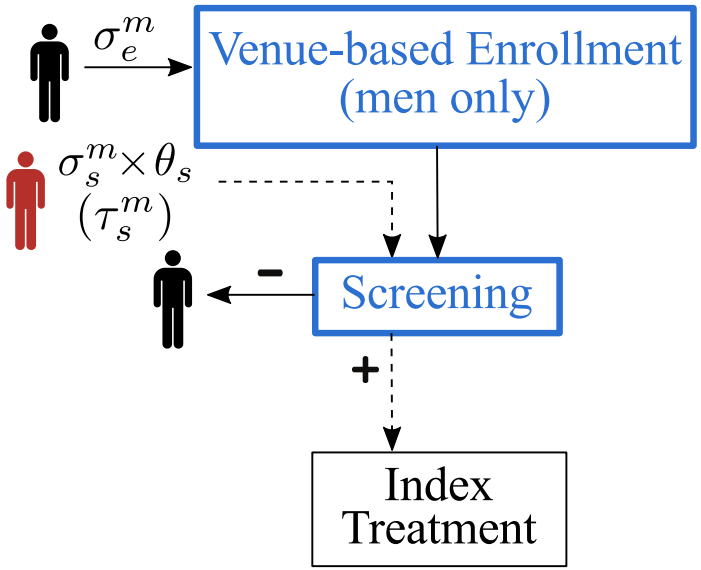
- **venue-based enrollment**
- high-prevalence neighborhoods
- barbershops, community colleges, universities



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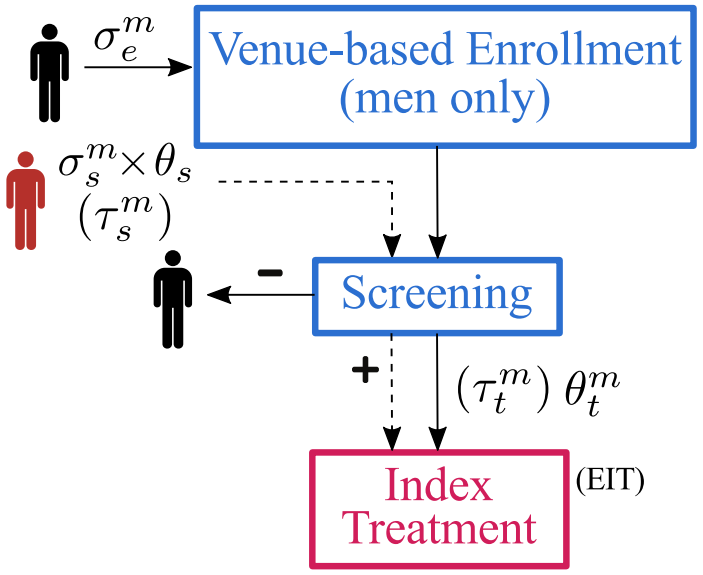

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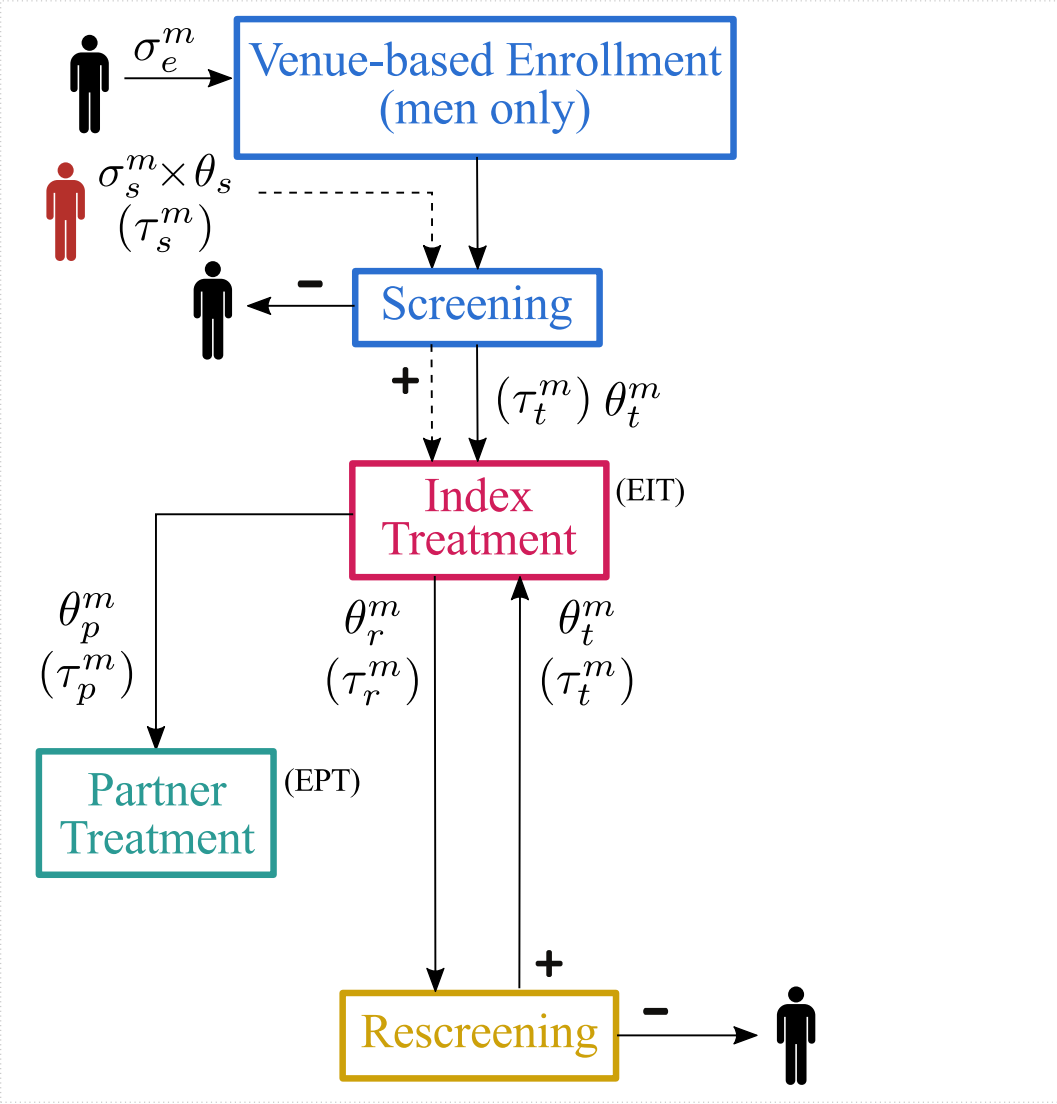

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Check It male-screening

- **venue-based enrollment**
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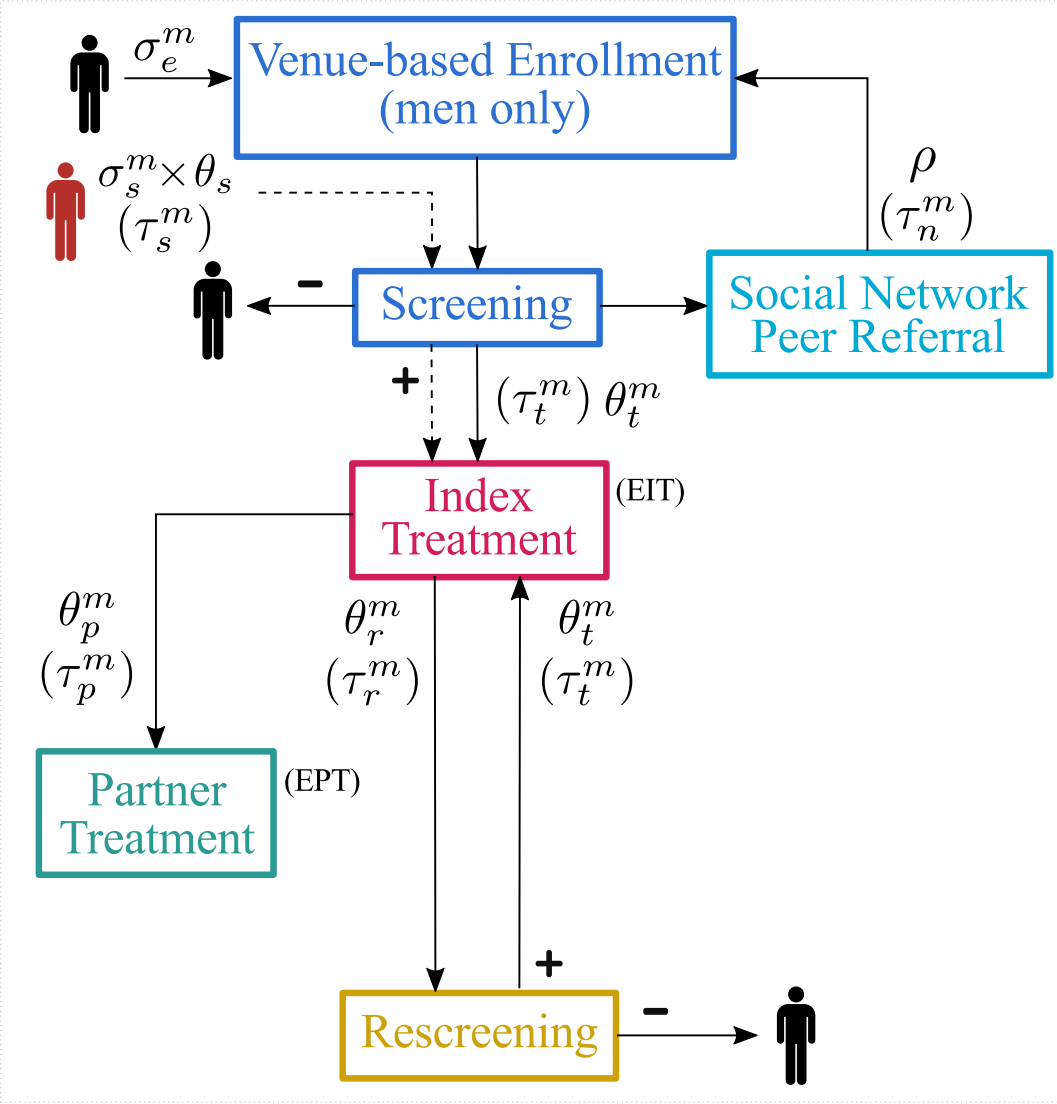
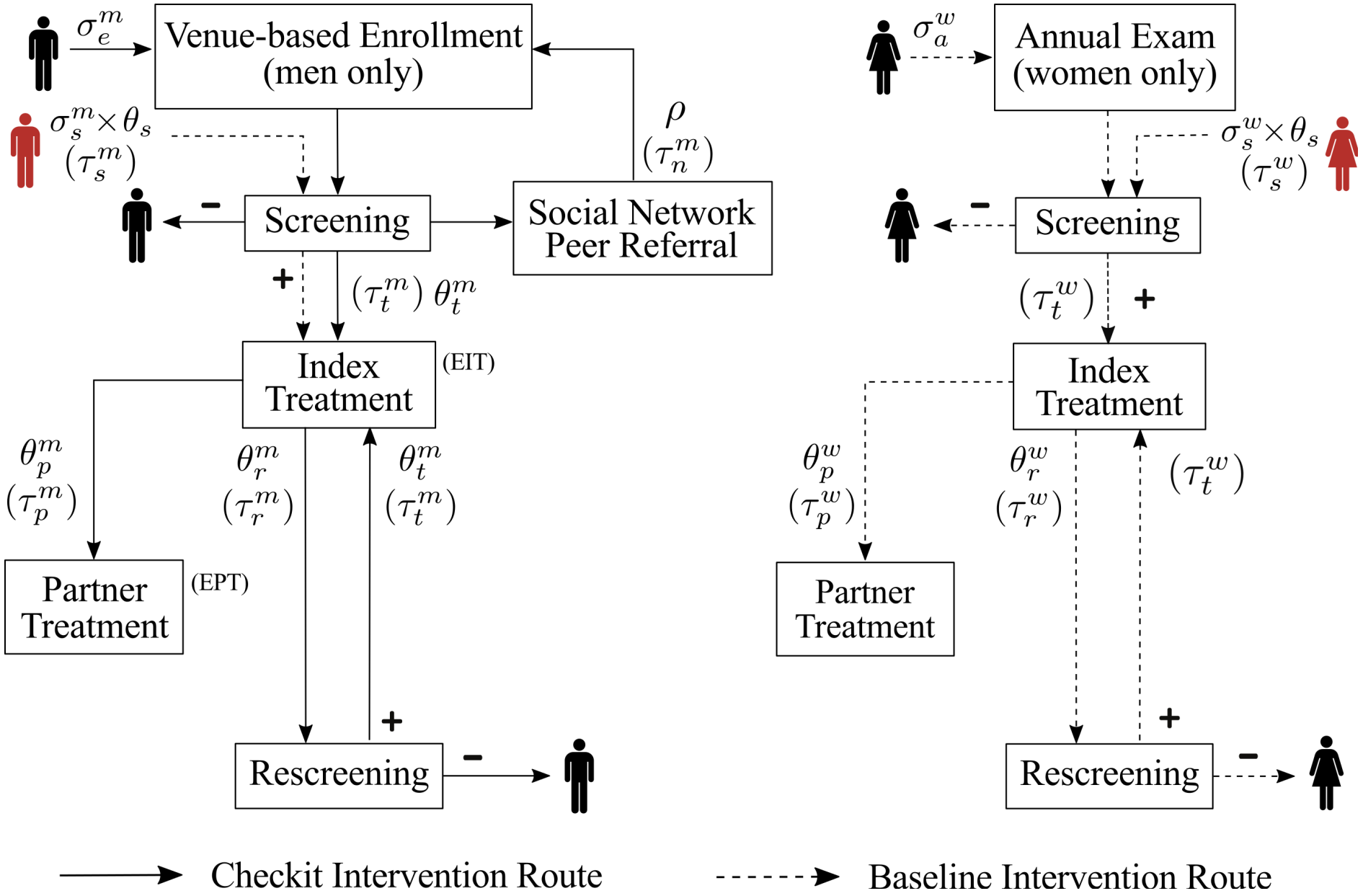
- **rescreening**
- **social network peer referral**

- refer friends in social network
- referral coupon, monetary incentive
- word-of-month, peer effect, etc




σ_e^m
Venue-based Enrollment (men only)
$\sigma_s^m \times \theta_s$
(τ_s^m)
ρ
(τ_n^m)
Screening
Social Network Peer Referral
(τ_t^m) θ_t^m
Index Treatment
(EIT)
θ_p^m
(τ_p^m)
θ_r^m
(τ_r^m)
θ_t^m
(τ_t^m)
Partner Treatment
(EPT)
Rescreening
σ_a^w
Annual Exam (women only)
$\sigma_s^w \times \theta_s$
(τ_s^w)
Screening
(τ_t^w)
Index Treatment
θ_p^w
(τ_p^w)
θ_r^w
(τ_r^w)
(τ_t^w)
Partner Treatment
Rescreening
Checkit Intervention Route
Baseline Intervention Route

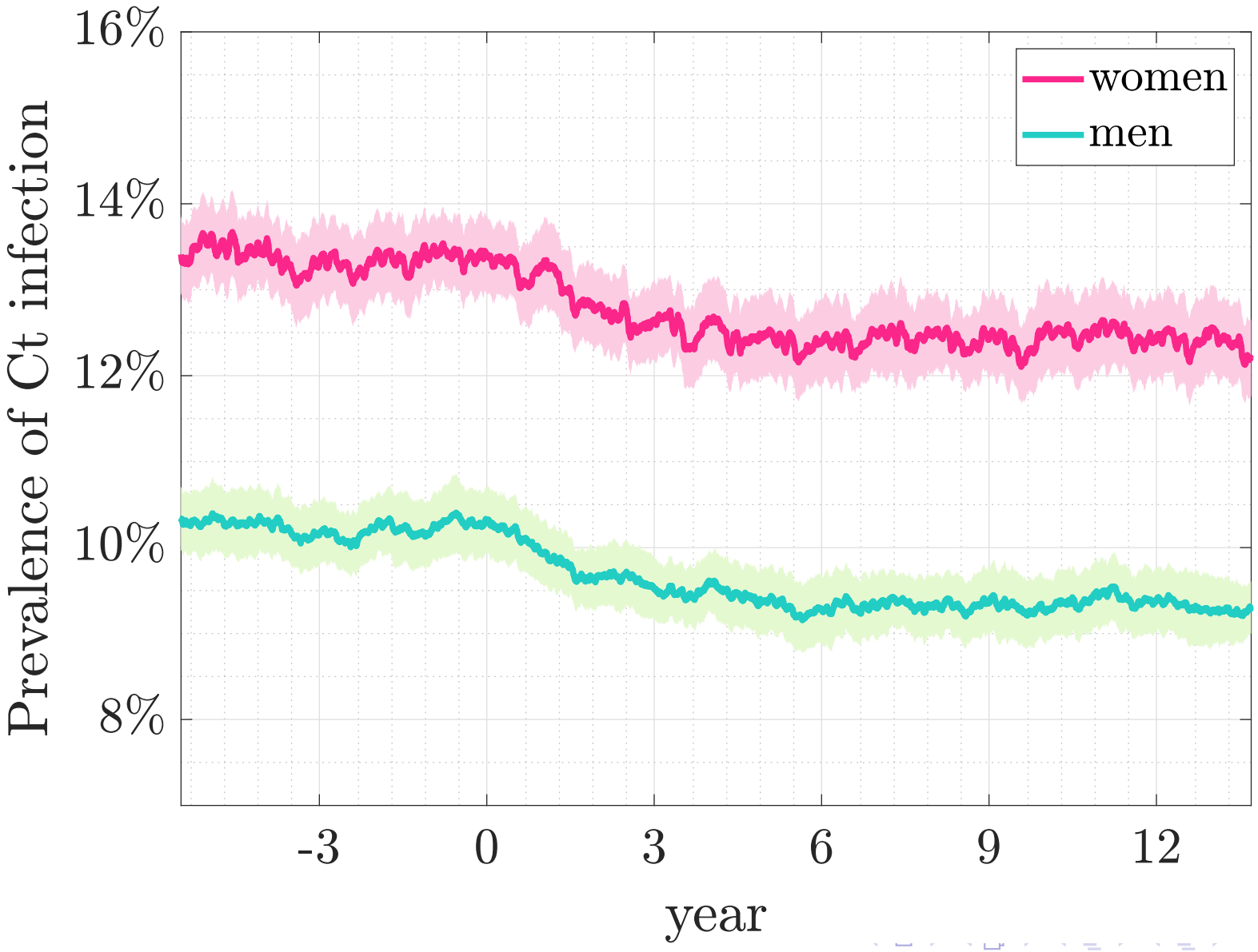
Outlines

Check It intervention at current intensity

Current intervention intensity of Check It

- venue-based enrollment 7.5% per year
  - peer-recruited: about every three men bring one more friend
- index treatment rate 76%, delay = 12 days
- partner treatment rate 27%, delay = 2 days
- rescreening 8%, delay = 102 days

Check It intervention at current intensity



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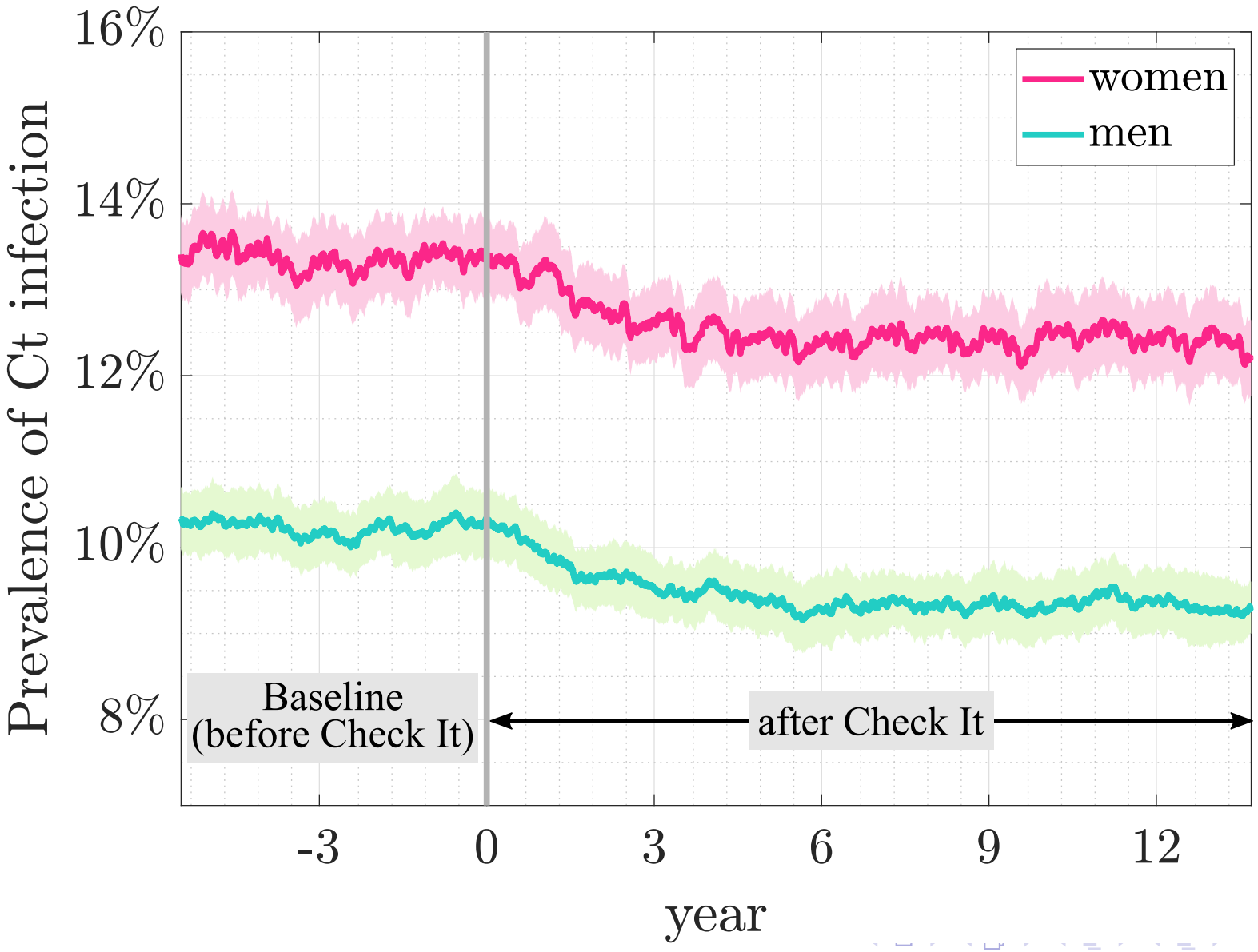

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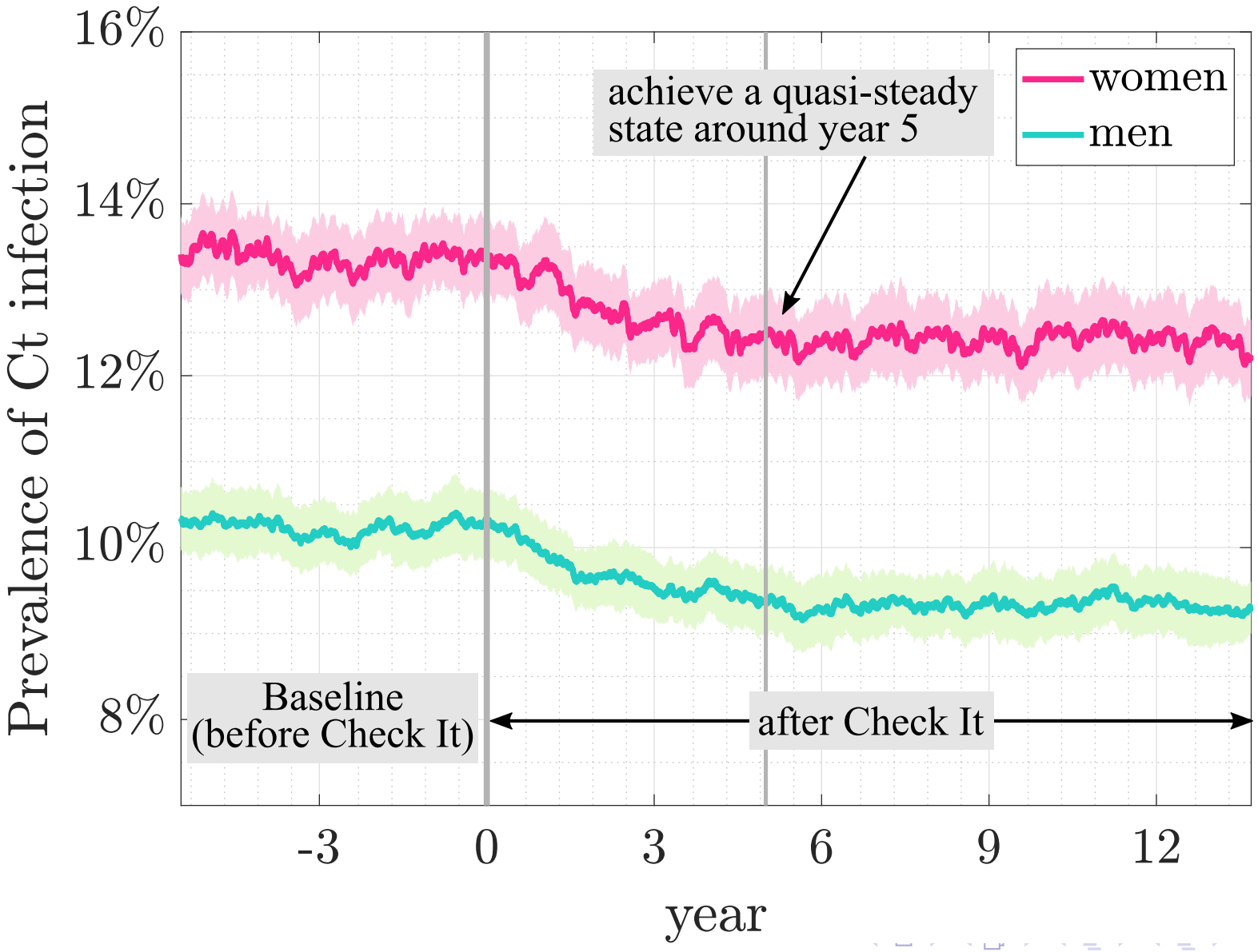

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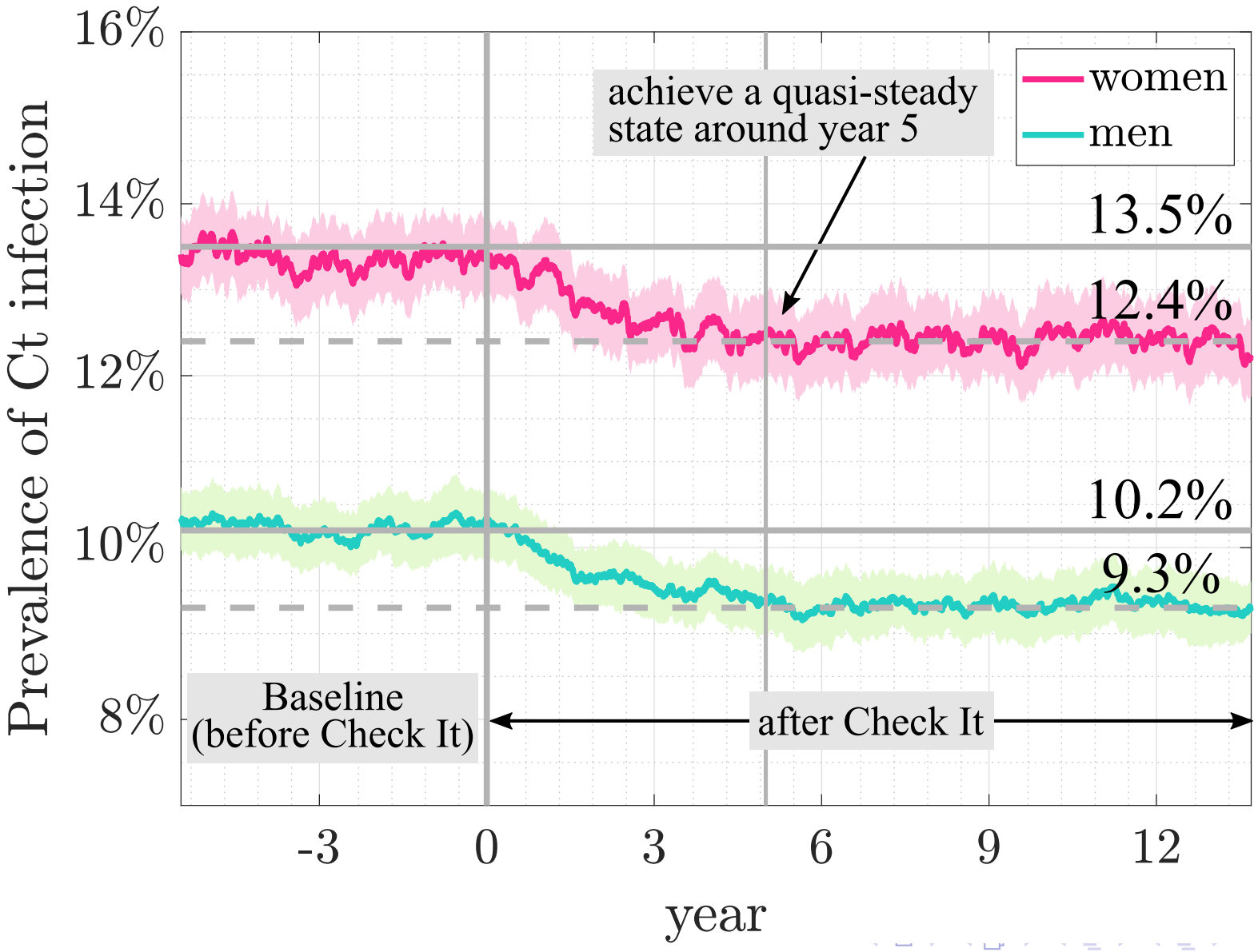
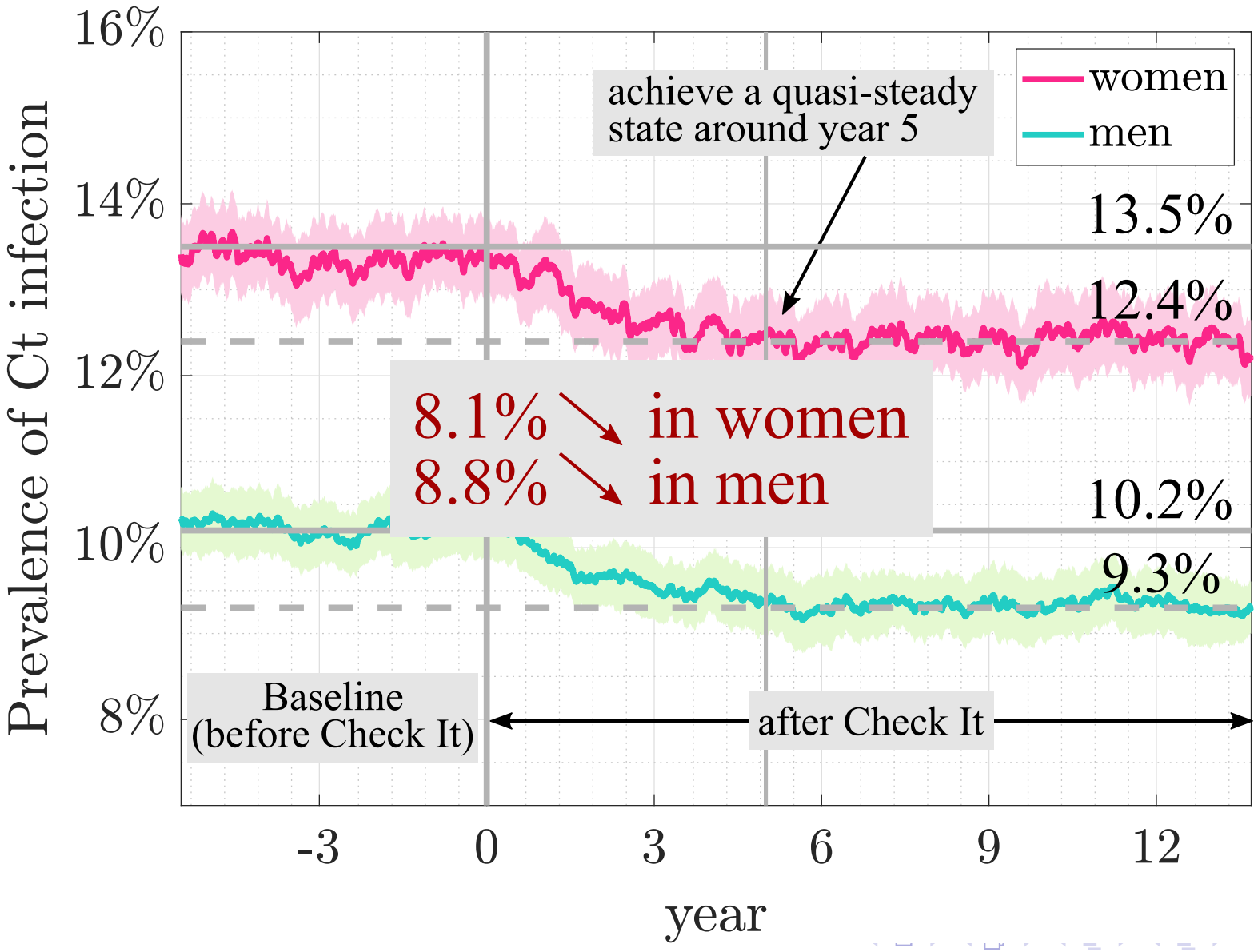
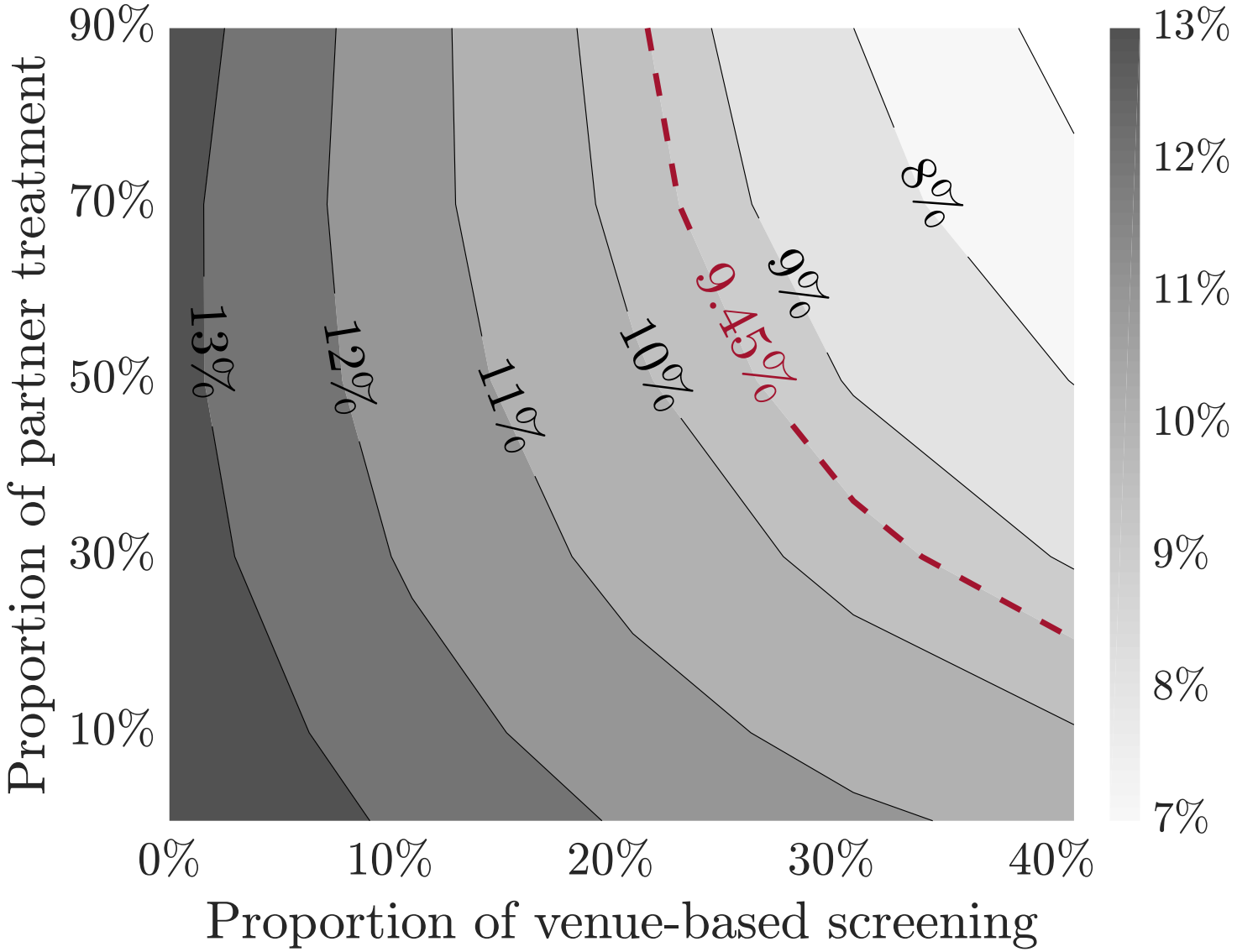


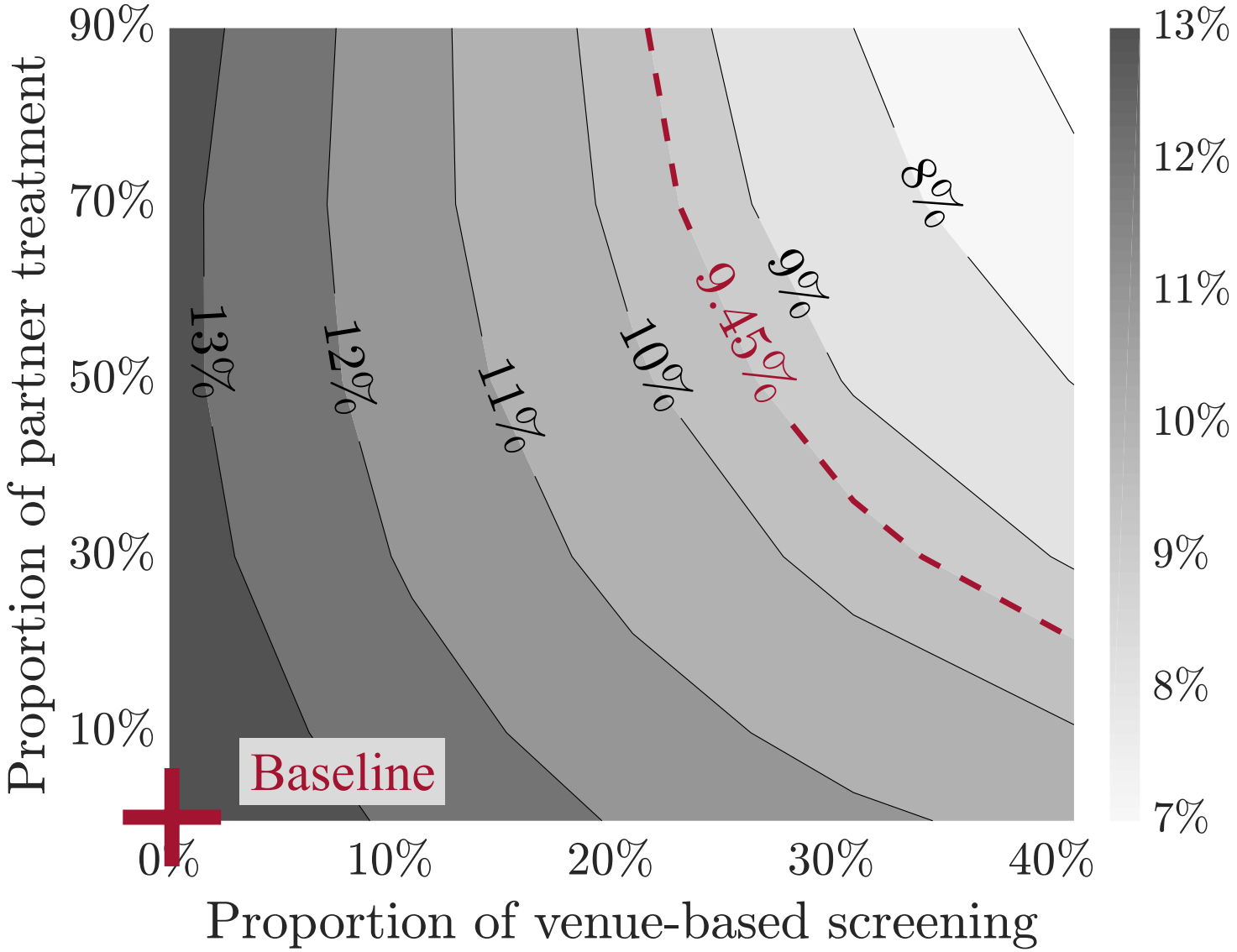
Check It intervention at current intensity



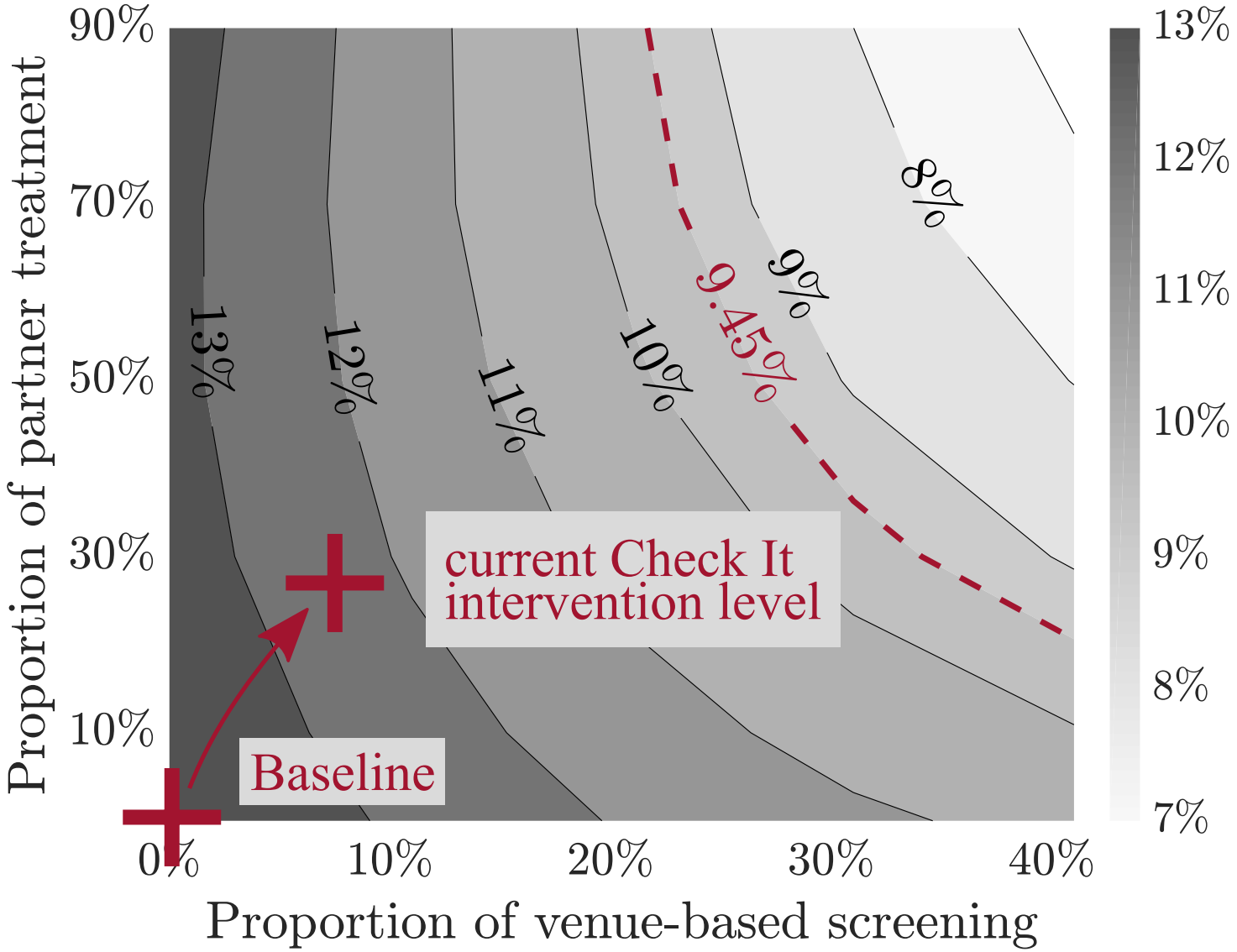
Male-screening intervention help to reduce Chlamydia prevalence in women



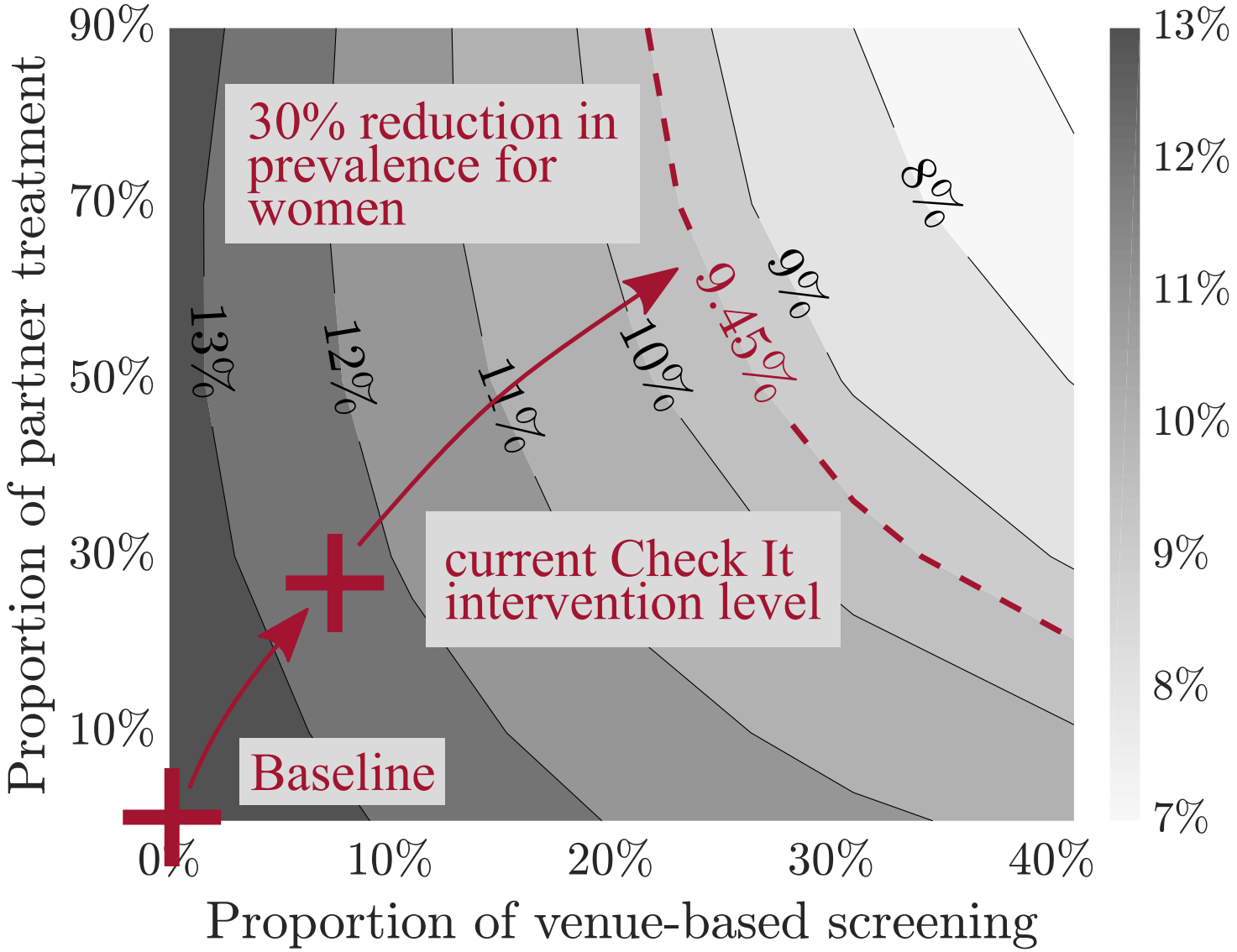
Male-screening intervention help to reduce Chlamydia prevalence in women



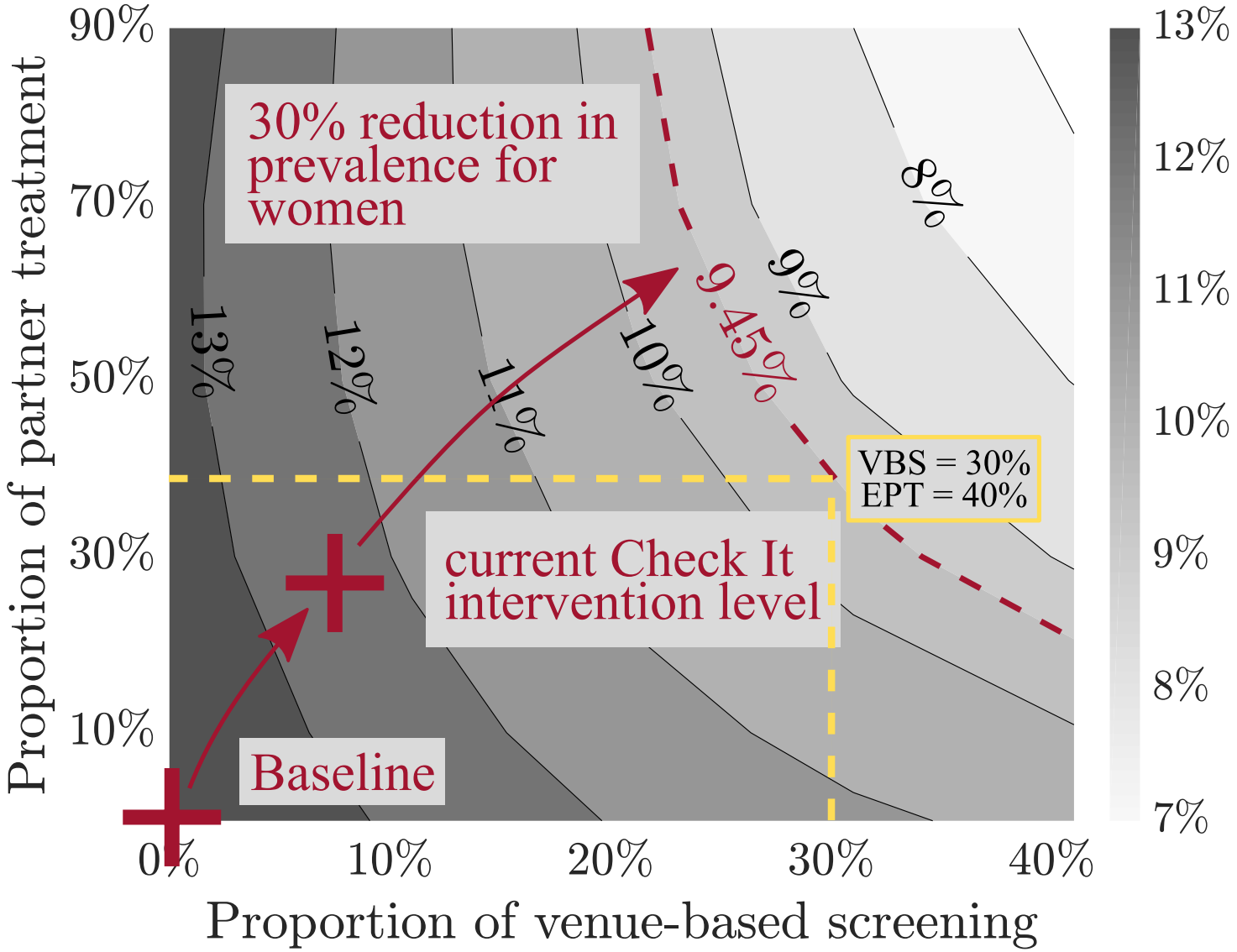
Male-screening intervention help to reduce Chlamydia prevalence in women



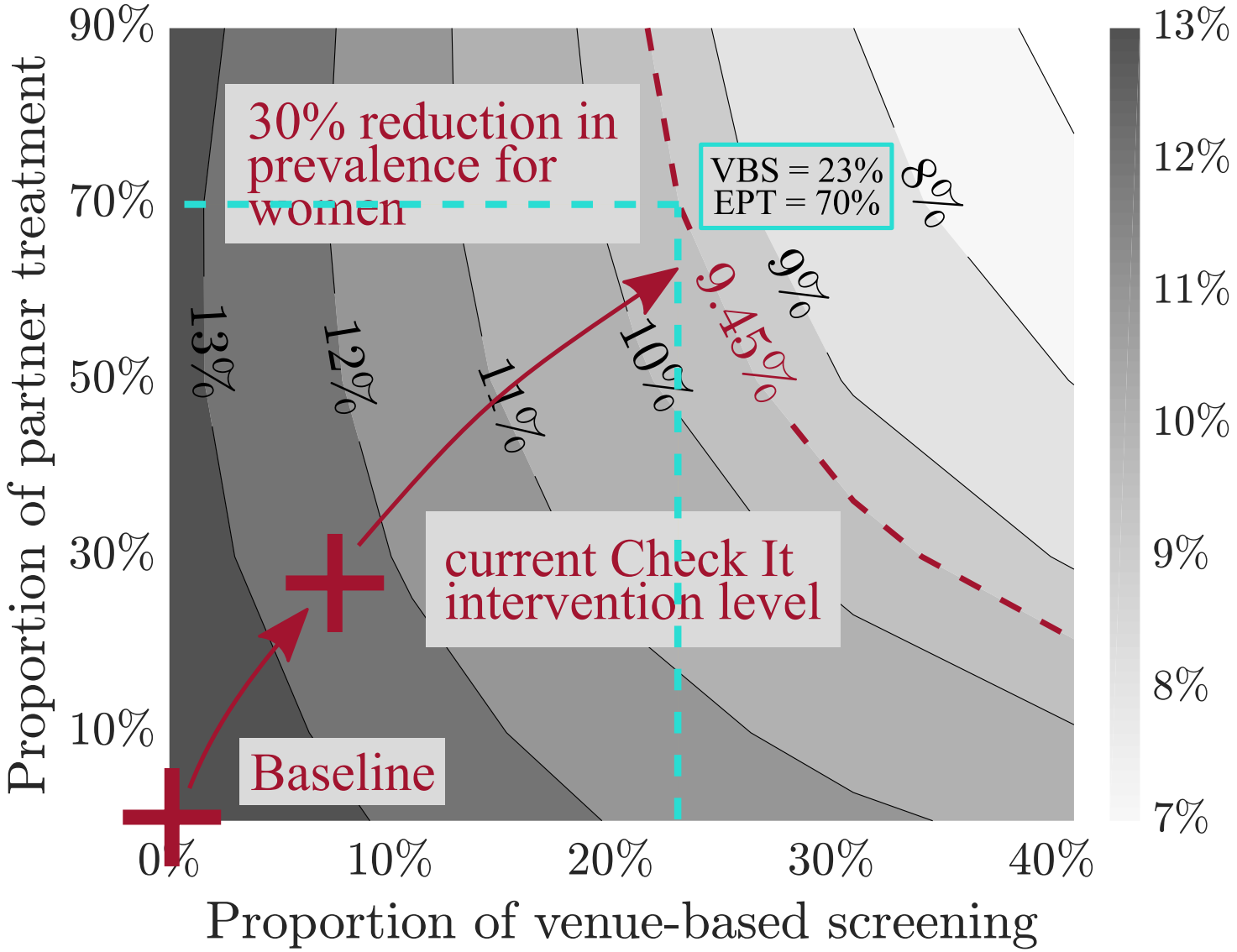
Male-screening intervention help to reduce Chlamydia prevalence in women



Male-screening intervention help to reduce Chlamydia prevalence in women



Male-screening intervention help to reduce Chlamydia prevalence in women



Conclusion

- We proposed a stochastic, heterosexual and individual-based model that describes
  - the Chlamydia epidemic over sexual networks, and
  - the ongoing intervention strategies to control the prevalences.
- Our model
  - provides a mathematical framework to quantify how effective different combinations of interventions will be in mitigating Chlamydia, and
  - predicts that venue-based screening of young African American men has the potential to affect womens rates

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