

A modelling study to investigate the role of extragenital infection in the persistence of gonorrhoea prevalence in MSM in urban Australia

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Introduction

Treatments for gonorrhoea are readily available in urban Australia and they have effectively reduced the average duration symptomatic urethral infection to within a few days. Furthermore, with at least 60% of MSM in urban areas being tested annually [1], and untreated urethral infections persisting for around 15-26 weeks [2], most gonorrhoea infections are expected to resolve in less than one year. And yet, the gonorrhoea positivity among urban Australian MSM has remained stable for at least a decade and has even increased in recent years [3,4], with gonorrhoea prevalence at extragenital sites (rectal and pharyngeal) reaching as high as 4% [5].

Hypothesis

Given gonorrhoea infections at extragenital sites are usually asymptomatic, it is possible that a large proportion of rectal and pharyngeal infections remain untreated for a long period, allowing gonorrhoea to persist in the population despite the high rate of symptom-driven treatment.

Method

An individual-based model of gonorrhoea transmission was developed to describe an urban MSM population.

Each MSM has 3 sites of infection: urethral, rectal and pharyngeal. The transmission pathway and the properties of the infection at each site summarised in Figure 1.

Transmission between urethral and rectal sites can occur during unprotected anal sex, with likelihoods of 28.6% and 23.3% for regular and casual partnership respectively.

All oral sex acts are assumed to be unprotected.

Symptomatic infection assumed to last for short period due to treatment.

Asymptomatic infection assumed to last for longer period since treatment will not be sought.

The model was calibrated against sexual behaviour and prevalence data for MSM population in urban Australia [1, 4-8].

Site-specific transmissibility is inferred by calibrating the model to rectal and pharyngeal gonorrhoea prevalence in an MSM population and is listed in Table 1.

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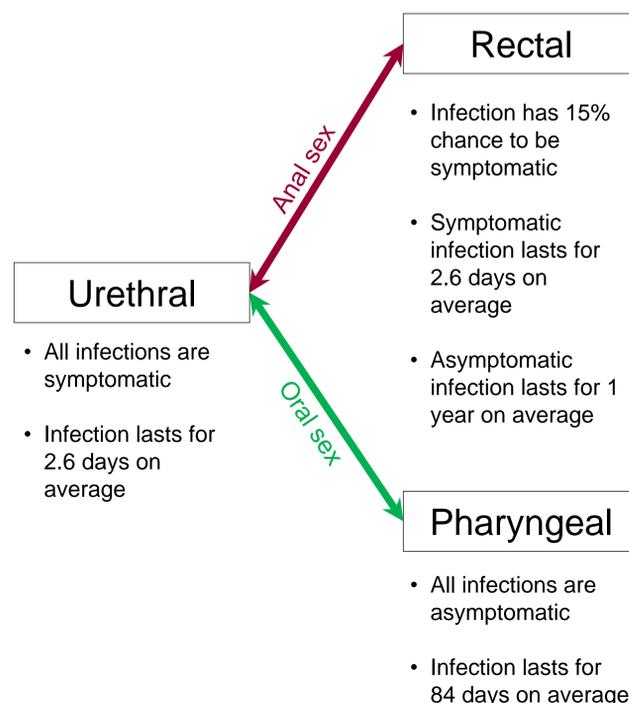


Figure 1: Properties of genital and extragenital infection used in the model.

Acts	Transmission direction	Transmission probability
Anal sex	Urethral to rectal	0.8402
	Rectal to urethral	0.0243
Oral sex (fellatio)	Urethral to pharyngeal	0.6268
	Pharyngeal to urethral	0.0865

Table 1: Calibrated transmission probability per unprotected sex act.

Results

Gonorrhoea can persist in the model, with the median prevalence at equilibrium (defined as the average prevalence over the last 10 years of simulations run to 60 years) as listed in Table 2.

Result in Table 3 shows gonorrhoea prevalence will be reduced to less than 3% if condoms are used for all anal sex acts within the model, but the complete elimination of gonorrhoea is unlikely.

Gonorrhoea does not persist in most simulation runs (85%) if condoms are used in 20% of oral sex acts. If condom usage for oral sex acts is greater than 25%, then gonorrhoea cannot persist at all.

Site	Model predicted prevalence (median, 25th-75th percentile)	Calibration target
Urethral	1.5% (1.4% - 1.6%)	To be as low as possible
Rectal	4.1% (4.0% - 4.2%)	4.6% [5]
Pharyngeal	3.8% (3.7% - 3.9%)	3.9% [5]

Table 2: The prevalence at equilibrium for all sites at baseline model.

Condom usage	Site	Model predicted prevalence (median, 25th-75th percentile)
Increased to 100% for anal sex	Urethral	1.0% (1.0% - 1.1%)
	Rectal	0.0% (0.0% - 0.0%)
	Pharyngeal	2.7% (2.5% - 2.9%)
Increased to 20% for oral sex (on top of baseline usage for anal sex)	Urethral	0.1% (0.1% - 0.1%)
	Rectal	0.4% (0.3% - 0.5%)
	Pharyngeal	0.3% (0.2% - 0.4%)

Table 3: The prevalence at equilibrium for all sites under increased condom usage.

Conclusion

Gonorrhoea can persist in an MSM population despite short duration of urethral and symptomatic infection, as asymptomatic rectal and pharyngeal infections acts as a reservoir of untreated infection.

Oral sex has a greater influence on gonorrhoea persistence than anal sex due to the high frequency of unprotected oral sex between casual partners.

Increasing the use of condoms for oral sex could lead to a substantial reduction in the prevalence of gonorrhoea among MSM, although achieving a substantial increase in condom usage for oral sex may be difficult [9].