How the disruption in sexually transmitted infection care due to the COVID-19 Pandemic could lead to increased sexually transmitted infection transmission among men who have sex with men in The Netherlands: a mathematical modeling study

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How the Disruption in Sexually Transmitted Infection Care Due to the COVID-19 Pandemic Could Lead to Increased Sexually Transmitted Infection Transmission Among Men Who Have Sex With Men in The Netherlands: A Mathematical Modeling Study

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Background: During the COVID-19 pandemic, the disruption in care for sexually transmitted infections (STIs) and the social distancing measures have led to reductions in STI testing and sexual behavior. We assessed the impact of these COVID-19–related changes on transmission of *Chlamydia trachomatis* (CT) and *Neisseria gonorrhoeae* (NG) among men who have sex with men (MSM) in The Netherlands.

Methods: We developed a mathematical model for CT and NG transmission among MSM, accounting for COVID-19–related changes in sexual behavior and testing in 2020 to 2021. Changes in 2020 were estimated from data from the Dutch COVID-19, Sex, and Intimacy Survey among MSM and the National Database of STI Clinics. Because of the lack of data for 2021, we examined several scenarios covering a range of changes.

Results: A reduction of 10% and 40% in STI testing of symptomatic and asymptomatic, respectively, individuals with a 10% to 20% reduction in numbers of casual partners (according to partner status and activity level) during the second lockdown, resulted in a 2.4% increase in CT prevalence, but a 2.8% decline in NG prevalence in 2021. A 5% and 30% reduction in STI testing of symptomatic and asymptomatic, respectively, individuals with the same reduction in casual partners resulted in a 0.6% increase in CT prevalence and a 4.9% decrease in NG prevalence in 2021.

Conclusions: The disruption in STI care due to COVID-19 might have resulted in a small increase in CT prevalence, but a decrease in NG prevalence. Scaling up STI care is imperative to prevent increases in STI transmission.

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In response to the COVID-19 pandemic, countries have introduced measures aiming to reduce physical contacts. In The Netherlands, restrictive measures were imposed in mid-March 2020, referred to as "intelligent lockdown."[1,2] In mid-May 2020, the pandemic was subsiding and the measures were progressively relaxed,[3] except from the recommendation to keep 1.5 m distance when meeting others. The second wave of COVID-19 resulted in a second lockdown in mid-October 2020.[1] The stringency of measures during the 2 lockdowns varied over time and differed from those in other countries.[4] Measures included limitations in visitors, the occasional closing of schools, sport facilities, bars/café's, restaurants, and a curfew in the evening hours.[1–3]

The pandemic had a major impact on the health care sector. Health care personnel and facilities were mostly devoted to the care of COVID-19 patients. Care for sexually transmitted infections (STIs) was hampered and people postponed STI consultations because of fear of COVID-19.[5–7] In April 2020, the number of STI consultations in The Netherlands was reduced by 80%, compared with before the pandemic.[6] Sexually transmitted infection care was scaled up in the summer of 2020, but was again disrupted in the first quarter of 2021, when COVID-19 hospitalizations increased.[1]

The COVID-19 pandemic and responses to it also affected sexual behavior.[5,7] Opportunities to physically meet sex partners were reduced and people refrained from sexual contacts to adhere to the social distancing measures. In a study among men who have sex with men (MSM) in The Netherlands, 64% of participants reported sexual activity during the first lockdown and 76% during June to July 2020, as opposed to 82% in January to February 2020.[7] Variations in sexual behavior during the COVID-19 pandemic have been reported in several countries.[8,9] Nevertheless, reports on STI diagnoses during 2020 demonstrate that STI transmission was not halted, even during periods with strict COVID-19 measures.[6,10–13]

Although the observed reductions in STI testing could be partially attributed to reduced sexual behavior and need for testing, the interruptions in STI services might have had an adverse effect on STI spread if substantial sexual activity was maintained. Trends in STI diagnoses may not be representative of actual trends in STI transmission, because of the reduced capacity of STI services and the changes in health-seeking behavior. Therefore, it remains unclear whether the reduction in sexual contacts among MSM in The Netherlands was sufficiently high to counterbalance STI care disruption. To address this issue, we developed a mathematical model that describes transmission of 2 of the most common STIs in MSM, *Chlamydia trachomatis* (CT) and *Neiiseria gonorrhoeae* (NG). We investigated the impact of COVID-19–related changes in STI testing and sexual behavior on CT and NG transmission.

MATERIALS AND METHODS

The Transmission Model

We developed a mathematical pair-formation model[14,15] that describes the formation and dissolution of main partnerships. We also included 1-time and short-term casual partnerships, which include 1 or multiple sexual contacts, respectively (see Supplement for a detailed description of the model, http://links.lww.com/OLQ/A731; and Tables 1, 2 for parameter values). In the model, men could have only 1 main partner, but multiple casual partners, which could be concurrent with a main partnership. Men who have sex with men were distinguished as low-activity or high-activity MSM, with different rates of forming main or casual partnerships, frequencies of condomless anal intercourse (CAI), and testing rates. Parameters for sexual behavior before the COVID-19 pandemic were estimated from data from the Amsterdam Cohort Study (ACS) among MSM in Amsterdam[5] and for STI testing from data from the National database of STI clinics in The Netherlands.[16] We modeled anogenital CT and anogenital NG infections, but we did not account for site-specific infections, such that urogenital and anorectal infections were assumed to be 1 type of infection. Both CT and NG infections can be symptomatic or asymptomatic.[17,18] Symptomatic cases are treated and recover, whereas asymptomatic cases remain infectious until natural recovery, unless found positive via opportunistic testing (which covers testing for any other reasons than due to symptoms) and treated.[18,19]

Changes in Sexual Behavior and STI Testing, Due to the COVID-19 Pandemic

We distinguished different periods with COVID-19–related changes in testing and sexual behavior derived from available data. The magnitude of the changes in each period mimics the severity of the pandemic and the strictness of the COVID-19 measures in that period (Table 3):

- The first phase of the COVID-19 pandemic:
  - o The first lockdown (mid-March till end of May 2020), with stringent COVID-19 measures. The number of casual partners, the rate of acquiring new main partners, and the frequency of CAI within main partnerships were reduced, compared with their levels before COVID-19.[7] We included a major decrease in STI testing frequency for asymptomatic cases and a somewhat smaller decrease for symptomatic cases.[16]
  - o The between-lockdowns period (June till mid-October 2020) with less stringent measures. The reduction in numbers of sexual partners and STI testing were smaller than those during the first lockdown.[7,16]
- The second phase of the COVID-19 pandemic:
  - o The second lockdown (mid-October 2020 till mid-April 2021), with strict measures. The reduction in numbers of partners and STI testing was assumed to be higher than those during the summer, but lower than during the first lockdown.
  - o The postlockdown period (mid-April till end of August 2021), with mild COVID-19 measures being progressively relaxed. We assumed a small reduction in sexual behavior and testing similar to that between the 2 lockdowns.
- After the COVID-19 pandemic (from September 2021): We assumed that, because of the COVID-19 vaccination, the restrictive measures will be lifted in September 2021, and the levels of sexual behavior and testing will be similar to those before COVID-19.

The changes in sexual behavior during the first lockdown and the between-lockdowns period were estimated using data from the first round of the COVID-19, Sex, and Intimacy Survey.[7] In this survey, respondents reported their sexual behavior in three 2-month periods in 2020: before, during, and after the first lockdown. At this moment, no survey data are available for the changes in sexual behavior after the summer of 2020. Because of fatigue in following COVID-19 measures,[7] we assumed that the reduction in the second phase of the pandemic will not be higher than the reduction in the first phase. We considered 3 hypothetical levels of reduction in the second phase: (i) large reduction (20–30% in second

TABLE 1. Model Parameters*

Parameters	Symbol	Value	Source
Percentage symptomatic	θ		
CT		30–50%	31s–39s
NG		35–75%	31s–33s, 39s–43s
Duration of symptomatic CT or NG	$1/\gamma_s$	1–2 wk	32s, 44s–46s
Duration of asymptomatic infection	$1/\gamma_a$		
CT		10–14 mo	31s–36s, 41s, 46s, 47s
NG		5–7 mo	41s, 48s, 31s
Transmission probability per CAI act	β		
CT		0.1–0.3	31s–33s
NG		0.3–0.5	49s–51s, 43s, 31s, 32s
Average duration of short-term partnerships		2 wk	ACS data and[5]
Rate of entry into and exit out of the population, per year	μ	0.02	Assuming MSM are sexually active for 50 y
Size of MSM population	N	200,000	52s
Parameter for assortative mixing			
Main partnerships	ε_S	75%	Model assumption
Casual partnerships	ε_C	60%	Model assumption

*Parameters with ranges were included with these ranges in the uncertainty analysis.

TABLE 2. Parameters That Depend on the Sexual Activity Group of Individuals

Parameter for Activity Group *i*, *j* = *L*, *H*	Symbol	Activity Group*	
		Low	High
% of MSM in each activity group†		75%	25%
Rate of forming main partnerships per year‡	ρ_i	0.28	0.30
Duration of main partnerships, years†			
Between 2 men of same activity group	d_{ii}	3–5	0.75–1.5
Between 2 men of different activity group	d_{LH}	$(d_{LL} + d_{HH})/2$	
Rate of dissolving main partnerships per year	σ_{ij}	$1/d_{ij}$	
No. CAI acts between main partners per year†			
Between 2 men of same activity group	u_{ii}	40–60	60–80
Between 2 men of different activity group	u_{LH}	$(u_{LL} + u_{HH})/2$	
No. 1-time partners with whom men have CAI, per year†			
Singles	α_i	1.01	7.28
Men with a main partner	$\widehat{\alpha}_i$	0.68	5.36
No. short-term partners with whom men have anal intercourse, per year†			
Singles	w_i	2.72	6.97
Men with a main partner	$\widehat{w}_i$	1.06	5.74
No. CAI acts per short-term partner†		1.04–1.24	1.38–1.58
Average interval between opportunistic testing (y)§	$1/\tau_i$	3–5	0.5–1.5
Percent of activity group being single†		22–42%	34–54%
Chlamydia prevalence (% of activity group with CT infection at the end of 2019)¶			7–12%
Gonorrhea prevalence (% of activity group with NG infection at the end of 2019)¶			8–13%

*Men in the high activity group were those who reported having anal intercourse with more than 10 partners in the preceding 6 months.

†Based on data from the ACS among MSM in Amsterdam.

‡Obtained from earlier uncertainty analyses carried out with the rate of forming main partnerships ranging between 0.25 and 0.9 partners per year, based on the inverse of the average duration of main partnerships. The values used in the analyses presented in this manuscript were selected from the initial uncertainty ranges to reduce variation in model results and ensure agreement of model results with data.

§Obtained from the model fitting.

¶Based on.[4,8,9]

lockdown, 0–15% in postlockdown), assuming the same reduction in the second phase as in the first phase; (ii) moderate reduction (15–25% in second lockdown, 0–10% in postlockdown), assuming a slightly lower reduction in the second phase than in the first phase; (iii) small reduction (10–20% in second lockdown, 0–5% in postlockdown), assuming a much lower reduction in the second phase than in the first phase. The percentage reduction in each parameter relating to sexual behavior in a period C of the pandemic was calculated as $100 \times (\theta_o - \theta_c)/\theta_o$, where θ_o and θ_c are the values of the parameter before the pandemic and in period C of the pandemic, respectively.

The change in STI testing was estimated based on data from the National Database of STI clinics in The Netherlands[16] until December 2020. For the change in testing during the second lockdown (until mid-April 2021), we had data only until December 31, 2020. Because the numbers of COVID-19 hospitalizations increased considerably in January 2021 and again in March to April 2021,[3] it is possible that the disruption in STI care was greater after December 31, 2020, than in November to December 2020. Therefore, we examined 2 scenarios for the possible change in STI testing in the second lockdown: (a) small reduction in testing: 5% for symptomatic, 30% for asymptomatic, as calculated from the data for November to December 2020 and (b) large reduction in testing: 10% for symptomatic, 40% for asymptomatic (assuming an average reduction in the second lockdown somewhat higher than the reduction in November–December 2020). Finally, we assumed that the reduction in STI testing in the postlockdown period will be slightly lower than in the between-lockdowns period, due to a scaling up of STI care capacity. The percentage reduction in testing in period C of the pandemic was calculated as $100 \times (\theta_o - \theta_c)/\theta_o$, where θ_o and θ_c are the levels of testing before the pandemic and in period C of the pandemic, respectively.

In total, we examined 6 combinations of changes in the second phase of the COVID-19 pandemic, with (a) large or (b) small reduction in STI testing; and with (i) large, (ii) moderate, or (iii) small reduction in the numbers of casual partners.

Additional Scenarios for the Impact of COVID-19

We examined 3 scenarios with additional changes introduced one by one, relating to other hypothetical changes (for which no data are available yet):

- Extension of COVID-19 measures by 2 months: we examined a scenario where the postlockdown period is extended by 2 months, until the end of October 2021.
- Home testing: because of the limited capacity for STI testing, some individuals may have used home tests.[20,21] We examined a hypothetical scenario where home tests replaced a quarter of the tests that were not carried out at health care facilities. We assumed the same accuracy and treatment characteristics for home tests as for clinic-based tests.
- Smaller reduction in short-term casual partners: to reduce opportunities for COVID-19 transmission, some individuals may have chosen to have multiple sex contacts with 1 casual partner (short-term partner), than 1 sex contact with multiple partners (1-time partners).[22] In that case, the reduction in the number of short-term casual partners might have been smaller than the reduction in the number of 1-time casual partners. In this scenario,

TABLE 3. Percentage Change in Model Parameters Relating to STI Testing and Sexual Behavior Among MSM in The Netherlands in 2020–2021 Due to COVID-19

		1st Phase of Pandemic		2nd Phase of Pandemic		
		1st Lockdown	Between-Lockdowns		2nd Lockdown	Postlockdown
		Mid March to End May 2020	June to Mid October 2020	Assumed Level of Reduction	Mid October 2020 to Mid April 2021	Mid April to August 2021
Changes in STI testing frequency*						
Symptomatic cases		−40%	0	Small	−5%	0
				Large	−10%	0
Asymptomatic cases		−70%	−25%	Small	−30%	−15%
				Large	−40%	−20%
Changes in number of casual partners per month†						
Single MSM	Low-activity	−25%	−15%	Large	−25%	−15%
				Moderate	−20%	−10%
				Small	−15%	−5%
	High-activity	−20%	0	Large	−20%	0
				Moderate	−15%	0
				Small	−10%	0
MSM with main partner	Low-activity	−20%	−10%	Large	−20%	−10%
				Moderate	−15%	−5%
				Small	−10%	0
	High-activity	−30%	−10%	Large	−30%	−10%
				Moderate	−25%	−5%
				Small	−20%	0
Changes for main partnerships†						
CAI frequency		−10%	0		−10%	0
Formation main partnerships		−15%	−5%		−15%	−5%

Percentage change in each parameter calculated compared with its value in 2019, before COVID-19 pandemic.

*Changes in STI testing were based on data from the National Database of STI clinics in The Netherlands from January to December 2020.[6] The reduction in the 2nd lockdown was assumed to be as estimated from data in November–December 2020 (small reduction) or higher than that in November–December 2020 (high reduction). The change in postlockdown period was assumed.

†The changes in sexual behavior during the first phase of the pandemic were based on data from the "COVID-19, Sex, and Intimacy Survey."[7] For the second phase, we assumed a large, moderate, or small reduction in numbers of casual partners; and the same reductions with main partners as in the first phase. The change in the number of casual partners was assumed to be the same for 1-time casual partners and short-term casual partners.

we assumed that the reduction in the number of short-term casual partners was half of that observed in the data.

Model Fitting

Parameters with uncertain values were included in the model with a range of values (see Tables 1, 2). Using Latin Hypercube Sampling,[23] we sampled 8000 combinations of parameter values and selected combinations that resulted in model results within specific ranges, determined by data for 2019: 22% to 42% of low-activity MSM and 34% to 54% of high-activity MSM being single (based on ACS data); CT prevalence of 7% to 12% and NG prevalence of 8% to 13% among high-activity MSM.[16,24,25] The fitting procedure is described in detail in the Supplement (section A4), http://links.lww.com/OLQ/A731.

Presentation of Results

We show results for the percentage change in CT prevalence and NG prevalence compared with the scenario without changes due to COVID-19. The model calculations were carried out for 7 years: the 2 years of the COVID-19 pandemic (2020–2021) and the 5 years after the end of COVID-19 measures (2022–2026). We present medians and interquartile ranges (IQRs).

RESULTS

The Impact of Individual Changes in Sexual Behavior or Testing

In this paragraph, we present results about the change in prevalence after changing one of the parameters relating to STI testing and sexual behavior (and keeping all other parameters at their pre–COVID-19 levels). Accounting only for a reduction in testing of asymptomatic cases (with a small reduction in the second phase of the pandemic), we found an increase of 11.9% (IQR, 11.1–12.8%) in CT prevalence and 12.1% (IQR, 11.1–13.31%) in NG prevalence at the end of 2021 (Fig. 1). Accounting only for decreased testing of symptomatic individuals resulted in a small increase (of 0.3–1.4%), whereas reduced rate of forming main partnerships led to a small decline (of 0.2–0.4%) in prevalence of CT or NG in 2021. Reduced CAI frequency with main partners resulted in a decline of 1.8% to 3.1% in prevalence in 2021. Decreased numbers of 1-time casual partners caused a decline of 5.2% (IQR, 4.9–5.7%) in CT prevalence and 8.7% (IQR, 8.3–9.3%) in NG prevalence, whereas decreased numbers of short-term casual partners resulted in a decline of 8.3% (IQR, 7.8–8.8%) in CT prevalence and 12.2% (IQR, 11.8–12.9%) in NG prevalence in 2021.

The Combined Impact of Changes in Sexual Behavior and Testing

Figure 2 shows the combined effect of all COVID-19–related changes. With a small reduction in STI testing, we found a decline of 4.2%, a decline of 1.9%, or an increase of 0.6% in CT prevalence in 2021, if the reduction in numbers of casual partners in the second phase of the pandemic was large, moderate, or small, respectively (Fig. 2A). With a small reduction in STI testing, NG prevalence in 2021 was reduced (by 12.2%, 8.6%, or 4.9%, if the reduction in numbers of casual partners in the second phase was large, moderate, or small, respectively; Fig. 2C). With a large reduction in

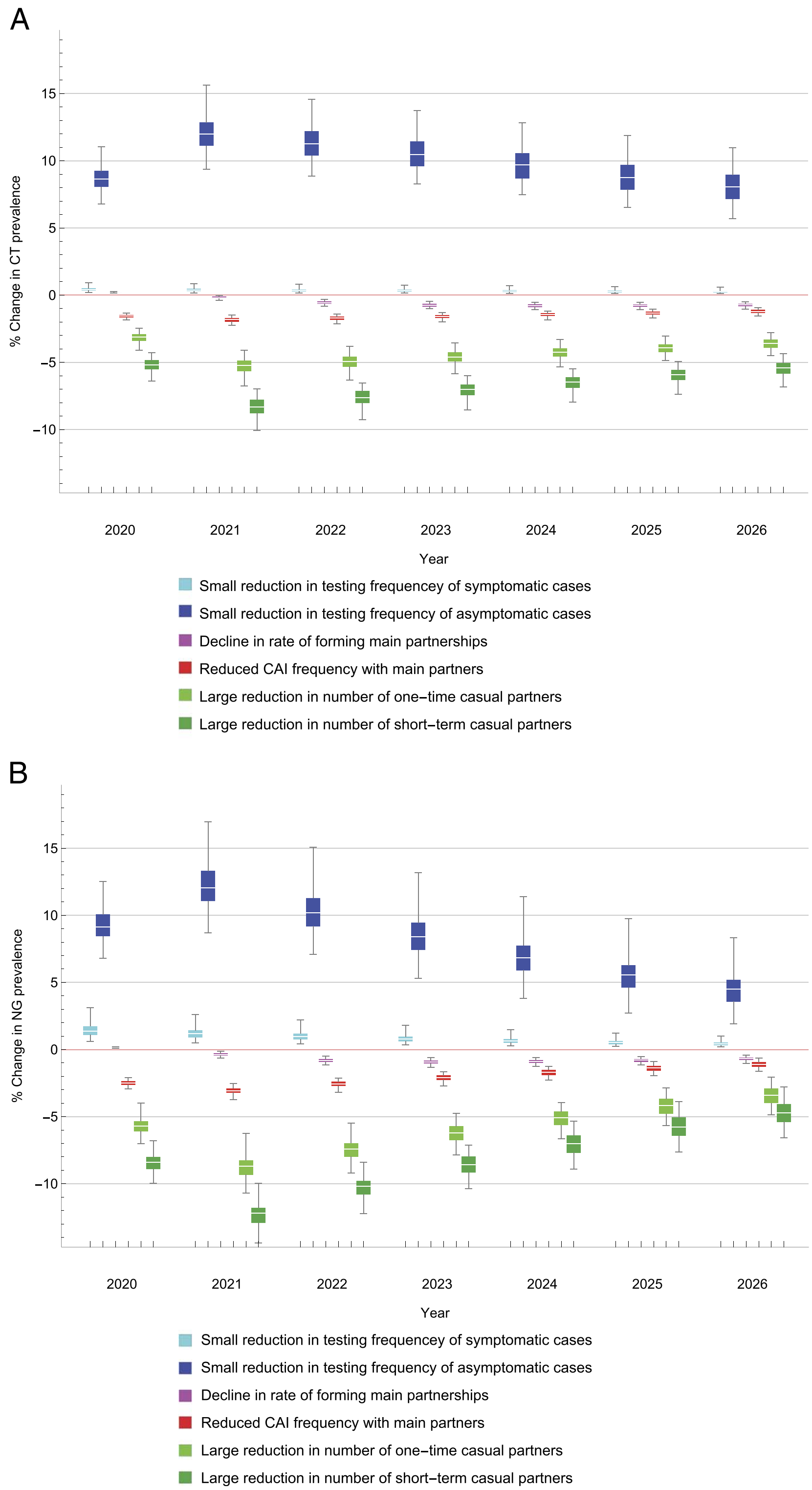

Figure 1. The percentage change in prevalence of (A) CT and (B) NG, among men who have sex with men in The Netherlands in 2020 to 2026. The change was calculated with individual changes in STI testing or sexual behavior: cyan, small reduction in testing frequency of symptomatic cases; blue, small reduction in testing frequency of asymptomatic cases; pink, decline in rate of forming main partnerships; red, reduced CAI frequency with main partners; light green, large reduction in number of 1-time casual partners; dark green, large reduction in number of short-term casual partners. Percentage change was calculated compared with the scenario without changes in testing or sexual behavior due to COVID-19. The actual changes are given in Table 3. Prevalence was calculated as the percentage of MSM infected with CT or NG at the end of each calendar year. White line segments show the medians. Colored boxes denote the IQRs, and the black line segments show the range of the results from the uncertainty analysis.

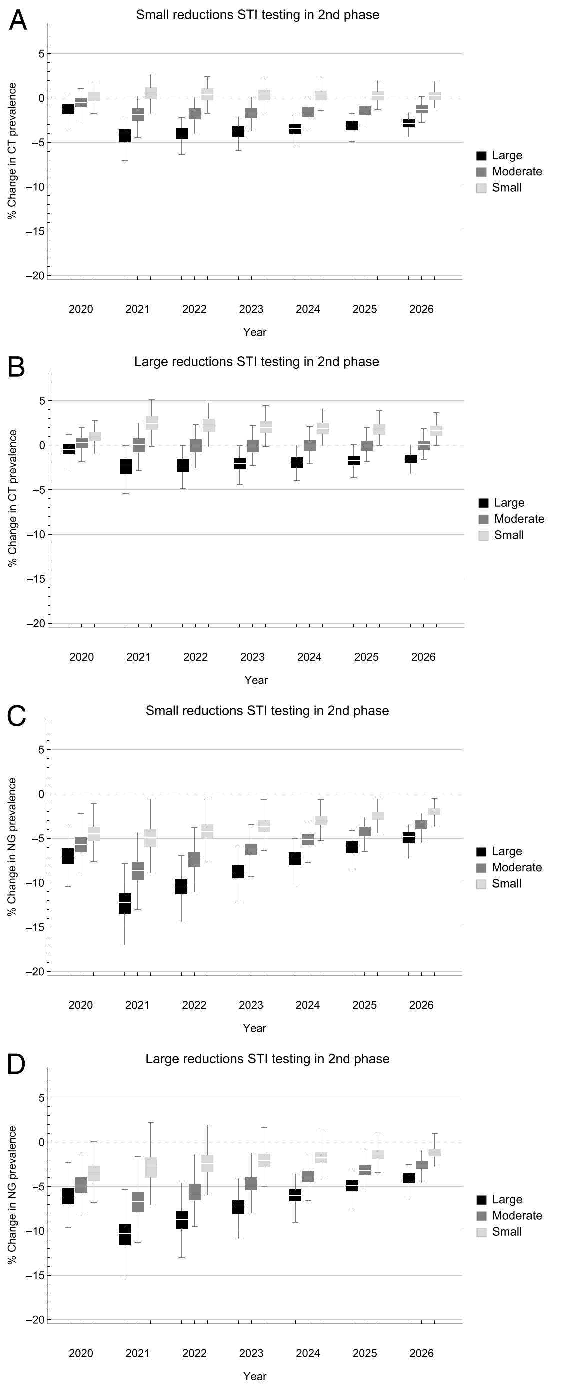

Figure 2. The percentage change in prevalence of CT and NG infections among men who have sex with men in The Netherlands in 2020 to 2026, resulting from a combination of changes in sexual behavior and STI testing due to the COVID-19 pandemic, compared to the scenario without changes due to COVID-19. (A), (B): change in CT prevalence; (C), (D): change in NG prevalence. The following scenarios are shown: small (left panels) and large (right panels) reduction in STI testing in the second phase of the pandemic; with large (black), moderate (dark gray), or small (light gray) reduction in the numbers of casual partners in the second phase of the pandemic. The changes in model parameters are shown in Table 3. White line segments show the medians, colored boxes denote the IQRs, and the black line segments show the range of the results from the uncertainty analysis.

STI testing (Fig. 2D), the decline in NG prevalence in 2021 was smaller than that with a small reduction in testing (Fig. 2C). The same was observed for CT prevalence with a large decline in casual partners, whereas we found an increase of 0.1% or 2.4% in CT prevalence, if the reduction in numbers of casual partners in the second phase was small or moderate (Figs. 2A, B). The changes in STI prevalence were reduced after 2022, but small differences were observed up to 2026.

Additional Scenarios for the Impact of COVID-19

With a small or moderate reduction in the numbers of casual partners in the second phase of the pandemic, a 2-month extension of the COVID-19 measures would result in somewhat higher CT and NG prevalence (Fig. 3): the increase in prevalence will be slightly higher (for the scenarios with an increase) and the decline in prevalence will be slightly lower (for the scenarios with a decline). Nevertheless, with a large reduction in the numbers of casual partners in the second phase, a 2-month extension of the COVID-19 measures would result in greater decline in CT and NG prevalence (Fig. 3).

With home testing, the reduction in CT and NG prevalence was higher than the reduction without home testing (Fig. 3). Furthermore, all scenarios with home testing examined here resulted in reduced CT and NG prevalence.

A smaller decline in the number of short-term casual partners would result in an increase in CT prevalence in all scenarios. Moreover, there would be only small declines in NG prevalence and even a small increase in NG prevalence in 1 case (with a small reduction in casual partners and large reduction in testing in the second phase) (Fig. 3).

DISCUSSION

The disruption in STI care due to COVID-19 would have resulted in a major increase in CT and NG prevalence among MSM, if there had been no changes in sexual behavior. However, the COVID-19 restrictions, including confinement and social distancing measures, have also resulted in a reduction in sexual contacts, which might be sufficiently high to counterbalance the STI care disruption and lead to reduced STI transmission. Nevertheless, a small increase in CT and NG prevalence may occur if the reduction in sexual contacts in the second phase of the pandemic (which is still ongoing) is much lower than the reduction during the first phase and/or the disruption in STI care in the second phase becomes relatively high. The variations in CT and NG prevalence due to the indirect effects of the COVID-19 pandemic might remain for at least 5 years after the end of COVID-19 measures. The use of home tests, with some considerable uptake, can diminish the adverse effect of STI care disruption and lead to a reduction in both STIs. In contrast, if there has been only a small reduction in short-term casual partners, there may have been a slight increase even in NG prevalence.

Our study is the first modeling study assessing how CT and NG prevalence has been affected by the COVID-19 pandemic based on data about the actual changes in STI testing and sexual behavior in 2020 due to COVID-19. Another strength of our study is that we included 4 periods with large reductions in sexual behavior and testing during periods with strict COVID-19 measures and small reductions in periods with less strict measures. Furthermore, an asset of our work is that we report the impact of COVID-19 on CT and NG transmission separately. Because of the different duration and percentage symptomatic infections, the disruption in STI care affects the transmission of CT and NG differently. The reduction in STI testing, based on our data, was higher for individuals without symptoms than for those with symptoms. Therefore, more

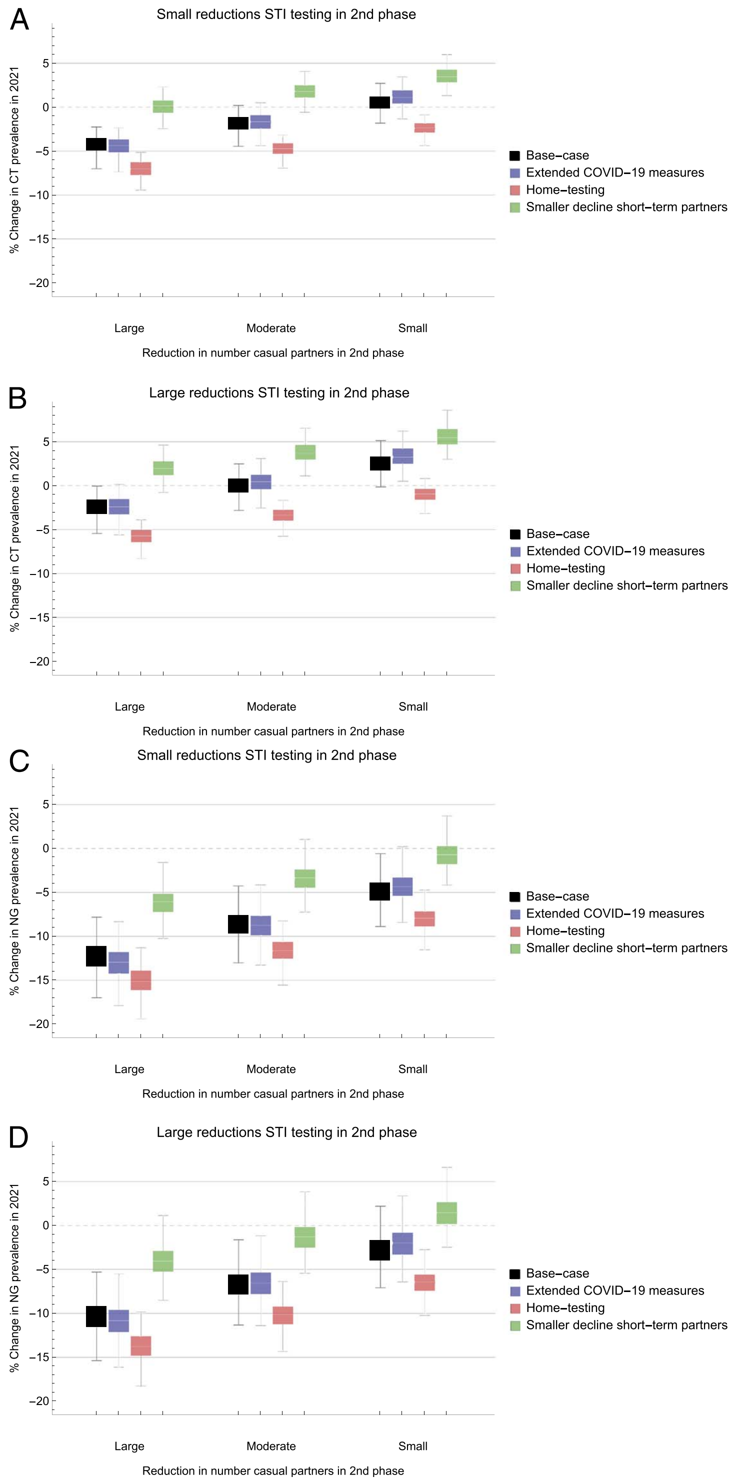

Figure 3. The percentage change in prevalence of *C. trachomatis* (CT) and *N. gonorrhoeae* (NG) infections among men who have sex with men in 2021, resulting from changes in sexual behavior and STI testing due to the COVID-19 pandemic, compared to the scenario without changes due to COVID-19. Top panels: changes in CT prevalence; bottom panels: changes in NG prevalence. The following scenarios are shown: small (left panels) and large (right panels) reduction in STI testing in the second phase of the pandemic; with large, moderate, or small reduction in the numbers of casual partners in the second phase of the pandemic (as indicated on the horizontal axes). Black: base-case scenario, as in Figure 2. Blue: extension of COVID-19 measures by 2 months (until the end of October 2021, instead of end of August in base-case scenario). Red: scenario with home testing; home tests replaced 25% of the tests that were not carried out at health care facilities. Green: scenario with smaller reduction in short-term casual partners; it was assumed that the reduction in the number of short-term casual partners was half of that observed in the data and used for the base-case scenario. The changes in model parameters are shown in Table 3. White line segments show the medians, colored boxes denote the IQRs, and the black line segments show the range of the results from the uncertainty analysis.

CT infections will be missed or late diagnosed, than NG infections, because the fraction symptomatic is higher among NG infections than among CT infections. Because of this difference in the reduction in testing of symptomatic versus asymptomatic infections and the difference in the percentage symptomatic CT versus percentage symptomatic NG infections, we found a small increase in CT prevalence, but a small decline in NG prevalence, when the decrease in sexual activity was small. This explains also our finding that the reduction in NG prevalence was higher than the reduction in CT prevalence (for the scenarios with reduced CT prevalence).

A limitation of this study is that we are reporting the impact of the COVID-19 pandemic, while that is still ongoing. It is uncertain when the COVID-19 measures will be lifted and whether sexual behavior and testing at that point will return to their pre–COVID-19 levels or even higher.[21] In addition, because we are at the moment in the second phase of the pandemic, we had data on STI testing and sexual behavior mainly for the first phase of the pandemic. We expect, however, that the 6 combinations of changes in sexual behavior and testing in the second phase of the pandemic that we examined provide a clear picture of the possible impact on CT and NG prevalence. Another limitation of our study is that we considered urogenital and anorectal infections as 1 type of infection. Differences in the transmission potential of urogenital and anorectal infections, as well as preferences for insertive or receptive anal sex could influence the dynamics of CT and NG. Further, we accounted for variations in sexual behavior during the pandemic only according to level of sexual activity and partner status. We did not account for changes in sexual behavior according to other factors, such as age, medical factors indicating higher risk for COVID-19 complications, or other factors relating to higher risk for CT or NG infection. A study in Amsterdam found that factors indicating higher risk for COVID-19 complications were not significantly associated with reporting casual sex partners during the first lockdown, compared with not reporting casual sex partners.[5]

Until now, there have been only few modeling studies assessing the impact of the COVID-19 pandemic on STIs. The impact on HIV has been studied[26,27] and a modeling study for the impact on HIV and STIs has shown that a 50% reduction in sexual partnerships for 18 months with interruption of clinical services for 18 months could reduce the number of CT and NG cases by 23,800 over 5 years[28]; the same reduction in sexual partnerships for 3 months would result in a 5-year population impact of 57,500 additional CT and NG cases.[28] These studies, however, are based on hypothetical changes in testing and sexual behavior. Moreover, the study by Jenness et al[28] reported only the change in the combined number of CT and NG infections.

These results emphasize the importance of testing for STI control. Despite the reduced testing capacity, the numbers of CT and NG diagnoses among MSM in The Netherlands in December 2020 had reached levels similar to those in January 2020 (data from the National Database of STI Clinics, The Netherlands). Consequently, minimizing STI care disruption is of utmost importance, even in times of other crises.[29] That will remain challenging as long as COVID-19 hospitalizations are high or COVID-19 restrictions are in force. Inventing or expanding alternative ways to provide care (such as telehealth, self-tests or self-sampling, extending opening hours or physical spaces) is necessary.[11,30]

In conclusion, the disruption in STI care due to the COVID-19 pandemic might have resulted in a small increase in CT prevalence if the reduction in sexual behavior in the second phase of the pandemic, which is still ongoing, is relatively small. On the other hand, the indirect effects of the COVID-19 pandemic have probably resulted in a decline in NG prevalence. Scaling up STI care as soon as possible is imperative to prevent increases in STI transmission.

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