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STI testing, diagnoses and online chlamydia self-sampling among young people during the first year of the COVID-19 pandemic in England

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Ethics statement: This study was undertaken for health protection purposes under the permissions granted to UKHSA to collect and process pseudonymised surveillance data under Regulation 3 of The Health Service (Control of Patient Information) Regulations 2020 and under Section 251 of the NHS Act 2006.

Some findings from this research have been presented at the British Association for Sexual Health and HIV annual conference in 2020 and 2021.

Abstract (200/200)

Purpose:

COVID-19 control measures reduced face-to-face appointments at sexual health services (SHSs). Remote access to SHSs through online self-sampling was increased. This analysis assesses how these changes affected service use and STI testing among 15-24 year olds ('young people') in England.

Methods:

Data on all chlamydia, gonorrhoea and syphilis tests from 2019-2020 among English-resident young people were obtained from national STI surveillance datasets. We calculated proportional differences in tests and diagnoses for each STI, by demographic characteristics, including socioeconomic deprivation, between 2019-2020. Binary logistic regression was used to determine crude and adjusted odds ratios (OR) between demographic characteristics and being tested for chlamydia by an online service.

Results:

Compared to 2019, there were declines in testing (chlamydia-30%; gonorrhoea-26%; syphilis-36%) and diagnoses (chlamydia-31%; gonorrhoea-25%; syphilis-23%) among young people in 2020. Reductions were greater amongst 15-19 year-olds *vs*. 20-24 year-olds. Amongst people tested for chlamydia, those living in the least deprived areas were more likely to be tested using an online self-sampling kit (males; OR=1.24[1.22-1.26], females; OR=1.28[1.27-1.30]).

Conclusion:

The first year of the COVID-19 pandemic in England saw declines in STI testing and diagnoses in young people and disparities in the use of online chlamydia self-sampling which risk widening existing health inequalities.

Key words: Young people, COVID-19 pandemic, STIs, Chlamydia, Gonorrhoea, Syphilis, Socioeconomic deprivation, online STI testing, COVID-19 impact, STI service provision

Implications and contributions (49/50)

There was a decrease in STI testing of young people during the first year of the COVID-19 pandemic in England with larger reductions among teenagers. There was an increase in use of online STI self-sampling services but with inequalities in provision which risk widening existing inequalities in sexual health.

Main text word count/limit: 2476/3000

Background

Sexually transmitted infections (STIs) present a public health challenge in England. The burden of STIs is greatest amongst young people aged 16-24 years and they are most likely to access sexual health services (SHSs) [2-6]. Between 2010-12, they had the highest prevalence of chlamydia (3.1% of women and 2.3% of men in this age group). The prevalence of gonorrhoea was highest amongst people 20-24 years of age[7].

The majority of chlamydia and gonorrhoea infections are asymptomatic, particularly amongst women, and may result in poor sexual and reproductive health if left untreated[8]; this includes a higher risk of pelvic inflammatory disease (PID), and ectopic pregnancy, which are preventable with early diagnosis and treatment[9, 10]. Consequently, opportunistic chlamydia screening has been offered to sexually active 15-24 year olds in England since 2003 through the National Chlamydia Screening Programme (NCSP).

There have been increases in attendances at SHSs between 2016-2020[3]. However, SHS delivery was greatly disrupted in March 2020 after the introduction of public health measures to reduce COVID-19 transmission such as national lockdowns, the requirement to stay at home, and social distancing. Moreover, the introduction of legislation restricting social interaction may have resulted in some people with STI-related symptoms avoiding attending SHSs due to fear of being judged for breaking these rules, creating a false sense of reduced demand on STI testing services[11]. However, to ensure continued provision of STI testing, SHSs across England were rapidly reconfigured to provide more remote care via online consultations[3].

To understand how STI testing, diagnoses and service use among 15-24 year olds in England changed during the first year of the COVID-19 pandemic, we compared the demographic characteristics of young people tested for STIs in 2019 and 2020 then, among all young people tested for chlamydia, determined the correlates of being tested via an online service instead of a face to face appointment.

Methods

Data description

We conducted a retrospective cohort study of 15-24 year olds (hereafter referred to as 'young people') residing in England who received an STI test or diagnosis utilising data from the GUMCAD STI Surveillance System and the CTAD Chlamydia Surveillance System. GUMCAD is a pseudonymised and depersonalised dataset of all attendances at SHSs in England and was used to obtain data on chlamydia, gonorrhoea and syphilis tests and diagnoses in young people attending this setting; syphilis diagnoses included primary, secondary and early latent stages[12, 13]. CTAD is a pseudonymised and depersonalised dataset of all publicly provided chlamydia tests and diagnoses, including those made through the NCSP, and was the source of data for chlamydia tests and diagnoses from community-based settings (those offering non-specialist STI-related care such as general practices and pharmacies [some pharmacies provide a home-based self-sampling kit, which are shipped to the laboratory.])[14, 15]. All tests and diagnoses are coded by healthcare practitioners in keeping with surveillance reporting specifications. To avoid double counting of tests or diagnoses in each surveillance system, only one test or diagnosis of each STI for each person with a unique person identifier was counted within a 6-week episode[15]. Neither GUMCAD nor CTAD include personal identifiers so individuals cannot be

matched between datasets; individuals are identified using a clinic-specific patient identification code in GUMCAD[16] and a unique patient identifier number in CTAD[14].

The study period was from 1st January 2019 to 31st December 2020 (inclusive), where data from 2019 relates to the pre-COVID period and 2020 relates to the first year of the COVID-19 pandemic. To be considered in the analysis data were restricted to people aged 15-24 years, at the time of the test or diagnosis, residing in England. Residential location was defined using the lower super output area (LSOA), small geographical areas for the reporting of small area statistics with an average size of 1,620 residents[17]. To obtain a measure of area-level socioeconomic deprivation, LSOAs were used to match to quintiles of the 2019 Index of Multiple Deprivation (IMD) dataset[18]. Additionally, the LSOAs were matched to the 2011 census area classification to categorise young people as living either in an urban or rural setting [19-21]. Ethnicity was categorised using the national Census classification, as follows: Asian (including Bangladeshi, Chinese, Indian, Pakistani and any other Asian background), Black African, Black Caribbean, Other Black ethnicity, Mixed ethnicity (including White and Black Caribbean, White and Black African, White and Asian and any other Mixed or Multiple ethnic background), Other, and White[22].

Statistical analysis

We determined the proportional change in the characteristics of young people tested for STIs between 2019 and 2020. Demographic and clinical characteristics included age group (15-19 or 20-24 years), area of residence (rural or urban), residential area-level deprivation, (as defined by IMD quintile, where quintile 1 is the most deprived and quintile 5 is the least deprived), ethnicity, gender and public health region of residence (categorised as: East Midlands, East of England, London, North-East, North-West, South-East, South-West, West Midlands and Yorkshire and

Humber) these characteristics were compared for all three STIs as they can be assessed in both CTAD and GUMCAD surveillance systems. Sexual orientation (including heterosexual males, men who have sex with men [MSM], heterosexual females and women who have sex with women [WSW]), and HIV status (categorised as; HIV diagnosed, HIV undiagnosed or unknown) were compared for gonorrhoea and syphilis as they are only collected in the GUMCAD surveillance system. Testing services (categorised as physical or online services) were compared for chlamydia only, as the CTAD surveillance system comprehensively captures all chlamydia testing from all publicly-commissioned testing services. The Pearson's chi-square test was used to compare these characteristics across both years.

Subsequently, to assess any inequalities in the access to online self-sampling services for chlamydia testing (hereafter: 'online chlamydia testing'), we restricted the sample to young people tested for chlamydia then used binary logistic regression to determine the crude and adjusted associations with being tested via an online service (yes vs. no); all models were stratified by gender. Bivariate models were created to determine the unadjusted odds ratios (ORs) for being tested online and residential area-level deprivation, as defined by IMD quintile (the primary independent variable), and each potential confounder (year of test, age group, area of residence and region of residence). All associations with a p-value less than 0.05 were considered to be statistically significant and all variables that had significant crude associations were included in the multivariable model. Adjusted odds ratios (aORs) were calculated using hierarchical modelling and covariates were added using a forward building approach. Firstly, Model 1 was constructed with year of test included a priori due to the scale up of online service provision during 2020[3]. The remaining covariates were added sequentially as follows: Model 2 was based on

Model 1 with age group included as a confounder. Model 3 was based on Model 2 with the addition of area of residence. Lastly, Model 4 comprised Model 3 with the inclusion of region of residence. Ethnicity was excluded from the regression analysis due to a high degree of item non-response: 29% of young people tested for chlamydia were reported with an unspecified ethnic group in CTAD. All data analyses were performed using version Stata v15 (College Station, TX, USA)[23].

Results

Trends in STI tests and diagnoses

There were 26-36% decreases in tests and diagnoses for chlamydia, gonorrhoea and syphilis among young people between 2019 and 2020 (Tables 1-3). However, there were greater proportional decreases among 15-19 compared to 20-24 year olds. By ethnicity, testing and diagnoses of all 3 STIs decreased for all ethnic groups with larger proportional declines among young people of Asian and Black non-African/non-Caribbean ethnicities. The number of chlamydia tests fell across all the different types of services offering testing (47%; 1,041,553 to 554,299), with the exception of online services where there was a 33% increase in testing between 2019 (271,684 tests) and 2020 (361,622 tests). Comparisons by sexual orientation could only be done for gonorrhoea and syphilis and, in both cases, testing and diagnoses fell to the largest extent (33-46%) among heterosexual men.

Correlates of being tested for chlamydia via an online service

Amongst all young people tested for chlamydia, those living in the least deprived areas were more likely to be tested online (unadjusted odds ratios - males: 1.24 [1.22-1.26]; females: 1.28 [1.27-1.30]) compared to young people living in the most deprived areas. This association remained after adjusting for confounders in the final

model (males: 1.29 [1.27-1.32]; females 1.32 [1.30-1.34]) (Table 4). In the final model, there was a greater likelihood of being tested for chlamydia via an online service in 2020 [(males: 2.81 [2.77-2.84]; females: 2.45 [2.44-2.47]) vs. 2019] and a similarly increased likelihood amongst 20-24 year olds [(males: 1.47 [1.45-1.49]; females: 1.63 [1.61-1.64]) vs 15-19 year olds]. Online testing was also more likely among residents of urban areas [(males: 1.17 [1.15-1.20]; females: 1.16 [1.15-1.17]) vs rural] and was generally less likely among all regions of residence compared to London (*Appendix B*).

Discussion

There was a decrease in STI testing and diagnoses among young people during the first year of the COVID-19 pandemic, with up to 50% larger decreases in teenagers. In keeping with the reconfiguration of SHSs in 2020 to offer more remote consultations, we found a 33% increase in chlamydia testing of young people via online services, but there was evidence of inequalities in access to testing via this modality.

Among young people tested for chlamydia, those living in the least deprived areas were more likely to be tested for chlamydia online, compared to those living in the most deprived areas. Further inequalities in chlamydia online testing were found, with young people living in rural areas or regions outside London and those aged 15-19 being less likely to be tested for chlamydia using an online service. This suggests that there may be socioeconomic or structural barriers to online testing, which may include lack of online access. 15-19 year olds may find it more difficult to be tested for chlamydia using an online service if they are still living with their parents and are unable to discreetly receive the self-sampling kit. The greater likelihood of being tested for chlamydia online for young people living in London reflects the fact that there is a pan-London online sexual health service for all London residents[24].

The reductions in STI testing between 2019 and 2020 are partly due to the extensive public health measures to help reduce the transmission of COVID-19[25]. Moreover, individuals may have delayed their visits to SHSs due to fear of COVID infection[26] and with lockdown restrictions it would have been difficult to meet and interact with new people, reducing the possibility of new sexual encounters[26]. All these factors may have contributed to the decline in STI testing in 2020.

Our findings are consistent with international literature highlighting the negative impact the COVID-19 pandemic had on STI testing. A report from the EuroTEST COVID-19 impact assessment consortium found that, among 34 countries in the World Health Organization European Region and in different test settings, 95% of them tested less than half the expected number of people between March and May 2020, this decline continued until August 2020[27]. Research in the USA found a reduction in STI testing and case detection resulting in more than, 27,000 missed cases of chlamydia and 5,500 cases of gonorrhoea between March and June 2020[25]. The implications of these missed cases are likely to be increased community transmission due to the asymptomatic nature of these STIs and associated long-term sexual and reproductive health complications[25]. Studies have found that testing via online services is preferred over physical services, particularly amongst young people[28], but this may not be the case for teenagers who are living at home. The advantages of online services include privacy and the ability to self-sample[29]. Previous research has found that online testing is more likely to be used by women and those between the ages of 20-30 compared to younger age groups. Consistent with our findings, research conducted amongst online services and SHSs in London found those living in less deprived areas are more likely to use online services when testing for an STI even when adjusting for confounders[30].

Our analysis benefitted from a very large sample from national surveillance datasets which included patient-level data with key demographic factors so we could robustly assess differences in testing patterns within different subgroups. However, our analysis is not without limitations. Urban and rural area classifications were based on the 2011 census (the most up to date dataset at the time of writing) and these may not be accurate for all areas of England in 2020. We were unable to adjust for

ethnicity in the regression analysis predicting being tested online for chlamydia due to a high proportion of missing values for ethnicity in the CTAD surveillance system. The regression analysis was restricted to chlamydia because we were only able to reliably identify all sources of online testing for chlamydia by using a combination of CTAD and GUMCAD data at the time of writing. While GUMCAD is a rich source of data on STI testing, it underestimates online testing for gonorrhoea and syphilis as it could only identify online testing by standalone online providers, and not online testing provided as an alternate service by physical SHSs, in 2019 and 2020. Similarly, we did not perform a regression analysis with count data to determine correlates of being tested for chlamydia online vs not being tested – this is because of a lack of underlying population data for all key variables (e.g. age-group, gender and residential area-level deprivation). However, as we have comprehensive data on all young people tested for chlamydia, we were able to assess the correlates of being tested online. Whilst we included deprivation quintile in our analyses, this in an area-level, rather than individual-level, measure of deprivation and is subject to the ecologic fallacy. Additionally, the larger proportional drop in STI tests among teenagers may be explained by residual confounding as our analyses could not take risk behaviours such as multiple condomless sex partners into account, and it is unclear how this varied between 15-19 and 20-24 year olds between 2019 and 2020.

Reduced testing, missed infections and late diagnoses may have potential consequences such as the increase in PID and infertility[31]. This will impact the quality of life of young people with STIs and increase costs to the healthcare system with the need for treatments for STI-related complications or sequelae. Additionally, the difference in the means of testing between those in the least and most deprived areas suggests barriers to access to online services, which should not occur, as STI

testing is free at the point of delivery in England. Given the increasing shift to online service provision, there remains a need to assess how equitably they are provided and to reduce the risk of differential access widening existing inequalities in sexual health. This will require innovative health promotion strategies and targeted interventions for young people living in the most deprived areas.

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Table 1. Number of gonorrhoea test and diagnoses among 15–24 year olds residing in England, by demographic characteristics: 2019 to 2020

	Tests			Diagnoses		
	2019	2020	Percentage difference	2019	2020	Percentage difference
Age						
15 to 19	238,554	157,303	-34%	8,278	5,815	-30%
20 to 24	559,757	433,457	-23%	17,397	13,447	-23%
Ethnicity						
Asian	31,993	20,516	-36%	985	641	-35%
Black African	35,797	26,257	-27%	1,396	1,259	-10%
Black Caribbean	29,370	21,071	-28%	1,892	1,345	-29%
Other Black ethnicity	9,130	5,755	-37%	513	353	-31%
Mixed ethnicity	47,461	35,606	-25%	2,175	1,729	-21%
White	554,275	382,189	-31%	16,393	11,327	-31%
Other	9,572	6,292	-34%	409	303	-26%
Unknown ethnicity	80,713	93,074	15%	1,912	2,305	21%
Sexual orientation						
Heterosexual Males	196,172	131,192	-33%	6,557	4,554	-31%
MSM	47,550	39,356	-17%	6,525	4,782	-27%
Heterosexual Females	465,906	363,502	-22%	11,037	8,419	-24%
WSW	4,561	5,244	15%	61	78	28%
Unknown sexual orientation	84,122	51,466	-39%	1,495	1,429	-4%
Area of residence						
Rural	79,697	60,021	-25%	1,590	1,100	-31%
Urban	704,883	518,388	-26%	23,643	17,773	-25%
Unknown area of residence	13,731	12,351	-10%	442	389	-12%
Residential area-level deprivation (Deprivation Quintile)*						
1 (most deprived)	179,282	130,529	-27%	7,756	5,944	-23%
2	193,177	144,229	-25%	7,027	5,463	-22%
3	157,740	118,779	-25%	4,651	3,437	-26%
4	134,641	98,672	-27%	3,296	2,323	-30%
5 (least deprived)	119,740	86,200	-28%	2,503	1,706	-32%
Unknown deprivation quintile	13,731	12,351	-10%	442	389	-12%
Region of residence						
East Midlands	57,710	43,033	-25%	2,102	1,570	-25%
East of England	74,590	58,536	-22%	1,851	1,535	-17%
London	204,435	151,651	-26%	8,554	6,676	-22%
North–East	30,391	19,930	-34%	965	713	-26%
North–West	88,276	54,658	-38%	3,094	1,915	-38%
South–East	122,652	86,955	-29%	2,509	1,620	-35%
South–West	69,963	56,043	-20%	1,314	862	-34%
West Midlands	80,152	59,789	-25%	2,788	2,341	-16%
Yorkshire and Humber	59,577	48,957	-18%	2,144	1,676	-22%
Unknown region of residence	10,565	11,208	6%	354	354	0%
HIV status						
HIV diagnosed	1,574	969	-38%	316	198	-37%
HIV negative or unknown	796,737	589,791	-26%	25,359	19,064	-25%
Total	798,311	590,760	-26%	25,675	19,262	-25%

*Deprivation quintile is an area-level measure of deprivation and socioeconomic status based on the 2019 Index of Multiple Deprivation (IMD) quintiles

Table 2. Number of syphilis test and diagnoses among 15–24 year olds residing in England, by demographic characteristics: 2019 to 2020

	Tests			Diagnoses		
	2019	2020	Percentage difference	2019	2020	Percentage difference
Age						
15 to 19	136,686	78,620	-42%	223	139	-38%
20 to 24	382,761	255,340	-33%	948	766	-19%
Ethnicity						
Asian	24,157	14,354	-41%	61	40	-34%
Black African	25,799	17,443	-32%	19	24	26%
Black Caribbean	19,560	12,608	-36%	29	36	24%
Other Black ethnicity	6,165	3,547	-42%	17	9	-47%
Mixed ethnicity	31,476	21,445	-32%	72	50	-31%
White	351,999	211,583	-40%	861	626	-27%
Other	6,880	4,455	-35%	21	24	14%
Unknown ethnicity	53,411	48,525	-9%	91	96	5%
Sexual orientation						
Heterosexual Males	146,927	78,987	-46%	192	121	-37%
MSM	44,921	35,974	-20%	693	568	-18%
Heterosexual Females	283,049	185,791	-34%	220	154	-30%
WSW	2,866	2,767	-3%	3	3	0%
Unknown sexual orientation	41,684	30,441	-27%	63	59	-6%
Area of residence						
Rural	50,909	30,084	-41%	74	55	-26%
Urban	459,186	294,991	-36%	1,070	837	-22%
Unknown area of residence	9,352	8,885	-5%	27	13	-52%
Residential area-level deprivation (Deprivation Quintile)*	114,267	70,837	-38%	357	275	-23%
1 (most deprived)	128,123	84,643	-34%	327	245	-25%
2	102,827	66,940	-35%	219	168	-23%
3	87,324	54,707	-37%	149	111	-26%
4	77,554	47,948	-38%	92	93	1%
5 (least deprived)						
Unknown deprivation quintile	9,352	8,885	-5%	27	13	-525
Region of residence						
East Midlands	38,033	19,792	-48%	72	43	-40%
East of England	48,082	28,046	-42%	59	59	0%
London	142,416	103,316	-27%	382	315	-18%
North–East	20,684	11,430	-45%	91	78	-14%
North–West	55,936	30,863	-45%	205	127	-38%
South–East	82,258	56,890	-31%	137	99	-28%
South–West	45,034	28,029	-38%	61	63	3%
West Midlands	42,700	23,298	-45%	76	60	-21%
Yorkshire and Humber	37,252	24,131	-35%	72	48	-33%
Unknown region of residence	7,052	8,165	16%	16	13	-19%
HIV status						
HIV diagnosed	949	618	-35%	58	43	-26%
HIV negative or unknown	518,498	333,342	-36%	1,113	862	-23%
Total	519,447	333,960	-36%	1,171	905	-23%

*Deprivation quintile is an area-level measure of deprivation and socioeconomic status based on the 2019 Index of Multiple Deprivation (IMD) quintiles

Table 3. Number of chlamydia test and diagnoses among 15–24 year olds residing in England, by demographic characteristics: 2019–2020

	Tests			Diagnoses		
	2019	2020	Percentage difference	2019	2020	Percentage difference
Age						
15 to 19	418,019	258,419	-38%	48,138	31,140	-35%
20 to 24	914,914	670,879	-27%	80,288	57,165	-29%
Ethnicity						
Asian	38,185	25,549	-33%	3,077	2,046	-34%
Black African	41,229	31,450	-24%	5,587	3,977	-29%
Black Caribbean	35,566	26,380	-26%	5,449	3,653	-33%
Other Black ethnicity	9,914	6,710	-32%	1,408	887	-37%
Mixed ethnicity	55,686	44,242	-21%	6,479	5,031	-22%
White	740,482	533,857	-28%	72,369	51,307	-29%
Other	11,440	7,974	-30%	1,145	794	-31%
Unknown ethnicity	400,431	253,136	-37%	32,912	20,610	-37%
Gender						
Female	940,083	669,050	-29%	82,920	57,636	-30%
Male	380,647	252,121	-34%	44,173	29,476	-33%
Unknown gender	12,203	8,127	-33%	1,333	1,193	-11%
Online vs. Physical services						
Online services	271,684	361,622	33%	22,838	31,726	39%
Physical services	1,041,553	554,299	-47%	104,343	55,607	-47%
Unknown testing service	19,696	13,377	-32%	1,245	972	-22%
Area of residence						
Rural	147,884	106,001	-28%	12,899	9,017	-30%
Urban	1,105,688	774,434	-30%	107,641	74,482	-31%
Unknown area of residence	79,361	48,863	-38%	7,886	4,806	-39%
Residential area-level deprivation (Deprivation Quintile)*				33,041		
1 (most deprived)	290,480	202,207	-30%	29,881	22,991	-30%
2	299,190	209,304	-30%	23,280	20,884	-30%
3	255,757	180,401	-29%	18,732	16,095	-31%
4	217,828	154,037	-29%	15,606	12,967	-31%
5 (least deprived)	190,317	134,486	-29%		10,562	-32%
Unknown deprivation quintile	79,361	48,863	-38%	7,886	4,806	-39%
Region of residence						
East Midlands	104,710	77,763	-26%	11,149	7,829	-30%
East of England	137,273	102,422	-25%	11,886	9,302	-22%
London	298,401	199,182	-33%	28,481	18,347	-36%
North–East	61,670	43,572	-29%	5,921	4,818	-19%
North–West	162,097	102,017	-37%	16,571	10,129	-39%
South–East	182,138	125,763	-31%	17,257	11,864	-31%
South–West	134,229	98,483	-27%	11,587	7,833	32%
West Midlands	111,664	77,602	-31%	11,812	8,373	-29%
Yorkshire and Humber	140,751	102,494	-27%	13,762	9,810	-29%
Total	1,332,933	929,298	-30%	128,426	88,305	-31%

*Deprivation quintile is an area-level measure of deprivation and socioeconomic status based on the 2019 Index of Multiple Deprivation (IMD) quintiles

Table 4. Unadjusted and adjusted logistic regression analysis of the association between deprivation quintile* and chlamydia testing via an online service among 15–24 year olds in England: 2019–2020, stratified by gender

		Crude Odds Ratio (95% CI)	Model 1, Adjusted Odds Ratio** (95% CI)	Model 2, Adjusted Odds Ratio± (95% CI)	Model 3, Adjusted Odds Ratio¥ (95% CI)	Model 4, Adjusted Odds Ratio‡ (95% CI)
Male	**Residential area-level deprivation (Deprivation Quintile)***					
	1 (most deprived)	1	–	–	–	–
	2	1.30 (1.28 – 1.33)	1.32 (1.29 – 1.34)	1.30 (1.28 – 1.32)	1.31 (1.29 – 1.34)	1.18 (1.16 – 1.20)
	3	1.40 (1.38 – 1.43)	1.42 (1.40 – 1.45)	1.41 (1.39 – 1.43)	1.46 (1.43 – 1.48)	1.35 (1.32 – 1.37)
	4	1.36 (1.34 – 1.39)	1. 39 (1.36 – 1.41)	1.39 (1.36 – 1.41)	1.45 (1.42 – 1.48)	1.37 (1.35 – 1.40)
	5 (least deprived)	1.24 (1.22 – 1.26)	1.25 (1.23 – 1.28)	1.26 (1.23 – 1.28)	1.31 (1.29 – 1.34)	1.29 (1.27 – 1.32)
Female	**Residential area-level deprivation (Deprivation Quintile)***					
	1 (most deprived)	1	–	–	–	–
	2	1.34 (1.32 – 1.35)	1.35 (1.34 – 1.37)	1.34 (1.32 – 1.35)	1.35 (1.34 – 1.37)	1.20 (1.19 – 1.21)
	3	1.40 (1.39 – 1.42)	1.42 (1.40 – 1.43)	1.40 (1.39 – 1.42)	1.46 (1.44 – 1.47)	1.33 (1.32 – 1.35)
	4	1.39 (1.38 – 1.41)	1.40 (1.39 – 1.42)	1.40 (1.38 – 1.41)	1.46 (1.45 – 1.48)	1.38 (1.36 – 1.39)
	5 (least deprived)	1.28 (1.27 – 1.30)	1.29 (1.27 – 1.30)	1.29 (1.28 – 1.31)	1.35 (1.33 – 1.37)	1.32 (1.30 – 1.34)

*Deprivation quintile is an area-level measure of deprivation and socioeconomic status based on the 2019 Index of Multiple Deprivation (IMD) quintiles

** Model 1 adjusted for year of test

± Model 2 adjusted for year of test and age group

¥ Model 3 adjusted for year of test, age group and area of residence

‡ Model 4 adjusted for year of test, age group, area of residence and region

Appendix A

Table A1) Demographic characteristics of 15–24 year old males tested for chlamydia in England: 2019–2020

	Number and proportion tested in online services	Number and proportion tested in physical services
Age group (years)		
15–19	37,627 (23.1%)	124,890 (76.8%)
20–24	152,859 (32.5%)	317,392 (67.5%)
Area of residence		
Rural	20,521 (28.2%)	52,145 (71.8%)
Urban	165,813 (89.0%)	356,975 (68.3%)
Unknown area of residence	4,152 (11.1%)	33,162 (88.9%)
Region of residence		
London	58,322 (37.0%)	99,114 (63.0%)
East Midlands	18,518 (38.5%)	29,578 (61.5%)
East of England	17,513 (25.2%)	52,085 (74.8%)
North–East	5,240 (18.9%)	22,510 (81.1%)
North–West	10,012 (14.6%)	58,466 (85.4%)
South–East	21,454 (25.7%)	61,869 (74.2)
South–West	22,052 (34.6%)	41,587 (65.3%)
West Midlands	14,520 (27.8%)	37,618 (72.1%)
Yorkshire and Humber	22,855 (36.7%)	39,455 (63.3%)
Year of test		
2019	81,880 (21.5%)	298,767 (78.5%)
2020	108,606 (43.1%)	143,515 (56.9%)
Residential area-level deprivation (Deprivation Quintile)*		
1 (most deprived)	34,679 (26.6%)	95,436 (73.3%)
2	45,911 (32.1%)	96,871 (67.8)
3	41,352 (33.8%)	81,030 (66.2%)
4	35,331 (33.0%)	71,259 (66.8%)
5 (least deprived)	29,061 (31.3%)	64,524 (68.7%)
Unknown deprivation quintile	4,152 (11.1%)	33,162 (88.9%)
Total	190,486	442,282

*Deprivation quintile is an area-level measure of deprivation and socioeconomic status based on the 2019 Index of Multiple Deprivation (IMD) quintiles

Table A2) Demographic characteristics of 15–24 year old females tested for chlamydia in England: 2019–2020

	Number and proportion tested in online services	Number and proportion tested in physical services
Age group (years)		
15–19	102,232 (20.2%)	404,106 (79.8%)
20–24	337,692 (30.6%)	765,103 (69.4%)
Area of residence		
Rural	44,744 (24.9%)	135,043 (75.1%)
Urban	383,826 (28.6%)	957,935 (71.4%)
Unknown area of residence	11,354 (13.0%)	76,231 (87.0%)
Region of residence		
London	123,797 (36.8%)	212,252 (63.2%)
East Midlands	43,825 (32.8%)	89,923 (67.2%)
East of England	38,838 (22.9%)	130,417 (77.0%)
North–East	11,834 (15.7%)	63,595 (84.3%)
North–West	29,550 (15.4%)	162,180 (84.6%)
South–East	52,636 (24.0%)	166,789 (76.0%)
South–West	50,939 (30.2%)	117,440 (69.7%)
West Midlands	33,625 (24.9%)	101,346 (75.1%)
Yorkshire and Humber	54,880 (30.5%)	125,267 (30.5%)
Year of test		
2019	188,169 (20.0%)	751,914 (80.0%)
2020	251,755 (37.6%)	417,295 (62.4%)
Residential area-level deprivation (Deprivation Quintile)*		
1 (most deprived)	84,665 (23.6%)	273,626 (76.4)
2	105,764 (29.3%)	255,330 (70.7)
3	94,142 (30.3%)	216,725 (69.7%)
4	79,044 (30.1%)	183,472 (69.9%)
5 (least deprived)	64,955 (28.4%)	163,825 (71.6%)
Unknown deprivation quintile	11,354 (13.0%)	76,231 (87.0%)
Total	439,924	1,169,209

*Deprivation quintile is an area-level measure of deprivation and socioeconomic status based on the 2019 Index of Multiple Deprivation (IMD) quintiles

Appendix B

Table B1) Adjusted logistic regression analysis of the association between deprivation quintile* and chlamydia testing via an online service among 15–24 year old males in England: 2019–2020

	Adjusted Odds Ratio (95% CI)
Age group (years)	
15–19	1
20–24	1.47 (1.45–1.49)
Area	
Rural	1
Urban	1.17 (1.15–1.20)
Region of residence	
London	1
East Midlands	1.03 (1.01–1.05)
East of England	0.49 (0.48–0.50)
North–East	0.37 (0.35–0.38)
North–West	0.26 (0.25–0.26)
South–East	0.56 (0.55–0.58)
South–West	0.84 (0.82–0.85)
West Midlands	0.62 (0.60–0.63)
Yorkshire and Humber	0.93 (0.91–0.95)
Year of test	
2019	1
2020	2.81 (2.77–2.84)
Residential area-level deprivation (Deprivation Quintile)*	
1 (most deprived)	1
2	1.18 (1.16 –1.20)
3	1.35 (1.32–1.37)
4	1.37 (1.35–1.40)
5 (least deprived)	1.29 (1.27–1.32)

*Deprivation quintile is an area-level measure of deprivation and socioeconomic status based on the 2019 Index of Multiple Deprivation (IMD) quintiles

** All p-values <0.05

Table B2) Adjusted logistic regression analysis of the association between deprivation quintile* and chlamydia testing via an online service among 15–24 year old females in England: 2019–2020

	Adjusted Odds Ratio (95% CI)
Age group (years)	
15–19	1
20–24	1.63 (1.61–1.64)
Area	
Rural	1
Urban	1.16 (1.15–1.17)
Region of residence	
London	1
East Midlands	0.80 (0.79–0.81)
East of England	0.44 (0.43–0.44)
North–East	0.31 (0.30–0.31)
North–West	0.28 (0.27–0.28)
South–East	0.51 (0.50–0.51)
South–West	0.68 (0.67–0.69)
West Midlands	0.53 (0.52–0.54)
Yorkshire and Humber	0.71 (0.70–0.72)
Year of test	
2019	1
2020	2.45 (2.44–2.47)
Residential area-level deprivation (Deprivation Quintile)*	
1 (most deprived)	1
2	1.20 (1.19 –1.21)
3	1.33 (1.32–1.35)
4	1.38 (1.36–1.39)
5 (least deprived)	1.32 (1.30–1.34)

*Deprivation quintile is an area-level measure of deprivation and socioeconomic status based on the 2019 Index of Multiple Deprivation (IMD) quintiles

** All p-values <0.05

Appendix C

Table C1) Number and proportion of chlamydia tests by testing service and deprivation quintile* amongst 15-24 year old males in England: 2019-2020

		Deprivation Quintile*				
	Testing service	1 (most deprived)	2	3	4	5 (least deprived)
Physical services	Specialist sexual health service	69,860 (53.7%)	71,130 (49.8%)	57,781 (47.2%)	49,387 (46.3%)	43,850 (46.9%)
	Non-specialist sexual health service	5,721 (4.4%)	3,591 (2.5%)	2,276 (1.9%)	1,612 (1.5%)	1,462 (1.6%)
	General Practice (GP)	9,207 (7.1%)	10,366 (7.3%)	9,123 (7.5%)	7,615 (7.1%)	6,358 (6.8%)
	Pharmacy	647 (0.5%)	978 (0.7%)	1,046 (0.9%)	915 (0.9%)	836 (0.9%)
	Termination of Pregnancy centres	5 (0.0%)	6 (0.0%)	5 (0.0%)	6 (0.0%)	3 (0.0%)
	Other**	8,687 (6.7%)	9,847 (6.9%)	9,968 (8.1%)	10,364 (9.7%)	11,234 (12.0%)
Online services	Online	34,679 (26.7%)	45,911 (32.2%)	41,352 (33.8%)	35,331 (33.2%)	29,061 (31.1%)
	Total±	130,115	142,782	122,382	106,590	93,585

*Deprivation quintile is an area-level measure of deprivation and socioeconomic status based on the 2019 Index of Multiple Deprivation (IMD) quintiles

** Includes other services providing chlamydia testing, such as outreach settings, prisons, education settings and any other settings

±Totals include tests from unknown testing services

Table C2) Number and proportion of chlamydia tests by testing service and deprivation quintile* amongst 15-24 year old females in England: 2019-2020

		Deprivation Quintile*				
	Testing service	1 (most deprived)	2	3	4	5 (least deprived)
Physical services	Specialist sexual health service	138,082	133,456	107,714	89,520	78,302
		(38.5%)	(37.0%)	(34.6%)	(34.1%)	(34.2%)
	Non-specialist sexual health service	16,847	11,184	6,816	4,893	3,792
		(4.7%)	(3.1%)	(2.2%)	(1.9%)	(1.7%)
	General Practice (GP)	67,115	64,873	60,091	53,046	49,186
		(18.7%)	(18.0%)	(19.3%)	(20.2%)	(21.5%)
	Pharmacy	1,834	2,653	3,063	2,598	2,561
		(0.5%)	(0.7%)	(1.0%)	(1.0%)	(1.1%)
	Termination of Pregnancy centres	8,325	7,248	5,142	3,708	2,971
		(2.3%)	(2.0%)	(1.7%)	(1.4%)	(1.3%)
	Other**	35,464	31,428	29,881	24,528	23,889
		(9.9%)	(8.7%)	(9.6%)	(9.3%)	(10.4%)
Online services	Online	84,665	105,764	94,142	79,044	64,955
		(23.6%)	(29.3%)	(30.3%)	(30.1%)	(28.4%)
	Total±	358,291	361,094	310,867	262,516	228,780

Deprivation quintile is an area-level measure of deprivation and socioeconomic status based on the 2019 Index of Multiple Deprivation (IMD) quintiles

** Includes other services providing chlamydia testing, such as outreach settings, prisons, education settings and any other settings

±Totals include tests from unknown testing services