CT cases (due to increases in screening and subsequent detection of asymptomatic cases), despite an underlying decrease in actual CT infections in the population. The total estimated costs associated with CT infection over this time period were over $1.0 billion, or $56.4 million per year. The costs of screening and treatment of asymptomatic infections as a proportion of total CT costs were estimated to have increased over time, while the costs of long-term sequelae associated with untreated infections declined the same period.

Conclusions Despite increases in screening over time, the total economic burden associated with CT in Canada remains high; however, the projections of our model suggest that these increases in screening and the subsequent detection of asymptomatic infections may be reducing the costs associated with the treatment downstream sequelae of untreated infections. Further investigation of trends in chlamydia-associated complications is required to better understand the impact of screening on CT incidence in Canada.

Epidemiology oral session 2: Human papillomavirus

O1-S02.01 EPIDEMIOLOGY OF, AND BEHAVIOURAL RISK FACTORS FOR, SEXUALLY TRANSMITTED HUMAN PAPILLOMA VIRUS INFECTION IN A SAMPLE OF THE BRITISH POPULATION

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Background Persistent infection with high-risk sexually transmitted human papilloma viruses (HR-HPV) can lead to development of cervical and other cancers while low-risk types (LR-HPV) may cause genital warts, the most commonly-diagnosed viral STI in the UK. An HPV immunisation programme, using the bivalent vaccine protecting against types 16 and 18, was introduced in the UK in 2008. The frequency of HPV types is important baseline information against which to monitor the direct and indirect effects of vaccination. Here we examine the proportion of the population with detectable infection with HPV in urine collected in 1999–2001 for the National Survey of Sexual Attitudes and Lifestyles (Natsal-2) and the relationship with demographic and behavioural variables.

Methods Natsal-2 was a probability sample survey of men and women aged 16–44 resident in Britain involving computer-assisted personal interviewing. Half of all sexually-experienced respondents aged 18–44 were invited to provide a urine sample. 3436 samples were tested using an in-house Luminex-based HPV genotyping system.

Results HPV DNA was detected in 29.0% (95% CI 26.7% to 31.3%) of samples from women and 17.4% (95% CI 15.1% to 19.8%) from men. Any of 13 HR-HPV types was detected in 15.9% (95% CI 14.1% to 17.8%) of women's samples and 9.6% (95% CI 8.0% to 11.6%) of men's. Vaccine preventable types 16 and/or 18 were found in 5.5% (95% CI 4.5% to 6.8%) of women and 3.0% (95% CI 2.1% to 4.3%) of men; and types 6 and/or 11 in 4.7% (95% CI 1.8% to 3.3%) of women and 2.2% (95% CI 1.5% to 3.1%) of men. 4.1% (95% CI 3.1% to 5.2%) of women had HPV 16 and/or 18 without any other HR-HPV. In multivariate analysis, HR-HPV was associated with number of new partners, in women with younger age, single status, and partner concurrency, and in men with number of unprotected partnerships and age at first intercourse.

Conclusion This is the first population-based probability sample study of the distribution of sexually transmissible HPV types in Britain. It is also the first to undertake a detailed analysis of relationships with demographic and behavioural variables and to include men. HPV DNA was detectable in urine of a high proportion of the sexually active British population; the lower prevalence in males reflected lower detection sensitivity for HPV in urine from males. In both genders HPV was strongly associated with sexual risk behaviour.

O1-S02.02 ARE THERE MUTUAL ASSOCIATIONS BETWEEN THE INCIDENCE OF HPV INFECTION AND OTHER SEXUALLY TRANSMITTED INFECTIONS AFTER CONTROLLING FOR SEXUAL BEHAVIOUR?

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Background We aimed to determine (i) if other sexually transmitted infections (STIs) increase the risk of incident human papillomavirus (HPV) infection and (ii) if HPV infection predicts the incidence of other STIs.

Abstract O1-S02.02 Table 1 Unadjusted and adjusted estimates of detection of other STIs on HPV incidence (total number of visit pairs=3221)

	Number of visit pairs N=3221	Incident detection at current visit	Unadjusted OR† (95% CI)	Adjusted OR† (95% CI)
Diagnosis of the following at previous visit	*N (col %)*	*New cases of any HPV, n= 241(7.5%) n (row%)*	*New detection of any HPV type across consecutive visits*	
STIs other than HPV infection*				
No	3158 (98.0)	230 (7.3)	1.0	1.0
Yes	63 (2.0)	11 (17.5)	2.46 (1.31 to 4.62)	2.16 (1.08 to 4.34)
		New cases of any HR-HPV, n=110 (3.4%) n (row%)	*New detection of any HR- HPV type across consecutive visits*	
STIs other than HPV infection*				
No	3158 (98.0)	105 (3.3)	1.0	1.0
Yes	63 (2.0)	5 (7.9)	2.42 (0.93 to 6.27)	2.01 (0.74 to 5.48)

*STIs other than HPV infection included the following: laboratory diagnoses of genital chlamydia, gonorrhoea, syphilis, as well as clinical diagnoses of genital herpes or trichomoniasis.
†Estimates adjusted for age and study site at enrolment, as well as the following covariates assessed at each follow-up visit: pap smear diagnosis at previous visit, contraceptive use in last 6 months, number of lifetime partners, partners having sex with others in last 6 months, having new partner in last 12 months, male partner using condom in last 6 months, number of partners in last 6 months.
HPV, human papillomavirus; HR-HPV, High-risk HPV, defined as HPV types 16, 18, 31, 33, 35, 39, 45, 51, 52, 56, 58, 59, 66 (IARC 2007); STIs, sexually transmitted infections.

Abstract O1-S02.02 Table 2 Unadjusted and adjusted estimates of HPV detection on incidence of other STIs (total number of visit pairs=3221)

Detected with the following at previous visit		New cases of other STIs, n=46 (1.4%) n (row%)	New detection of other STIs across consecutive visits	
Any HPV				
No	2590 (80.4)	31 (1.2)	1.0	1.0
Yes	631 (19.6)	15 (2.4)	**1.94 (1.05 to 3.58)**	1.81 (0.94 to 3.49)
		New cases of other STIs, n=46 (1.4%) n (row%)	***New detection of other STIs across consecutive visits***	
Any HR-HPV				
No	2930 (91.0)	38 (1.3)	1.0	1.0
Yes	291 (9.0)	8 (2.7)	2.14 (1.00 to 4.61)	2.00 (0.82 to 4.83)

Estimates adjusted for age and study site at enrolment, as well as the following covariates assessed at each follow-up visit: pap smear diagnosis at previous visit, contraceptive use in last 6 months, number of lifetime partners, partners having sex with others in last 6 months, having new partner in last 12 months, male partner using condom in last 6 months.
Covariates that were found to be statistically significantly associated with the outcomes ($p<0.05$) and/or significantly influence the effect size of the primary association of interest (≥10%) were included in the final models for confounding control. Parity, smoking status, and other factors measured, such as age of sexual debut and frequency of sex in last 6 months,*did not* satisfy these criteria in the data analyses and hence were*not* included in the final models.
HPV, human papillomavirus; HR-HPV, High-risk HPV, defined as HPV types 16, 18, 31, 33, 35, 39, 45, 51, 52, 56, 58, 59, 66 (IARC 2007); STIs, sexually transmitted infections.

Methods Women aged 20–38 years were followed semi-annually for 18 months in Thailand (n=1200). Assessment was made on cervical HPV genotypes, cervical cytology, sexual behaviour, demographic factors and diagnoses of other STIs including chlamydia, gonorrhoea, syphilis, genital herpes and trichomoniasis. Incident detection was defined as any type-specific HPV or other STI which was detected at current visit but not at previous visit. Associations were measured by ORs with 95% CIs estimated in generalised estimating equation models.
Results During follow-up, 241 new cases of HPV, 110 incident cases of high risk (HR)-HPV and 46 new cases of other STIs were observed. Diagnosis of other STIs at previous visit was statistically significantly associated with twofold increased odds of any new HPV detection after controlling for sexual behaviour, age, pap smear status and contraceptive use [adjusted OR (aOR): any HPV: 2.16 (95% CI: 1.08% to 4.34%)] (Abstract O1-S02.02 table 1). No significant association was found between diagnosis of other STIs and subsequent incident detection of HR-HPV [aOR: 2.01 (95% CI: 0.74% to 5.48%)] (Abstract O1-S02.02 table 1). Positive detection of any HPV or HR-HPV predicted nearly twofold increased odds of other STIs with the estimates bordering on statistical significance [aORs: any HPV: 1.81 (95% CI: 0.94% to 3.49%); HR-HPV: 2.00 (95% CI: 0.82% to 4.83%)] (Abstract O1-S02.02 table 2).
Conclusions We show that other STIs increase the risk of HPV incidence after controlling for sexual behaviour. The data qualitatively suggest mutual associations of HPV with other STIs. Further studies are warranted to evaluate if these reflect true biologic interactions between HPV and other sexually transmitted microbial agents, or mere confounding from unmeasured sexual risks.

O1-S02.03 MULTIPLE SEX PARTNERS AND LACK OF CONDOM USE FOR ANAL SEX ARE ASSOCIATED WITH MULTIPLE ANAL HPV INFECTIONS AMONG MEN HAVING SEX WITH MEN: THE HIM STUDY

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Background Human Papillomavirus (HPV) infection is the primary cause of anal cancer. While multiple HPV infections in the anal canal may accelerate disease progression, there are no reports of behavioural factors associated with multiple anal HPV infections among men having sex with men (MSM) and men having sex with women (MSW). We hypothesised that infection with multiple HPV types in the anal canal among MSM was associated with multiple sex partners and lack of condom use for recent anal sex. For comparison, we also assessed the role of multiple partners and condom use among MSW.
Methods Genotyping for 37 HPV types was conducted on anal canal exfoliated cell specimens from men, ages 18–70, from São Paulo, Brazil; Cuernavaca, Mexico; and Tampa, Florida, USA. Specimens from the pre-enrolment visit of a 4-year prospective study were analysed. Eligibility included no history of genital warts and no current STD diagnosis including HIV. Exfoliated cell samples between the anal verge and the dentate line of the anal canal were obtained with a saline-wetted swab. A total of 193 MSM and 1407 MSW provided evaluable specimens. For multivariable analyses we used Poisson regression with a robust sandwich estimator. Association estimates were adjusted for potential confounders.
Results Multiple HPV infections were present in the anal canal of 34.7% of MSM and 4.0% of MSW. Prevalence of multiple HPV infections was stable by age group among MSW (p trend=0.65) but declined among MSM (p trend=0.009). After adjustment for potential confounders, ≥2 male anal sex partners in the past 3 months (OR 2.47, 95% CI 1.43% to 4.27% vs 0–1 men) and lack of condom use at last anal sex (OR 1.51, 95% CI 1.07% to 2.12% vs condom use) were associated with detection of multiple anal HPV infections among MSM. Among MSW, ≥2 female sex partners in the past 6 months (OR 1.81, 95% CI 1.02% to 3.21% vs 0–1 women) was associated with detection of multiple anal HPV infections while condom use at last vaginal sex was not associated with infection (no condom use: OR 0.90, 95% CI 0.51% to 1.61% vs condom use).
Conclusions These data suggest that lowering the number of sex partners may reduce infection with multiple HPV types at the anal canal among MSM and MSW. Additionally, using condoms during anal sex among MSM, even among men with multiple partners, may reduce multiple anal HPV infections at the anal canal. Questions:alan.nyitray@moffitt.org

O1-S02.04 EVIDENCE OF HPV VACCINE EFFECTIVENESS IN REDUCING GENITAL WARTS: AN ANALYSIS OF CALIFORNIA PUBLIC FAMILY PLANNING ADMINISTRATIVE CLAIMS DATA, 2007–2009

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Background The quadrivalent HPV vaccine, available in the US since 2006, is recommended for females age 9–26. This vaccine prevents HPV types 6 and 11, which cause 90% of genital warts (GW). Because of the rapid development of GW after infection, monitoring GW trends may provide early evidence of population level vaccine effectiveness.
Methods Trends in GW diagnoses were assessed using clinical encounter claims data from the California Family Planning Access Care and Treatment program which serves low-income females and males. Following implementation of diagnostic coding requirements, reliable data on International Classification of Diseases