### O16.5 CONCORDANCE OF ANAL, PENILE, AND ORAL HUMAN PAPILLOMAVIRUS HR-HPV INFECTIONS AND HPV SEROPOSITIVITY IN HIV-INFECTED AND HIV-NEGATIVE MEN WHO HAVE SEX WITH MEN: THE HIV & HPV IN MSM ($H_2$M) STUDY

doi:10.1136/sextrans-2013-051184.0177

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**Background** Infection with human papillomavirus (HPV) is not generally followed by seroconversion for reasons not yet fully understood. This cross-sectional study investigated concordance between high-risk (hr) HPV infections at three anatomical sites and concordant seropositivity, in both HIV-infected and HIV-negative men who have sex with men (MSM).
**Methods** MSM aged ≥ 18 years were recruited from the Amsterdam Cohort Studies, an STI clinic and an HIV treatment centre in Amsterdam, the Netherlands. The associations between anal, penile, and oral HPV infections and concordant seropositivity of 7 hr-HPV types (16, 18, 31, 33, 45, 52 and 58) were estimated using generalised estimating equations (GEE) regression analyses.
**Results** Among the 306 HIV-infected MSM 93% were hr-HPV seropositive (i.e. seropositive for at least one of the 7 hr-HPV types) and 69% were infected with at least one anal, penile, or oral hr-HPV infection. Of 441 HIV-negative MSM 74% were hr-HPV seropositive and 41% were infected with one or more hr-HPV infections. Type-specific hr-HPV seropositivity was not more likely for men with concordant infections at multiple anatomical sites (OR 1.58, 95% CI 1.06–1.86) compared to those with concordant infections at only one anatomical site (OR 1.45, 95% CI 1.22–1.73). In multivariable analysis, adjusting for key demographic and sexual behavioural factors, type-specific hr-HPV seropositivity was associated with concordant anal hr-HPV infections (OR 1.60, 95% CI 1.32–1.92), but not with concordant penile (OR 0.79, 95% CI 0.58–1.06) or oral (OR 1.36, 95% CI 0.85–2.17) hr-HPV infections; in stratified analyses, these associations were similar for HIV-infected and HIV-negative men.
**Conclusions** In both HIV-infected and HIV-negative MSM, anal hr-HPV infections were associated with hr-HPV seropositivity, while penile and oral hr-HPV infections were not. Our findings support the hypothesis that seropositivity differs by the type of epithelium infected, implying that mucosal infection may provide a stronger signal to the immune system.

### O16.6 PRE-VACCINATION SEROPREVALENCE OF 15 HUMAN PAPILLOMAVIRUS (HPV) TYPES AMONG SLOVENIAN WOMEN SCREENED FOR CERVICAL CANCER

doi:10.1136/sextrans-2013-051184.0178

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**Background** Our objective was to estimate the seroprevalence of 11 high-risk (hr) HPV types (HPV 16, 18, 31, 33, 35, 39, 45, 52, 56, 58, 59) and four low-risk (lr) HPV types (HPV 6, 11, 68, 73) among Slovenian women screened for cervical cancer before the introduction of vaccination against HPV.
**Methods** 3259 serum specimens from the Slovenian HPV prevalence survey were tested for HPV type-specific antibodies with a multiplexed pseudovirion-based serological assay (PsV-Luminex).
**Results** Seropositivity for any of the 15 HPV types was 65.7%, any of the 11 hr-HPV types 59.2%, and any of the four lr-HPV types 33.1%. Antibodies against multiple HPV types were more common (45.3%) than against single HPV types (20.4%). Antibodies against at least one of the four vaccine HPV types (HPV 6, 11, 16, and 18) were detected in 40.8% women. Among hr-HPV types seropositivity was the highest for HPV 16 (25.2%) and among lr-HPV types for HPV 6 (19.1%). Age-specific seropositivity for HPV 16 was the highest among 30–39 years old women (29.6%) and decreased with increasing age to 14.0% among 60–64 years old women ($p = 0.014$). Seropositivity for any of the hr-HPV among women with pathological cytology was 76.8% and those negative for intraepithelial lesion or malignancy 58.3% ($p < 0.001$).
**Conclusion** Our results show a substantial burden of lifetime sexual exposure to these 15 HPV types before the introduction of vaccination and also a relatively high cumulative exposure to at least one of the four vaccine HPV types. Thus, vaccination of females before sexual debut with a quadrivalent HPV vaccine has a potential to contribute to a substantial reduction of the burden of cervical infections and cervical cancer as well as some other HPV related morbidity, including genital warts. Our data also present the baseline for monitoring HPV long-term vaccination impact.

## O.17 - Programme evaluation

### O17.1 INCREASED HIV PREVENTION PROGRAMME COVERAGE AND DECLINE IN HIV PREVALENCE AMONG FEMALE SEX WORKERS IN SOUTH INDIA

doi:10.1136/sextrans-2013-051184.0179

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**Objectives** As one way of assessing the impact of *Avahan*, the India AIDS Initiative of the Bill & Melinda Gates Foundation, we examined the association between HIV prevention programme indicators and changes in HIV prevalence among female sex workers (FSWs) between 2006 and 2010.
**Methods** HIV prevalence among FSWs was measured in two large surveys (2006 and 2010) across 24 districts in south India (n~11,000 per round). A random-effect multilevel logistic regression analysis was performed using HIV as the outcome, with individual independent variables (from both surveys) at level 1 and district-level FSW-specific programme indicators (from the *Avahan* computerised monitoring system) and contextual variables (from Indian government datasets) at level 2. Program indicators included their 2006 value, the difference in their values between the surveys, and the interaction between the latter and study round. The analysis also controlled for baseline HIV prevalence and its interaction with study round.
**Results** HIV prevalence among FSWs decreased from 17.0% (round 1) to 14.2% (round 2; $p < 0.001$). The odds ratio (OR) of the interaction term between the difference in programme coverage (% of FSWs contacted by the programme in a given year) and the survey round was 0.995 ($p = 0.006$), indicating that increased coverage was significantly associated with the decline in HIV prevalence between rounds. ORs comparing HIV prevalence between rounds varied with the level of increase in coverage and were statistically

significant with coverage increase ≥ quartile (Q) 1: OR = 0.85 at Q1, 0.78 at Q2, 0.66 at Q3 and 0.51 at Q4.

**Conclusions** These findings suggest that increased programme coverage was associated with declining HIV prevalence among FSWs covered by the *Avahan* programme. The triangulation of our results with those from other approaches used in evaluating *Avahan* suggests a major impact of this intervention on the HIV epidemic in southern India.

## 017.2 HIV PREVENTION AT SCALE: HAS IT WORKED? EVALUATION OF THE IMPACT OF THE AVAHAN PROGRAMME IN SOUTH INDIA

doi:10.1136/sextrans-2013-051184.0180

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**Background** *Avahan*, the India AIDS initiative of the Bill & Melinda Gates Foundation, is the largest targeted HIV preventive intervention in the world. We examine evidence for its overall impact, and estimate HIV infections averted across *Avahan* districts.

**Methods** A mathematical model of HIV transmission among high-risk groups and the general population was developed. It was parameterised using data from serial cross-sectional surveys (IBBAs) within a Bayesian framework, to reproduce HIV prevalence trends amongst female sex workers (FSWs), their clients, and men who have sex with men (MSM) in 24 South Indian districts. We test whether these prevalence trends are more consistent with self-reported increases in consistent condom use (CCU) following *Avahan,* or a counterfactual assuming CCU increased at slower pre-*Avahan* rates. To assess this we used a Bayes factor, which also measures strength of evidence for the impact estimates. Using regression analysis, the prevention impact in the IBBA districts is extrapolated to all *Avahan* districts.

**Results** In 13/24 districts, modelling suggests medium to strong evidence for the large self-reported increase in CCU since *Avahan* implementation. Elsewhere evidence is weaker, with CCU generally already high pre-*Avahan*. Approximately 32,700 HIV infections (95% credibility interval 17,900–61,600) were averted over four years in IBBA districts with moderate/strong evidence. Adding districts with weaker evidence increases this to 62,800 (32,000–118,000), and extrapolation suggests that 202,000 (98,300–407,000) infections were averted across all 69 *Avahan* districts in South India, increasing to 606,000 (290,000–1,193,000) over ten years. Over four (ten) years, 42% (57%) of HIV infections were averted.

**Conclusion** This is the first evaluation of *Avahan* to account for the causal pathway of the intervention, changing risk behaviour in FSWs and MSM to avert HIV infections in these groups and the general population. The findings suggest considerable impact can be achieved from targeted behavioural HIV prevention initiatives.

## 017.3 DO WE NEED TO VACCINATE MALES AGAINST HPV?

doi:10.1136/sextrans-2013-051184.0181

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**Background** From mid-2007 Australia funded a universal HPV vaccination programme for young females, which achieved high coverage rates. In 2013, Australia has become the first country to extend the HPV vaccination programme to boys aged 12–13 years. A catch-up programme includes boys aged 14–15. The aim of this study was to look at the current and expected impact of the vaccination programme on genital warts in men.

**Methods** Eight Australian sexual health services provided data on all new patients. We compared trends in proportion of patients diagnosed with genital warts in the pre-vaccination (2004 to mid-2007) and vaccination (mid-2007 to 2011) periods. Furthermore, we used a mathematical model of HPV transmission to predict the impact of male vaccination on the incidence of genital warts.

**Results** In the pre-vaccination period, there was no change in proportion of men diagnosed with genital warts. In the vaccination period, there were significant declines in proportions of < 21 (81.8%, compared to 92.6% decline in women) and 21–30 year old (51.1%, compared to 72.6% in women) heterosexual men diagnosed with genital warts; from 12.1% in 2007 to 2.2% in 2011 and from 18.2% in 2007 to 8.9% in 2011 respectively. There was no significant decline in diagnosis in men > 30 years of age, or in homosexual or bisexual men. Results of the model are in-line with this decline in men. With the introduction of male vaccination programme, the model predicts a much lower incidence, approaching elimination, in coming decades.

**Conclusion** Although there has been a decline in the proportion of young heterosexual men diagnosed with genital warts suggesting herd immunity, the decline is slower than that of young females and no decline is observed in homosexual/bisexual men. The male vaccination programme will lead to near elimination of genital warts in both females and males in Australia.

## 017.4 EVALUATING THE COST EFFECTIVENESS OF TARGETED VACCINATION STRATEGIES TO REDUCE INCIDENCE OF HPV-RELATED CANCER AND OTHER CLINICAL OUTCOMES IN MEN WHO HAVE SEX WITH MEN (MSM) IN BRITISH COLUMBIA, CANADA

doi:10.1136/sextrans-2013-051184.0182

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**Background** Of late, there has been discussion around the potential for vaccinating males in addition to the routine female human papillomavirus (HPV) vaccination programme against cervical cancer. While men who have sex with women (MSW) will likely receive some protection from female vaccination, men who have sex with men (MSM) remain vulnerable. Incidence rates of vaccine preventable cancers are disproportionately represented among MSM.

**Methods** Based on the natural history of infection progression for HPV subtypes 6, 11, 16 and 18, mathematical transmission dynamics and cost-effectiveness analysis models were developed to assess the prevalence and incidence of these subtypes among the MSM population in the Greater Vancouver Area, British Columbia, Canada. Model parameters, demographic, and epidemiological data were informed from provincial data and the literature.

We simulated three additional vaccination strategies, in combination with the current programme (Grade 6 schoolgirls (with 70% vaccine coverage)): first, vaccination of Grade 6 boys (with 70% vaccine coverage); second, vaccinating 18-year old self-identified MSM (with 25, 50 or 75% vaccine coverage); and finally, vaccinating any MSM within the vaccine-approved age range (with 25, 50 or 75% vaccine coverage).

**Results** There is significant variability of cost estimates associated with clinical outcomes related to the HPV vaccine-preventable strains in the literature. Our sensitivity analysis indicates that the implementation of any scenario tested is incrementally cost effective, assuming a baseline of the current girls-only immunisation programme. On average, overall incidence of anal, penile, and oropharyngeal cancer cases attributable to vaccine-preventable strains will be reduced by approximately 90%, within 50 years, and given effective prophylaxis and lifelong immunity.