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.