**Methods** We used data collected from FSWs and clients in three districts (A, B, C) in Karnataka state, India, as part of the Avahan AIDS Initiative, a large-scale targeted HIV prevention program. A deterministic model of HIV transmission among FSWs/clients was parameterised/fitted to the district (A) with the highest FSW/client HIV prevalence in 2005 (33.9%/6.2%). We conducted multiple sensitivity analyses to examine how sexual structure parameters (Abstract O1-S08.06 figure 1) influenced modelled HIV prevalence within district A and identified sources of heterogeneity that could explain differences in HIV prevalence between district A and districts B and C.

**Results** Duration of sex work (2.6-fold), duration of the repeat client/FSW relationship (1.7-fold) and numbers of clients of FSWs (1.6-fold) exhibited the largest differences across districts. In district A, doubling the numbers of clients of FSWs, numbers of visits to FSWs by clients and frequency of sex acts with repeat clients increased HIV prevalence the most. Interestingly, doubling the duration of the repeat FSW-client relationship and fraction of repeat clients decreased HIV prevalence the most (Abstract O1-S08.06 figure 1). The observed differences in the mean numbers of clients per month between districts (A:56; B:46; C:34) could alone explain most of the lower HIV prevalence in districts B and C relative to district A. Relative to that observed in district A, the lower number of sex acts with repeat clients in district B and larger FSW population size in district C could also explain these districts' lower HIV prevalence.

**Conclusions** The impact of each sexual structure parameter on HIV prevalence depended on the values of other parameters, since many parameters were correlated to keep the total number of FSW-client/client-FSW partnerships equal. Although the rules defining how parameters need to be empirically validated, results demonstrate how their definition were of critical importance in influencing outcomes. The heterogeneous risk faced by FSWs needs to be recognised to explain differences in HIV prevalence, and to inform population-specific interventions capable of addressing the complexities implied by this heterogeneity.

# Epidemiology oral session 9: Use of observational data and mathematical modelling for impact evaluation

## O1-S09.01 INCREASED CONDOM USE AND DECREASED HIV & STI PREVALENCE AMONG FEMALE SEX WORKERS FOLLOWING A TARGETED HIV PREVENTION PROGRAM IN KARNATAKA, SOUTH INDIA

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**Background** We assessed the impact of a large-scale, targeted HIV prevention program among female sex workers (FSWs) in Karnataka state, south India.

**Methods** In the context of an HIV prevention program involving 18 districts, funded by the Bill & Melinda Gates Foundation, we conducted initial (R1) and two follow-up (R2 and R3) survey rounds (integrated behavioural and biological assessments), involving random samples of urban FSWs in three selected districts. The total urban FSW population size of the three districts is estimated at 8600. Initial surveys were conducted at 7–19 months following program commencement in 2004–2005, and each follow-up survey at two to three year intervals thereafter. Multivariable logistic regression models were used, with weights to account for a complex sampling design. Results presented are for the three districts combined.

**Results** 1242 FSWs participated in R1, 1238 in R2 and 1248 in R3. In R3, 98% and 92% of FSWs reported contact by a peer educator and having visited a project STI clinic, respectively. HIV prevalence declined steadily from R1 to R3, and in R3 compared to R1, there were reductions in HIV prevalence (24.8% vs 13.3%, adjusted OR (AOR)=0.59, 95% CI 0.41% to 0.86%, p=0.005); active syphilis (12.7% vs 8.8%, AOR=0.44, 95% CI 0.31% to 0.61%, p<0.001); and high-titre syphilis (6.6% vs 3.2%, AOR=0.33, 95% CI 0.21% to 0.51%, p<0.001). Trichomoniasis (Tv), chlamydial infection (Ct) and gonorrhoea (Ng) were assessed in one district in R3. From R1 to R3, Tv declined from 32.9% to 3.5% (AOR=0.07, 95% CI 0.04% to 0.15%, p<0.001); Ng from 5.4% to 0.9% (AOR 0.22, 95% CI 0.0.07% to 0.71%, p=0.01); and Ct from 10.8% to 4.6% (AOR 0.38, 95% CI 0.19% to 0.75%, p=0.006). Comparing R3 with R1 in all three districts, reported condom use at last sex increased significantly for repeat clients (60.1% to 93.9, AOR 11.2, 95% CI 7.2% to 17.5%, p<0.001); for occasional clients (81.0% to 88.2%, AOR 2.8, 95% CI 1.9% to 4.1%, p<0.001); and for regular (non-commercial) partners (24.4% to 55.9%, AOR 5.0, 95% CI 2.4% to 10.3%, p<0.001). Condom use overall was strongly associated with level of peer educator contact, having been exposed to condom demonstrations, and attendance at a program health clinic.

**Conclusions** Over 6 years, this large-scale HIV prevention program for FSWs achieved high rates of program coverage, high rates of condom use with clients, and significant reductions in HIV and STI prevalence. It will be important to sustain these efforts in the long term.

## O1-S09.02 HIV ELIMINATION WITHOUT ANTIRETROVIRAL THERAPY (ART) IN SOUTHERN INDIA: MODELLING AND PROJECTED COSTS

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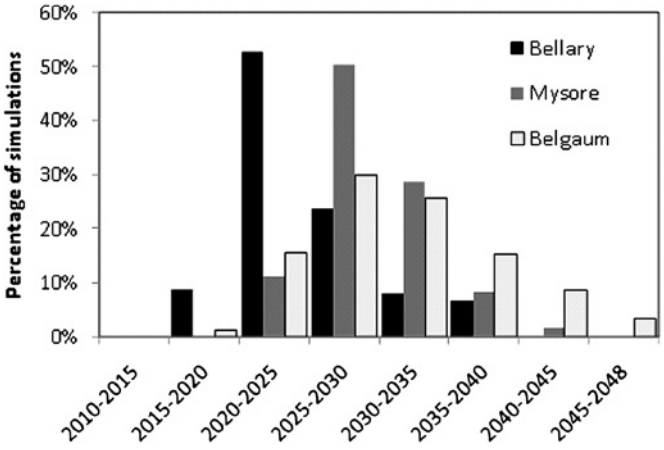
**Background** There is widespread interest in the use of antiretroviral therapy for eliminating HIV. However, it is possible that bringing other existing interventions to scale, such as condom promotion among female sex workers (FSWs) could reduce HIV transmission to low levels in some settings. Avahan, the Indian AIDS Initiative, has attained high coverage among FSWs in southern India, achieved large increases in condom use (>90% use condoms consistently), and substantial reductions (35–60% relative decreases over 5 years) in FSW HIV prevalence have been observed in the three districts with three rounds of FSW surveys. This modelling analysis projects the long-term impact of the Avahan intervention strategy in these districts.

**Methods** A bespoke dynamical model of HIV transmission among FSW/clients was parameterised and fitted to district specific behavioural and STI/HIV prevalence data within a Bayesian framework. The model fits for each district were used to determine whether the long-term impact of the current level of condom use achieved through Avahan, will reduce the HIV incidence among FSWs and clients to less than 1 infection per 1000 FSWs and clients per year (elimination definition used by Granich, Lancet 2009). The probability of local elimination, time till elimination, and costs (extended from detailed costing for first 3 years in 2008 US$) and HIV infections averted of achieving this was estimated.

**Results** With the current high level of condom use in all 3 districts, the probability that the HIV incidence among FSWs and clients becoming <1 infection per 1000 by 2050 is >95%. The Abstract O1-

S09.02 figure 1 suggests local elimination is likely to occur earlier in Bellary (median: 2023) than in Mysore (2028) and Belgaum (2030), with the required intervention duration being 11–35 years. The discounted cost of achieving local elimination in each of the settings is estimated to be $8-11 000 000 with 5000–11 000 HIV infections averted up to 2050.




Abstract O1-S09.02 Figure 1 Posterior distribution of the year when HIV indicates in FSWs and clients goes below 1 infection per 1000 FSWs and clients.

**Conclusion** Our results suggest Avahan could result in local elimination of HIV among FSWs and clients in these districts without ART. Current discussions around the use of ART for HIV elimination should also consider other prevention strategies, especially in concentrated epidemic settings where eliminating HIV from FSWs and clients is likely to eliminate HIV in the general population. Our modest estimated costs for local elimination could be completely offset against averted ART costs.

## O1-S09.03 MAIN RESULTS AND IMPACT ANALYSIS OF ANNUAL CHLAMYDIA SCREENING IN A LARGE REGISTER-BASED PROGRAMME IN THE NETHERLANDS

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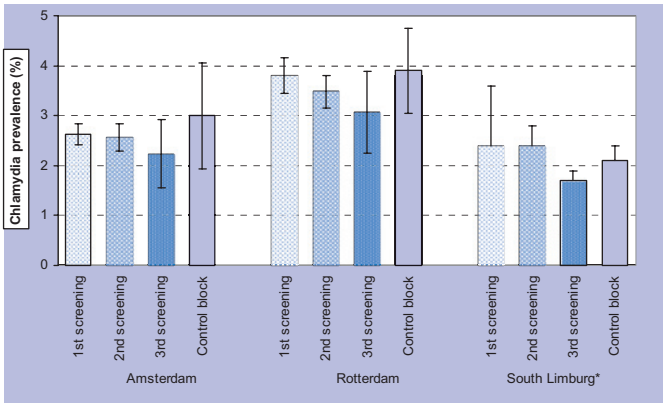
**Background** Chlamydia screening programmes can only work when they motivate sufficient persons at risk to get tested regularly. The outcomes of the Chlamydia Screening Implementation (CSI) in the Netherlands are novel and valuable because of the large scale of the programme (315 000 young persons targeted), its systematic nature (invitations based on municipal registers) and its multiple screening rounds (annual invitations in three consecutive years).

**Methods** From April 2008 to March 2010, Chlamydia Screening was offered annually to municipal-registered 16–29 year olds in three regions of the Netherlands. A phased implementation was applied by grouping clusters in three random, risk-stratified blocks. Participation and positivity rates were compared between blocks submitted to 1, 2 or 3 screening rounds (3rd round only partially completed). The effect of the repeated screening rounds on the prevalence of Chlamydia in the whole target group was estimated by weighting procedures comparing demographic characteristics of participants and target group.

**Results** The participation rate in the first round was 16% among all invitees and 20% among the sexually active target population (M13%, F 25%). The participation fell down to 11% in blocks invited two times and 9% in the block invited three times, whereas it was 13% in the control block invited in round two only. The positivity rate in round one was 4.2% among all participants. Positivity rates decreased significantly to 4.0% in blocks screened twice and to 3.5% in the block screened thrice (p=0.04); in the control block 4.3% tested positive. The population prevalence was estimated at 2.6% in Amsterdam, 3.8% in Rotterdam and 2.4% in South Limburg. The prevalence declined over the three screening rounds, but declines were not significant (see Abstract O1-S09.03 figure 1).




Abstract O1-S09.03 Figure 1 Estimated Chlamydia prevalence among young people invited for Chlamydia screening 1, 2 or 3 times at annual intervals, as compared to a control group invited only once. [*bars indicate high-low estimates for South Limburg, an adaptation to correct for participant selection.

**Conclusions** The participation in the CSI project was lower than expected and declined with repeated invitation. Chlamydia positivity rates were reduced by 17% in clusters screened three times, whereas these stayed high in control groups. Only a small and non-significant impact on population prevalence was measured. Further extrapolation of the findings in a simulation model suggest a limited impact on Chlamydia prevalence after 10 years of screening and estimates of cost-effectiveness do not support a nationwide roll-out of this programme in the Netherlands.

## O1-S09.04 MODELLED IMPACT OF CHANGING PARTICIPATION RATES ON EFFECTIVENESS OF POPULATION BASED CHLAMYDIA SCREENING

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