and thus be cost-saving especially after HPV testing is deployed as a screening tool. However, it is in the post-vaccination era when the cohorts of women vaccinated in their teens enter screening age that this approach may prove most valuable by permitting a surveillance system that can serve two roles simultaneously: monitoring duration of vaccine protection (with HPV typing for those who are positive) and screening for cervical cancer. The author will present the arguments for an integrated approach that involve the two prevention strategies against this disease: HPV vaccination and molecular testing in cervical cancer screening.

S12.3 WHAT IS THE LATEST DATA FROM THE 2 COMMERCIALLY AVAILABLE PROPHYLACTIC CERVICAL CANCER VACCINES?

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Since 2007 two prophylactic HPV vaccines (a bivalent incorporating VLPs 16 and 18, plus a quadrivalent vaccine with VLPs 16, 18, 6, 11) have been licensed for use. This was based on excellent efficacy, immunogenicity and safety data from phase 3 clinical trials. In addition there is also some cross protection for disease for phylogenetically related genotypes. Where these vaccines have been incorporated into public health programs with high coverage, (particularly targeted school based programs), already reductions in those disease those with the shortest incubation periods, are being seen that is, genital warts for the quadrivalent vaccine.

The greatest challenge today is to obtain wide vaccine coverage to those countries with the highest incidence of disease.

S12.4 GENITAL WARTS: PREVENTION, DIAGNOSIS, TREATMENT AND COUNSELLING

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Genital warts (GW) are one of the most common reasons for consultation at an STI clinic. A majority of partners sexually exposed to GW will develop GW. Half of cases of GW will have cleared within 4 months. Condoms' efficacy has been demonstrated but need high compliance to achieve good protection. When lesions are not clearing reassessment of diagnosis may be necessary. Therapeutic options include patient applied and office base therapies. Some patients may need repeated cycles of therapy or combined modalities. Counselling for smoking cessation and HIV testing should be offered. High level of anxiety and sexual concerns are common. Partner notification is not recommended. Patients with GW and their actual and future partner(s) should be counselled about HPV quadrivalent prophylactic vaccine.

S13 Respondent-driven sampling: where we are and where should we be going?

S13.1 RESPONDENT-DRIVEN SAMPLING: USES, ASSUMPTIONS, LIMITS AND PROSPECTS

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Respondent-driven sampling (RDS) is widely used to obtain estimates of quantities such as HIV prevalence, but is also used to examine correlates of infection, and less frequently, to help characterise social networks of individuals in "hidden" populations. The popularity of RDS stems in part from the often rapid recruitment of individuals from the target population as well as from the potential to obtain (asymptotically) unbiased estimates using information only from the sample. I will review the assumptions required for this potential to be realised, whether these assumptions are broken in practice, and the impact of breaking assumptions on statistical inference. I will also discuss improvements to the design and analysis of RDS studies, including schemes for giving out coupons, obtaining absolute sizes of at-risk populations using capture-recapture, and the utility of detailed social network inventories.

S13.2 ASSESSING RESPONDENT-DRIVEN SAMPLING

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Respondent-driven sampling is a network-based technique for estimating traits in hard-to-reach populations, for example, the prevalence of HIV among drug injectors. In recent years RDS has been used in more than 120 studies in more than 20 countries, and by leading public health organisations, including the Centers for Disease Control and Prevention in the USA. Despite the widespread use and growing popularity of RDS, there has been little empirical validation of the methodology. In this talk, I investigate the performance of RDS by simulating sampling from 85 known, network populations. Across a variety of traits we find that RDS is substantially less accurate than generally acknowledged, and that reported RDS CI are misleadingly narrow. Moreover, it is unlikely RDS performs any better in practice than in our simulations as we model a best-case scenario in which the theoretical RDS sampling assumptions hold exactly. Notably, the poor performance of RDS is driven not by the bias, but by the high variance of estimates, a possibility that had been largely overlooked in the RDS literature. Given the consistency of our results across networks and our generous sampling conditions, we conclude that RDS as currently practiced may not be suitable for key aspects of public health surveillance where it is now extensively applied. This work is joint with Matthew Salganik.

S13.3 AN EMPIRICAL EVALUATION OF RESPONDENT-DRIVEN SAMPLING

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Objective Respondent-driven sampling (RDS) is an increasingly widely used variant of snowball sampling, that proponents claim can provide unbiased estimates. RDS has not been rigorously evaluated in the field. This study evaluated RDS by comparing estimates from an RDS survey with total-population data.

Methods Total-population data on age, tribe, religion, socioeconomic status, sexual activity and HIV status were available on a population of 2402 male household-heads from an open cohort in rural Uganda. An RDS survey was carried out in this population, employing current RDS methods of sampling (RDS-sample) and statistical inference (RDS-estimates). Analyses were repeated for the full RDS sample and a small sample of the first 250 recruits (including 10 seeds).

Results 927 household-heads were recruited (including 10 seeds). Full and small RDS-samples were largely representative of the total-population for most variables, but under-represented men who were younger, of higher socioeconomic status, and with unknown sexual activity and HIV status. RDS statistical inference methods failed to reduce these biases. Only 31–37% (depending on method and sample size) of RDS-estimates were closer to the true population proportions than the RDS-sample proportions. Only 50–74% of RDS bootstrap 95% CIs included the population proportion.
Conclusions RDS produced a generally representative sample of this well-connected non-hidden population. However, current RDS inference methods failed to reduce bias when it occurred. Whether RDS can collect the data required to reliably remove bias and measure precision during analysis is unresolved. As such, although RDS may be a feasible and cost-effective method for sampling hidden or hard-to-reach populations, RDS should still be regarded as a (potentially superior) form of convenience sample, and caution is required when interpreting findings from RDS studies.

S13.4 USE OF RESPONDENT-DRIVEN SAMPLING FOR MONITORING HIV BEHAVIOURS AMONG INJECTING DRUG USERS IN THE UNITED STATES

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Background Approximately 1.1 million persons in the United States are living with HIV and for 18.5% their infections are attributable to injection drug use. In 2009 there were an estimated 5063 new HIV diagnoses attributed to injection drug use. In 2002, CDC developed the National HIV Behavioural Surveillance System (NHBS) to help state and local health departments in areas with high AIDS prevalence monitor behaviours and use of prevention services in groups at highest risk for HIV infection, including injection drug users (IDU). NHBS uses a sampling method most appropriate for each group; respondent-driven sampling (RDS) was chosen as the method for NHBS-IDU. We describe implementation and key monitoring indicators from the first two rounds of NHBS-IDU.
Methods NHBS-IDU is implemented in more than 20 cities every 3 years using a standardised protocol for conducting surveys and HIV testing among persons who had injected drugs within the 12 months prior to interview. Data are analysed for each city independently and then aggregated and weighted to form national estimates.
Results During the first IDU cycle (NHBS-IDU1, conducted 2005–2006), a total of 13 519 persons in 23 cities were recruited to participate, which resulted in 11 471 persons included in the final dataset. A total of 10 901 persons received 34 038 coupons to recruit others; 13 115 (62%) coupons were returned (range by city: 52.2%–75.3%). Challenges to the underlying assumptions of RDS included a somewhat high (5%) proportion of participants who reported their recruiter was "a stranger" and limited geographic cross-recruitment, suggesting IDU networks were not linked. These issues were found for some cities and were addressed in the operational guidance for NHBS-IDU2, conducted during 2009. Data from NHBS are used to monitor national progress in HIV prevention for IDU; in NHBS-IDU1, an estimated 32.8% of IDU shared syringes, and 63.4% had unprotected vaginal sex; 66.3% had been tested for HIV, and 29.7% had participated in an HIV behavioural intervention.
Conclusions Use of RDS for NHBS-IDU has identified challenges in implementation and analysis that continue to further the development of this method for conducting behavioural surveillance among IDU in order to characterise the HIV epidemic in the USA.

S14 Research in progress: updates from American STD association developmental award recipients

S14.1 GENITAL AND ORAL HUMAN PAPILLOMAVIRUS IN ADOLESCENT MALES

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Background Human papillomavirus is a common STI which causes genital warts and cancers in males. Studies of HPV in adult males are underway, but the epidemiology and natural history of HPV in adolescent males has not been investigated. The purpose of this study is to describe genital and oral HPV infections in young men.
Methods A subset of young men was recruited from an ongoing study of the male adolescent penile and urethral microbiome and sexual behaviours. Participant consent and parental permission were obtained. This study was approved by the Institutional Review Board at Indiana University. Approximately every 3 months, genital swabs and an oral rinse sample were collected from each participant. Genital swabs were collected using saline wetted cotton swabs rubbed over the entire skin surface of the participant's glans penis, penile shaft, and scrotum. Participants provided oral samples by a swish and spit method using 15 ml of mouthwash. Samples were tested for HPV using the 37 HPV type Linear Array HPV Genotyping Test (Roche). Participants completed daily cell phone diary entries and quarterly surveys about their sexual behaviours. Descriptive statistical analysis was performed using SPSS.
Results A total of 34 adolescent males were recruited, ages 14–18 at enrolment (mean 15.8; SD 1.18). The racial/ethnic identity of participants was: 19 (55.9%) black, 12 (35.3%) white, and 3(8.8%) other. At the time of their first HPV sample collection, 19 participants (55.9%) reported ever having vaginal sex, 8 participants (23.5%) reported ever giving oral sex, 16 participants (47.1%) reported ever receiving oral sex, and 5 (14.7%) reported ever having anal sex. In their enrolment genital samples, HPV (high risk (HR) plus low risk (LR)) was detected in 13 of 34 participants (38.2%); HR types were detected in nine participants and LR types were detected in eight participants. Seven participants had >1 HPV type. HPV was detected in both sexually active participants and those denying prior sexual contact. One participant had trichomonas at enrolment; no participants had gonorrhoea or chlamydia. In the enrolment oral samples, HPV was detected in one participant (HPV 6).
Conclusions This study provides the first information about HPV genital and oral infections in adolescent males. Genital HPV can be detected in adolescent males, and is not predicted by prior vaginal or oral sex. Oral HPV was infrequently detected in this small sample.

S14.2 A STUDY OF AFRICAN AMERICAN AND LATINA WOMEN AND HUMAN PAPILLOMAVIRUS: LESSONS LEARNT

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Background African American and Latina women in the United States suffer from sexually transmitted infections at higher rates than white women. It is particularly important to prevent HPV in these groups as they also suffer disproportionately from cervical cancer. From 2006, a prophylactic HPV vaccine has been approved for use in girls and women aged 9–26 years. However, public health focus has been on young girls and teens. There are limited options