among FSWs derived from independent data sources, was more consistent with observed HIV trends, and if these trends could have occurred without post-Avahan increases in CCU (two null hypotheses were assumed—one being more (H0b) and less conservative(H0a)). The most likely CCU hypothesis was used to predict the intervention impact on HIV prevalence/incidence and HIV infections prevented.

Results Using the most likely CCU hypothesis for each district (H1), results so far suggest that the increase in condom use post-Avahan may have resulted in between 21 and 45% of new HIV infections being averted among FSWs in Mysore, Belgaum and Bellary respectively from 2004 to 2007. Similar results were obtained for clients but the absolute number averted was 2–8 fold more. Model projections (Abstract S7.3 figure 1) suggest that this has resulted the large decrease in HIV prevalence observed in these districts, and that this would not have occurred in the absence of Avahan. The syphilis treatment component alone prevented <9 and 13% of new HIV infections over 1 and 10 years. Impact projections for the general population and additional districts will be presented.

Conclusions These Bayesian modelling results, combined with observed HIV prevalence trends and evidence of successful implementation and scale-up of Avahan, provides plausible evidence that Avahan has reduced HIV transmission to a large extent among high-risk groups.

S7.4 COST-EFFECTIVENESS OF TARGETED HIV PREVENTIONS FOR FEMALE SEX WORKERS: AN ECONOMIC EVALUATION OF THE AVAHAN PROGRAMME IN SOUTHERN INDIA

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[1,2]S Chandrashkar, [1]A Vassall, [1,3]L Guinness, [1,4]M Pickles, [5]B Reddy, [5]G Shetty, [4]M C Boily, [6]K Lowndes, [7,8]M Alary, [1]P Vickerman. *[1]London School of Hygiene and Tropical Medicine, London, UK; [2]St Johns Research Institute, India; [3]Australian Centre for Economics Research in Health, Australian National University; [4]Imperial College, London, UK; [5]Karnataka Health Promotion Trust, Bangalore, India; [6]Health Protection Agency, London, UK; [7]URESP, Centre de recherche FRSQ du CHA universitaire de Québec, Québec, Canada; [8]Département de médecine sociale et préventive, Université Laval, Québec, Canada*

Objective(s) The aim of the presentation paper is to assess the cost-effectiveness of HIV prevention interventions for female sex workers in India, in the context of large-scale programme effort, the Avahan Programme.

Design/methods We estimate cost-effectiveness using comprehensive measurements of cost; and, impact estimates based on dynamical transmission models of HIV and STI transmission that are fitted to observed prevalence trends. Our primary outcome measure is incremental cost per DALY averted (ICER) for the HIV prevention programme compared to a "do-nothing" base case.

Results In 2007, the implementing NGO cost per person reached at least once in a year ranges from US$47 to US$154. When all costs are taken into account (including expertise enhancement, management and contracting costs), the cost per person reached increases to US$112 to US$ 213, depending on location and year. Median incremental costs per infection averted range from US$ 876 (370, 3040) to US$2574 (1344, 7132). Median incremental costs per DALY averted range from US$49 (20 171) in to US$ 143 (74, 388). These costs per DALY may increase as results from other states are included.

Conclusions This study presents robust evidence that demonstrates that HIV prevention interventions targeted at high risk vulnerable groups can achieve substantial reductions in HIV infections at an acceptable cost in a concentrated epidemic setting. Moreover, we demonstrate cost-effectiveness in the context of a programme that is delivering HIV prevention at scale. However, the achievement of cost-effectiveness varies by setting. Our findings suggest that those responsible for HIV programmes should therefore consider funding targeted HIV prevention programmes at high risk groups in India and beyond, but should take into account setting specific drivers of the HIV epidemic.

Symposium 8: The global public health challenge of untreatable multidrug-resistant Neisseria gonorrhoeae "superbug" (MDR-GC)

S8.1 LESSONS LEARNT FROM GLOBAL HIV DRUG RESISTANCE INITIATIVE: IMPLICATIONS FOR MDR-GC

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D Sutherland. *Global Public Health, Canada*

The WHO, in collaboration with the Bill and Melinda Gates Foundation and the International AIDS Society developed the Global HIV Drug Resistance Network. It is comprised of a network of countries and accredited laboratories. The Network serves as an advisory and evaluation function to the WHO HIV drug resistance team and countries implementing the strategy. Surveillance of HIV drug resistance is critical because it helps to detect the circulation of resistance strains and directs measures to preserve programme effectiveness.

This presentation will explore how lessons learnt from the HIV drug resistance initiative could be applied to slow the spread of MDR-GC.

S8.2 SYNERGY: PUBLIC HEALTH, CLINICIANS, LABORATORIES AND MANAGEMENT GUIDELINES

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I Martin, T Wong. *Public Health Agency of Canada, Canada*

There is growing concern that the increasing prevalence of AMR in *N gonorrhoeae* will compromise effective treatment and disease control efforts. Early warning systems and the creation of, public health, clinical and laboratory networks are critical to detect the emergence of resistance and treatment failures.

Using specific examples to illustrate best practises, this presentation will focus on mechanisms to:

Enable adequate, timely AMR surveillance to inform treatment guidelines;

Establish a strategy to rapidly detect patients with gonococcal infections who experience a clinical and/or microbiological treatment failure especially with recommended cephalosporin or azithromycin therapy; and

Promote effective public health and clinical management of patients and their sexual partners.

S8.3 RESEARCH AND TRAINING NEEDS

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J A Dillon. *University of Saskatchewan, Canada*

Establishing treatment guidelines, improving capacity to monitor antimicrobial susceptibility, and adequate supply of quality medications are key strategies to slow the spread of resistant gonorrhoea. Advances in the public health and clinical management of

N gonorrhoeae stem from basic research on the biology of the organism, the development of diagnostic capabilities, and the availability of more effective drugs. The "bench to practise" translation of this research is vital to building capacity.

This presentation will focus on the gonorrhoea resistance research and training opportunities to contribute to the prevention and control efforts.

S8.4 LABORATORY HARMONISATION AND QUALITY-ASSURANCE ISSUES: CHALLENGES AND OPPORTUNITIES

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C Ison. *Health Protection Agency Centre, UK*

There are significant gaps in gonococcal susceptibility data particularly in high-burden countries. Laboratory detection of gonococci with reduced susceptibility to azithromycin and cephalosporins is of particular concern. Coordinated and standardised laboratory testing approaches that ensure quality assurance are vital to detect emerging resistance and optimise treatment.

This presentation will explore current gaps and identify opportunities, including roles of laboratory networks, in building regional diagnostic capacity.

S8.5 GLOBAL ACTION PLAN TO COMBAT ANTIMICROBIAL RESISTANCE IN *NEISSERIA GONORRHOEAE*: CHALLENGES AND OPPORTUNITIES

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F J Ndowa. *World Health Organization, Geneva, Switzerland*

The WHO is drafting a strategic response to the threat of untreatable *Neisseria gonorrhoeae*. The main objective of the Global Action Plan to combat AMR in *N gonorrhoeae* is to devise nationally and regionally appropriate public health actions to address this global threat. This includes technical and programmatic guidance to countries, regions and global stakeholders.

This presentation will discuss the basic elements of the draft WHO Action Plan.

Symposium 9: Applications of program science in the field of STI

S9.1 THE ROLE OF MATHEMATICAL MODELS IN PLANNING AND EVALUATING PROGRAMMES

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G Garnett. *Imperial College, London, UK*

The potential use of mathematical models in programme science will be reviewed. The adoption, planning, implementation, and evaluation of programmes in global health should be an iterative process where the collection and analysis of data plays a significant role in planning and evaluation. Mathematical models provide a framework for the integration of data from multiple sources, predicting the impact of programmes based on efficacy data for the range of interventions combined and providing counterfactuals to estimate effect sizes in evaluating impact. Mathematical models describing the impact of alternative interventions are central in health economic analyses. Models can usefully be combined with theories describing why programmes should have an impact in the design and evaluation of the programmes. Synergies in interventions can be considered at multiple levels: in the individual both in enhancing behaviour changes and combining to reduce risks; in populations changing the epidemiological context; in programme activities; and in creating environments where interventions can succeed. Models explain what we can expect from these synergies and help us identify how to integrate new technologies into programmes.

S9.2 MONITORING AND EVALUATION: LINKING PROGRAMMING AND RESEARCH

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A Vassall. *London School of Hygiene and Tropical Medicine, London, UK*

Researchers are becoming increasingly interested in the evaluation of STI/HIV interventions that take place in "real world" programmatic or health systems settings. Likewise, programme and health service managers are facing ever growing demands to demonstrate results and achieve "value for money". Monitoring and evaluation (M&E) systems are fundamental to both efforts. However, research and programme efforts are often not closely linked, with data being collected and analysed independently.

This presentation will examine M&E from a researchers' perspective. It will outline how a programme science perspective can contribute to the development of robust and useful M&E systems and processes. We will present two case studies. The first, the Integra project, evaluates the integration of HIV and SRH services in Kenya and Swaziland. It illustrates how research complemented routine M&E systems in a "real world" setting. This case demonstrates the benefits to programme managers of combining M&E data with economic research to enhance service performance. At the same time Integra researchers were able to use M&E data to examine the impact of "real world" issues like drug stock-outs on their research results. The second case study, the CHARME project, is an evaluation of the Avahan HIV prevention programme in India. This case illustrates the value of linking monitoring systems with research efforts to establish plausible evidence of the relationship between cost, programme activities and intensity and impact of an HIV prevention programme; where no control areas or "stepped wedge" evaluation design was feasible, due to rapid scale-up.

Finally, the presentation will identify a number of over-arching lessons learnt from these cases, and other experiences. It will highlight the importance of investing in a wide range of monitoring and evaluation activities, that go beyond Management Information Systems and qualitative peer evaluation. It will explore ways of enhancing and linking research and programme efforts, so that M&E can relate STI/HIV inputs, outputs and outcomes in a robust and logical way; but, at the same time, remains feasible and "value for money" in large scale "real world" settings.

S9.3 THE PROGRAMME SCIENCE OF SCALE: THE AVAHAN EXPERIENCE

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A RamaKrishnan. *Bill & Melinda Gates Foundation, India*

The Avahan HIV prevention programme of the Bill & Melinda Gates Foundation in India has achieved scale/quality/coverage, and is beginning to show signs of HIV impact on high risk groups and the general population. The approach of the programme has been to combine business principles of scaling up with technical aspects of HIV programming to develop a model for scaling up public health interventions through designing, organising, executing and sustaining for scale. This presentation will share the background of the Avahan programme, its results, and a framework for the programme science of scaling up.