# Transmission dynamics of HIV among men who have sex with men in Southern India: insights from mathematical modelling

HC Johnson, AM Foss, PT Vickerman, AE Phillips, JR Williams,
R Watts, J Anthony, K Gurav, BM Ramesh, CM Lowndes,
M-C Boily, R Washington, S Moses, JE Bradley, M Alary, CH Watts

Gender Violence & Health

SRH & HIV
Programme for Research & Capacity Building on Sexual & Reproductive Health & HIV in Developing Countries

CHARME-INDIA
HIV/AIDS Research Monitoring and Evaluation in India

DFID Department for International Development

amfAR
AIDS RESEARCH

LONDON SCHOOL OF HYGIENE & TROPICAL MEDICINE

www.hivtools.lshtm.ac.uk

# Background

- In India the HIV epidemic remains concentrated in high-risk groups including men who have sex with men (MSM)

- Indian MSM show considerable behavioural heterogeneity in anal sex roles

- Different MSM behavioural subgroups are likely to have different risks of infection and some may contribute disproportionately to the epidemic

- Detailed data have been collected in an *Integrated Behavioural & Biological Assessment* (IBBA) in Bangalore

2

# Aims

**Within a Southern Indian setting:**

- simulate the transmission of HIV among MSM

- estimate the contribution from each MSM subgroup to the HIV epidemic among MSM

- compare the potential impact of different prevention interventions

- determine which are the most important MSM subgroups to reach with a prevention strategy

- establish the extent to which behavioural heterogeneity influences the HIV epidemic among MSM
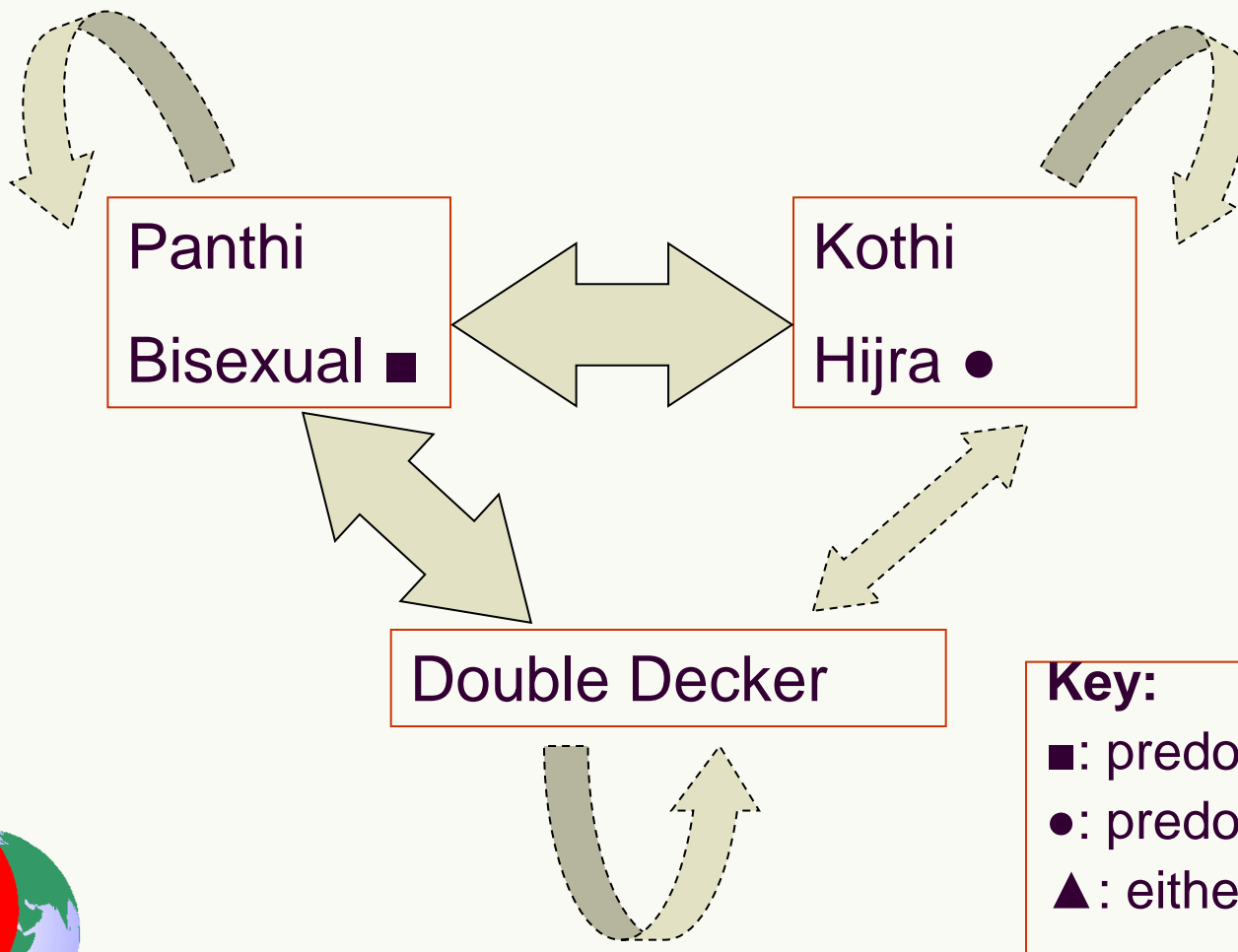
3

# Methods: model building, parameterisation and fitting

- A deterministic compartmental model has been developed

- The model:

    - simulates joint transmission dynamics of HIV, herpes and syphilis

    - incorporates 3 behavioural subgroups of MSM in a Southern Indian setting

    - is parameterised and fitted to setting-specific behavioural and epidemiological data with non-setting-specific biological parameters being derived from the literature

4

# Methods: sexual interactions between MSM identity subgroups

Panthi

Bisexual ■

Kothi

Hijra ●

Double Decker

**Key:**

■: predominantly insertive

●: predominantly receptive

▲ : either insertive or receptive

# Bangalore preliminary data analysis for model parameterisation: prevalence

|  | Panthi / Bisexual | Kothi / Hijra | Double Decker | **All MSM** |
|---|---|---|---|---|
| HIV seroprevalence in IBBA (2005) | 13% | 23% | 13% | **18%** |
| Syphilis seroprevalence in IBBA (2005) | 8% | 13% | 9% | **12%** |
| HSV-2 seroprevalence in IBBA (2005) | 30% | 39% | 27% | **36%** |

The Bangalore data were collected as part of the monitoring and evaluation of Avahan, the multisite HIV prevention intervention funded by the Bill & Melinda Gates Foundation

6

# Bangalore preliminary data analysis for model parameterisation: reported behaviour
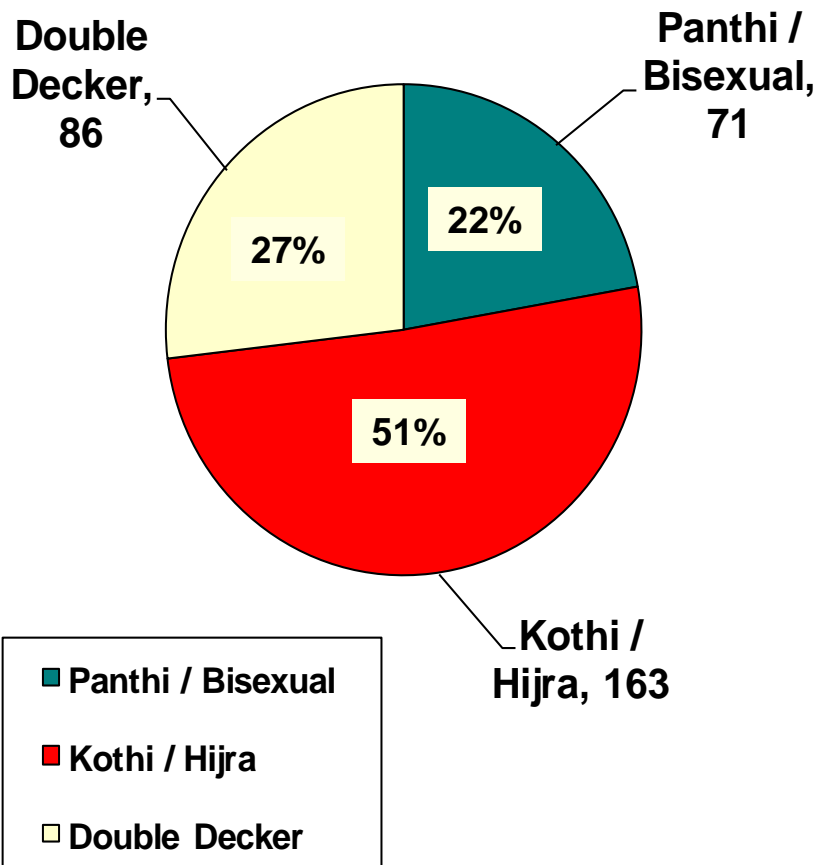
|  | Panthi / Bisexual | Kothi / Hijra | Double Decker | **All MSM** |
|---|---|---|---|---|
| Average no. of partners per month (IBBA) | 9 | 57 | 19 | **36** |
| Proportion of sex acts that are insertive (IBBA) | 73% | 8% | 12% | **23%** |
| Proportion of sex acts protected by condom (IBBA) | 59% | 76% | 65% | **69%** |
| Proportion of MSM ever having had sex with female (IBBA) | 89% | 34% | 69% | **56%** |

The Bangalore data were collected as part of the monitoring and evaluation of Avahan, the multisite HIV prevention intervention funded by the Bill & Melinda Gates Foundation

7

# Bangalore preliminary data analysis for model parameterisation: population sizes



**Double Decker, 86**

**Panthi / Bisexual, 71**

22%

27%

51%

**Kothi / Hijra, 163**

Legend:
- ■ Panthi / Bisexual
- ■ Kothi / Hijra
- □ Double Decker

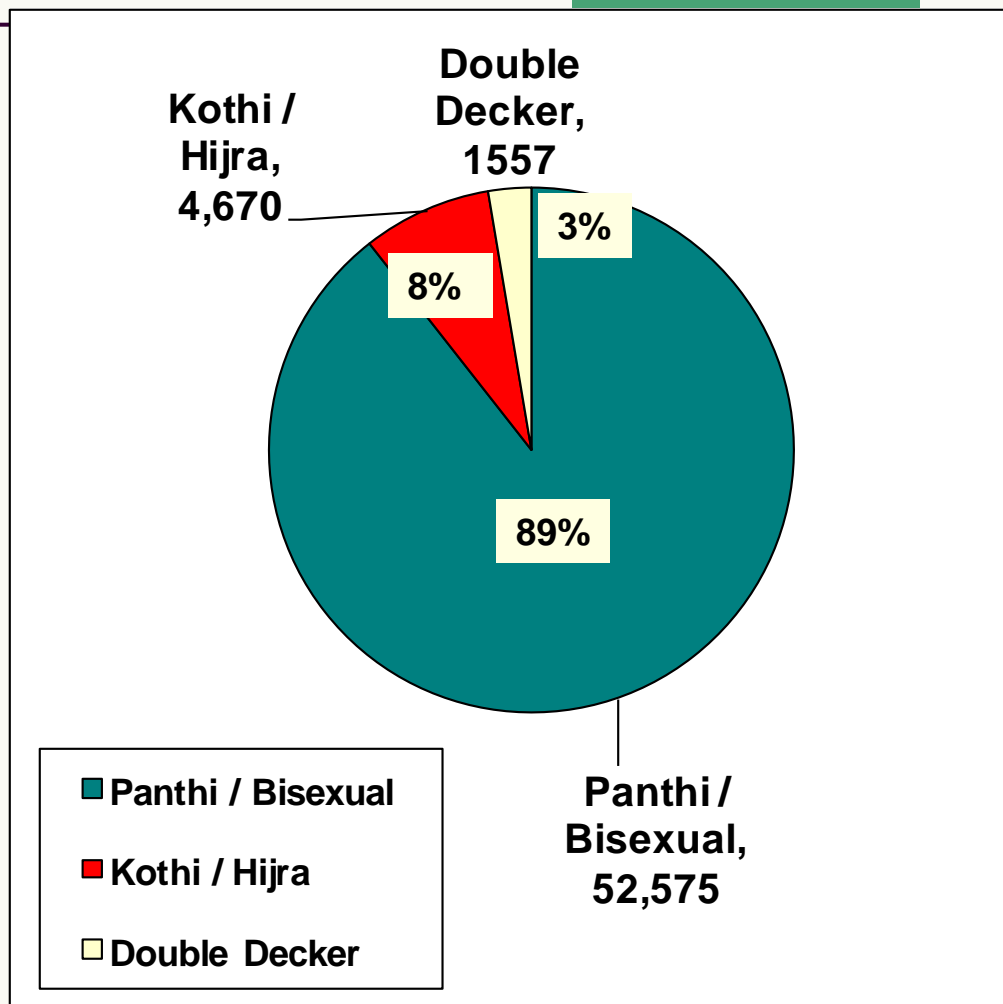**Number of MSM of each subgroup in Bangalore IBBA sample**

- Initial insights into the MSM population in Bangalore came from IBBA

- Need to estimate size of 'hidden MSM' population, by identity subgroup

- IBBA over-representative of high-risk, predominantly receptive, MSM

8

- Estimated number of Kothi, Hijra and Double Decker from Sangama MSM programme

- Used IBBA ratio of Kothi / Hijra to Double Decker

- Calculated ratio of number of partners per month, assuming Panthi / Bisexual are mostly clients of Kothi / Hijra



Kothi / Hijra, 4,670

Double Decker, 1557

Panthi / Bisexual, 52,575

8%

3%

89%

Legend:
- Panthi / Bisexual
- Kothi / Hijra
- Double Decker

**Estimated total number of MSM of each subgroup in Bangalore Urban**

# Sampling, behaviour and reporting issues

- Estimating number and behaviour of 'hidden MSM', and HIV prevalence among those not included in the high-risk MSM IBBA sample

- Fluidity of identity groupings according to situation / specific partner

- Movement between identity subgroups over time

- Possibly some disparities between reported identity and behaviour

- Reporting bias

# Conceptual framework for types of parameters and forms of parameter uncertainty

**Parameters specific to intervention**

- HIV- and STI- efficacy of new intervention

- Coverage & use of new intervention
- Sexual behaviour & use of pre-existing methods (after)

**Setting-specific parameters**

- HIV/STI prevalence
- When/how HIV/STI entered
- Sexual behaviour (before)
- Size of population groups, and mobility and mortality
- Levels of access/use of pre-existing methods (before)

- Existing STI treatment type/effectiveness
- Duration of STIs
- Natural history of HIV/STIs

**Biological parameters from literature**

- Condom efficacy
- Duration of initial HIV high viraemia
- HIV high viraemia cofactor
- HIV/STI transmission probabilities
- STI cofactor(s)

# Modelling issues

- 3 sexual behavioural subgroups and 2 roles in anal sex
  - Lack of data on who has sex with whom
- Handling uncertainty:
  - Identify several model fits to evaluate the uncertainty in the projections
  - Model validation
  - Scenarios analysis for intervention parameters
  - Conduct multivariate sensitivity analysis to explore robustness of findings

12

# Next steps

- Estimate the contribution from each subgroup to the HIV epidemic among MSM

- Model potential impact of interventions reaching different subgroups of MSM

  - Impact among MSM

  - Impact among female partners of MSM

- Parallel analysis using data from Peru

- Further explore importance of MSM behavioural heterogeneity for HIV epidemic in Bangalore, and implications for future research and prevention priorities

13

# **Acknowledgements**

- **Collaborators:**
  - London School of Hygiene & Tropical Medicine, UK
  - Imperial College London, UK
  - Sangama NGO, Bangalore, India
  - Karnataka Health Promotion Trust, Bangalore, India
  - University of Manitoba, Winnipeg, Canada
  - St. John's Medical College and Hospital, Bangalore, India
  - Health Protection Agency, London, UK
  - Centre hospitalier affilié universitaire de Québec and Université Laval, Canada

- **Funders:**
  - Support for this research has been provided by amfAR, The American Foundation for AIDS Research
  - Some authors/coauthors also members of DFID-funded RPC
  - Conference fees funded by Centre for Mathematical Modelling of Infectious Diseases, LSHTM

www.hivtools.lshtm.ac.uk