# Modeling population viral load metrics for monitoring impact of treatment as prevention

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### Background

- Population viral load (VL) measures are used to assess the impact of antiretroviral treatment (ART) as prevention on HIV transmission (guidelines by CDC, 2011)
- Conclusions regarding their correlation with trends in incidence are controversial (Miller et al 2013)
- Interpretation of these measures is difficult because of methodological uncertainties and sampling biases due to hidden populations (undiagnosed and persons with primary infection)

### **Methods**

- Sexual transmission model for HIV infection, diagnosis and treatment
- 2 epidemiological scenarios: generalized epidemic in sub-Saharan Africa (SSA) and concentrated epidemic among men who have sex with men (MSM) in Western Europe (WE)
- Different parameters: average time to diagnosis in chronic infection, annual dropout percentage, HIV prevalence before ART, VL in primary infection birth



VL measures:

population VL (PVL), community VL (CVL), monitored VL (MVL)

2 methods of	averaging	of individual	VLS

notation	definition
$\mathrm{PVL}_{\mathrm{N}}$	$\sum_{k=1}^{4} \left( VLI_k \times I_k + VLD_k \times D_k + VLA_k \times A_k \right) / N$
$\mathrm{CVL}_{\mathrm{N}}$	$\sum_{k=1}^{4} \left( VLD_k \times D_k + VLA_k \times A_k \right) / N$
$\mathrm{MVL}_{N}$	$\sum_{k=1}^{4} (VLA_k \times A_k)/N$
$\mathrm{PVL}_{\mathrm{IDA}}$	$\sum_{k=1}^{4} \left( VLI_{k} \times I_{k} + VLD_{k} \times D_{k} + VLA_{k} \times A_{k} \right) / \sum_{k=1}^{4} \left( I_{k} + D_{k} + A_{k} \right)$
$\mathrm{CVL}_\mathrm{DA}$	$\sum_{k=1}^{4} \left( VLD_k \times D_k + VLA_k \times A_k \right) / \sum_{k=1}^{4} \left( D_k + A_k \right)$

Relative contributions of infected subgroups to PVL









#### Association between HIV incidence and MVL





### Results

Time dependent dynamics of VL measures



## Conclusions

- Temporal dynamics of PVL, CVL, MVL are complex and depend on timinas of different interventions
- Relative contributions of infected subgroups and infection stages to these measures are independent of the methodology
- Relative contribution of undiagnosed population to PVL is twice higher for SSA than for WE (34% and 16%)
- Reductions in MVL and incidence may have the same but also opposite trends
- MVL is not a key determinant of HIV incidence
- Other measures (e.g. % of individuals with VL above 400 cp/mL) might be more useful for surveillance purposes

References: CDC, Guidance on community viral load, 2011 Miller, Powers, Smith, Cohen, Lancet Inf Dis 13, 459, 2013

