Advancing Public Health Surveillance for HIV in an Era of Epidemic Control

Dr. Hank Tomlinson | July 20, 2018
Public Health Surveillance

- Informs **epidemiology**: burden, distribution, and transmission dynamics of disease in populations
- Informs **response**: resource allocation, program planning and implementation, outcomes & impact assessment
- Multiple methods needed to provide complementary data
  - Examples in HIV surveillance:
    - Population data derived from cross-sectional surveys
      - Population-based HIV Impact Assessments
      - Key/Priority Population Surveys
    - Clinical data derived from patient records & registers for case-based surveillance
Evolution of Global HIV Surveillance

1990

- Knowledge, Attitudes, Practices (KAP) Surveys in General and Targeted Populations

2000

- Addition of HIV testing to General Household-Based Population Surveys

2010

- Return of HIV Test Results within Surveys and Surveillance
- ACASI for Key Topics in Surveys

2020

- Additional Biomarkers in Gen Pop Surveys, with Return of Results & Linkage to Care
- Additional Biomarkers in Key Pop Surveys, Return of Results & Linkage to Care

CLINICAL

- ANC Sentinel Surveillance (with Unlinked Anonymous Testing (UAT))
- Expansion of HIV Programs and Routinely Collected Services Data
- Expanded Use of Routine Service Data for Surveillance
- Systematizing HIV Case Surveillance, Building on Routine Service Data, with Rapid Recency Testing

Improvement in Epidemic Modelling, Estimates & Projections
Evolution of Global HIV Surveillance

Preparing for an Era of Epidemic Control

**Epidemic Control:**
- Fewer new HIV infections,
- All new PLHIV started on ART
- High ART coverage among all PLHIV
- High quality programs focused on
  - Gaps and solutions
  - Targeting geographies and populations

**Surveillance informing Epidemic Control**
- Periodic population measures
  - Behavioral/clinical and biomarker
  - General and key populations
- High quality clinical data, case-based surveillance
- Sustainable information systems
- Strengthened, sustainable country capacities
Evolution of Global HIV Surveillance

Increasing demand and complexity requires country capacity in integrated areas: including surveillance, laboratory, information systems, and program response.
Evolution of Global HIV Surveillance

• Within PEPFAR, CDC was invited to marshal its integrated expertise

• PEPFAR special initiatives in:
  o Population-based HIV Surveys
  o Routine Case-based Surveillance
  o Integrating Rapid Recency Testing into Routine HIV Testing and Case-based Surveillance

• Operationalizing global HIV surveillance guidance in collaboration with multilateral organizations - WHO, UNAIDS

• Close relationships with Ministries of Health and indigenous partners
Population-based HIV Surveys

Building on experience in Kenya with KAIS

- HIV Incidence/Prevalence
  - Adults
  - Children
- Program impact
  - Prevention
    - HTC
    - Injection safety
    - PMTCT
  - Care and treatment
    - ART program
    - HIV care
    - TB/HIV
- OVC
- Key Populations

*Note: Incidence estimation is not a primary objective for countries with lower prevalence (<3%)

http://journals.lww.com/jaids/toc/2014/05011
Population-based HIV Surveys

**Design:**
- General population household-based cluster surveys
- Estimate impact of HIV programs at population level
- Questionnaires include behavioral measures and uptake of HIV services and interventions
- Biomarkers include HIV diagnostic testing, CD4, viral load, HIV recency
- Sample sizes typically:
  - ~15,000 households
  - ~35,000 adults and children

**Primary Objectives:**
- Estimate national HIV incidence among adults, age 15 y and above*
- Estimate national and subnational prevalence of viral load suppression (HIV RNA <1000 c/ml) among adults

**Secondary Objectives:**
- Estimate national and subnational HIV prevalence among adults
- Estimate national HIV prevalence among children, 0–14 y
- Describe uptake of HIV testing and ART services among PLHIV
- Describe CD4 count, detectable ARVs, transmitted drug resistance among PLHIV

*Note: Incidence estimation is not a primary objective for countries with lower prevalence (<3%)
ICAP PHIA project includes:
Malawi, Zimbabwe, Zambia, Swaziland, Lesotho, Uganda, Tanzania, Namibia, Cameroon, Cote d’Ivoire, Ethiopia, Kenya, Haiti, Rwanda

Additional surveys:
* South Africa (HSRC)
* Nigeria (Univ of Maryland)
* Botswana

Year of Implementation
- 2015-16
- 2016-17
- 2017-18
- 2018-19
Complexity of Population-based HIV Surveys

- Household-based biomarker surveys
- Collection, processing, transport and storage of ~25,000-30,000 blood specimens (venous draw)
- Aliquoted in ~100,000+ vials of plasma + ~50,000+ DBS cards/survey
- Multi-level specimen handling, testing, labeling and data entry
- Attention to specimen integrity plus data integrity, across survey & lab
- **Survey main objectives rely on high quality laboratory data**
- Training, training, training…
- Return of results in the household
- Active linkage to treatment
Population-based HIV Surveys

Selected other HIV and non-HIV measures

Voluntary Medical Male Circumcision (VMMC)

Sexual Violence

VIOLENCE IN LESOTHO

HIV prevalence among women who have been physically forced to have sex (39.3%) is higher than in those who have not been physically forced (31%).

(Source: SHIMS2 Summary Sheet)

(Source: LePHIA Summary Sheet)
Selected other HIV and non-HIV measures

**Syphilis**

(Syphilis Prevalence Among Adults, by Sex)

(Source: ZIMPHIA Summary Sheet)

**Cervical Cancer**

IAS 2018 Poster: Cervical cancer screening and prevalence and treatment of cervical abnormality in women living with HIV: Results from the Malawi Population-based HIV Impact Assessment (MPHIA) 2015-16
Population-based HIV Surveys

Selected other HIV and non-HIV measures

Hepatitis B

Prevalence of Hepatitis B Virus, by Sex, Age and HIV Status

Among adults ages 15 to 59 years, prevalence of infection with hepatitis B virus (HBV) is higher among HIV-positive (71%) than HIV-negative (54%) adults. Among children ages 0 to 14 years, HBV infection is more prevalent among HIV-positive (52%) than HIV-negative (13%) children. Prevalence of HBV is especially high among HIV-positive males ages 15 to 59 years (10%).

Hepatitis B virus testing was conducted in each household using a serological hepatitis B surface antigen (HBsAg) rapid diagnostic test, which helps to diagnose acute infection and confirm chronic infection.

Prevalence of Chronic Active Hepatitis B, by Sex, Age, and HIV Status

This also tested a subset of participants for hepatitis B surface antigen to get a national estimate of chronic active hepatitis B prevalence. Among adults ages 15-64, prevalence of active hepatitis B infection is similar among HIV positive and HIV negative individuals. Although the estimate for HIV positive individuals (5.2 percent) is slightly higher compared with HIV negative individuals (3.6 percent), the estimates are not statistically different. These are the first national estimates of the prevalence of chronic active hepatitis B in Tanzania and will be foundational for developing the national hepatitis response.

Prevalence of Hepatitis B Surface Antigen Among Persons Aged 0-64, by Region

Hepatitis B testing was conducted using a serological rapid diagnostic test for the hepatitis B surface antigen. The seroprevalence of hepatitis B surface antigen among persons aged 0-64 varies across Uganda, from 0.8% in South-West region to 4.6% in Mid-North region. The seroprevalence of hepatitis B surface antigen among adults aged 15 to 64 in Uganda is 4.1%. The prevalence is 5.4% and 3.0% in men and women aged 15-64, respectively. The prevalence is 0.7% and 0.6% in boys and girls, respectively, aged 0-14.

(Sources: ZAMPHIA Summary Sheet, UPHIA Summary Sheet, THIS Summary Sheet)
Population-based HIV Surveys

Specimen Repositories

- Survey repositories include dried blood spots (DBS) and plasma for all participants (who agreed to future testing)
  - 800,000 plasma aliquots
  - 400,000 DBS aliquots
- CDC working with Ministries of Health to develop repository use plans which reflect their public health needs
  - Nutrition/micronutrient studies (pediatric population)
  - Vaccine preventable diseases (antibodies)
  - Renal health
- Potential for future use in validation, evaluation, research:
  - New tests or technologies
  - Validation studies using DBS (comparing it to matched plasma)
Future Population-based HIV Surveys

• Repeat surveys in selected countries
  • Subnational focus where necessary, optimal

• Additional countries surveyed

• Explore additional efficiencies to reduce cost
  • E.g., Reduce time in household with shorter questionnaire

• New ways of assessing incidence

• Joint HIV/TB surveys

• Complementary use of other data sources
  • E.g., Maximize utility of case surveillance data to ensure linkage of newly diagnosed PLHIV to treatment
Measuring Incidence

As incidence declines, measuring change will become increasingly difficult

- Alternate measures such as population viremia are often closely correlated with HIV incidence

Explore possibilities of rapid recency test

- Potential for surveys as validation for use in surveillance and program
- May shorten time from data collection to dissemination

National: Male 30+ viremia vs. female 15-29 incidence

\[ y = 0.6904x - 0.6113 \]

\[ R^2 = 0.91517 \]

*Incidence and Viral load data from 7 PHIA surveys
Joint TB-HIV Surveys

- **Design**
  - Cross-sectional single-stage cluster sampling design
    - Enumeration area = primary sampling unit; all/most households eligible
  - Data collection at “hub” (TB survey design)
  - Include all ages (TB surveys exclude children)
  - HIV-related data and biomarker measures added for all participants (irrespective of TB signs/symptoms)

- **Pilot in South Africa (2018)**
  - Evaluate survey uptake of combined HIV and TB measures
  - Evaluate interview and biomarker data quality
  - Estimate approximate costs of a joint TB/HIV survey
  - Document lessons learned to inform scale-up of joint surveys in the future

- **Botswana**: Planning joint design for BAIS-V (2018)
ALL COUNTRIES SHOULD:

• Conduct biobehavioral surveys (BBS) regardless of epidemic setting

• Regularly update population size estimates

• Detailed guidance is provided in the new *Biobehavioral Survey Guidelines for Populations at Risk for HIV* ("Blue Book") released in late-2017

• Also see the BBS section of the PEPFAR FY18 COP guidance (section 9.4.6, page 328)

• One-stop comprehensive resource for how to plan, implement, and use findings from biobehavioral surveys (BBS) and population size estimation (PSE)

• Developed by CDC in partnership with USG partners in PEPFAR, WHO, UNAIDS, FHI 360, and other collaborators
Population Size Estimation (PSE)

• Key population denominators difficult to ascertain, often of questionable quality
  • CDC promotes use of methods based on empirical data collection and sound statistical concepts

• Ongoing efforts to improve quality of PSE:
  • Development of training materials, technical guidance
  • Operational research into advanced PSE methods: Three source capture recapture
  • Inclusion of Network Scale Up Method in select gen pop household surveys
HIV Case Reporting and Case-based Surveillance

- **HIV Case Reporting**
  - Individual-level reporting of newly HIV diagnosed cases to a public health authority

- **HIV Case-based Surveillance (CBS)**
  - Initial HIV case report **AND** subsequent reporting of sentinel events
  - Individual-level de-duplicated data on a national cohort of diagnosed PLHIV to monitor epidemic trends, determinants of infection, and program impact

- **Geographic coverage**
  - National or sub-national

- **Frequency**
  - Ongoing, with monthly, quarterly, or annual reports

WHO consolidated guidelines (June 2017)

Key Clinical Surveillance Data Points Along the Course of HIV Disease

- Diagnose HIV infection earlier, with same-day start on treatment
- Measure and track sentinel events over the course of disease
- Routine, ‘real-time’ use of case-based data

**HIV infection**

- **Primary Prevention**
- **Secondary and Tertiary Prevention**

**Advanced HIV**

**Death**

**Information on uninfected persons**
- Number at risk
- Demographics
- Risk behaviors
- Use of prevention interventions

**Information at HIV diagnosis**
- Demographics
- Number recently infected
- Exposed partners and children
- Mode of transmission
- Linkage to care/treatment
- Use of prevention interventions

**Information among HIV+ persons**
- Characteristics
- Disease progression
- Exposed partners and children
- Linkage to care/treatment
- Retention in care
- Receipt of recommended services
- Treatment outcomes (viral load)

**Mortality among HIV+ persons**
- Vital statistics for HIV and non-HIV causes
Integrating Rapid Recent Infection Testing in HIV Testing Services for Real-time Surveillance and Response

**Background**
- Lack of data to monitor trends and determinants of recent infection to guide HIV programming

**Objectives**
- Implement surveillance of ongoing transmission to direct a rapid response
- Monitor trends in recent infection and identify hot-spots of recent transmission

**Design considerations**
- Newly diagnosed HTS clients consent to recency testing, with or without a questionnaire
- Blood specimens tested with a rapid recency assay, confirmed with viral load test
- Results returned to clients with counselling
- Integrate into HIV case reporting systems where feasible
## Integrating Rapid Recent Infection Testing

### Rapid Recency Assay Field Evaluations, Fiscal Year 2018

<table>
<thead>
<tr>
<th>Activity</th>
<th>Country</th>
<th>Description</th>
<th>Results returned?</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field assay validation</td>
<td>Vietnam</td>
<td>Comparison of HIV rapid recency results with LAg and confirmed HIV test results using stored samples from HIV testing sites</td>
<td>No</td>
<td>Complete</td>
</tr>
<tr>
<td></td>
<td>Malawi</td>
<td>Comparison of HIV rapid recency results with LAg results in the central laboratory using samples from the DREAMS recency study</td>
<td>LAg results returned; Asante results not returned</td>
<td>Ongoing</td>
</tr>
<tr>
<td>Application in surveys</td>
<td>Ukraine</td>
<td>Application in 2017 IBBS</td>
<td>Asante test results returned, prior to VL testing</td>
<td>VL testing ongoing</td>
</tr>
<tr>
<td></td>
<td>Vietnam</td>
<td>Application in MSM cohort study – testing of stored samples</td>
<td>No</td>
<td>Analysis ongoing</td>
</tr>
<tr>
<td>Application in routine HIV testing services and use of data for surveillance and program improvement</td>
<td>Malawi</td>
<td>Application of test for newly diagnosed pregnant AGYW attending first ANC visit in Lilongwe, Blantyre, Zomba, and Machinga routine ANC testing</td>
<td>Yes</td>
<td>Ongoing</td>
</tr>
<tr>
<td></td>
<td>Central America</td>
<td>Integration into routine HTS for MSM and TG attending VICITS clinics; Integration into national HIV case reporting</td>
<td>Yes</td>
<td>Ongoing</td>
</tr>
<tr>
<td></td>
<td>Rwanda</td>
<td>Implementation at point of ART registration for newly diagnosed in 23 facilities in Kigali; Integration into HIV case-based surveillance</td>
<td>Yes</td>
<td>TOT complete April 2018 Planned implementation in May</td>
</tr>
<tr>
<td></td>
<td>Vietnam</td>
<td>Integration into routine HTS; Emergency Operations Center for recency data management</td>
<td>No</td>
<td>TOT in April 2018 Planned for June 2018</td>
</tr>
</tbody>
</table>
The Way Forward

General Population HIV Surveys (~20 PEPFAR Standard Countries)

- Repeat surveys in prior countries, with subnational focus where optimal
- Support conduct of surveys in additional countries

Key Population HIV Surveys

- Ensure all surveys conducted to new BBS guidelines
- Support use of population size estimation methods based on data and sound statistical concepts

Case-based HIV Surveillance (CBS)

- Provide technical assistance to country development of case-based surveillance systems
  - Prioritizing countries at/near epidemic control, with appropriate governance and capacity

Integrating Rapid Recency in Routine HIV Testing and CBS

- Focus on countries highlighted in PEPFAR Epidemic Control Strategy
Thank You!