Multiplier Methods With Respondent Driven Sampling (RDS) Surveys

Dimitri Prybylski, PhD, MPH
Epidemiologist
U.S. CDC Thailand Global AIDS Program Asia Regional Office

Slides are based largely on slides prepared by Dr. Lisa Johnston and borrowed from University of California, San Francisco, Global Health Sciences

Key Population Size Estimation Guidelines

Download these great resources and other useful information from www.aidsdatahub.org

Population Size Estimates for Different Purposes

1. Know Your Epidemic Analysis

2. National Level Geographic Prioritization

3. Local Level Program Planning and Budgeting

4. Measuring Program Coverage

5. Estimates and Projections

6. Aggregating data for national level indicators

Population size estimation should be integral function of surveillance systems

• How many of you have done an IBBS survey in a population where you had no estimate of the population size?

• Relatively straightforward to integrate PSE into RDS surveys (BSS or IBBS)

• Size estimates are what make the prevalence and behavioral data relevant
Overview of Direct Population Size Estimation Methods

Mapping-based methods
- "Census"
- Enumeration

Survey-based methods
- Multiplier with probability surveys
- Capture-Recapture
- Network Scale-up

Service data
- Unique object

Source: UNAIDS/WHO Working Group on Global HIV/AIDS and STI surveillance. Guidelines on estimating the size of populations most at risk for HIV.

Two types of Multipliers commonly used with RDS

- Service Multiplier
- Unique Object Multiplier

Multiplier Method Assumptions

- No individual accounted more than once in each multiplier (non-duplicated data)
- Limited in and out migration
- Two data sources are independent of each other (i.e., inclusion in one is not related to inclusion in the other)
- Data source (the survey) is representative of the hidden population
- Service population is entirely contained within the RDS survey target population

Multiplier Formula

\[ S = \frac{N}{P} \]

- \( S \) = size of population
- \( N \) = number of population accessing service
- \( P \) = RDS weighted proportion in the survey attending service (based on response to questions)

If using RDS, you would use the weighted proportion for \( P \). For 95% CI use those generated with the weighted proportions.

Service Multiplier Method in Practice

Data needed:

1. **Count of the population from the service delivery point:**
   - Good quality data (know this in advance!)
   - Unduplicated total number of the population
   - During a specified time period
   - Distinguish member from non-member of the population

2. **Proportion of population attending the service from the survey:**
   - During a specified time period
   - Use median interview date as reference end date
   - RDS survey ‘service exposure’ questions need to be clearly stated and should be piloted

How to obtain data needed:

1. **Data from service X:**
   - Number of FSW who received an HIV test between May 1, 2011 and April 30, 2012.
   - FSW are described as females, 18 years and above, who sold sex in exchange for money with more than one client in the past 6 months and reside or sell sex in City Z.

2. **Data from survey:**
   - Description of FSW used above.
   - Survey question: “Did you receive an HIV test from service X between May 1, 2011 and April 30, 2012?”

Data Collected to Estimate Population Sizes of PWID - Chiang Mai and Bangkok

<table>
<thead>
<tr>
<th>City</th>
<th>Service provider, project, facility</th>
<th>Number of clients or one time visits¹</th>
<th>Percent reporting visit (95% CI)²</th>
<th>Size of the population (S), (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bangkok</td>
<td>Tenofovir study</td>
<td>1,886</td>
<td>44.9 (37.7, 49.9)</td>
<td>4,200 (3,780 – 5,003)</td>
</tr>
<tr>
<td>Chiang Mai</td>
<td>Suboxone study</td>
<td>69</td>
<td>11.5 (2.9, 23.2)</td>
<td>600 (297 – 2,380)</td>
</tr>
<tr>
<td></td>
<td>Famai methadone clinic</td>
<td>48</td>
<td>3.2 (0.8, 6.6)</td>
<td>1,500 (727 – 6,000)</td>
</tr>
</tbody>
</table>

¹ Provided by services; ² Collected during RDS survey

**Data Collected to Estimate Population Sizes of PWID - Mauritius 2009 (n=511)**

<table>
<thead>
<tr>
<th>Service provider</th>
<th># of clients (counted one time)</th>
<th>% reporting visit (95% CI), n</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Centre de Solidarite</td>
<td>376</td>
<td>3.6 (1.6, 6.0), 17</td>
<td>0.011</td>
</tr>
<tr>
<td>Help de-addiction</td>
<td>929</td>
<td>16.3 (11.6, 21.6), 79</td>
<td>0.025</td>
</tr>
<tr>
<td>Sewa Sadan Sangram</td>
<td>980</td>
<td>9.5 (5.6, 13.7), 44</td>
<td>0.021</td>
</tr>
<tr>
<td>Dr. I. Goomany Centre</td>
<td>1,221</td>
<td>17.0 (12.7, 21.5), 93</td>
<td>0.023</td>
</tr>
<tr>
<td>Needle exchange</td>
<td>5,000</td>
<td>56.4 (50.1, 62.7), 299</td>
<td>0.031</td>
</tr>
</tbody>
</table>

1. Provided by services; 2. Collected during RDS survey  


**Possible sources of “benchmarks” or “multipliers” for PWID**

<table>
<thead>
<tr>
<th>Data Source</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drug treatment programs</td>
<td>In and out of detoxification, methadone</td>
</tr>
<tr>
<td>Police, incarceration</td>
<td>Arrested, registered, on probation</td>
</tr>
<tr>
<td>Hospital</td>
<td>Overdose, wound care, ER mention</td>
</tr>
<tr>
<td>HIV care</td>
<td>Clinic registries, surveillance cases</td>
</tr>
<tr>
<td>Prevention services</td>
<td>Needle-exchange, outreach contact, VCT</td>
</tr>
<tr>
<td>Testing, laboratories</td>
<td>HIV, HCV, HBV testing</td>
</tr>
<tr>
<td>Social services</td>
<td>Case management, housing, referrals</td>
</tr>
<tr>
<td>Research</td>
<td>Recent or on-going studies of IDU</td>
</tr>
</tbody>
</table>

Be creative! Brainstorm for your country

**Possible sources of “benchmarks” or “multipliers” for FSW**

<table>
<thead>
<tr>
<th>Data Source</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>STD, Social Hygiene Clinics</td>
<td>Identified as FSW, registered</td>
</tr>
<tr>
<td>Police, incarceration</td>
<td>Arrested, registered, on probation</td>
</tr>
<tr>
<td>Entertainment center, brothel</td>
<td>Listed as employee</td>
</tr>
<tr>
<td>HIV care</td>
<td>Clinic registries, surveillance cases</td>
</tr>
<tr>
<td>Prevention services</td>
<td>Outreach contact</td>
</tr>
<tr>
<td>Testing, laboratories</td>
<td>HIV</td>
</tr>
<tr>
<td>Unions, NGOs, social clubs</td>
<td>Member on list</td>
</tr>
<tr>
<td>Research</td>
<td>Recent or on-going studies of FSW</td>
</tr>
</tbody>
</table>

Be creative! Brainstorm for your country

Research Centre for Health Economics and Evaluation (ReCHEE)
Possible sources of “benchmarks” or “multipliers” for MSM

<table>
<thead>
<tr>
<th>Data Source</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>STD</td>
<td>Identified MSM, rectal or pharyngeal sites</td>
</tr>
<tr>
<td>Police, incarceration</td>
<td>Arrested for male-male sex, MSW</td>
</tr>
<tr>
<td>Sex worker study</td>
<td>Male sex worker</td>
</tr>
<tr>
<td>HIV care</td>
<td>Clinic registries, surveillance cases</td>
</tr>
<tr>
<td>Prevention services</td>
<td>Outreach contact</td>
</tr>
<tr>
<td>Testing, laboratories</td>
<td>HIV, extra-urethral STI</td>
</tr>
<tr>
<td>Activists, NGOs, social clubs</td>
<td>Member on list</td>
</tr>
<tr>
<td>Research</td>
<td>Recent or on-going studies of MSM</td>
</tr>
<tr>
<td>Be creative!</td>
<td>Brainstorm for your country</td>
</tr>
</tbody>
</table>

Concerns about Multiplier Method

- Highly dependent on availability and quality of data collected for other purposes (service data)
- May require expert knowledge of the services and the population to assess bias
- Positive correlation between the survey and service data sources tends to lead to underestimates of population size
- Never use as the truth....it is an estimate

Lessons learned using SMM

- Work with services to manage the collection of data from clients and to be able to count each client one time
- Avoid non-independence of data sources
  - Do not conduct surveys in the same place from which you gather data
  - Make sure seeds are not only found through services from which you gather service data
  - Make sure to meet assumptions in the RDS survey to the extent possible
  - Use exact time frames in data collection (e.g., June 1 2010 to December 31, 2010 rather than the “preceding 6 months”)
- Use multiple multipliers and triangulate results
- Use a strategic consensus process with stakeholders and triangulate results from different PSE methods using different data sources

Unique Object Multiplier Method

1. Shortly before conducting a probability based survey, distribute an object to persons known to be part of the population
   - Object should be memorable, not of value and not label the person
   - Instruct persons not to give away the object to others
2. During the survey ask each participant if they received a unique object

\[ S = \frac{O}{P} \] (size = number of objects given out / proportion who reported getting one in the survey)
Unique object multiplier example

Estimate the size of the MSM population. Survey team distributes 400 special key chains to MSM two weeks before the survey starts. In the questionnaire, respondents asked if they received a key chain and are shown an example of the object. 10% of the survey respondents reported receiving the key chain. Using the multiplier formula:

\[ 0.10 = \frac{400}{\text{Total street based MSM}} \]

Total MSM = \frac{400}{0.1} = 4000

Capture-recapture vs. multiplier method

- In capture-recapture, both data sources must randomly sample from the population
  - Multiplier method requires one source be random
- In capture-recapture, you need names or other personal identifiers
  - Multiplier method does not need names or identifiers, just an unduplicated count or percent of members of the population from institutional source
- In capture-recapture, you need to match specific names in both sources or multiple sources
  - Multiplier method only needs count or percent

Additional tips for multiplier methods

- When should we give out the objects?
  - Close to the launch of the survey; Around 1-2 weeks before survey
- To whom?
  - Members of same population that will be sampled in the survey
  - Mix them across the area: do not run the risk of missing or recapturing a “clump”
- By whom?
  - Outreach workers, NGO personnel, interviewers for survey
  - Document how they were distributed, by whom, to whom, when
- Won’t people give the objects to other people?
  - Tell them not to!
  - Ask them from whom and where they got it from during the survey
  - Use the “red hat” method
- How many objects should we give out? (How many individuals need to be on the service list?)
  - More objects than the sample size for the survey
  - Consider a projected proportion of the target population
Conclusions, key points:

• The multiplier methods can strike a pragmatic balance of resources and theoretical rigor

• Service multiplier method less resource intensive and easier to conduct than object multiplier method

• But, vulnerable to key assumptions and many potential biases

• Conceive and use multiple multipliers of good quality

• Mapping and qualitative research is needed for all methods

Cutting edge new survey method: Hancock RDS PSE method

• Uses social network size data to estimate PSE by assuming the network size distribution of successive waves reflects a depletion of the population

• The estimates use a Bayesian framework
  • A “guess” or prior knowledge of the population size
  • RDS data – coupon information and network sizes
  • No other data sources
  • Gives point estimates and confidence intervals

• Need RDS Analyst software ([www.hpmrg.org](http://www.hpmrg.org)) – free public domain software


Thank you!