

MINISTRY OF EDUCATION AND TRAINING

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**ASSESSMENT OF SIZE ESTIMATION
METHODS OF HIV INFECTION HIGH
RISK POPULATIONS IN CAN THO**

Specialization: Epidemiology

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SUMMARY OF PHD DISSERTATION

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Epidemiology

ABBREVIATIONS

AIC	Akaike Information Criterion
IBBS	Integrated Behavioral and Biological Survey
CI	Confidence Interval
MARP	Most at risk population
PWID	People who inject drug
WB	World Bank study (the third data source)
CI	Confidence Interval
C-RC	Capture – recapture
OR	Odd Ratios
FSW	Female sex worker
TT05/06	Rehabilitation center
Var	Variance
VCT	Voluntary HIV counseling and testing

INTRODUCTION

Rationale of the study

HIV epidemic of a country is heavily influenced from populations most at risk to HIV (MARP), including people who inject drug (PWID) and female sex workers (FSW). With information on size estimation of MARP, epidemiologists can develop models of HIV estimates and projections, policy-makers can make plan for prevention, care and treatment activities and evaluate effectiveness of implemented programs.

There have been many surveys/studies measuring HIV prevalence and behaviors that spread HIV in Vietnam recently. However, the questions of how many PWID and FSW have not been addressed. The program has mainly used indirect data from different sources with varied values due to different data collection purposes and definition of populations, or not wide enough coverage.

With the need of population size estimation and method assessment, this study was conducted in Can Tho, a HIV focus city with varied data sources, small and undispersed geographical area for implementation, in order to achieve two following objectives:

1. Estimating the size of populations high risk to HIV (people who inject drug, female sex workers) applying different methods in Can Tho in 2012-2013;
2. Assessing reliability and feasibility of a number of methods to estimate the size of high risk to HIV populations.

New findings of the thesis

The study showed estimated number of PWID and FSW in Can Tho city with scientific evidence achieved. The consenting results were compared, triangulated among different methods and additional data sources, as well as received the consensus of experts in the field and locally.

This has been the first study so far to estimate the size of MARP in Vietnam applying different scientific methods and implementing at provincial level, which assessed reliability and feasibility of applied methods.

Scientific and practical meaning of the thesis

Thesis used modern, reliable research methods in estimating the size of high risk to HIV populations. Statistical techniques were applied when collecting and analyzing data to ensure accuracy, reliability, and representativeness of the studied populations. Since then, the study has come up with appropriate estimates and relevant evidence to evaluate each method used.

Estimated number of two populations PWID, FSW helps for the planning, implementation and evaluation of prevention, intervention activities in Can Tho city. Other provinces with similar conditions may also apply the methods that were assessed in this study.

Layout of the thesis

The main body of the thesis consists of 120 pages, not counting the cover pages, acknowledgement, table of contents, lists and annexes. Specifically, the sections are distributed as follows: Introduction 2 pages; Study objectives 1 page; Chapter

1–Overview 33 pages; Chapter 2–Methodology 17 pages; Chapter 3–Results 36 pages; Chapter 4–Discussion 30 pages; Conclusions 1 page; Recommendations 1 page, and List of publications 1 page.

The thesis has 47 tables, 2 figures and 8 pictures.

The appendix includes 117 references (34 in Vietnamese, 83 in English); 17 study tools (questionnaires, data collection forms and procedures).

CHAPTER 1: LITERATURE REVIEW

1.1. Overview of size estimation of high risk populations

Most-at-risk population to HIV is an important component of HIV surveillance. Most countries have developed surveillance systems for HIV/AIDS and behaviors but lacking the ability to estimate number of MARP. The guidelines for population size estimation were developed since 2003 and updated in 2010, in which many countries have adopted different methods, on different populations and in different context, conditions.

1.2. Methods of population size estimation

There are two categories of methods: methods based on data collected from an most-at-risk population and methods based on data collected from the general population.

1.2.1. Census and enumeration methods

Census methods try to count every individual in an at-risk population. Enumeration methods start with a sampling frame, count individuals in chosen units then scale up to the size from structure of the sample frame.

These are straightforward to calculate and easy to understand. Where a list or sampling frame exists and population of interest is well defined, accessible, the method is less time and resource-consuming. With hidden populations, dispersed geographical areas, the count cannot be completed and is expensive to conduct.

1.2.2. Nomination method

This method starts with a limited but visible and accessible part of a larger population. These persons are asked to refer other individuals who share their risk behavior and so on.

Nomination accesses to hidden populations. However, those populations tend to be highly connected, referrals may duplicate. This starts with visible members of the group who may not be representative of the complete population, a sample will over-represent those with large personal networks, and low level of interaction with other networks will be neglected in this type of sampling. The method is useful for conducting formative research as part of program development.

1.2.3. Capture – recapture method (C–RC)

This method bases on two independent sampling loops on the need to estimate population. Numbers of individuals sampled at one time, selected in a second and selected at both times are used to estimate the population size.

This is a more scientific method but relies on assumptions that are hard to meet (two samples must be independent and not correlated, each population member has an equal chance of selection, each member must be correctly identified as

‘capture’ or ‘recapture’, closed population, sample size of each capture must be large enough).

1.2.4. Multiplier

Multiplier relies on two data sources, usually from program data and representative surveys of target populations. Divide number who received service by proportion reporting receiving the service in survey to estimate the population size.

The method is straightforward with existing data. Method assumptions include: two data sources must be independent, the two populations for the data sources are equivalent, must have aligned time periods, age ranges and geographic areas. Data collected from existing sources may be inaccurate.

1.2.5. Surveys

To estimate size of hidden population, respondents in general household survey are asked if they have high risks.

Surveys are generally easy to implement, longstanding statistical methods, so results will be relatively easy to analyze and defend and are politically influential. Surveys are less useful when behavior is rare, those at risk may not be found in households. If behavior has been stigmatized within a society, respondents will be less truthful.

1.2.6. Network scale-up

This bases on household survey, asking about behavior of the people they know instead of asking participants' behavior. Estimate is based on average number of individuals the participants know and average personal network.

A single survey can be used to create size estimates for multiple hidden populations, and individuals more likely to

report behavior of others than their own behavior. Disadvantage of the method is that required adjustments for estimates are still being developed (barrier effect, transmission effect).

1.3. Size estimation method application in Vietnam

Currently in Vietnam, size estimation of high-risk populations has been relying mostly on the officially reported data, program approached data, and results from small-scale methods. These information sources are usually not sufficient in coverage, differently and inappropriately defined, or unreliable existing data for estimation.

1.4. Method selection for application

By excluding difficult-to-apply methods and prioritizing available data, three selected methods were police census (manage official data on social evils), multiplier (with multiple existing data sources), and capture-recapture (method activities can be managed).

CHAPTER 2: METHODOLOGY

2.1. Study subjects

PWID were male or female, 16 years old or more, injected drug in the last 1 month, and be present in Can Tho in the study period. FSW were female, 16 years old or more, sold sex in the last 12 months, and is present in Can Tho in the study period.

2.2. Study site: whole 9 districts (85 communes) in Can Tho.

2.3. Time period: 2011 – 2013.

2.4. Study design: cross-sectional and using secondary data.

2.5. Procedures

For objective 1

Multiplier method relied on two sources of data. The first source was a count from program data (number of PWID, FSW who received HIV testing and results at voluntary HIV counseling and testing (VCT) in the last 6 month; number of PWID, FSW who have been in 05/06 center (TT05/06). The second source was a representative survey of PWID, FSW. The surveys asked respondents whether they received the service (in the same period of time). Divide the number who received service by the proportion reporting receiving the service in the survey to estimate the population size. 95% confidence interval was calculated. The two data sources were screened and clarified for aligned time periods, age ranges and geographic areas.

Police census method invited 523 precinct police officers in Can Tho to participate. The managed, estimated numbers of PWID, FSW were collected through a short questionnaire auto-completed by the police officers. Study team collaborated with 9 district police departments to organize data collection sessions, ensuring proper and full participants.

Capture–recapture method conducted two independent cross-sectional samples. At capture round with chain-referral sampling method, 573 PWID and 605 FSW were distributed

unique objects. The recapture using time-location sampling method interviewed 406 PWID and 400 FSW.



Picture 2.2. Unique objects

Number of PWID, FSW captured (n_1), number of PWID, FSW recaptured (n_2) and number of PWID, FSW who were in both samples (m) were used to estimate the size (N):

$$N = (n_1 * n_2) / m; 95\% \text{ CI} = N \pm 1.96 \sqrt{\text{Var}(N)},$$

in which: $\text{Var}(N) = [n_1 \times n_2 \times (n_1 - m) \times (n_2 - m)] / [m^2 \times (m + 1)]$.

Mapping was a step to develop sampling frame for recapture round. Number of PWID, FSW derived from this process was used as reference figures triangulated with results of three main methods.

Results from different methods were compared, triangulated and discussed among local experts, since then agreed consenting results (median estimates and ranges).

For objective 2

The reliability of method was analyzed by evaluating differences between derived results and consolidated results, method assumptions achieved or not. The feasibility was assessed by analyzing advantages and disadvantages when implementing in the field, ability to overcome limitations, and resource used for each method.

To evaluate independence of the two samples of capture-recapture, a data source from a cross-sectional survey on PWID and FSW in Can Tho in the same period (WB study) was used, in which participants were asked if they received unique objects (in capture sample) and being interviewed (in recapture) previously. Two techniques used to analyze were Wittes (calculated Odds Ratio, independent if $OR=1$, dependent if $OR \sim 1$) and Log-linear modeling (found the optimal model based on p-value and Akaike Information Criterion (AIC)).

2.6. Ethical consideration

The study protocol and forms was reviewed and approved by the National Institute of Hygiene and Epidemiology Internal Review Board.

CHAPTER 3: RESULTS

3.1. Estimated size of PWID, FSW in Can Tho in 2012-2013

3.1.1. Results of multiplier method

Table 3.5: Results from VCT – Recapture multiplier

Indicators	PWID	FSW
Number of clients to VCT for HIV testing and received result in 3-8/2012	674	455
% of the recaptured came to VCT for HIV testing and received results in 3-8/2012	33%	62%
Average estimated size	2,017	737
Low estimated size	1,864	688
High estimated size	2,169	806

This multiplier estimated 2,017 PWID [1,864–2,169] and 737 FSWs [688–806].

Table 3.9: Results from TT05/06–IBBS multiplier

Indicators	PWID	FSW
Number of people ever been to Can Tho 05/06 center	1,268	306
% of IBBS participants ever been in Can Tho 05/06 center	45%	6%
Average estimated size	2,791	5,352
Low estimated size	2,634	4,752
High estimated size	2,949	5,951

Average, low and high PWID, FSW estimates were 2,791 [2,634–2,949], 5,352 [4,752–5,951] respectively.

3.1.2. Results of police census method

There were 1,201 drug users and 1,043 PWID in community estimated by participated precinct police officers.

High estimation of FSW was 809, 366 for low estimate and 535 on average in Can Tho.

3.1.3. Results of capture – recapture method

Table 3.19: Results from capture - recapture

Indicators	PWID	FSW
# people received object	547	590
# people interviewed	374	374
# people received object and interviewed	129	125
Average estimates	1.621	1.768
95% confident interval	1,423–1,818	1,545–1,992

Average estimates and 95% CIs of PWID and FSW were 1,621 [1,423–1,818] and 1,768 [1,545–1,992] respectively.

Table 3.20: Summary of results from applied methods

Methods	PWID	FSW
Police census	1,043	809
VCT–recapture multiplier	2,017 [1,864-2,169]	737 [668-806]
TT05/06–IBBS multiplier	2,791 [2,634-2,949]	5,352 [4,752-5,951]
Mapping	1,014-1,588	1,113-1,733
Capture – recapture	1,586 [1,393-1,779]	1,765 [1,542-1,989]

For PWID, multiplier method estimated the highest numbers, followed by C-RC, mapping, and police census. From highest to lowest estimates for FSW group were TT05/06–IBBS multiplier, C-RC, mapping, police census, and VCT–recapture multiplier.

3.1.4. Results of additional methods

High and low PWID estimates from mapping were 1,014–1,558, and 1,113–1,733 for FSW. When conducting Wisdom of the Crowd method, 12 local experts in Can Tho estimated 1,442 [1,000–2,000] for PWID and 1,771 [1,200–2,300] for FSW group.

3.2. Reliability and feasibility of the applied methods

3.2.1. Programmatic multiplier

Table 3.24: Differences between multiplier and consolidated results

Multipliers	Result	Distance	Difference
PWID			
VCT–recapture	2,017	417	26%
TT05/06–IBBS	2,791	1,191	74%

FSW			
VCT–recapture	737	-963	-57%
TT05/06–IBBS	5.352	3.652	215%

Results from multipliers for both groups were much different compared to the consolidated results (1,600 PWID, 1,700 FSWs).

Existing program data (VCT and TT05/06) was not sufficient enough in terms of coverage (especially for FSW group) and information for adjustment as required by the method assumptions.

The implementation process lasted in 15 days, equivalent to 45 person-days with a total budget of over 21 million dong.

3.2.2. Police census

This method had the process to ensure data coverage and to avoid data duplication and omission.

Table 3.27: Differences between police census and consolidated results

Police census	Result	Distance	Difference
PWID			
Managed in community	814	-786	-49%
Estimated in community	1,043	-557	-35%
FSW			
Managed in community	535	-1,165	-69%
Estimated in community	809	-891	-52%

The differences ranged from 35% (estimated PWID) to 69% (managed FSW).

The police census was conducted in 15 days, or 96 person-days, with 73 million dong.

3.2.3. Capture – recapture

Using the third data source (WB) to assess the independence of the two samples. Among 89 survey participating PWID, 48 respondents had received unique objects, 25 people were interviewed and 20 people were present at both rounds. Among 91 FSW, there were 42, 36, and 24 people participated in capture, recapture and both samples, respectively. Each data pair was calculated based on the C-RC formula to estimate the average results. Low and high estimates were given by calculating 95% confident interval.

Table 3.31: Results of data pairs – PWID group

		Recapture		
		+	-	
Capture	+	20	5	25
	-	28	36	
		48		89
				n1 = 547, n2 = 374, m = 129 Var = 9,685 SD = 98.4 N = 1,586 [1,393 – 1,779] OR = 5.1 [1.6 – 18.0]

		WB		
		+	-	
Recapture	+	20	28	48
	-	109	390	
		129		547
				n1 = 374, n2 = 89, m = 25 Var = 45,752 SD = 213.9 N = 1,331 [912 – 1,751] OR = 2.6 [1.4 – 5.1]

		Capture		
		+	-	
WB	+	20	109	129
	-	5	240	
		25		374
				n1 = 89, n2 = 547, m = 48 Var = 8,822 SD = 93.9 N = 1,014 [830 – 1,198] OR = 8.8 [3.0 – 27.6]

All 3 data pairs had OR which higher than 1, the most dependent sources (WB and Capture with highest OR=8.8) were merged, then repeated calculation of estimates with merged source and recapture, when $n_1=374$, $n_2=636$, $m=134$, calculated $N=1,775$ [1,562–1,988].

Table 3.32: Results of data pairs – FSW group

		Recapture			n1 = 590, n2 = 374, m = 125 Var = 12,977 SD = 113.9 N = 1,765 [1,542 – 1,989] OR = 4.1 [1.5 – 11.1]
		+	-		
Capture	+	24	12	36	
	-	18	37		
		42		91	

		WB			n1 = 374, n2 = 91, m = 36 Var = 13,194 SD = 114.9 N = 945 [720 – 1,171] OR = 5.9 [3.0 – 11.9]
		+	-		
Recapture	+	24	18	42	
	-	101	447		
		125		590	

		Capture			n1 = 91, n2 = 590, m = 42 Var = 19,007 SD = 137.9 N = 1,278 [1,008 – 1,549] OR = 4.7 [2.2 – 10.4]
		+	-		
WB	+	24	101	125	
	-	12	237		
		36		374	

For FSW group, the most dependent sources WB and Recapture (OR=5.9) were merged, then created a new data pair of WB/Recapture – Capture, with $n_1=590$, $n_2=465$, $m=143$, $N=1,919$ [1,692–2,146].

Results from Log-linear modeling in table 3.35 showed the estimates of hidden PWID, plus the number already know

PWID (740 participants in three data sources), from which, total PWID at low, average and high estimates were calculated. All model had similar estimates, with about 1,500 PWID. There was no model indicating independence of the data sources when all p values were lower than 0.05. The smallest AIC value was in P1xP3 model.

Table 3.35: Number of PWID estimated from each model

Model	Hidden	Total	Low est.	High est.
Independence	699	1,539	1,397	1,707
P1xP2	720	1,560	1,408	1,742
P2xP3	510	1,350	1,159	1,615
P1xP3	835	1,675	1,493	1,897
P1xP2+P2xP3	517	1,357	1,142	1,689
P1xP2+P1xP3	855	1,695	1,522	1,979
P1xP3+P2xP3	1,728	2,568	1,546	5,715
P1xP2+P1xP3+P2xP3	4,552	5,392	2,351	15,940

For FSW group, P1xP2 model had the lowest AIC value, with estimate of 1,770 people.

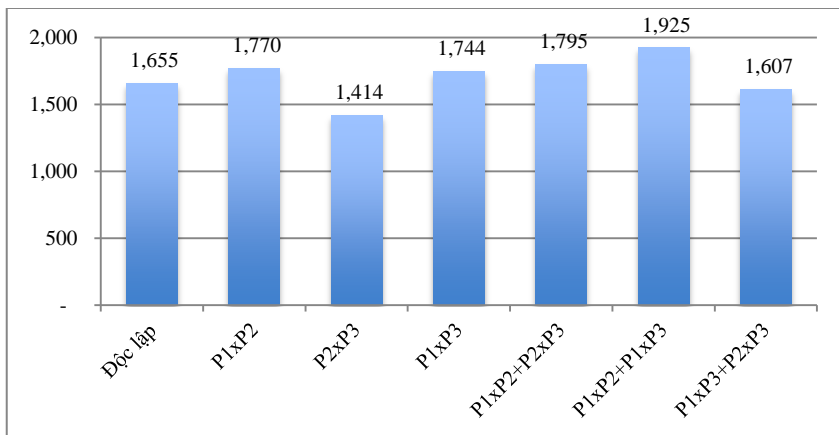


Figure 3.2: Number of FSW estimated from each model

Estimates of PWID with differences under 15% were two-data-source C–RC, three-data-source C–RC, optimal model. For FSW, these were also two-data-source C–RC, three-data-source C–RC, optimal model.

Table 3.36: Differences between C–RC and consolidated results

C – RC	Result	Distance	Difference
PWID			
Capture - recapture	1,586	-14	-1%
Capture - WB	1,014	-586	-37%
Recapture - WB	1,331	-269	-17%
Merged C–RC	1,775	175	11%
Optimal model	1,695	95	6%
FSW			
Capture - recapture	1,765	65	4%
Capture - WB	1,278	-422	-25%
Recapture - WB	945	-755	-44%
Merged C–RC	1,919	21	13%
Optimal model	1,770	70	4%

C–RC (including mapping process) was implemented in two months (603 person-days) with total 324 million dong.

CHAPTER 4: DISCUSSION

4.1. Estimated size of PWID, FSW in Can Tho in 2012-2013

4.1.1. Results from programmatic multiplier

Some method assumptions were met (aligned time periods, age ranges and geographic areas). PWIDs, FSWs received program services (VCT, TT05/06) and those did not have the same chance of being selected to surveys (RC, IBBS). RC and

IBBS were representative surveys. Program data collected from all VCT sites in Can Tho warranted the coverage.

The program data had limitation. There was not software and coding system for client management. Both VCT and TT05/06 data sources were counted as number of visits, not number of people, although some adjustments were done to correct a number of people but these were indirect methods. With self-reported VCT information of risk behaviors, large numbers of clients were classified into "other" category in the logbook. This was an important reason resulting much lower number of FSWs compared to other methods (737 FSWs). TT05/06 data was clarified to be equivalent with IBBS source but in reality some criterion such as "number of people" or "present in Can Tho" were difficult to achieve. Definition of population was not strictly equivalent, while RC and IBBS sampled PWIDs "who injected in the last month" and FSW "who sold sex in the last 12 months" but VCT and TT05/06 did not have this information. Characteristics of PWIDs and FSWs who were managed in TT05/06 differed from those participated in HIV/AIDS surveys, led to low chance of being selected in both data sources, resulted higher estimated size compared to other methods (2,791 PWIDs, 5,352 FSWs).

4.1.2. Results from police census

System, criteria, and number of precinct police officers in Can Tho were identified prior to method implementation to invite proper and enough participants, ensuring coverage and avoiding duplication, omission of data.

Several factors resulted in underestimates. The first was social desirability, police officers tended to report lower than the actual number. Data of sex work was not officially managed and only accessed to entertainment establishments such as restaurants, karaoke bars, massage and public venues of parks, streets, omitted some channels such as sex work via phone, internet. Estimated number of PWID from this method was not much different from the official reports (1,201 versus 1,187). Local experts also recognized that this result account for 70% the actual number.

4.1.3. Results from capture – recapture

Assumption "closed population" was met since the time between two samples capture and recapture was short, avoiding big events. Matching information could be identified by distributing and recapturing unique object. Both capture and recapture samples were random, representative and weights were used when analyzing data.

In fact, incentives and nice unique objects led to duplication samples. Recapture based on mapping frame reached only PWID and FSWs in hotspots, not hidden ones (41% of PWID said they usually inject at home).

Mapping results showed higher numbers than IBBS 2013 and program outreach data. This mapping exercise covered entire Can Tho city, not just in some sentinel districts as implemented before. According to the local experts, with small and undispersed geographic like Can Tho, estimates from mapping reflected the actual number. This mapping result primarily served to sampling frame rather than collecting

sufficient information for the purpose of size estimation of high-risk populations such as frequency and number of hotspots per week.

"Wisdom of the crowd" was conducted with 12 local experts showed relatively consistent estimate compared to the consenting results from different methods. An interesting thing of this method was that in the discussion although experts said high estimated number of FSW from police census (809 FSW) but when being asked to anonymously provide actual number of FSW, the lowest number was 1,200. The difference between providing estimate numbers in writing (anonymous) and officially reported figures reflected influence of "social desirability".

4.2. Reliability and feasibility of the methods

4.2.1. Programmatic multiplier method

Results of this method had much difference compared to the consolidated results in both two PWID and FSW groups. Some data requirements were not met such as equivalence of population definition, specificity of program data (VCT, TT05/06), sufficiency of reported information, and information for screening of population definition. Experiences from the previous studies had shown that quality of existing program data be inconsistent and time-consuming to adjust. These two data issues indicated low reliability of the results.

To be used for the purpose of size estimation with multiplier method, data reporting system need to be adapted to meet the method data requirements. Data management software and identification number system for each individual are

needed but relatively difficult in practice due to insufficient conditions and VCT program allowing anonymous customers in order to encourage usage of service. Despite of simple and low-required resources, the feasibility of the method application using VCT and TT05/06 data is limited since improvement of program data quality is very difficult.

4.2.2. Police census method

In this method, process to ensure coverage and to avoid duplication of data was guaranteed. However, major encountered issue was to collect estimated actual number, with the two reasons stated in the previous section. There were reporting requirements of official sectors and social desirability of respondents. These two factors are in fact very difficult to overcome within the study. With FSW group, underestimated results showed inappropriate application of this method, one more important issue was that sex work has been not included in rehabilitation center anymore.

The police census method had advantages of direct calculation, understandable to policy makers, not highly required statistics and sampling, less time-consuming and resources. However, though it was done in a small and undispersed geographical city, for two populations of PWID and FSW, this method had difficulties to get reliable results feasibility.

4.2.3. Capture – recapture method

By analyzing the procedures done in the field, triangulating with additional data sources, results of this method were closest to the consolidated values. To assess the

method assumptions in terms of step observation (tracking and supervising activities in the field) and qualitative analysis (interviewing study members who implemented this method activities), the steps required by method were done strictly and properly. However, when using the third data source to analyze, both techniques applied to assess the independence of two samples (Wittes and Log-linear modeling) showed underestimates for both PWID and FSW groups, as well as difficulties in reaching hidden individuals (who did not come to hotspots, were less likely to be sampled). The third data sources used for independence assessment was not well prepared in terms of sample size and clear identifying information of individual (to determine participants were captured, recaptured or sampled in both rounds), these issues limited accuracy of the results. Experiences from research studies and project activities have indicated that these limitations can be overcome in preparation and implementation in the field. Regarding resources used, this method lasted relatively long time period (60 days, 603 person-days) and bigger expenses than the other methods.

This method gave relatively closed results compared to the consolidated numbers, implementation processes met method assumptions, and limitations can be improved if well prepared and implemented, although these require complicated statistical analysis to assess the independence of two samples. The problem with this approach is how to reduce the resources needed to be feasible in the future. The experience of other countries and recommendations of the technical working group

on size estimation indicated that using one of two samples or even the third data source from a available existing data source in order to reduce resources.

Mapping exercise with advantages such as ensured coverage of data, less-difference results and less costly can be applied to the area like Can Tho city. However, some information was not collected in order to adjust the mapping results mapping. Technically, this process can be improved if information for adjustment is collected and this is an additional data source to supplement to other methods.

Collecting information, comments and consent ideas from local experts was also a valuable source since this outcome was relatively closed to real number, with a simple activity and inexpensive.

CONCLUSIONS

➤ Estimated population size of PWIDs and FSWs

Estimated size of people who inject drug in Can Tho in 2012-2013 ranged from 1,400 to 1,800, with average of 1,600 people. The range of female sex workers was from 1,550 to 2,000 and 1,700 on average. These derived results based on triangulation of applied methods (program multipliers, police census, capture-recapture) and other data sources, assessment of activities and assumptions achieved in the field, quality of input data collected, comments and inputs from local experts.

➤ Assessment of applied size estimation methods

It was difficult to apply program multiplier method for estimation of the size of people who inject drug and female sex

workers using existing data system of rehabilitation centers. Data from voluntary HIV counseling and testing sites was only used for estimating the size of people who inject drug, in condition of having information for adjustment.

Police census method was not suitable for size estimation of female sex workers. Routinely reported numbers from provincial department of public security can be used to justify and adjust for estimating the size of people who inject drug population.

There was no method resulting exact numbers, each method had advantages and disadvantages. Capture – recapture and programmatic mapping methods were appropriate for size estimation of who inject drug and female sex workers in Can Tho.

A third data source could be used to assess the independence assumption of capture and recapture samples, and to merge dependent sources for more reliable results. This additional data source needs to be prepared for enough sample size and identifying information so individuals captured in three samples can be matched.

RECOMMENDATIONS

Using the estimated number of 1,600 [1,400-1,800] PWIDs and 1,700 [1,550-2,000] FSWs for development of HIV/AIDS prevention programs in Can Tho city.

If C-RC will be used, integrating a number of questions into representative surveys with high-risk populations to

minimize costs and using additional data sources to assess the reliability of the method.

With geographically small and undispersed site as Can Tho city, mapping can be applied to estimate the size of PWIDs and FSWs. Information for adjustment should be collected for more accurate results.

LIST OF PUBLICATIONS

1. Le Anh Tuan, Nguyen Minh Son, Nguyen Anh Tuan (2015), *Police census: feasibility in size estimation of people who inject drug, female sex workers in Can Tho*, Journal of Preventive Medicine, Volume XXV, Issue 6 (166), Hanoi.
2. Le Anh Tuan, Nguyen Minh Son, Nguyen Anh Tuan (2015), *Assessment of independence of capture – recapture samples in estimating size of female sex workers in Can Tho*, Journal of Preventive Medicine, Volume XXV, Issue 4 (164), Hanoi.
3. Le Anh Tuan, Nguyen Anh Tuan, Lai Kim Anh, Nguyen Danh Lam (2012), *Size estimation of female sex workers in Can Tho city*, Journal of Practical Medicine, Issue 12 (854), page 5-7.