

Mapping and population size estimation of men who have sex with men, transgender persons, and high-risk women in Bhutan

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List of acronyms and definitions

CSW	Commercial sex worker (operationalized as receiving cash for sex in the last year; female unless specified)
FSW	Female sex worker (operationalized as receiving cash for sex in the last year)
HIV	
HRW	High risk woman (women employed at or frequenting entertainment establishments, used as a proxy for women likely to engage in sex work or have high numbers of sexual partners)
MoEA	Ministry of Economic Affairs
MSM	Men who have sex with men
NSB	National Statistics Bureau
TG	Transgender person
TGM	Transgender man
TGW	Transgender woman
UNAIDS	

Executive Summary

Purpose and objectives. This report presents the results of Bhutan’s key population size estimation exercise implemented from 13 November, 2019 to 31 January, 2020. The overarching purpose of the exercise is to provide rigorous data on key populations at risk for HIV in Bhutan to guide prevention and care policies and programs. Objective 1 is to estimate the number of high risk women (HRW), commercial sex workers (CSW), men who have sex with men (MSM), transgender women (TGW), and transgender men (TGM) at the national and dzongkhag level. Objective 2 is to map the locations and venues where these key populations can be reached. Objective 3 is to measure the HIV-related risk and preventive behaviors of these key populations. This summary presents the major findings pertaining to these objectives. Additional results, interpretations, strengths, and limitations are in the body of the report. An overview of the methods follows, with specific implementation notes accompanying each results section. Further details on the theoretical framework and methodologies are in the appended protocol.

Key population size estimates were made applying multiple methods in nine dzongkhag: Thimphu, Chhukha, Wangdue, Sarpang, Paro, Samdrup Jongkhar, Monggar, Punakha, and Bumthang. Methods included key informant mapping, census and enumeration, object multiplier, service multiplier, and three-sample capture-recapture with bias correction. Results of these different methods were synthesized through a Bayesian process to arrive at “best fit” estimates using all available data. The estimates derived for the nine study sites were used to extrapolate to the 11 dzongkhag not included in the study using linear regression models with proxy indicators. Proxy indicators are data that provide a marker for the numbers of key populations in all dzongkhag. Several proxies were considered that were available from the National Statistics Bureau and the Ministry of Economic affairs. The strongest correlations were the per dzongkhag number of drayangs plus karaoke venues for HRW; number of drayangs, karaoke venues, plus bars for CSW; and number of licensed bars for MSM, TGW, and TGM.

Objective 1:

There are an estimated **976** high risk women (HRW) in Bhutan, of whom **418** are commercial sex workers (CSW).
There are an estimated **1,670** MSM, **74** TGW, and **292** TGM.

Table: Estimated number of HRW, CSW, MSM, TGW, and TGM in Bhutan, 2020.

Dzongkhag	HRW	CSW	MSM	TGW	TGM
Thimphu*	229	100	438	19	76
Chhukha*	111	77	350	15	61
Samtse	38	22	84	4	15
Wangdue Phodrang*	38	21	80	4	14
Sarpang*	66	54	239	11	42
Paro*	91	31	120	5	21
Trashigang	18	0	0	0	0
Samdrup Jongkhar*	42	21	80	4	14
Monggar*	38	28	116	5	20
Punakha*	50	5	0	0	0

Trongsa	34	7	8	0	1
Dagana	26	9	20	1	4
Pema Gatshel	14	13	43	2	8
Tsirang	26	0	0	0	0
Bumthang*	54	15	45	2	8
Zhemgang	18	1	0	0	0
Trashi Yangtse	26	14	48	2	8
Haa	26	0	0	0	0
Lhuentse	18	0	0	0	0
Gasa	14	0	0	0	0
Bhutan Total	976	418	1,670	74	292

*Sites of primary data collection.

Hotspot venue mapping. The exercise also mapped the venues where key populations congregate within the nine field sites. Focus group discussions and in-depth interviews were conducted to elicit venues where key populations can be reached. Interviews were conducted with primary key informants (i.e., members of the key populations), secondary key informants (i.e., community persons who are not key population members, but have relevant knowledge, e.g., drayang owners), and other stakeholders (i.e., persons with professional knowledge of key populations, e.g., outreach workers). Participant observation verified the presence of key populations and peak attendance hours.

Objective 2:
101 venues where key populations can be reached were mapped in nine dzongkhag of Bhutan

Table: Numbers and types of venues with HRW, CSW, MSM, TGW, TGM in Bhutan, 2020.

Site, dzongkhag	Drayang	Karaoke	Club	Spa	Hotel	Others*	Total
Thimphu	12	3	5	--	--	3	23
Phuentsholing	8	7	--	11	--	--	26
Wangdue	3	2	--	--	--	--	5
Gelephu	3	--	2	--	3	2	10
Paro	5	--	2	--	--	--	7
Samdrup Jongkhar	2	3	2	--	--	4	11
Monggar	2	2	1	--	--	--	5
Punakha	5	--	1	--	--	--	6
Bumthang	6	--	2	--	--	--	8
Total	46	17	15	11	3	9	101

*Others venues included: open spaces, markets, snooker halls, pubs, bars, office spaces

HIV-risk and preventive behaviors and measures of stigma, discrimination, and violence. Key population members were recruited by intercepting at venues (HRW, CSW) and through peer referrals (CSW, MSM, TGW, TGM). Those eligible and consenting were administered a

face-to-face questionnaire. The survey achieved robust samples of each population with an overall sample size of 948. Key HIV-related indicators are summarized in the table below.

Table: Indicators of HIV risk and preventive behaviors, and experiences of stigma, discrimination, and violence among HRW, CSW, MSM, TGW, and TGM in Bhutan, 2020.

Indicator	HRW, venue (N=168)	CSW, venue (N=157)	CSW, referral (N=192)	MSM, referral (N=273)	TGW, referral (N=34)	TGM, referral (N=124)
Provided sex for cash, ever	0%*	100%	100%	17.4%	73.3%	1.9%
Mean sex partners in 30 days	1.3	4.5	5.8	5.8	12.7	1.4
Consistent condom use (cas)	25.0%	45.9%	64.7%	43.0%	27.3%	2.2%
Consistent condom use (pay)	--	70.8%	85.5%	62.5%	76.5%	50.0%
Tested for HIV in last year	61.1%	62.6%	23.6%	40.9%	58.8%	22.8%
Tested for STI in last year	43.3%	40.1%	13.1%	23.3%	50.0%	4.1%
Outreach contact in last year	39.2%	33.6%	17.8%	6.9%	56.3%	52.9%
Stigma experience**	67.9%	82.8%	59.9%	35.4%	91.2%	95.2%
Health care discrimination**	34.5%	45.2%	20.3%	18.5%	55.9%	47.6%
Sexual violence**	22.0%	24.2%	25.5%	6.6%	29.4%	4.8%

*Data for HRW who never provided sex for cash. **Attributed to status as HRW, CSW, MSM, TGW, or TGM. Cas = casual partners, pay = paying partners.

Objective 3:
Indicators of high sexual risk, low preventive behaviors, and experiences of stigma and discrimination point to the need for community- led and sensitized programs.

Discussion and Recommendations. As a proportion of the adult population over age 15 years, HRW make up 0.39% of women in Bhutan, while CSW represent 0.17%. Consider only the urban female adult population, their corresponding figures are 1.00% and 0.49%, respectively. MSM are 0.59% of adult men (1.53% of urban men); TGW are 0.03% of adult women (0.08% of urban women), and TGM are 0.10% of adult men (0.27% of urban men). The behaviors of these key populations place them at risk for HIV and STI. Under-diagnosis and under-treatment may result from low levels of HIV/STI testing and experiences of discrimination in the health care system. Data speak to the need for key population-friendly HIV testing and prevention services, sensitization of health providers to sexual and gender minorities, and [stakeholder input here...].

I. Background and Need

Historically, Bhutan has experienced a low-level HIV epidemic [1]. Compared to other countries in the region, Bhutan's HIV epidemic started later, with the first case diagnosed in 1993, and progressed more slowly. Sporadic cases appeared between 1993 and 2000. From 2000 to 2013, the number of new HIV diagnoses rose from 9 to 51. Since 2013, there has been a plateau in the number of new HIV diagnoses, fluctuating between 49 and 58 annually. To June 2019 there were a cumulated 663 HIV diagnoses, 505 of whom are known to be alive, and 450 of whom are on antiretroviral treatment provided by the Ministry of Health. UNAIDS models place the number of people living with HIV in Bhutan at 1,265. The national response to HIV is geared to end the epidemic by 2030. Targets to achieve this vision include increasing the proportion of persons living with HIV who are diagnosed to >90%, the proportion of those diagnosed on antiretroviral treatment at 100%, and the proportion with sustained viral suppression at >90% by 2020.

Bhutan may stand in contrast to other countries in South and South East Asia in its pattern of HIV epidemiologic progression. Typically, key populations at elevated risk acquire infection early in an epidemic, when the conditions for rapid spread were already present (e.g., high sexual partner turn-over, multiple concurrent partnerships, low condom use). These key populations include men who have sex with men (MSM), transgender persons (TG), and high-risk women (HRW) who include commercial sex workers (CSW). HIV incidence rises fast in these populations, often accelerating after a threshold of 5% prevalence. HIV transmission to the sexual partners of key populations becomes substantial, raising the overall prevalence of HIV for the nation. At this point, the epidemic has moved from low-level to concentrated.

Several factors are cause for concern that conditions are present for greater spread of HIV among key populations in Bhutan. First, with a passive surveillance system, under-reporting of HIV cases is possible. Second, UNAIDS projections and low CD4 counts among new diagnoses indicate that many infections go undiagnosed for long periods of time. Therefore, the number of people living with HIV may be under-estimated and the potential for onward transmission from persons who are untreated may be high. Third, MSM, TG, and HRW status has not been systematically recorded in surveillance or program data. A disproportionate burden of infection in these populations may be unrecognized. Fourth, indicators of risk suggest high potential for increased sexual transmission of HIV. These include rising incidence of sexually transmitted infections (STI), low condom uses in all types of partnerships, high levels of multiple sex partners, and the apparent emergence of commercial and transactional sex [1-5]. Finally, there is increasing concern that the prevention needs of key populations have been inadequately addressed, particularly MSM, TG, and HRW [3,6].

Whether Bhutan will follow a progression from a low level to concentrated epidemic, similar to other countries in the region, or start on a trajectory towards eliminating HIV by 2030 may hinge upon reaching MSM, TG, and HRW with effective programs. The Ministry of Health of Bhutan has embarked on a nationwide HIV prevention and awareness program with targeted interventions for MSM, TG, and HRW. Unfortunately, there is a scarcity of data on these populations in Bhutan – beginning with knowing their numbers, where they can be found, and measures of sexual risk behaviors that may drive HIV transmission. These basic data are needed to appropriately allocate limited resources, set targets for programs activities, gauge the reach of these programs, and assess their impact on HIV incidence.

Past attempts at population size estimates have met unique challenges in Bhutan [6]. The typical venues or hotspots where MSM, TG, and HRW congregate in other parts of the world may not exist in Bhutan. As in much of the world, selling sex is illegal and same-sex sex behavior was criminalized until recently. Moreover, these behaviors are highly stigmatized, seldom openly discussed, and remain hidden. Prior research found little evidence of “gay” and “transgender” communities coalescing in the country [7]. A survey conducted in Bhutan in 2016 was able to recruit only 30 MSM and 12 TG [3]. The training of MSM, TG, and HRW as peer outreach workers in Bhutan has been underway but is nascent. Bhutan faces the special challenge of small population sizes. State of the art methods to conduct population size estimation and probability-based sampling for precisely measuring sexual risk behaviors require sufficient numbers, a sufficient proportion who are visible, and social networks that connect large numbers of other members.

To address these challenges in key population size estimation in Bhutan, we implemented multiple methodologies as described in this report and in the appended protocol. Population size estimation procedures incorporated existing knowledge, stakeholder and community input, visualization of the hotspots where the key populations congregate, and statistical models. The approach followed UNAIDS guidelines [8] that recommend using multiple approaches to produce the most credible estimates, to triangulate robust results, to provide checks and balances, and to minimize the risk of drawing false conclusions due to the biases or logistical failures from any single method. A major lesson learned during implementation is that not all methods succeed as planned – another reason multiple methods need to be attempted. This report describes both the success and failures encountered in the field, deriving lessons learned for future studies and public health programs for key populations in Bhutan.

II. Methods Overview

Details of the methods and their theoretical frameworks are included in the protocol appended to this report. This section presents an overview of the methods used to achieve the following objectives:

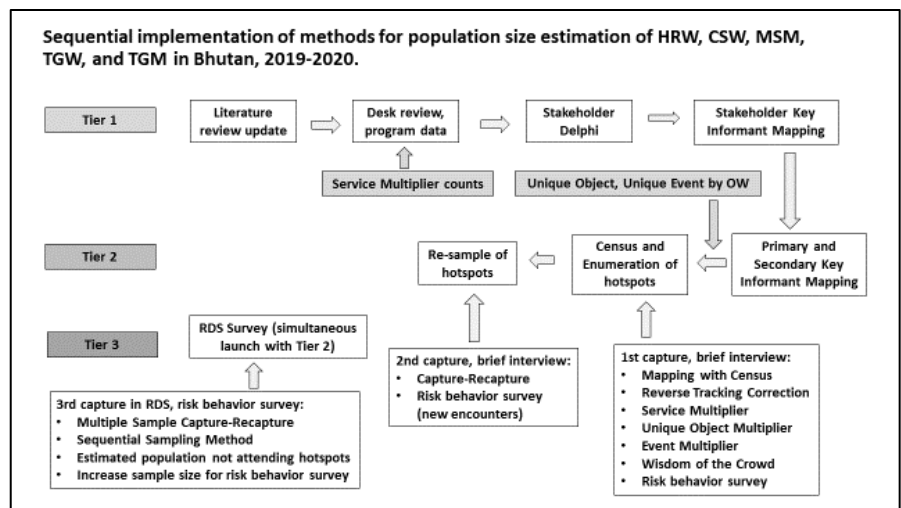
Objectives:

1. To establish national and sub-national geographic area population size estimates for key populations at risk for HIV, including high risk women (HRW), commercial sex workers (CSW), men who have sex with men (MSM), transgender women (TGW), and transgender men (TGM) in Bhutan.
2. To produce a detailed mapping of the hotspots and affiliated numbers of HRW, CSW, MSM, TGW, and TGM in nine dzongkhag (Thimphu, Phuentsholing, Wangdue, Gelephu, Paro, Samdrup Jongkhar, Monggar, Punakha, and Bumthang).
3. To measure indicators of sexual risk behaviors and preventive practices in relation to HIV among HRW, CSW, MSM, TGW, and TGM in Bhutan.

Study population definitions: The present report addresses five key populations: men who have sex with men (MSM), transgender women (TGW), transgender men (TGM), high-risk women (HRW), and commercial sex workers (CSW). Definitions of these populations are varied, complex, and contextual. Definitions may include different self-identities, behaviors, circumstances, and time periods. We adopted a public health response perspective. The target populations are those that prevention programs seek to engage by virtue of their current behavior or near future risk for HIV. The target populations are those that can be contacted through outreach to venues, through social media, peer referrals, and by referral to fixed site services gear towards key populations. MSM are defined as men 18 years and older who have had anal or oral sex with another man or TG in the last 12 months. TGW and TGM are defined as persons 18 years and older who were assigned a sex at birth that is different from their current gender identity. HRW are women 18 years and older who work at or visit “hotspots”, defined as environments where high risk sexual behaviors are frequently initiated (e.g., commercial sex work, transactional sex, multiple and concurrent partnering, high partner turn-over, and sexual networking within and between key populations). CSW were defined as women 18 years or older who have received cash payment for sex. In the course of implementing this study, we classified two types of CSW by virtue of how they were recruited and by differences in their risk profiles. One group of CSW were women recruited in the same venues who met the definition of HRW and also provided sex for cash. The second group were recruited by peer referral and were not employed by or affiliated with specific venues, although the often frequented the same venues.

Population size estimation methods:

Following UNAIDS guidelines [8], several methods (Figure) were sequentially implemented to triangulate robust population size estimates and minimize the impact of biases and errors resulting from any single approach. Flexibility is needed in



implementing the methods for different sites and different populations as the minimum requirements may not be present for all key populations. Methods progressive build from global knowledge, to local knowledge, to empirical data collection, to mathematical modeling. The methods attempted in this exercise included: literature review, desk review, Delphi, Mapping with Census and Enumeration, Reverse Tracking Correction, Service Multiplier, Unique Object Multiplier, Event Multiplier, Wisdom of the Crowd, Capture-Recapture, Multiple Sample Capture-Recapture, and Sequential Sampling. These methods were organized into three phases or “tiers” of activities according to the nature of data collection.

Tier 1 activities entail an updated published and gray literature review, analysis of programmatic data related to key populations, examination of public traffic on social media sites, and gathering information from stakeholder key informants (e.g., providers of services to key populations). Stakeholder key informants (principally HISC staff and peer outreach workers) were convened and as district teams generated a list of potential hotspots, arrived at pre-implementation estimates of the number of key populations (Delphi), and identify primary and secondary key informants.

Tier 2 activities entailed collection of data from hotspots, key population members, and other persons associated with hotspots through focus group discussions and in-depth interviews. Primary key informants were community members who expanded the map of potential hotspots, the number and types of key populations present, and periods of peak attendance. Secondary key informants were persons with knowledge of specific hotspots (e.g., entertainment venue owners, male clients, taxi drivers, etc.) who provided information on hotspot locations and attendance patterns. The summation of the numbers of key populations affiliated with the venues comprises the Key Informant Mapping estimation method. Once the list of elicited venues with potential key populations was complete, team members verified the presence of key populations, creating a comprehensive map of hotspots and venues. The team then engaged peer outreach workers and NGO members to distribute a small gift (key chain) to key population members through social networks and venues for the Unique Object Multiplier Method, and assist with hosting a mobilization event for the Event Multiplier Method. Field teams then visited hotspots at each site on consecutive days on three separate occasions about one week apart to gather counts for the Mapping with Census and Enumeration Method, Reverse Tracking Correction, and Capture-Recapture Method. The first visit systematically counted key populations present at all hotspots at the days and times of peak attendance as reported by key informants. The second visit included a Brief Intercept Survey that visited a random sample of the mapped venues to systematically and consecutively intercept persons to obtain indicators of risk behavior and collect data used for size estimation methods (i.e., Service Multiplier, Unique Object Multiplier, Event Multiplier, and Wisdom of the Crowd). A second field mapping using a random one-in-four sample of venues was done one week later to complete the Multiple Sample Capture-Recapture Method.

Tier 3 entailed implementation of respondent-driven sampling (RDS) surveys in selected districts and key populations with sufficient network sizes [9]. RDS entails long chains of peer referrals, similar to snowball sampling, to recruit a representative sample of key populations independently of hotspot attendance. In the event, the requirements of conventional RDS could not be met (i.e., willingness to refer participants to a fixed site, limiting referrals per participant, obtaining long chains of peer referrals). Therefore adaptations were made to create a practical peer-directed sampling (“PDS”) approach. The peer-directed sampling entailed peer outreach workers contacting their networks to make introductions with snowballing (i.e., larger groups of referrals per peer), followed by identifying other peers able to refer while doing the venue-based interviews. In addition, peer outreach workers recruited from LGBT-oriented online sites including geo-locating data apps. The resultant PDS surveys obtain risk behavior data of key populations who are not directly affiliated with hotspots.

Analysis, synthesis, extrapolation, and stakeholder input. Analysis and synthesis followed the statistical requirements of each individual method, combined multiple individual estimates through a Bayesian approach, and used modeling to extrapolate from the nine study sites to the whole of Bhutan. First, population size estimates were calculated from each of the individual method as described for each result below and in the appended protocol. Second, the Bayesian Anchored Multiplier was used to combine the individual estimates and arrive at “best estimate” of the sizes of the key populations in each study site based on the collected data [10]. The Bayesian approach updates the probability for a hypothesis (i.e., the number of key population members in a given site) as more evidence or information becomes available, repeatedly seeking the most probably fit of the data given the different estimates and their distributions. Third, extrapolation was done using these site estimates through linear regression analysis. Linear regression modeled the population sizes in the nine dzongkhag against a “proxy” indicator that is available for all 20 dzongkhag. The proxies with the highest explanatory value (i.e., the highest adjusted R^2) used to model the population sizes in the 11 dzongkhag not included in the field exercises. Finally, stakeholder input on the final calculations was solicited [TBD] to identify and reconcile inconsistencies, implausible estimates, and potential biases. The stakeholders, serving as a post-implementation Delphi Method panel, determined the final “consensus” estimate and upper and lower plausible bounds. Stakeholders also provided input on interpretations of indicators and on recommendations stemming from findings.

Note on suppression of cell sizes <5?

III. Results for High Risk Women (HRW) and Commercial Sex Workers (CSW)

A. Results of size estimation methods for HRW and CSW

1. Published and Grey Literature Review Estimates

[Were there any prior HRW or CSW estimates for Bhutan? If not, update published literature for the South and Southeast Asia region. Previously from Van de Pitte et al: Asian low 0.2% to Asian high 2.6%. Note: our results are HRW make up 0.39% of the total adult female population or 1.00% of the urban adult female population. For CSW, the figures are 0.17% of all adult women, or 0.49% urban adult women. Therefore our estimates fall within the published literature, someone one the low end.]

2. Delphi Method Estimates: stakeholder impressions on the number of HRW, pre-implementation

The Delphi process entailed establishing a panel of local experts, by profession and life experience, to provide their impressions or best guesses on the numbers key population members. The process repeated polls the panel while facilitating discussion and introducing data. The pre-implementation Delphi was done in August 2019 in Paro. The panel comprised 24 members, including key population members, NGO workers, HISC staff, and their partnered

peer outreach workers. Members worked in teams according to the dzongkhag of their activities. They were asked to consider the number of hotspot venues in their area and the number of HRW affiliated with those venues. Two polls were taken, before and after the facilitated discussion. The final results (table below) represent the median of each group’s response on the second poll. Of note, the seven dzongkhag listed below are not the same as the nine where other size estimation activities were done (Trongsa was not included and Paro, Monggar, and Wangdue were added). Debriefing after data collection, the impression of many team members (who participated in this Delphi process) was that there were more HRW in Bhutan than they previously thought, and that a large percentage of them engaged in commercial sex work.

Table: Delphi estimates for the population sizes of HRW in seven locations of Bhutan, in seven locations of Bhutan, August 2019 (pre-implementation).

Site, dzongkhag	Number of stakeholders	Estimated number of HRW
Thimphu	5	140
Phuentsholing	6	123
Gelephu	3	121
Samdrup Jongkhar	3	130
Punakha	3	65
Bumthang	1	50
Trongsa*	3	25
Total for sites	24	654

*Trongsa was not included as a data collection site. The pre-implementation Delphi did not include Paro, Wangdue, and Monggar.

3. Wisdom of the Crowds Method Estimates: community perceptions on their estimated numbers

The Wisdom of the Crowds theory posits that a central tendency (e.g., mean or median) of a large sample can provide an estimate of difficult question (e.g., the number of key population members in an area). Capitalizing on the survey of 948 key population members implemented to measure HIV-related behaviors, we asked HRW and CSW how many women they believed provided sex for money in Bhutan. Women were asked about the number of CSW, not HRW. The question was two-staged: first asking how many they personally knew, and second their best guess of how many there are in Bhutan. These questions proved challenging for respondents to interpret and translate to their experience, therefore caution is advised in interpretation. The table below presents the average responses and 95% confidence intervals from the survey data. The data required exclusion of imprecise and many non-numeric answers (e.g., “many”), responses with unclear reference points (e.g., whether “90% of girls” being all women or drayang employees), and implausible outliers (e.g., “lakh”). On the other hand, highly conservative responses were retained in the average (e.g., “none” was included as 0).

Table: HRW and commercial sex worker CSW perceptions on the number of CSW that they personally know and that they believe are in Bhutan, 2020.

Respondents	Number of CSW they personally know Mean (95% CI)	Number of CSW they believe are in Bhutan Mean (95% CI)
HRW at venues	3.5 (2.7 – 4.3)	720 (372 – 1,068)
CSW at venues	7.3 (6.1 – 8.5)	682 (377 - 987)
CSW by referral	8.6 (7.5 – 9.7)	463 (289 - 637)

4. Key Informant Mapping and Venue Elicitation

Primary, secondary, and other stakeholder key informants were interviewed or participated in focus group discussions to identify all possible venues where key populations could be found. Primary key informants were key population members, including those known to peer outreach workers, those referred by other key informants, and those encountered in the field during mapping. Secondary key informants were community persons who are not key population members but have special knowledge of key populations (e.g., drayang owners and managers, male clients of clubs, taxi drivers, etc.). Stakeholder key informants are persons who professionally provide services to key populations. The process of identifying new key informants proceeded site by site and continued until “saturation” was achieved. That is, more key informants were interviewed until no new venue was mentioned. Overall, xx primary, xx secondary, and xx stakeholder key informants were interviewed; xx focus group discussions were held. The following table summarizes the venue elicitation outcomes. Because there was high overlap across all key populations for the venues, the table refers to venues with any mention of the five key populations being potentially present.

Table: Types of venues with HRW, CSW, MSM, TGW, and TGM identified through key informant interviews, focus group discussions, and field observation, Bhutan, 2020.

Site, dzongkhag	Drayang	Karaoke	Club	Spa	Hotel	Others*	Total
Thimphu	12	3	5	--	--	3	23
Phuentsholing	8	7	--	11	--	--	26
Wangdue	3	2	--	--	--	--	5
Gelephu	3	--	2	--	3	2	10
Paro	5	--	2	--	--	--	7
Samdrup Jongkhar	2	3	2	--	--	4	11
Monggar	2	2	1	--	--	--	5
Punakha	5	--	1	--	--	--	6
Bumthang	6	--	2	--	--	--	8
Total	46	17	15	11	3	9	101

*Others venues included: open spaces, office sites, markets, snooker halls, pubs, bars

5. Key Informant Mapping Method Estimates of HRW and CSW

The process describe above also asked key informants for their estimates of the number of key populations affiliated with each venue. For venues mentioned by multiple key informants, the median estimate and range of responses is shown. Results highlight a key limitation of the method in that it was difficult for key informants to distinguish who among the HRW engaged in

commercial sex work. Additionally, some secondary key informants may not wish to disclose the presence of CSW at the venue (e.g., owners, managers), creating an under-estimation bias. Of note, the survey of HRW and CSW interviewed at the venues found a much higher proportion engaging in commercial sex work, even when reporting on their own behavior (see below).

Table: Estimated number of HRW and CSW by key informants, Bhutan, 2020.

Site, Dzongkhag	All HRW Mid (Low, High)	CSW Mid (Low, High)
Thimphu	214 (140 – 287)	82 (62 – 102)
Phuentsholing	139 (112 – 166)	0 (na)
Wangdue	26 (na)	0 (na)
Gelephu	52 (40 – 63)	25 (18 – 31)
Paro	49 (42 – 55)	1 (0 – 1)
Samdrup Jongkhar	36 (30 - 41)	0 (na)
Monggar	46 (42 – 49)	10 (8 - 11)
Punakha	65 (na)	4 (na)
Bumthang	127 (91 – 142)	10 (2 – 18)
Total	754 (588 – 894)	132 (94 – 167)

Note: “na” when there was no variation in estimates by key informants.

6. Mapping with Census and Enumeration Method Estimates

Once the list of venues was complete, staff visited each mentioned to verify being still active and count of key populations. Counting was done on three occasions. The first count systematically visited every venue mentioned by key informants, scheduling the visit to occur preceding and during peak attendance hours. This first visit provided the “census”; that is, attempting to count all key population members. This count is shown in the second column of the table below. Field staff attempted to distinguish HRW from CSW; however, this proved infeasible to do by sight. Instead, the counts below are segmented to HRW and CSW according to the survey interviews of women at the venues (see below). The second count was done on a random sample of the venues, with the number of venues set proportionate to size according to the Key Informant Mapping results above. The randomization was done by writing the venue names on cards and shuffling the deck. Cards were drawn from the deck by staff, continuing selection until the projected number of HRW at the sites was reached (with alternates also randomly selected in the event of low attendance). The second visit results are scale-up from the sample to the total based on the sampling fraction of venues visited. The third visit was done at a one-in-four random selection of the venues in each site, as described for the second visit, with counts scale-up to the total based on the sampling fraction of venues visited. Of note, the first visit distributed the key chain for the Unique Object Multiplier Method, the second visit conducted the Brief Intercept Surveys, the third visit implemented a check list to complete the 3rd capture of the Multiple Sample Capture-Recapture Method.

Table: Population size estimates based on census and enumeration mapping of HRW and CSW at venues, Bhutan, 2020.

Site, dzongkhag	Census Count HRW	Census CSW*	1 st Capture Estimate HRW	1 st Capture CSW*	2 nd Capture Estimate HRW	2 nd Capture CSW*
Thimphu	207	96	251	117	279	130
Phuentsholing	168	107	230	147	303	194
Wangdue	30	16	45	24	38	21
Gelephu	42	11	70	18	100	26
Paro	74	28	69	26	49	18
Samdrup Jongkhar	39	16	83	33	94	37
Monggar	17	4	25	6	23	5
Punakha	52	34	53	34	72	47
Bumthang	66	33	53	27	68	34
Total	695	344	879	431	1,026	511

*Based on proportion of HRW who are CSW from the venue-based questionnaire.

7. Reverse Tracking Correction Method

The Reverse Tracking Correction Method can adjust mapping estimates when there is uncertainty around information gathered from one source (e.g., relying only on key informant estimates, or only one visit). The approach is possible in the present exercise by examining the field counts with each visit and the key informant estimates. However, at this stage, the method is redundant given the multiple samplings to the venues, and results are unlikely to change estimates. Applying the method is therefore deferred unless determined needed at a later date.

8. Event Multiplier Method

The Event Multiplier Method was planned to arrive at key population size estimates by counting the numbers attending a mobilization event for HRW and CSW. This count could then be leveraged to estimate the total population size using the brief intercept survey, as described below for the Unique Object Multiplier Method. Unfortunately, the event was poorly attended (19 CSW) and did not provide sufficient sample size. The event was used for HIV/STI health education and as a focus group discussion for venue elicitation.

9. Service Multiplier Method: HIV testing at HISC

The Service Multiplier Method to estimate key population size is similar to the Event and Unique Object Multiplier Methods. The planned service count was to use the HISC data, counting the number of women tested whose occupation was listed as “Entertainment/bar worker”. Unfortunately, several uncertainties in the count made the method infeasible. For example, the occupational category was blank for a large proportion of testing records, women may not answer that this is their occupation when testing, and the category may not exactly align with HRW.

10. Unique Object Multiplier Method Estimates: Object and 1st Capture

The Unique Object Multiplier Method estimated the number of HRW in the following manner. First, outreach workers distributed a memorable object to as many HRW they encountered during the first visit to all venues for the census. In this case, the object was a key chain. Second, women later interviewed for the brief intercept survey during the second visit to the random sample of venues (“1st Capture”) were asked if they had received the key chain. The total population size estimate can be calculated by knowing the number of key chains given and the proportion of the population receiving one as determined in the survey. The calculation is given by the formula:

$$\text{Total number in population} = \frac{\text{number of objects given}}{(\text{number in survey receiving object} / \text{number in survey})}$$

For example, the overall calculation is: 182 objects given in Thimphu / (86 survey participants receiving objects / 100 interviewed) = 212. The 95% confidence interval is based on the calculation of standard error for capture-recapture methods. The proportion of HRW who are CSW was segmented based on the responses of women in the brief intercept survey.

Table: Population size estimates based on the Unique Object Multiplier Method with first capture at venues, HRW and CSW, Bhutan, 2020.

Site, dzongkhag	HRW survey respondents	N receiving object	N objects given	HRW population size estimate (95% CI)	CSW population size estimate* (95% CI)
Thimphu	100	86	182	212 (177-247)	98 (82-115)
Phuentsholing	47	37	159	202 (159-245)	129 (101-156)
Wangdue	24	15	30	48 (25-71)	26 (14-38)
Gelephu	31	25	40	50 (32-68)	13 (8-17)
Paro	24	18	48	64 (41-87)	24 (15-33)
Samdrup Jongkhar	15	14	39	42 (28-56)	17 (11-22)
Monggar	9	8	11	12 (5-19)	3 (1-4)
Punakha	34	34	45	45 (32-58)	29 (21-38)
Bumthang	40	38	57	60 (44-76)	30 (22-38)
Total (sum of sites)				734 (542-926)	369 (276-462)

*Based on proportion of HRW who are CSW from the venue-based questionnaire.

11. Object and 2nd Capture Estimates

During the third visit to the venues (“2nd Capture”), HRW were asked a checklist of whether they participated in prior events, including whether they received the key chain. The same calculation above can be applied to estimate the total number of HRW. Also as above, the proportion of HRW who are CSW was determined from the brief intercept survey responses.

Table: Population size estimates based on the unique object multiplier with second capture at venues, high risk women (HRW) and commercial sex workers (CSW), Bhutan, 2020.

Site, dzongkhag	HRW 2 nd capture respondents	N receiving object	N objects given	HRW population size estimate (95% CI)	CSW population size estimate* (95% CI)
Thimphu	32	25	182	233 (178 – 287)	108 (83 - 134)
Phuentsholing	38	30	159	201 (156 – 247)	129 (99 - 158)
Wangdue	5	5	30	30 (19 - 41)	16 (10 - 22)
Gelephu	7	7	40	40 (28 - 52)	10 (7 - 14)
Paro	7	6	48	56 (33 - 79)	21 (12 - 30)
Samdrup Jongkhar	5	5	39	39 (27 - 51)	16 (11 - 20)
Monggar	4	4	11	11 (4 - 18)	2 (1 - 4)
Punakha	10	10	45	45 (32 - 58)	29 (21 - 38)
Bumthang	13	13	57	57 (42 - 72)	29 (21 - 36)
Total (sum)				712 (639 - 905)	360 (266 - 454)

*Based on proportion of HRW who are CSW from the venue-based questionnaire.

12. 1st and 2nd Capture-Recapture

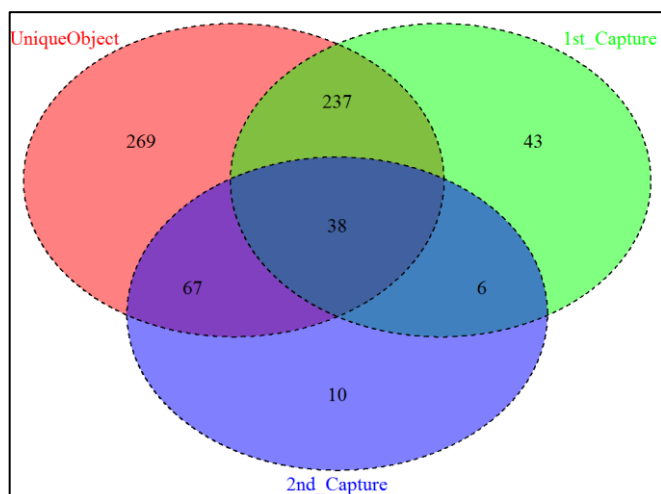
Another calculation of the total population size of HRW can be made from the overlap between the 1st and 2nd Captures. Unfortunately, in this case the sample sizes too small for the calculation by each dzongkhag. Results below are for the nine sites overall.

Site, dzongkhag	HRW 2 nd capture respondents	HRW reporting 1 st capture	HRW in first capture	HRW population size estimate (95% CI)	CSW population size estimate* (95% CI)
Total	121	44	324	891 (660 – 1,122)	430 (319 – 542)

*Based on proportion of HRW who are CSW from the venue-based questionnaire.

13. Multiple Sample Capture-Recapture Method: Object, 1st, and 2nd Capture-Recapture

A potential bias of the multiplier and capture-recapture methods is non-independence. That is, the population size is likely to be under-estimated if there is an increased chance that some persons have an increased likelihood to be captured multiple times (i.e., beyond chance alone). For example, a select part of the population is more familiar with the staff or researchers and are therefore more amenable to multiple interactions. The opposite bias can also happen; that is, some part of the population is more adverse to engaging the population and have a decreased likelihood to be captured multiple times (i.e., beyond chance alone). In this scenario, population size estimates are over-stated. Fortunately, a third capture allows for modeling and correcting for these types of bias through interaction terms. The analysis is therefore possible for HRW. The figure below illustrates the overlaps between the unique object distribution, the first capture in the field (the brief intercept interview), and the second capture in the field (with checklist).



Using the multiple sample capture-recapture method, the adjusted number of HRW in the nine study sites total is 720 (95% CI 700 – 742). Using the survey data on how many HRW are CSW within each site, the adjusted number of CSW for all sites is 353 (95% CI 345 – 362). Unfortunately, the numbers in each individual dzongkhag are too small for direct estimates. Individual dzongkhag estimates can be done by apportioning the overall estimates to the percentage in each of the dzongkhag as determined by the other size estimation methods. To arrive at

the best estimates of these percentages, we can combine the multiple estimates above into a single a best estimate for each dzongkhag. The combining of these data is done by a Bayesian approach as described below.

14. Bayesian Synthesis (Anchored Multiplier Method). A Bayesian process (the Anchored Multiplier [ref]) was used to fit all of the available data into an estimate that best explains the various point estimates and their distributions from the different sources. For each of the 9 sties, we combined the results of the four methods that provided estimates at the dzongkhag level. These included the Key Informant Mapping, Census and Enumeration Mapping, Object/1st Capture, and Object/2nd Capture Methods. A free online site provides this synthesis by entering each point estimate above and range or distribution [ref]. The process also requires a prior estimate to build upon. The prior estimate used was the full range (highest to lowest) of all estimates assuming a uniform distribution.

Table: Anchored Multiplier synthesis for dzongkhag-level estimates of HRW, Bhutan, 2020.

Site, Dzongkhag	Key Informant Mapping	Census Mapping	Object / 1 st Capture	Object / 2 nd Capture	Anchored multiplier synthesis
Thimphu	214 (140-287)	251 (207-279)	212 (177-247)	233 (178-287)	235 (213-256)
P/ling	139 (112-166)	230 (168-303)	202 (159-245)	201 (156-247)	196 (156-240)
Wangdue	26 (13-39)	38 (30-45)	48 (25-71)	30 (19-41)	36 (29-44)
Gelephu	52 (40-63)	70 (42-100)	50 (32-68)	40 (28-52)	51 (41-60)
Paro	49 (42-55)	69 (49-74)	64 (41-87)	56 (33-79)	61 (48-76)
S Jongkhar	36 (30-41)	83 (39-94)	42 (28-56)	39 (27-51)	59 (39-83)
Monggar	46 (42-49)	23 (17-25)	12 (5-19)	11 (4-18)	33 (21-47)
Punakha	65 (33-98)	53 (34-72)	45 (32-58)	45 (32-58)	48 (41-57)
Bumthang	127 (91-142)	66 (53-68)	60 (44-76)	57 (42-72)	68 (66-70)

These synthesized dzongkhag level results were then used apportion the total number of HRW determined by the multiple sample capture recapture method to each dzongkhag. Similarly, the

relative numbers of CSW from the survey data were used to apportion the number of CSW in each dzongkhag.

Table. Synthesized empirical population size estimates for HRW and CSW using the multiple sample capture-recapture pooled estimate apportioned to the nine dzongkhag based on Bayesian synthesis of site-specific estimates, Bhutan, 2020.

Site, dzongkhag	HRW N	CSW N
Thimphu	215	100
Phuentsholing	179	114
Wangdue	33	18
Gelephu	47	12
Paro	56	21
Samdrup Jongkhar	54	22
Monggar	30	7
Punakha	44	28
Bumthang	62	31
Total	720	353

The results above represent the best empirical results of the data collected in the nine study sites. These nine estimates are used for the extrapolation model to estimate the number of HRW and CSW in the 11 non-study dzongkhag and for Bhutan overall.

B. Extrapolation of size estimates for HRW and CSW to the dzongkhag and national levels

Assumptions for extrapolation. Creating models for extrapolation is an imperfect process that requires many assumptions that may or may not hold. For our model, the first assumption is that the data collected from the nine dzongkhag sites provide a complete picture of the key populations in those dzongkhag. Conceptually, the size estimate really represents the “reachable” population. That is, data are oriented towards women affiliated with venues, circulated through venues, or have social network connections close to those in venues. The limitation of this assumption is that the field exercise is likely to have left out some venues (e.g., they were not divulged by key informants), or some CSW were outside the social networks of those included in the PDS survey. A related, second assumption is that HRW and CSW in rural areas and small towns are not counted, also being outside the study area and their networks not connected to other HRW and CSW. Conceptually, the size estimate really represents the more urban segment of Bhutan. For the purposes of program planning, these constraints also prevail. That is, programs based on outreach and peer-referral may also not reach these women and other means to provide services would be needed. Moreover, given that HRW and CSW require a clientele basis, the numbers in rural areas are likely to be small. A third assumption is that we can identify proxy data that are correlated with the number of HRW and CSW at the dzongkhag level. Proxy data are measures that are available for all 20 dzongkhag that have a high correlation with the population size estimates in the nine dzongkhag study sites. The relationship between the proxy and the nine size estimate is the basis to extrapolate to the empirical data (nine sites) to the whole

of Bhutan (20 sites). The table below lists the several proxies examined. The highest adjusted R² is a basis for selecting the best proxy.

Table: Assessment of proxy indicators for extrapolation of HRW and CSW estimates from the 9 study dzongkhag to the total 20 dzongkhag of Bhutan, 2020.

Proxy considered, indicator by dzongkhag level	Source	Adjusted R ² with HRW (p-value)	Adjusted R ² with CSW (p-value)
Number of entertainment venues (e.g., drayang plus karaoke)	MoEA	0.7907 (0.001)	0.5522 (0.013)
Number of licensed bars	MoEA	0.7407 (0.002)	0.5751 (0.011)
Entertainment plus bars	MoEA	0.7649 (0.001)	0.5895 (0.010)
Population density	NSB	0.6520 (0.005)	0.4566 (0.027)
Female urban population	NSB	0.7373 (0.002)	0.4877 (0.022)
Male urban population	NSB	0.7600 (0.001)	0.5155 (0.018)
Female divorce number	NSB	0.6619 (0.005)	0.4121 (0.037)
Distance from Thimphu	NSB	0.0398 (0.286)	0.0453 (0.297)
Location on border	NSB	-0.1179 (0.705)	-0.1002 (0.619)

Urbanicity defined as the number of female/male population living in urban areas; percent urban was also examined with poorer model fit.

NSB = National Statistics Bureau of Bhutan; MoEA = Ministry of Economic Affairs, Bhutan.

With the exceptions of location on the border and distance from Thimphu, there are several strong proxies for the numbers of HRW and CSW per dzongkhag. The number of entertainment venues in each dzongkhag (drayangs and karaoke venues) appeared to be the best proxy for HRW and the number of entertainment venues plus bars appeared to be the best proxy for CSW based on the highest adjusted R² factors. Of note, combinations of proxies were examined, but did not substantially improve the models. For example, we examined the correlation of CSW numbers with the rate of divorce plus location on the border plus the number of entertainment venues plus bars. However, overall adjusted R² was not improved over entertain venues plus bars. The following linear regression models were chosen for extrapolation:

$$\text{Number of HRW per dzongkhag} = 4.06 \times \text{number of entertainment venues} + 13.64$$

$$\text{Number of CSW per dzongkhag} = 0.17 \times \text{number of entertainment/bars} - 19.40$$

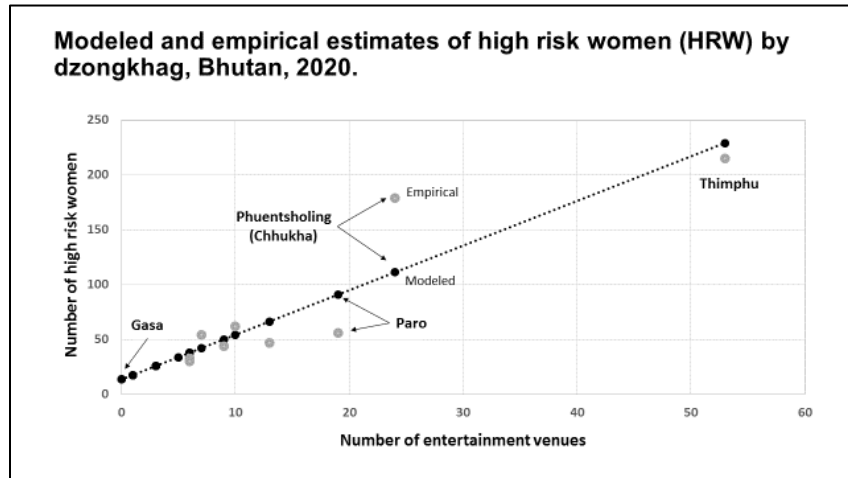
These formula were applied to data the MoEA producing the modeled estimates in the table below. The total modeled estimated number of HRW for Bhutan is 976. The modeled number of CSW in Bhutan is 418.

Table: Modeled number of HRW and CSW based on synthesized empirical estimates in nine dzongkhag and proxy indicators, Bhutan, 2020.

Dzongkhag	Proxy: Number of entertainment venues	Modeled number of HRW	Proxy: Number of entertainment plus bars	Modeled number of CSW
Thimphu	53	229	691	100
Chhukha	24	111	562	77
Samtse	6	38	240	22
Wangdue Phodrang	6	38	236	21
Sarpang	13	66	424	54
Paro	19	91	294	31
Trashigang	3	26	196	14
Samdrup Jongkhar	7	42	237	21
Monggar	6	38	277	28
Punakha	9	50	141	5
Trongsa	5	34	152	7
Dagana	3	26	164	9
Pema Gatshel	0	14	187	13
Tsirang	3	26	68	0
Bumthang	10	54	200	15
Zhemgang	1	18	117	1
Trashi Yangtse	1	18	71	0
Haa	3	26	47	0
Lhuentse	1	18	102	0
Gasa	0	14	45	0
Total	-	976	-	418

Gasa, Lhuentse, Haa, Tsirang, and Trashi Yangtse had projected numbers of CSW below 0.

The figure below shows the modeled estimates with comparison to the empirically-derived estimates from the Bayesian synthesis of data collected in nine dzongkhag. Notable examples to highlight are that Thimphu’s empirical estimate is very close to its modeled number of HRW. Whereas Phuentsholing’s (Chhukha’s) modeled estimate is lower than the empirically derived

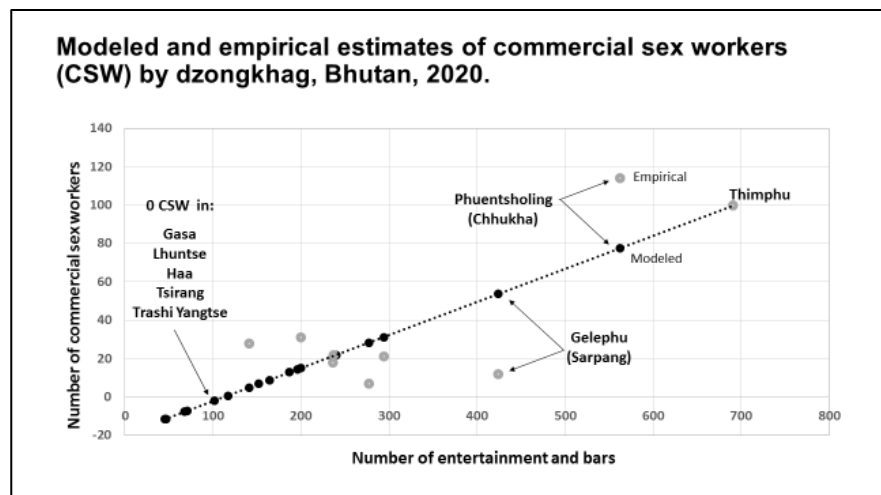


estimate, and Paro’s modeled estimate is higher than the empirical estimate. Overall, the nine study sites included in the data collection are projected to cover 73.8% of the HRW in Bhutan.

The comparison highlights that modeling is not perfect and that judgement is needed when considering whether to use modeled or empirical estimates. On the one hand,

given that 11 of 20 dzongkhag do not have empirically-derived estimates, using the modeled estimates places on dzongkhag on equal footing with respect to national planning. Planning within and between the nine study sites may choose to use the empirical estimates. Additionally, other data or special considerations may lead to using empirical estimates over the modeled estimates. For example, Phuentsholing’s context as the major border town may warrant planning based on the higher empirical estimate.

The figure to the right shows the comparison of the modeled estimates for the number of CSW in all dzongkhag compared to the empirically-derived estimates from the nine study sites. Examples to highlight are that Thimphu’s modeled estimate for CSW is exactly the same as its empirical estimate.



Phuentsholing (Chhukha) again had a higher empirical estimate for CSW compared to its modeled estimate. Gelephu (Sarpang) had a lower empirical estimate of CSW compared to its modeled estimate. This latter finding raises another consideration. The empirical estimates may have missed key populations in their data collection. The model may suggest there are more CSW in Gelephu (Sarpang) than were reached by the study. Overall, the nine study sites included the data collection are projected to cover 84.2% of the CSW in Bhutan.

Stakeholder synthesis and input. [To be incorporated after stakeholder meetings. My expectation is that the stakeholders will be a reality check on some of these estimates, identifying which do not appear correct. This process can help arrive at a “consensus estimate” that is driven

by these data, but incorporate their input. I also hope they will be used to establish “plausibility bounds”, that is the lowest and highest acceptable numbers around a consensus estimate. Moreover, I think the stakeholder input is needed before we include too many conclusions, interpretations, and recommendations.]

C. Demographic and behavioral risk indicators for HRW and CSW

Sampling and recruitment of HRW and CSW. High risk women (HRW), including commercial sex workers (CSW) were recruited for interviews on HIV-related indicators during the data collection period largely overlapping the 1st Capture implementation from 13 November, 2019 through 31 January, 2020. HRW and CSW were recruited for brief interviews through two methods. The first recruitment method was by intercept at the mapped venues. Staff systematically visited all the mapped venues at peak attendance hours, attempting to recruit all HRW and CSW present. The second recruitment method used a peer-referral approach to recruit only CSW (see sampling methods for MSM, TGW, and TGM below). Outreach workers referred CSW known to them for the interview, who in turn referred other CSW in their social circles. Recruitment progressed through 2-3 waves of referrals in some sites to 8-9 waves in other sites. Across all sites and both recruitment methods an estimated 90%-95% of women intercepted or invited to participate agreed to the interview. The table below shows the recruitment by dzongkhag and recruitment method.

Should we suppress figures n<5 for confidentiality reasons? Perhaps show totals, but not fill in cells <5? May need to combine some categories. Only needed for actual data (respondents), KI estimates and model projections are not necessary. Explain in Methods section.

Table: Recruitment of high risk women (HRW) and commercial sex workers (CSW) for interviews, 13 November, 2019 to 31 January, 2020, Bhutan

Site, Dzongkhag	HRW (non-CSW) recruited at venues	CSW recruited at venues	CSW referred by peers	Total
Thimphu	54	47	65	166
Phuentsholing	17	30	54	101
Wangdue	11	13	16	40
Gelephu	23	8	18	49
Paro	15	9	2	26
Samdrup Jongkhar	9	6	10	25
Monggar	7	2	10	19
Punakha	12	22	8	42
Bumthang	20	20	9	49
Total	168	157	192	517

[For example, for CSW recruited in Samdrup Jongkhar and Monggar, we would have to put “<9” in each place, and leave the total as is. That way, the real risk or the perception of being identified as one of the two respondents in Monggar is mitigated. Similarly where highlighted.]

Demographic characteristics of HRW and CSW. The table below describes the demographic characteristics of women interviewed according to whether they acknowledge commercial sex work and by recruit at venues or by referral. While mean age was similar across all three groups, several differences are notable. CSW of both types had high levels of divorce. CSW not affiliated with a venue had high unemployment and low educational attainment. The finding that 82.3% of CSW not recruited at venues had nonetheless visited one or more venues in the last 30 days places this group within the “reachable” population. On the other hand, the data suggest that 17.7% of CSW might not be reached at venues.

Table: Demographic characteristics of high risk women (HRW) and commercial sex workers (CSW), interviewed, Bhutan, 2020.

Characteristic	HRW (non-CSW) (N=168) n (%)	CSW recruited at venues (N=157) n (%)	CSW referred by peers (N=192) n (%)
Mean age in years (SD)	24.8 (4.8)	24.4 (4.3)	26.6 (4.6)
Low education (none, primary only)	75 (44.6)	71 (45.2)	40 (20.8)
Marital status:			
Married	71 (42.5)	50 (31.9)	25 (13.2)
Living together (not married)	12 (7.2)	15 (9.6)	29 (15.3)
Single, never married	30 (18.0)	26 (16.6)	52 (27.4)
Divorced	49 (29.3)	64 (40.8)	83 (43.7)
Widowed	3 (1.8)	1 (0.6)	0 (0)
Other	2 (1.2)	1 (0.6)	1 (0.5)
Occupation:			
Entertainment/bar worker	146 (86.9)	151 (96.2)	20 (10.4)
Unemployed	3 (1.8)	1 (0.6)	109 (56.8)
Others	19 (11.3)	5 (3.2)	63 (32.8)
Visited at least one entertainment venue in the last 30 days (other than site of recruitment)	69 (41.1)	82 (52.2)	158 (82.3)

Categories do not always add up to total due to missing data, decline to answer, or don’t know.

Risk and preventive behaviors among HRW and CSW. Several indicators related to sexual risk behavior are notable in the table below. Having sex under the influence of alcohol (a risk factor for unprotected sex) was high (80.1%) among CSW not recruited at venues. Part of the explanation is that women working at drayangs and other venues may be forbidden to drink (at least in principle). The vast majority (>90%) of all women reported sexual debut before age 15 years. The number of sex partners in the last month was substantially higher among women acknowledging sex work, with a mean of 5.8 for CSW recruited outside of venues and 4.5 for women recruited at venues compared to 1.3 for HRW not engaging in sex work. Consistent condom use was low across all women and partner types, although higher with paying partners.

With respect to preventive behaviors, there was a substantial gap in knowing where to get an HIV test, ranging from 71.3% among HRW to 75.5% among CSW outside of venues. For HRW and CSW at venues, the HISC was the most common testing place mentioned; for CSW outside of venues the referral hospital was the most commonly mentioned. Moreover, less than half (49.7%) of CSW outside of venues had ever tested, with only 23.6% testing in the last year. HISC outreach efforts to women at venues may account for these differences in awareness and testing. Contact with other HIV/STI programs (education events, outreach worker contact, STI testing) were low in the last year across all women, with substantially lower contact among CSW outside of venues.

The table also presents indicators of stigma, discrimination, and violence that the women attributed to their status as HRW and CSW. For interpretation, the context of how widely their status is known needs to be understood. For example, majorities of HRW and CSW at venues said many people knew their status as HRW/CSW. Whereas, only 16.8% of CSW outside venues said this. Following these degrees of being identified, experiences of stigma, discrimination in health care services were higher among HRW and CSW at venues. Nearly half (45.2%) of CSW at venues reported experiences of discrimination when seeking health services. Experiences of violence of all types was high among all the groups of women.

Table: Indicators of HIV risk and preventive behaviors among high risk women (HRW) and commercial sex workers (CSW), Bhutan, 2020. (Note: respondents declined to answer many of the most sensitive questions. Proportions are shown among those providing an answer).

Indicators	HRW (non-CSW*) (N=168) n (%)	CSW at venues (N=157) n (%)	CSW by referral (N=192) n (%)
Provided sex for cash in lifetime? In last year (of those recalling last time)	0 (0) na	157 (100) 92 (95.8)	190 (100**) 151 (100)
Received something other than cash for sex in lifetime?	4 (3.5)	55 (45.8)	63 (36.6)
Drinks alcohol	87 (52.4)	103 (65.6)	144 (75.0)
Ever had sex under the influence of alcohol (of those who drink alcohol) If yes, condom use at last time?	24 (29.8) 12 (57.1)	52 (51.5) 25 (56.8)	113 (80.1) 57 (63.3)
Age at first sex: mean years (SD) Age at first sex under 15 years	10.3 (4.2) 152 (90.5)	10.4 (3.3) 142 (90.5)	10.1 (3.4) 183 (95.3)
Gender of sex partners in lifetime: Men only Women only Both	160 (98.8) 0 (0) 2 (1.2)	153 (97.5) 0 (0) 4 (2.6)	187 (97.9) 1 (0.5) 3 (1.6)
Had sex with a transgender person	1 (0.6)	7 (4.5)	17 (9.2)
Sexual identity: Straight Gay Bisexual	163 (97.0) 0 (0) 3 (1.8)	123 (99.2) 0 (0) 0 (0)	191 (99.5) 0 (0) 0 (0)

Lesbian	0 (0)	0 (0)	1 (0.5)
Other	2 (1.9)	1 (0.8)	0 (0)
Number of sex partners in last 30 days, mean (SD):			
Total	1.3 (1.6)	4.5 (4.9)	5.8 (6.4)
Steady, regular	1.0 (0.4)	1.6 (1.4)	1.2 (0.8)
Casual	0.2 (0.6)	1.0 (1.6)	1.0 (1.5)
Paying	0 (--)	2.0 (2.0)	3.5 (5.4)
Transactional	0 (--)	0 (--)	0.1 (2.3)
Always used condom with (of those with partner):			
Spouse	15 (22.4)	14 (23.7)	14 (42.4)
Steady, regular	25 (35.2)	33 (30.0)	41 (29.7)
Casual	5 (25.0)	28 (45.9)	66 (64.7)
Paying	8 (57.1)	80 (70.8)	159 (85.5)
Transactional	7 (70.0)	22 (52.4)	44 (81.5)
Know where to get a test?	119 (71.3)	115 (73.7)	145 (75.5)
If yes, aware of:			
Referral hospital	58 (48.7)	50 (43.5)	101 (69.7)
District hospital	27 (22.7)	19 (16.5)	12 (8.3)
BHU	3 (2.5)	1 (0.9)	3 (2.1)
HISC	71 (59.7)	81 (70.4)	78 (53.8)
Private	0 (0)	0 (0)	0 (0)
Ever tested for HIV	131 (78.4)	123 (79.4)	95 (49.7)
Tested in the last year among all women	102 (61.1)	97 (62.6)	45 (23.6)
Got last result (whenever last test was)	101 (78.3)	105 (84.4)	78 (81.3)
Ever attended HIV educational event	94 (56.3)	92 (60.5)	28 (14.8)
Attend event in last year among all women	60 (38.7)	63 (45.7)	15 (8.2)
Ever talked with an outreach worker about HIV	75 (47.2)	63 (41.5)	51 (27.6)
Outreach worker contact in last year, all women	62 (39.2)	48 (33.6)	31 (17.8)
Ever tested for STI?	86 (52.8)	79 (51.0)	54 (28.3)
Tested in last year among all women	71 (43.3)	61 (40.1)	24 (13.1)
Ever had symptoms of:			
Genital ulcers	17 (10.4)	24 (15.6)	22 (11.6)
If yes, in 2019	12 (70.6)	18 (75.0)	14 (63.6)
Genital discharge	42 (25.5)	48 (31.2)	71 (37.4)
If yes, in 2019	31 (73.8)	33 (68.8)	47 (66.2)
HRW/CSW status known to:			
No one	24 (14.3)	28 (17.8)	37 (19.4)
A few friends and family	49 (29.2)	41 (26.1)	92 (48.2)
Many people	92 (54.8)	80 (51.0)	32 (16.8)
Don't know	3 (1.8)	8 (5.1)	30 (15.7)
Experience stigma due to HRW/CSW status (often or sometimes)	114 (67.9)	130 (82.8)	115 (59.9)
Experience discrimination at health services because of HRW or CSW status (often or sometimes)	58 (34.5)	71 (45.2)	39 (20.3)

Experienced violence due to HRW or CSW status (ever):			
Any violence	85 (52.2)	108 (71.1)	131 (68.2)
Verbal	71 (42.3)	97 (61.8)	113 (58.9)
Physical	45 (26.8)	46 (29.3)	31 (16.2)
Sexual	37 (22.0)	38 (24.2)	49 (25.5)

*HRW not reporting providing sex for money were analyzed separately from HRW at venues who did report providing sex for money (i.e., classified as CSW at venues).

**Categories may not add up to total due to missing data, decline to answer, or don't know.

Percentages are among those who responded. For example, 2 women referred by peers as CSW denied providing sex for money.

IV. Results for men who have sex with men (MSM), transgender women (TGW), and transgender men (TGM)

A. Results of size estimation methods for MSM, TGW, and TGM

The same methods described above for HRW and CSW above were attempted for MSM, TGW, and TGM. However, a major challenge was that MSM, TGW, and TGM did not have the same affiliations with venues that are evident for HRW and CSW. The MSM, TGW, and TGM populations are present at fewer venues, in lower numbers, and with less consistent presence at the places where they can sometimes be found. This finding is consistent with previous studies in Bhutan, yet is somewhat out of the global and regional norm where these populations have congregated in select physical spaces (often highly LGBT-identified) [refs]. Meanwhile, MSM, TGW, and TGM appear frequently in online spaces, such as geo-locating dating apps. A consequence of the limited venue attendance is that many of the size estimation methods that were planned and attempted were not successful. Nonetheless, several size estimates were possible and are summarized here.

1. Published and Grey Literature Review Estimates

Summarize previous studies in Bhutan here:

NSB 2005: 2.0% of men had male partner (=5,692 if all adult men; = 2,184 if just urban men)

BSS 2006: 1.7% of adult men (=4,838 if all adult men, =1,857 if urban men)

PSE 2013: 9,000 (=3.2% if among all adult men, 8.2% if among urban men)

IBBS 2016: 0.6% of transport workers, 0.4% of migrant workers, 0% of military.

Global and regional literature summary. UNAIDS convention 2% - 5%, China 2%, Japan 2%, other studies are largely urban site specific and often high.

For discussion: our results are MSM are 0.59% of adult men (1.53% of urban men); TGW are 0.03% of adult women (0.08% of urban women), and TGM are 0.10% of adult men (0.27% of urban men).

2. Delphi estimates: stakeholder impressions on the number of MSM, TGW, TGM, pre-implementation

As described above for HRW, the Delphi panel considered the estimated number of MSM, TGW, and TGM in their areas of HIV prevention activities. The panel was asked to consider the numbers of MSM, TGW, and TGM affiliated with venues – a factor that is likely to result in low estimates of their overall numbers.

Table: Delphi estimates for the population sizes of MSM, TGW, and TGM in select locations of Bhutan, round 1 (pre-implementation) August 2019.

Site, dzongkhag	Number of stakeholders	Estimated number of MSM	Estimated number of TGW	Estimated number of TGM
Thimphu	5	15	8	30
Phuentsholing	6	7	5	10
Gelephu	3	10	8	41
Samdrup Jongkhar	3	7	1	7
Punakha	3	12	7	7
Bumthang	1	2	1	3
Trongsa*	3	3	2	5
Total for sites	24	56	32	103

*Trongsa was not included as a data collection site. The pre-implementation Delphi did not include Paro, Wangdue, and Monggar.

3. Wisdom of the Crowds Method Estimates: community perceptions on their estimated numbers

The table below summarizes the mean responses in the survey to the questions on the number of their own key population who they know personally, and the number they believe are in Bhutan. Similar caveats described for HRW and CSW pertain for MSM, TGW, and TGM.

Table: Men who have sex with men (MSM), transgender women (TGW), and transgender men (TGM) perceptions on the number they personally know and that they believe are in Bhutan, 2020. Responses are included only for their own group.

Key population	Number they personally know Mean (95% CI)	Number they believe are in Bhutan Mean (95% CI)
MSM	14.8 (11.8 - 17.8)	1,313 (552 – 2,074)
TGW	13.4 (10.4 – 16.3)	79 (49 – 109)
TGM	21.9 (13.5 – 30.3)	269 (206, 332)

4. Key Informant Mapping and Venue Elicitation

The venues elicited for HRW and CSW tended to be the same for MSM, TGW, and TGM, with lower attendance overall. The field validation exercise attempted to systematically assess the presence and numbers of MSM, TGW, and TGM present in all venues mentioned. However,

classifying the population by site (particularly MSM) readily proved infeasible. Identifying this limitation early in the field work lead to abandoning several methods that required venue-based counting and sampling.

5. Key Informant Mapping Method Estimates of MSM, TGW, and TGM

Despite the challenges noted above, key informants were queried on the numbers of MSM, TGW, and TGM at the venues under their knowledge. Results below confirm that MSM are in low attendance or are not distinguishable from other men. TGW were notably high, a possible result of their employment and visibility at drayang and other entertainment sites. Moderate presence was noted for TGM.

Table: Estimated number of men who have sex with men (MSM), transgender women (TGW), and transgender men (TGM) by key informants, Bhutan, 2020.

Site, Dzongkhag	MSM Mid (Low, High)	TGW Mid (Low, High)	TGM Mid (Low, High)
Thimphu	89 (57 - 120)	83 (61 - 104)	87 (74 - 99)
Phuentsholing	0 (na)	3 (2 - 4)	1 (na)
Wangdue	0 (na)	2 (na)	0 (na)
Gelephu	0 (na)	1 (na)	0 (na)
Paro	2 (na)	19 (17 - 20)	10 (6 - 13)
Samdrup Jongkhar	0 (na)	1 (0 - 2)	4 (0 - 7)
Monggar	0 (na)	0 (na)	0 (na)
Punakha	0 (na)	2 (na)	0 (na)
Bumthang	0 (na)	3 (na)	0 (na)
Total	91 (59 - 122)	113 (88 - 138)	102 (81 - 120)

Note: “na” when there was no variation in estimates by key informants.

6. Mapping with Census and Enumeration Method Estimates

Although initially attempted, the method of systematically counting all MSM, TGW, and TGM present at venues proved infeasible.

7. Reverse Tracking Correction Method

The inability of conducting census and enumeration of MSM, TGW, and TGM at venues precludes this method.

8. Event Multiplier Method

As with HRW and CSW, attendance at the event was too low to use for the calculation of population size. The event was attended by 6 MSM, 7 TGW, and 7 TGM.

9. Service Multiplier Method: two attempts

Two Service Multiplier Methods were attempted to estimate the numbers of MSM, TGW, and TGM. The first was to use HISC testing data where, in principle, MSM and TG status can be recorded. However, examination of these data raised too many doubts about their completeness. For all of the 2019 testing available for the study sites, only 1 instance of an MSM being tested was recorded. A total of 7 TGW were recorded; 3 TGM were recorded.

A second service multiplier proved feasible: membership with Rainbow Bhutan. Calculations are shown in the table below following the approach described for the Unique Object Multiplier Method for HRW above. Numbers were too small to calculate individual dzongkhag estimates.

Table: Population size estimates based on the Service Multiplier Method (Rainbow Bhutan memberships) for MSM, TGW, and TGM, Bhutan, 2020.

Key population	Survey respondents	Responded as member	Rainbow Bhutan membership	Population size (95% CI)
MSM	263	11	74	1,769 (669 – 2,869)
TGW	34	16	19	40 (17 – 63)
TGM	123	34*	24*	87 (44 – 130)

*More TGM said they were members of Rainbow Bhutan in the survey than are registered by Rainbow Bhutan.

10. Unique Object Multiplier Method Estimates: Object and Peer-Directed Survey

The methods follow those described for HRW above with the modification that the objects (also key chains) were distributed at venues and through peer networks. A separate recruitment through peer networks, starting one to two weeks later, provided the second capture to assess receiving the object. Numbers were too small to calculate dzongkhag level estimates.

Table: Population size estimates based on the Unique Object Multiplier Method (key chain) for MSM, TGW, and TGM, Bhutan, 2020.

Key population	Survey respondents	Got key chain	Key chains distributed	Population size (95% CI)
MSM	273	10	47	1,769 (669 – 2,869)
TGW	34	13*	11*	40 (17 – 63)
TGM	123	8	8	87 (44 – 130)

*More TGW said they received a key chain in the survey than were counted as receiving one in the census and enumeration exercise.

11. Object and 2nd Capture

Due to the infeasibility of finding sufficient numbers at venues, as discussed above, this method was not possible for MSM, TGW, and TGM.

12. 1st and 2nd Capture-Recapture

Due to the infeasibility of finding sufficient numbers at venues, as discussed above, this method was not possible for MSM, TGW, and TGM.

13. Multiple Sample Capture-Recapture Method

Unfortunately, given the infeasibility of the venue-based methods, no third capture of MSM, TGW, or TGM was obtained. Future population size estimations should plan for three or more overlapping captures of these populations that are not dependent upon physical venue-based recruitment.

14. Bayesian Synthesis (Anchored Multiplier Method).

Three size estimation results were available for Bayesian synthesis by virtue of not being venue-based: the Wisdom of the Crowds, Service Multiplier, and Unique Object Multiplier Methods. Estimates are for MSM, TGW, and TGM across the nine sites. The priors were the full range of all the estimates assuming a uniform distribution.

Key population	Wisdom of the Crowds	Service Multiplier	Object Multiplier	Anchored multiplier synthesis
MSM	1,313 (552-2,074)	1,769 (669-2,869)	1,769 (669-2,869)	1,463 (1,006-2,030)
TGW	79 (49-109)	40 (17-63)	40 (17-63)	64 (37-100)
TGM	269 (206-332)	87 (44-130)	87 (44-130)	256 (124-446)

Dzongkhag level estimates of MSM, TGW, and TGM. Without robust, direct population size estimates for individual dzongkhag, we chose to use the distribution of the residence in the sample (shown in the table below). A limitation of this assumption is that the survey may not be representative of the populations by residence. Future exercises should seek alternative proxy or method to apportion these populations by dzongkhag. Examination of the survey data indicate a high diversity of the current residence and dzongkhag of origin for all populations. For example, MSM resided in all nine of the study site dzongkhag while their site of birth included all 20 dzongkhag in Bhutan. The sample of TGW was small (N=34), yet they currently resided in 6 of the 9 study dzongkhag and were born in 16 of the 20 national dzongkhag. TGM resided in 8 of the 9 study dzongkhag and were born in 18 of the national 20.

Table: Anchored multiplier synthesis for dzongkhag-level estimates of MSM, TGW, TGM, nine sites, Bhutan, 2020.

Site, dzongkhag	LGBT % in survey	MSM	TGW	TGM
Thimphu	27.8%	407	18	71
Phuentsholing	32.5%	475	21	83
Wandue	3.2%	48	2	8
Gelephu	9.5%	139	6	24

Paro	4.6%	68	3	12
Samdrup Jongkhar	8.8%	129	6	23
Mongar	5.8%	85	4	15
Punakha	1.2%	17	1	3
Bumthang	6.5%	95	4	17
Total	100%	1,463	64	256

B. Extrapolation of size estimates for MSM, TGW, and TGM to the dzongkhag and national levels

Assumptions for extrapolation. Assumptions similar to those used for HRW and CSW were applied to MSM, TGW, and TGM. First, we assume data for the nine study dzongkhag provide a reasonably complete picture for the populations in those dzongkhag. While not venue-based, we also conceive of these estimates as pertaining to the “reachable” population. In the case of MSM, TGW, and TGM, reachability leans towards being networked to others in these populations. A second assumption is that the estimates are focused on urban areas, that the populations tend to reside in urban areas or circulate through them and are socially connected to others in the urban areas. We assume few MSM, TGW, and TGM would be solely reachable in rural areas. Perhaps to a greater degree than for HRW and CSW, this assumption may under-estimate the true population sizes as gender and sexual identity are not dependent upon access to urban areas (although expression of these identities and finding partners may be). This is supported by these populations being born in all 20 dzongkhag. A third assumption is that proxy indicator data correlated with estimates within the 9 study dzongkhag can be used to extrapolate to the 11 non-study dzongkhag and nationally. The appropriate proxies may be harder to identify. Nonetheless, several viable proxies are presented in the table below.

Table: Assessment of proxy indicators for extrapolation of MSM, TGW, and TGM estimates from the 9 study dzongkhag to the total 20 dzongkhag of Bhutan, 2020.

Proxy considered, indicator by dzongkhag level	Source	Adjusted R ² with MSM (p-value)	Adjusted R ² with TGW (p-value)	Adjusted R ² with TGW (p-value)
Number entertainment venues (e.g., drayang, karaoke)	MoEA	0.5204 (0.017)	0.5167 (0.018)	0.5181 (0.017)
Number licensed bars	MoEA	0.8037 (0.001)	0.7967 (0.001)	0.7984 (0.001)
Entertainment + bars	MoEA	0.7997 (0.001)	0.7928 (0.001)	0.7946 (0.001)
Distance from Thimphu	NSB	-0.0994 (0.615)	-0.1038 (0.634)	-0.1018 (0.625)
Population density	NSB	0.4145 (0.036)	0.4193 (0.035)	0.4121 (0.037)
Female urban population	NSB	0.4838 (0.023)	0.4842 (0.022)	0.4813 (0.023)
Male urban population	NSB	0.5142 (0.018)	0.5149 (0.018)	0.5118 (0.018)

Urbanicity defined as the number of female/male population living in urban areas; percent urban was also examined with poorer model fit.

NSB = National Statistic Bureau of Bhutan; MoEA = Ministry of Economic Affairs, Bhutan.

The number of licensed bars appears to be the strongest correlate of the number of all three populations (MSM, TGW, and TGM). The linear regression models to extrapolate to all 20 dzongkhag are:

$$\text{Number of MSM per dzongkhag} = 0.88 \times \text{number of bars} - 121.24$$

$$\text{Number of TGW per dzongkhag} = 0.039 \times \text{number of bars} - 5.24$$

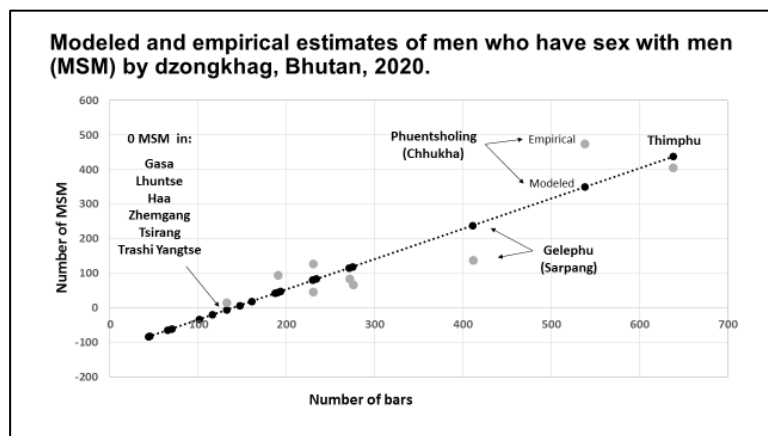
$$\text{Number of TGM per dzongkhag} = 0.15 \times \text{number of bars} - 20.95$$

Table: Modeled number of MSM, TGW, and TGM based on synthesized empirical estimates in nine dzongkhag and proxy indicators, Bhutan, 2020.

Dzongkhag	Proxy: Number of bars	Modeled number of MSM	Modeled number of TGW	Modeled number of TGM
Thimphu	638	438	19	76
Chhukha	538	350	15	61
Samtse	234	84	4	15
Wangdue Phodrang	230	80	4	14
Sarpang	411	239	11	42
Paro	275	120	5	21
Trashigang	193	48	2	8
Samdrup Jongkhar	230	80	4	14
Monggar	271	116	5	20
Punakha	132	0	0	0
Trongsa	147	8	0	1
Dagana	161	20	1	4
Pema Gatshel	187	43	2	8
Tsirang	65	0	0	0
Bumthang	190	45	2	8
Zhemgang	116	0	0	0
Trashi Yangtse	70	0	0	0
Haa	44	0	0	0
Lhuentse	101	0	0	0

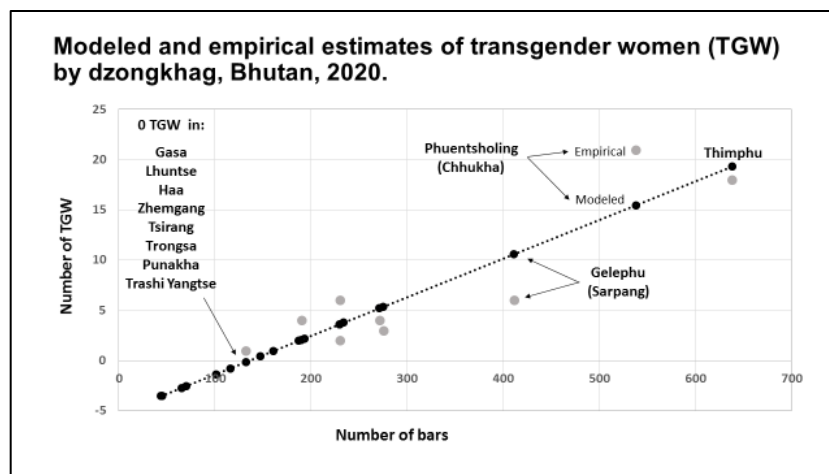
Gasa	45	0	0	0
Total	-	1,670	74	292

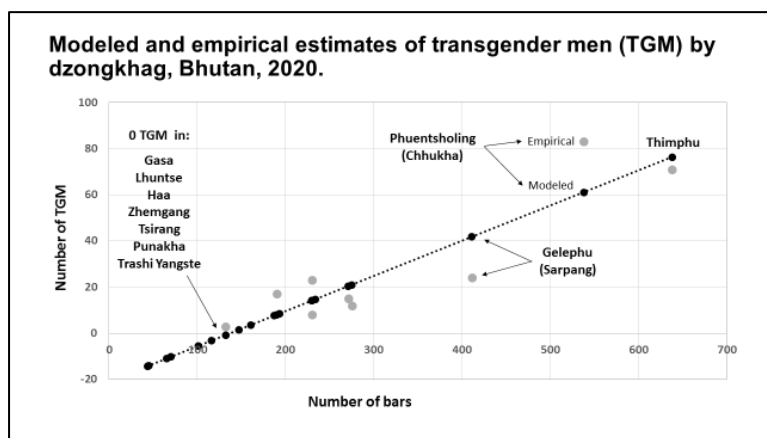
The following figures compare the empirical estimates for each population in the 9 study sites compared to the modeled estimates for all 20 dzongkhag.



For MSM, the empirical estimated population size for Phuentsholing (Chhukha) is higher than the modeled estimate, while the Gelephu (Sarpang) empirical estimate was lower than predicted by the model. Context is needed to assess which estimate is likely closer to the truth. Six dzongkhag were modeled to have a negative number of MSM, which would assign them to 0 for interpretation for program planning.

A similar pattern holds for TGW, with Phuentsholing having higher empirically estimated numbers than projected by the model and Gelephu have fewer empirically estimated than modeled. Notably nine dzongkhag are modeled to have no TGW (or “reachable” TGW). As a case in point for the need for context, TGW were encountered in Punakha yet the model projected none.





The pattern held for TGM, although numbers were higher overall and fewer dzongkhag had 0 projected TGM compared to TGW. Punakha also requires reconciliation between the 0 modeled and the fact that TGM were encountered there in the field.

Stakeholder synthesis and input

[To be incorporated after stakeholder meetings.]

C. Demographic and behavioral risk indicators for MSM, TGW, and TM

Sampling and recruitment of MSM, TGW, and TGM. The original protocol planned to conduct a conventional RDS survey of MSM, TGW, and TGM to measure indicators of HIV risk and preventive behaviors. Conventional RDS requires several assumptions be met (i.e., willingness to refer participants to a fixed site, limiting referrals per participant, obtaining long chains of peer referrals, a sufficiently large target population). These proved difficult to meet. To maintain peer-referral recruitment progress in all sites, adaptations were required, resulting in a modified, practical peer-directed sampling (“PDS”) approach. PDS entailed peer outreach workers contacting their networks to make introductions with snowballing (i.e., larger groups of referrals per peer), followed by identifying other peers able to refer. In addition, peer outreach workers recruited from LGBT-oriented online sites including geo-locating data apps. The end result was a hybrid recruitment method that obtained risk behavior data in a diverse sample of key population members who are not directly affiliated with specific hotspots, clinics, or programs. Broadly speaking, large samples of a small, finite population may yield similar results no matter how recruited as long as not severely restricted to one selective source. Using our population size estimates, the sampling fraction was 16% of all MSM, 46% of all TGW, and 42% of all TGM.

Demographic characteristics of MSM, TGW, and TGM. Sex was asked in two steps: the sex assigned at birth and the current gender identity. All (100%) of TGM were assigned female sex at birth and current identified as “transgender men”. All TGW (100%) were assigned male sex at birth and most (91.1%) currently identified as “transgender female”. TGM had substantially higher unemployment and lower education levels compared to MSM and TGW.

Table: Demographic characteristics of MSM, TGW, and TGM interviewed, Bhutan, 2020.

Characteristic	MSM (N=273) n (%)	TGW (N=34) n (%)	TGM (N=124) n (%)
Sex assigned at birth:			
Male	273 (100)	34 (100)	0 (0)
Female	0 (0)	0 (0)	124 (100)
Current gender identity:			
Male	269 (98.5)	1 (2.9)	0 (0)
Female	0 (0)	2 (5.9)	0 (0)
Transwoman	0 (0)	31 (91.1)	0 (0)
Transman	0 (0)	0 (0)	124 (100)
Don't know	1 (0.8)	0 (0)	0 (0)
Other	3 (1.1)	0 (0)	0 (0)
Age: Mean age (SD) or age categories?	28.8 (7.6)	25.7 (7.0)	24.6 (3.9)
Education level: none or primary only	29 (10.7)	5 (14.7)	39 (31.7)
Marital status:			
Married	56 (20.7)	0 (0)	0 (0)
Living together (not officially married)	17 (6.3)	2 (5.9)	44 (35.5)
Single, never married	168 (62.0)	30 (88.2)	78 (62.9)
Divorced	24 (8.9)	1 (2.9)	2 (1.6)
Widowed	1 (0.4)	0 (0)	0 (0)
Other	5 (1.9)	1 (2.9)	0 (0)
Unemployed	31 (11.4)	6 (17.7)	35 (28.2)

Risk and preventive behaviors among MSM, TGW, and TGM. Indicators of risk for HIV acquisition were notably high for TGW, consistent with the global literature [ref]. TGW had the highest proportion engaging in sex work and transactional sex, early sexual debut, and number of partners in the last 30 days. TGW were also most likely to report preventive behaviors including testing for HIV ever and in the last year, attending HIV educational events, having contact with outreach workers, and testing for STI in the last year. Experiences of stigma and discrimination due to their sexual/gender minority status need to be interpreted in the context of whether the key population members are known to be so. Overall, few (4.8%) said their MSM status was known to many people, half (50.0%) of TGW said their gender identity was known to many, while most (85.5%) of TGM said their gender identity was known to many. Experiences of stigma was highest among TGM (95.2%), while experiences of discrimination at health services was highest among TGW (55.9%). Physical (35.5%) and sexual violence was most common among TGW.

Table: Indicators of HIV risk and preventive behaviors among MSM, TGW, and TGM, Bhutan, 2020. (Note: respondents declined to answer many of the most sensitive questions. Proportions are shown among those providing an answer).

Indicators	MSM (N=273) n (%)	TGW (N=34) n (%)	TGM (N=124) n (%)
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Provided sex for cash in lifetime	46 (17.4)	22 (73.3)	2 (1.9)
Received something other than cash for sex in lifetime?	58 (22.1)	20 (66.7)	0 (0)
Drinks alcohol	192 (70.3)	28 (82.4)	89 (71.8)
Ever had sex under the influence of alcohol (of those who drink alcohol)	88 (56.4)	9 (39.1)	18 (21.2)
If yes, condom use at last time?	50 (64.9)	6 (75.0)	1 (5.9)
Age at first sex: mean years (SD)	10.3 (4.3)	8.0 (3.9)	9.6 (5.4)
Age at first sex under 15 years	234 (85.7)	33 (97.1)	111 (89.5)
Gender of sex partners in lifetime:			
Men only	96 (36.5)	28 (93.3)	0 (0)
Women only	1 (0.4)	0 (0)	103 (99.0)
Both	166 (63.1)	2 (6.7)	1 (1.0)
Had sex with a transgender person	87 (33.2)	5 (17.2)	3 (3.0)
Sexual identity:			
Straight	4 (1.5)	33 (97.1)	123 (97.5)
Gay	114 (41.8)	0 (0)	0 (0)
Bisexual	151 (55.3)	1 (2.9)	3 (1.9)
Lesbian	0 (0)	0 (0)	0 (0)
Other	4 (1.5)	0 (0)	1 (0.6)
Number of sex partners in last 30 days, mean (SD):			
Total	5.8 (9.0)	12.7 (13.4)	1.4 (1.3)
Steady, regular	1.2 (1.4)	2.3 (2.3)	0.6 (0.5)
Casual	2.2 (2.7)	2.2 (2.4)	0.6 (1.0)
Paying	1.8 (5.9)	4.5 (6.3)	0.1 (0.5)
Transactional	0.6 (2.0)	3.7 (4.4)	0.1 (0.5)
Always used condom with (of those with partner):			
Spouse	2 (2.9)	0 (0)	0 (0)
Steady, regular	38 (24.8)	6 (28.6)	1 (1.7)
Casual	77 (43.0)	6 (27.3)	1 (2.2)
Paying	55 (62.5)	13 (76.5)	1 (50.0)
Transactional	38 (64.4)	9 (52.9)	0 (0)
Know where to get a test?	201 (74.2)	26 (76.5)	105 (84.7)
If yes, aware of:			
Referral hospital	106 (52.7)	9 (34.6)	86 (81.9)
District hospital	39 (19.4)	5 (19.2)	8 (7.6)
BHU	11 (5.5)	1 (3.8)	6 (5.7)
HISC	104 (51.7)	22 (84.6)	65 (61.9)
Private	5 (2.5)	1 (3.8)	2 (1.9)
Ever tested for HIV	156 (58.0)	24 (70.6)	44 (35.8)
Test for HIV last year among all respondents	110 (40.9)	20 (58.8)	28 (22.8)
Got last result (whenever last test was)	153 (98.1)	24 (100)	25 (55.6)
Ever attended HIV educational event	67 (25.0)	22 (64.7)	66 (53.2)
Attended in last year among all respondents	28 (10.9)	12 (41.4)	50 (41.0)
Ever talked with an outreach worker about HIV	39 (14.4)	20 (58.8)	71 (58.2)
Outreach contact in last year among all respondents	18 (6.9)	18 (56.3)	63 (52.9)

Ever tested for STI?	83 (30.5)	18 (52.9)	7 (5.7)
Tested in last year among all respondents	63 (23.3)	17 (50.0)	5 (4.1)
Ever had symptoms of:			
Genital ulcers	21 (7.7)	6 (17.7)	1 (0.8)
If yes, in 2019	12 (57.1)	6 (100)	1 (100)
Genital discharge	13 (4.8)	13 (38.2)	12 (9.7)
If yes, in 2019	9 (69.2)	11 (84.6)	9 (75.0)
MSM/TGW/TGM status known to:			
No one	172 (63.0)	6 (17.7)	1 (0.8)
A few friends and family	73 (26.7)	10 (29.4)	15 (12.1)
Many people	13 (4.8)	17 (50.0)	106 (85.5)
Don't know	15 (5.5)	1 (2.9)	2 (1.6)
Experience stigma due to MSM/TGW/TGM status (often or sometimes)	96 (35.4)	31 (91.2)	118 (95.2)
Experience discrimination at health services because MSM, TGW, TGM status	50 (18.5)	19 (55.9)	59 (47.6)
Experienced violence due to MSM, TGW, TGM status:			
Any violence	60 (22.0)	23 (67.7)	117 (94.4)
Verbal	50 (18.3)	19 (55.9)	117 (94.4)
Physical	11 (4.0)	12 (35.3)	13 (10.5)
Sexual	18 (6.6)	10 (29.4)	6 (4.8)

Categories may not add up to total due to missing data, declined to answer, don't know. Percentages are among those who responded.

IV. Discussion, Limitations, Conclusions, and Recommendations

[This section left as notes awaiting stakeholder input.]

Main findings: focus on 3 main objectives answers, compare to previous reports, published literature.

Other important findings, lessons learned, interpretations of risk indicators. The methods that worked can be further strengthened. For example, the PDS approach for HIV sentinel surveillance.

Limitations:

- Methods for MSM challenged by low numbers of physical venues where they congregate, low attendance at venues, low affiliation with venues. Made many methods infeasible
- No third capture for MSM. Unable to adjust for potential biases in object multiplier and service multipliers

- Extrapolation for MSM very difficult without robust dzongkhag level data and good proxies
- Under reporting of sex for money in venue-based survey. Effect would under-estimate the number of CSW, particularly as a fraction of all HRW. Note that the stakeholder estimates of CSW affiliated with venues was the lowest of all. May be bias since CSW not supposed to operate at venues.
- Rural areas, small towns, and other places not included. However, could CSW operate outside large to medium towns? Or sites without identified hotspots. Extrapolation is conceptually to more urban areas where they can be reached.
- Conventional 95% confidence intervals not feasible for many estimates (e.g., KI mapping, census and enumeration, Delphi). This also complicates the creation of 95% CI for national estimates. Instead, propose to establish “plausible bounds” or “credible bounds” using stakeholder input. Such boundaries provide a reality check upon statistical models that may create impossibly upper and lower estimates, or imply more certainty than is warranted.

Recommendations

[Final recommendations should follow stakeholder input. To me, the data support the need for peers being able to provide HIV counseling and testing.]

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Annexes

- A. Protocol
- B. Brief Intercept Questionnaire
- C. ?

Annex A. Study Protocol

REBH SI.No1. STUDY TITLE

Mapping and population size estimation of men who have sex with men, transgender persons, and high-risk women in Bhutan

Study protocol

(Version 2: September 28, 2019)

Implementing Agency

National AIDS Control Programme (NACP), Thimphu, Bhutan

Funding Agency:

Global Fund and Royal Government of Bhutan

REBH SI.No2. NAMES AND INSTITUTIONAL AFFILIATIONS OF THE PRINCIPAL INVESTIGATOR AND OTHER INVESTIGATORS

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ROLES OF THE INVESTIGATORS

<p>Principal Investigator</p> <ul style="list-style-type: none"> • To guide the overall proposal development and implementation of the research activities • To mobilize fund and logistics of research • To recruit local enumerators and participants • To obtain permission including ethical approvals • To technical advisors in providing local information and data related to subject matter. • To assist NTA and ITA in the proposal development, implementation and analysis and report writing. • To ensure smooth conduct of research • To draft report and data dissemination in collaboration with PI and NTA 	<p>Co-Investigators.</p> <ul style="list-style-type: none"> • To assist the PI in all matters pertaining to the research • To participate and contribute in the proposal development and implementation of the research • To learn on how to conduct research and data analysis • To support PI and advisors in terms of information gathering, obtaining approvals and other activities related to the study.
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<ul style="list-style-type: none"> • To guide in submission of the final report to MoH, Global Fund and REBH. 	
<p>National Technical Advisor</p> <ul style="list-style-type: none"> • To develop proposal in collaboration with ITA and PI • To support in logistic arrangement of ITA • To guide the team on the proposal development and approvals • To conduct data collection and also train the enumerators, research assistants and PI and assistant PI • To write in report writing and data dissemination in collaboration with PI and NTA • To guide in submission of the final report to MoH, Global Fund and REBH. 	<p>International Technical Advisor.</p> <ul style="list-style-type: none"> • To guide, train and develop the proposal in collaboration with NTA, PI, assistant PI and other key stake holders • To train the enumerators on data collection, data entry and data analysis • To train NTA, PI, Assistant PI and enumerators • To guide and write in report writing and data dissemination in collaboration with PI and NTA

REBH SI.No3. PROJECT SUMMARY

This protocol presents the methodologies and procedures to answer the question “how many men who have sex with men, transgender persons, and high-risk women are there in Bhutan?” The study also seeks to measure sexual behaviours that place them at risk for HIV. Answers to these questions will strengthen Bhutan’s national response to the HIV epidemic by guiding appropriate resource allocation, setting targets for prevention programs, and gauging the impact of efforts towards ending HIV as a public health threat to the nation. Because there is no single gold standard method for estimating the sizes of key populations at risk for HIV, we take an approach of triangulation. We sequentially integrate several methods, including mapping and counting at “hotspots” (e.g., bars, other entertainment venues) and leveraging counts of these key populations seen at health services, attending mobilization events, and contacted by outreach workers using capture-recapture techniques. An anonymous, brief sexual risk behavior survey will be implemented by intercepting persons at hotspots, and through respondent-driven sampling (RDS) that recruits through peer referrals. The study will be implemented in major towns of nine districts, including Thimphu, Phuentsholing, Paro, Gelephu, SamdrupJongkhar, Bumthang, Wangdue-Punakha, and Monggar. Estimates from these study sites will be extrapolated to the whole of Bhutan using proxy measures available from the census (e.g., population density) and surveillance (e.g., HIV cases by district). At every stage of the study (design, formative, data collection, analysis, interpretation), we will involve community members and other stakeholder to arrive at population size estimates that are backed by scientific rigor and validated by the people who will use them. We anticipate the study will begin in late October and be completed by 31 December, 2019, culminating in the output of a comprehensive report that details the rationale, methods, data, conclusions, and recommendations.

REBH SI.No4. BACKGROUND AND RATIONALE

Fortunately for the present, current evidence indicates Bhutan experiences a low-level HIV epidemic [1]. Compared to other countries in the region, Bhutan's HIV epidemic appears to have started later, with the first case diagnosed in 1993, and progressed more slowly. Only sporadic cases appeared between 1993 and 2000. From 2000 to 2013, the number of new diagnoses rose from 9 to 51. Since 2013, there appears to be a plateau in the number of new HIV diagnoses, fluctuating between 49 and 58. Until June 2019 there has been an accumulated 663 HIV diagnoses, 505 of whom are known to be alive, and 450 of whom are on antiretroviral treatment provided by the Ministry of Health. While projections are uncertain, UNAIDS models place the number of people living with HIV in Bhutan at 1265. The national response to HIV is geared to end the epidemic by 2030. Targets to achieve this vision include increasing the proportion of persons living with HIV who are diagnosed to >90%, the proportion of those diagnosed on antiretroviral treatment at 100%, and the proportion retained in care with sustained viral suppression at >90% by 2020.

Bhutan may also stand in contrast to other countries in South and South East Asia in its pattern of HIV epidemiologic progression. Typically, key populations (KP) at elevated risk acquire infection early in an epidemic, when the conditions for rapid spread were already present (e.g., high sexual partner turn-over, multiple concurrent partnerships, low condom use). These KP include men who have sex with men (MSM), transgender persons (TG), and high-risk women (HRW). HIV incidence rises fast in these populations, often accelerating after a threshold of 5% prevalence. HIV transmission to the sexual partners of KP becomes substantial, raising the overall prevalence of HIV for the nation. At this point, the epidemic has moved from low level to concentrated.

Several factors are cause for concern that conditions are present for greater spread of HIV among KP in Bhutan. First, with a passive surveillance system, under-reporting of HIV cases is possible. Second, UNAIDS projections and low CD4 counts among new diagnoses indicate that many infections go undiagnosed for long periods of time. Therefore, the number of people living with HIV may be under-estimated and the potential for onward transmission from persons who are untreated may be high. Third, MSM, TG, and HRW status has not been systematically recorded in surveillance data until recently. A disproportionate burden and level of transmission in these populations may be unrecognized. Fourth, indicators of risk suggest high potential for increased sexual transmission of HIV. These include rising incidence of sexually transmitted infections (STI), low condom uses in all types of partnerships, high levels of multiple sex partners, and the apparent emergence of commercial and transactional sex [1-5]. Finally, there is increasing concern that the prevention needs of KP at high risk for HIV have been inadequately addressed, particularly MSM, TG, and HRW [3,6].

Whether Bhutan will follow a progression from a low level to concentrated epidemic, similar to other countries in the region, or start on a trajectory towards eliminating HIV by 2030 may hinge upon reaching MSM, TG, and HRW with effective programs. The Ministry of Health of Bhutan has embarked on a nationwide HIV prevention and awareness program with targeted interventions for MSM, TG, and HRW. Unfortunately, there is a scarcity of data on these populations in Bhutan – beginning with knowing their numbers, where they can be found, and measures of sexual risk behaviors that may drive HIV transmission. Without these basic data, it is impossible to

appropriately allocate limited resources, set targets for programs activities, gauge the reach of these programs, and assess their impact on HIV incidence.

Past attempts at population size estimates have met unique challenges in Bhutan [6]. The typical venues or hotspots where MSM, TG, and HRW congregate in other parts of the world may not exist in Bhutan. As in much of the world, selling sex is illegal and same-sex sex behavior was illegal until recently (on June 7, 2019 Bhutan’s lower house voted to repeal Sections 213 and 214 of the Penal Code that made same-sex sex illegal). Even if legal, these behaviors are highly stigmatized, seldom openly discussed, and remain hidden. Prior research found no clear evidence of “gay” and “transgender” communities coalescing in the country, either in public spaces, online, or through social media [7]. A survey conducted in Bhutan in 2016 was able to recruit only 30 MSM and 12 TG [3]. The training of MSM, TG, and HRW as peer outreach workers in Bhutan is nascent. Bhutan faces the special challenge of small population sizes. State of the art methods to conduct population size estimation and probability-based sampling for measuring sexual risk behaviors require sufficient numbers, a sufficient proportion who are visible, and social networks that connect large numbers of other members.

To address these challenges in KP size estimation in Bhutan, we propose a comprehensive protocol that brings multiple methodologies to bear. Population size estimation procedures will incorporate existing knowledge, stakeholder and community input, visualization of the hotspots where KP congregate, and statistical models to estimate their numbers where they cannot be reached. The protocol requires flexibility in adopting or adapting different methods for the different KP in the nine different districts. The approach follows UNAIDS guidelines [8] that recommend using multiple approaches to produce the most credible estimates, to provide checks and balances, and to minimize the risk of drawing false conclusions due to the biases or logistical failures any single method.

REBH SI.No5. OBJECTIVES

General objective:

1. To establish national and selected geographic area population size estimates, including sexual risk behavior, for MSM, TG, and HRW in Bhutan.

Specific objectives:

2. To generate the size estimations for MSM, TG, and HRW including their sexual risk behaviour in relation to HIV.
3. To produce a detailed mapping of the hotspots including sexual risk behaviour for the specific geographic areas (Thimphu, Phuentsholing, Paro, Gelephu, SamdrupJongkhar, Bumthang, Wangdue-Punakha, and Monggar), indicating the number of MSM, TG, and HRW in selected sites and geographical locations.
4. To write a detailed study report and publication with the local and national size estimates for MSM, TG, and HRW including their sexual risk behavior.

REBH SI.No6. STUDY DESIGN

Executive Summary / Overview

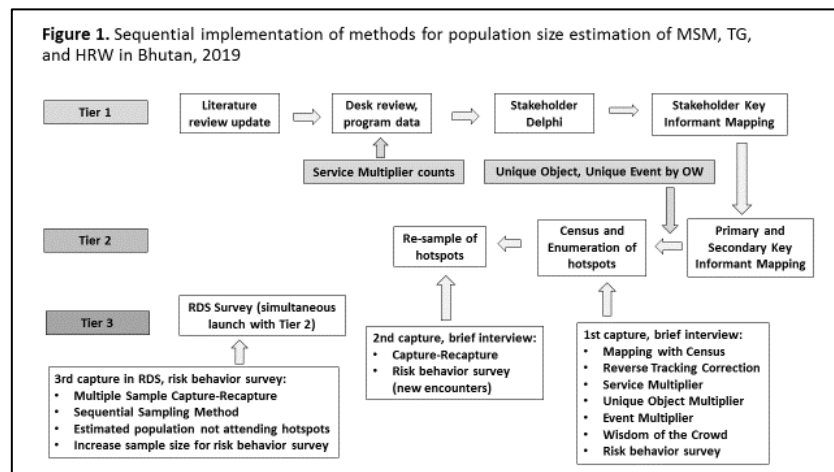
This protocol describes the rationale, methods, and procedures to conduct a mapping and size estimation study of key populations (KP) at risk for HIV in Bhutan, with measures of their sexual risk behaviors. Field activities will be implemented in eight study sites that cover nine towns in nine districts (Thimphu Thromdey, Phuentsholing, Paro Town, Gelephu, SamdrupJongkhar town, Bumthang town, Wangdue-Punakha (Bajo and Lobesa town), and Monggar town. Data collected from the nine districts will form the basis for extrapolation of estimates to the 11 districts without direct data collection, and to the national level. No minors will be included; a waiver to use oral rather than written informed consent is requested.

KP are communities that bear a high incidence and burden of HIV worldwide, yet data on their numbers and the behaviors that place them at risk are scant in Bhutan. The present protocol addresses three KP: men who have sex with men (MSM), transgender persons (TG), and high-risk women (HRW). Recognizing definitions of these populations are varied, complex, and contextual, including different self-identities, behaviors, circumstances, and time periods, we adopt a public health response perspective. The target populations are those that prevention programs seek to engage by virtue of their current behavior or near future risk. The target populations can be contacted through outreach to venues, through social media, and by fixed site services targeting KP. MSM are defined as men 18 years and older who have had anal or oral sex with another man or TG in the last 12 months. TG are defined as persons 18 years and older who were assigned a sex at birth that is different from their current gender identity. HRW are women 18 years and older who work or visit “hotspots”, defined as environments where high risk sexual behaviors are frequently initiated (e.g., commercial sex work, transactional sex, multiple and concurrent partnering, high partner turn-over, and sexual networking within and between KP).

Following UNAIDS guidelines [8], several sequentially implemented methods (Figure 1 below) will be used to triangulate robust population size estimates and minimize the impact of biases and errors resulting from any single approach. Flexibility is needed in implementing the methods for different sites and different populations as the minimum requirements may not be present, particularly for MSM and TG. Methods include: literature review, desk review, the Delphi Method, Mapping with Census and Enumeration, the Reverse Tracking Correction, Service Multiplier, Unique Object Multiplier, Event Multiplier, Wisdom of the Crowd, Capture-Recapture, Multiple Sample Capture-Recapture, and the Sequential Sampling Method. References for these methods in the published literature are provided in the Theoretical Framework table below. This protocol is organized into three “tiers” of activities according to the nature of data collection.

Tier 1 activities entail an updated published and gray literature review, analysis of programmatic data related to KP (e.g., for Service Multipliers), examination of public traffic on social media sites, and gathering information from stakeholder key informants (e.g., public health workers and providers of services to KP). Stakeholder key informants (principally

HISC staff and peer outreach workers) will be convened as a group and as district teams to generate a list of potential hotspots, arrive at initial estimates of the number of KP, and identify primary and secondary key informants.



Tier 2 activities entail collection of data from hotspots, KP community members, and other persons associated with hotspots through focus group discussion (FGD) and in-depth interviews (IDI). Primary key informants are KP community members who will expand the map of potential hotspots and periods of peak attendance. Secondary key informants are persons with knowledge of specific hotspots (e.g., entertainment venue owners, male clients, taxi drivers, etc.) who will also provide information on hotspot locations and attendance patterns. Once the map is complete, peers engaged by outreach workers and NGO will distribute a small gift to KP through social networks and venues for the Unique Object Multiplier Method, and assist with hosting a mobilization event for KP for the Event Multiplier. Field teams will visit hotspots on 3 consecutive days on two separate occasions about one week apart to gather counts for the Mapping with Census and Enumeration Method, the Reverse Tracking Correction, and the Capture-Recapture Method. The first visit will systematically count KP present at all hotspots at the days and times of peak attendance as reported by key informants. A Brief Intercept Survey will be done with persons systematically and consecutively met at the hotspot to verify KP status, obtain indicators of risk behavior, and collect data used for size estimation (i.e., Service Multiplier, Unique Object Multiplier, Event Multiplier, and Wisdom of the Crowd methods). A second field mapping will be done a week later in a random sub-sample of hotspots to complete the Capture-Recapture Method.

Tier 3 entails implementation of respondent-driven sampling (RDS) surveys in selected districts and KP with sufficient network sizes [9]. RDS entails long chains of peer referrals, similar to snowball sampling, to recruit a representative sample of KP independently of hotspot attendance. The RDS surveys will obtain risk behavior data of KP who do not attend the hotspots and allow for additional size estimation methods (i.e., Multiple Sample Capture-Recapture, Sequential Sampling methods).

Analysis, synthesis, and extrapolation will be done using several methods incorporating stakeholder input and national-level census and surveillance data. First, population size estimates will be generated from each of the individual methods listed above. Second, the Bayesian

Anchored Multiplier will combine the individual estimates to arrive at a “best estimate” and plausible upper and lower range [10]. Third, the stakeholder key informants will be reconvened as a Delphi panel to examine results, assess potential biases and limitations, and interpret the numbers from the study site towns to the districts as a whole. The process will arrive at a “consensus” or best estimate for each district and acceptable upper and lower bounds. Fourth, the stakeholders will help guide the extrapolation of size estimates to the 11 districts without data collection and to the national level. The method will use proxy indicators (i.e., variables available at the national level, such as population density, percent residing in urban areas, numbers of HIV or STI cases, or the number of entertainment establishments per district). Using stakeholder input to choose appropriate proxies, we will conduct a correlation analysis between proxies and KP population sizes as rates for the districts with data. Those proxies with the strongest correlations to KP sizes will be used in a linear regression model to fit the KP population rates for the 11 districts without direct data. National estimates will be the sum of KP estimated in all districts.

The proposed study will generate data to strengthen the national HIV response in several ways. The numbers of KP and their locations provide an evidence basis to prioritize populations and programs, appropriately allocate limited resources, and set targets for the delivery of services. The risk behavior data provide a better understanding of the drivers of HIV transmission in Bhutan and points for future prevention interventions. The survey data also provide a baseline for the reach and coverage of programs for KP as part of monitoring and evaluation. A comprehensive report on findings, interpretations, and recommendations will be generated, incorporating stakeholder input. Additional dissemination materials will include community forums hosted by the HISC and NGO, one-page factsheets, posters, PowerPoint presentations, national and international conference presentations, and manuscripts for national (i.e., *Bhutan Health Journal*) and international scientific journals. Added benefits of the project are the capacity building opportunities in the theory and implementation of research among KP through hands-on training to public health practitioners, program staff, and KP peer outreach workers. Finally, the project will help advocacy efforts for the rights of all Bhutanese as the most rigorous documentation of the existence of MSM, TG, and HRW across society.

Theoretical Framework for Population Size Estimation Methods to Be Used. According to UNAIDS, there is no gold standard method for KP population size estimation [8]. All methods are prone to potential biases [11]. Therefore, implementing several methods with different theoretical underpinnings helps minimize the risk of wrong conclusions based on incorrect assumptions or mistakes in the field compared to relying on one method. This protocol’s overall approach is to sequentially integrate several methods into operations as illustrated in Figure 1 above and describe in detail below. Flexibility is required in that not all methods may be possible for all KP in all sites. This may particularly be the case for MSM and TG for whom there are few if any hotspot venues and whose population sizes are likely small. Given the greater certainty of identifying sufficient hotspots for HRW, the methods, procedures, and sample size requirements described in this protocol are for HRW. If sufficient numbers of hotspot venues can be identified and the samples can be achieved for MSM and TG, then all procedures and sample sizes are the same for these KP. The following Table 1 summarizes the methods to be used, their required theoretical assumptions, and potential limitations with reference to the scientific literature.

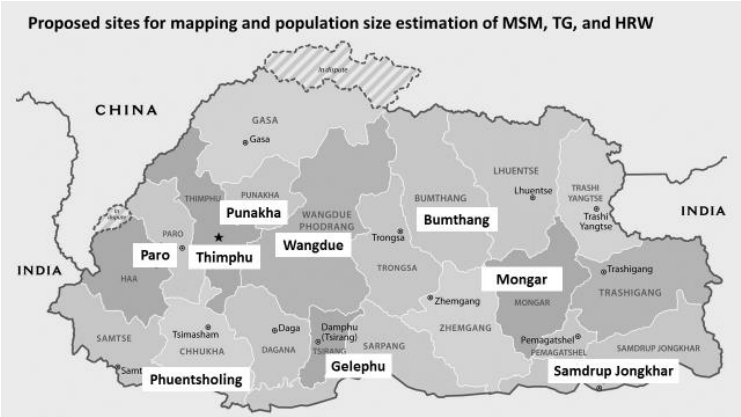
Table 1. Theoretical framework for proposed population size estimation methods.

Method [reference]	Theoretical assumptions	Potential limitations
Tier 1		
Published and gray literature review [12-14]	- Rates of KP in studies with similar context can be applied to Bhutan	- Bhutan's context may differ from all other settings
Desk review of program data [15]	- Unduplicated counts of KP clients from services provide a minimum estimate of the population size - Program data provide Service Multiplier Method benchmark counts	- Clients may not disclose KP status to service providers - Duplicate counting of clients at multiple visits
Delphi Method [16]	- Local stakeholders collectively hold knowledge on the likely size of KP - Iterative polling of local experts, with presentation of data, arrive at a best estimate and plausible range	- Local stakeholders may hold common biases
Stakeholder Mapping [17]	- Local stakeholders collectively hold knowledge on the likely hotspots and the numbers of KP attending	- Incomplete knowledge of hidden hotspots
Tier 2		
Primary and Secondary Key Informant Mapping [18]	- Persons with knowledge of the local environments can map the locations where KP congregate, and estimate their numbers	- Incomplete knowledge or disclosure of hotspots by key informants
Mapping with Census and Enumeration [17]	- KP congregate in identifiable hotspots - KP are visible in hotspots - KP are assignable to specific hotspots	- Some KP do not attend hotspots - Some KP cannot be distinguished from others - Mobility may result in duplicate counting
Reverse Tracking Correction [9]	- A correction factor for over or under estimation of KP at hotspots can be obtained in a random sample of hotspots	- Some KP do not attend hotspots
Service Multiplier, Unique Object Multiplier, Event Multiplier [15]	- The number of KP appearing in a "benchmark" list (e.g., received a service, gift, or attended an event) in a random sample is proportional to the total population size	- Non-independence of being on the list and being sampled - Errors in determining who is on the list
Wisdom of the Crowd Method [19]	- KP have insight on their numbers through their networks, lived experiences, and cultural signals - A central tendency (e.g., median) that eliminates extreme opinions arrives at a plausible estimate	- KP community perceptions may be influenced by feelings of isolation or advocacy needs

Capture-Recapture Method [20]	- The number of KP included in two independent samples is proportional to the total size of the population	- Non-independence of being in both samples or neither sample
Tier 3		
Multiple Sample Capture-Recapture [Wesson, 2017]	- With 3 or more captures, the non-independence of the Capture-Recapture Method can be modeled by the interaction terms of being on multiple lists	- Selecting the right model
Sequential Sampling Method [21]	- In RDS surveys, the decrease in reported network size over successive referral waves is proportional to the total size of the population	- Accuracy of reported networks size

REBH SI.No7. STUDY SETTING

Justification for Study Sites Selected. The study will be implemented in eight sites, which include nine towns in nine districts. Wangdue and Punakha will be considered as one study site.



The study sites were chosen to cover much of the demographic and geographic diversity of Bhutan, including the capital and largest city (Thimphu), border crossings with high levels of economic activity (Phuentsholing, Gelephu, SamdrupJongkar), and other areas for cultural representation, corridors of transportation, or tourism (Paro, Bumthang, Wangdue-Punakha, and Monggar). Thimphu and

Phuentsholing account for about half of HIV cases diagnosed to date; all districts account for the vast majority. Of note, Wangdue-Punakha will be treated as one study site, although two towns in two districts. Data collection from these sites is likely to cover a large proportion of the KP at risk for HIV in Bhutan while also providing insights on regional differences.

REBH SI.No8. STUDY PARTICIPANTS / ELIGIBILITY CRITERIA

Definitions of KP at risk for HIV require consideration of multiple contextual factors, including identity vs. behavior, recent vs. lifetime timeframe, rapidly changing communities and cultures, and comparability with definitions used by prior studies, programs, and public health surveillance. Recognizing definitions of these populations are varied, complex, and contextual; we adopt a public health response perspective. The target populations are those that programs seek to engage in HIV prevention by virtue of their current behaviour or near future risk. Therefore, the target populations are those who can be contacted through outreach to venues, through social media, and

by fixed site services targeting KP. We acknowledge this definition recognizes that persons with distant past behaviours, persons whose situations may be temporary (e.g., prisons, barracks), and persons who may not recognize or never express their gender identity or sexual orientation. The following are this protocol's operational KP definitions for size estimation and the eligibility criteria for participation in the Brief Intercept Survey and RDS Survey:

- **Men who have sex with men (MSM):** Bhutanese or non-Bhutanese males age 18 and above, who report anal or oral sex with another male or TG in the past 12 months, regardless of their motivations, sexual orientation, or sexual identity. We recognize that this definition does not include minors, men with male-male sexual encounters in the distant past, or in temporary circumstances. This operational definition may come close to, but not completely, “gay/bisexual” men. Moreover, the term “MSM” may be pejorative to some and should not be used as a term of identity or appear on materials about the study for community promotion.
 - To participate in the Brief Intercept Survey, MSM must meet this definition, be present in the hotspot at the time of field operations, and able to provide oral informed consent.
 - For the RDS Survey, MSM must meet this definition, be referred by another MSM or TG participant, and able to provide oral informed consent.

- **Transgender persons (TG), TG women and TG men:** TG women are Bhutanese or non-Bhutanese age 18 and above who were assigned male sex at birth and now self-identify as “transgender” or “woman” or a gender other than male. TG may or may not have undergone gender transition procedures (e.g., sex reassignment surgery, breast augmentation, facial implants), take hormones, or dress in women’s clothes or present as female all the time. TG men follow a parallel definition, reversing the gender in the above definition for TG women. The term “transgender” should be spelled out (i.e., not abbreviated) on materials for community promotion.
 - To participate in the Brief Intercept Survey, TG must meet this definition, be present in the hotspot at the time of field operations, and able to provide oral informed consent.
 - For the RDS Survey, TG must meet this definition, be referred by another MSM or TG participant, and able to provide oral informed consent.

- **High-risk women (HRW):** Bhutanese or non-Bhutanese women age 18 years and above who work or visit hotspot environments where high risk sexual behaviors are frequently initiated (e.g., commercial sex work, transactional sex, multiple and concurrent partnering, high partner turn-over, and sexual networking within and between KP). We anticipate that HRW will include female sex workers (FSW), but the definition does not require that the woman have engaged in commercial or transactional sex to be counted or participate in the sexual risk behavior surveys. Of note, the term “HRW” is not one of self-identity and should not be used on materials about the study for community promotion.
 - To participate in the brief intercept survey, HRW must meet this definition, be present in the hotspot at the time of field operations, and able to provide oral informed consent.
 - For the RDS survey, HRW must meet this definition, be referred by another HRW participant, and able to provide oral informed consent.

Stakeholder key informants. Information on hotspots will be gathered from stakeholder key informants who are persons whose jobs and professional experience concern KP, including

clinicians, counselors, outreach workers, persons working for NGO serving KP, and public health officials.

Primary key informants. Primary key informants are persons who are KP community members with information relevant to the conduct of this study. Primary key informants will be enrolled to provide information on hotspots and venues where they can be found, estimates of their numbers, social networks, potential barriers to participating in the proposed project, recommendations on the conduct of the project, and issues of relevance to HIV prevention and care programs. Eligibility criteria for primary key informants are:

1. Member of one of the KP as defined above (i.e., MSM, TG, or current or former FSW).
2. Age 18 years or older.
3. Able to provide oral informed consent.

Secondary key informants are persons who are not members of the KP population, but who have contact with and specific knowledge about MSM, TG, and HRW. These include, for example, entertainment venue owners, waitresses, patrons of entertainment venues, hotel staff, taxi drivers, police, and other residents surrounding hotspots with specific knowledge of the area. Eligibility criteria for secondary key informants are:

1. Persons with specific knowledge of KP in different locales.
2. Age 18 years or older.
3. Able to provide oral informed consent

Hotspot definition. We use the term “hotspot” broadly for individual venues (e.g., specific entertainment venues), or a set of venues of the same or different types in a close area where KP may circulate between them (e.g., a line of bars and entertainment venues in one alley or block), or a geographically compact or distinct area, such as several street blocks, or a sub-neighborhood.

REBH SI.No9. SAMPLE SIZE

The following table summarizes the projected sample sizes and participants of each study component. The rationale, assumptions, and calculations are presented in the methods sections for each component below. The table presents the likely maximum number needed.

Study component	Target population	Sample size
Stakeholder Delphi	HISC staff, outreach workers	15
Stakeholder Mapping	HISC staff, outreach workers	15
Service Multiplier	MSM/TG	87 (client count in records only)
	HRW	87 (client count in records only)
Unique Object Multiplier	MSM/TG	100 (objects distributed only)
	HRW	100 (objects distributed only)
Event Multiplier	MSM/TG	87 (attending event)
	HRW	87 (attending event)
Key Informant Mapping	National MSM focus group	10
	National TG focus group	10
	Local HRW focus groups	80
	Local MSM in-depth interviews	24

	Local TG in-depth interviews	8
	Local HRW in-depth interviews	24
	Secondary key informant interviews	24
Brief Intercept Survey (completes sample size requirements for multiple methods)	MSM/TG	300
	HRW	300
Respondent-Driven Sampling (RDS) Survey	MSM/TG	300
	HRW	300
Synthesis and Extrapolation	HISC staff, outreach workers	15
	Expanded stakeholders	25

REBH SI.No10-16. RECRUITMENT, DATA COLLECTION, VARIABLES, DATA SOURCES/MEASUREMENT, DATA MANAGEMENT, ANALYSIS

Tier 1 Procedures

Tier 1 uses existing data from published literature, reports, programs, and websites, as well as information provided by stakeholder key informants in their professional capacities. Several size estimation methods can be completed in Tier 1.

Literature Review. The published scientific literature and official reports (“gray literature”) will guide the KP size estimation in Bhutan in several stages.

- First, published estimates from other countries in the region and local reports on prior KP population size estimates in Bhutan will be incorporated into the Delphi process. Results of publications and reports will be updated and presented to the stakeholders during facilitated discussions, assessing their applicability to Bhutan in the present era.
- Second, prior local reports will guide the stakeholder mapping of hotspots, building upon the hotspots and types of venues where KP congregate.
- Third, updates of the literature will be presented to stakeholders when they are convened to synthesize and interpret the data gathered from the field.
- Fourth, the literature will help guide the extrapolation of data collected in the study sites with data to the 11 districts without data, and to the national level.

Several relevant local reports include: the Behavioural Surveillance Survey (2006) [2], the Formative Assessment on Stigma and Discrimination Impacting Universal Access to HIV and Health Services for Men who have Sex with Men and Transgender People in Bhutan [5], Mapping and Size Estimation of Men who have Sex with Men in Bhutan [6], and Integrated Biological and Behavioral Surveillance (IBBS) Surveys among vulnerable and Key Populations at Higher Risk in Bhutan (2016) [3]. This phase of activities will attempt to obtain the raw data and working files to help identify prior hotspots to update the mapping, preliminary counts, and proxies for extrapolation to other districts and nationally.

Desk Review of Service Program Data and Public Social Media Traffic. Data from clinical and social services for KP provide counts of the numbers of the population served, which serve as

lower floor size estimates (i.e., the “reachable and reached” population) and as the “benchmark” counts that will be used later for the Service Multiplier Method.

This protocol proposes to examine data from the HISC, including drop in and outreach HIV testing for KP, to establish the numbers of unduplicated KP clients seen in a specified time period (e.g., calendar year 2019). For example, the HIV Counseling and Testing Form used at HISC records individual clients with variables that map to the HRW target population, namely women whose occupation is “Entertainment/bar worker” (question 13, option g) and whose risk assessment indicates “Multiple partners/unprotected sex” (question 16, option j).

In addition to HISC testing data, this phase of activities will search for other data sources that may count KP. Alternative data sources are particularly needed for counts of MSM and TG as these KP are rarely recorded as such in HISC program data. Possible sources include the number of MSM and TG officially registered with Rainbow Bhutan, MSM-oriented social media sites (e.g., FacebookLGBT groups), or counts of MSM present on mobile dating apps (e.g., GRINDr) during a specified time period. These counts can also be used to establish lower floor estimates, applied as benchmarks for the Service Multiplier Method, and used as proxies to extrapolate estimates to other districts and nationally.

Stakeholder Delphi Method for District and National KP Population Size Estimation. The Delphi Method is a formal, iterative process used to elicit the informed perceptions of local experts on a specific question (in this case KP population sizes) to arrive at a consensus. The process is done to incorporate local knowledge, different perspectives, and lived experiences to fill gaps where data are not yet available and to avoid undue emphasis on quantitative results which are imprecise or subject to biases. The steps are to form a panel of local experts (the Delphi panel), poll them on their best-guess estimates, present new information, hold a facilitated discussion, followed by a repeat poll to allow panel members to revise their estimates. The panel is reconvened to repeat the process at different stages as new data become available. The process is led by a facilitator experienced with the Delphi Method who is independent of the local expert panel.

For the present study, the local expert Delphi panel is comprised of the HISC teams in each of the study sites, including the counselors and their peer outreach workers, for approximately 15 members who cover the eight study sites. The facilitator will be the international technical assistant. In each Delphi round, the panel members will provide an initial vote on the number of KP in their district target areas, participate in a discussion of the vote to reconcile discrepancies, followed by a repeat vote. The panel will be convened at minimum of twice:

1. Prior to field data collection to summarize the current knowledge on KP numbers based on known contacts, the networks of contacts, known hotspots, and services delivered by their respective HISC and partners.
 2. At the completion of all data collection to review data analysis, synthesize findings, and help guide the extrapolation of data to other districts and nationally.
- **Sample size of the Delphi panel: ~15**

Stakeholder Key Informant Mapping with Hotspot Size Estimation. As part of the program planning process to provide outreach services to KP, each district HISC team creates a map of their local hotspots with associated numbers of KP thought to be present. These maps constitute one population size estimate as well as platform for other methods to update and build upon.

- **Sample size of stakeholder key informants for mapping hotspots:** ~15

Collection of Service Counts, Distribution of Unique Objects, and Hosting of Events for the Multiplier Methods. Tier 1 activities include steps that contribute to the Service, Unique Object, and Event Multiplier Methods. Each method entails obtaining a “benchmark” count of the KP population. This count is later leveraged to estimate the total KP population size by obtaining an estimate of the proportion of the population who are included in the benchmark through the Brief Intercept and RDS surveys (see below). We propose three types of benchmarks:

- **Service Multiplier benchmarks** originate from client counts of KP users specific services. As described above, HISC testing records have unduplicated HRW client counts that can serve as the benchmark (e.g., number of HRW tested for HIV in 2019). Tier 1 activities include the analysis of the HISC databases to obtain the precise benchmark counts at each site. Service benchmarks for MSM and TG may include registration with Rainbow Bhutan or profiles on social media oriented to MSM and TG such as LGBT-oriented Facebook groups. Tier 1 activities will attempt to obtain these counts and search for other possible benchmarks. Multiple benchmarks for each KP are preferred.
- **Sample size for the Service Multiplier:** The sample size estimate for the Service Multiplier Method is based on having sufficient overlap (i.e., ≥ 20) in the number of persons included in both the benchmark and in the Brief Intercept Survey to estimate the upper end of the total population size. Using 0.8% [12] as a projected upper end estimate of the percent of women who are HRW, the total estimate would be 1,235 women for the nine towns [22]. With a Brief Intercept Survey sample size of 300 in the nine towns, 20 recaptures would be 7% of the sample. To estimate at population size of 1,235, a minimum of 87 HRW clients need to be in the service count (i.e., $87 / 0.07 = 1,242$). HISC data indicate that this minimum number is feasible. For example, Phuentsholing HISC sees about 12 HRW per month, therefore 8 months of service data in 2019 provide ample counts for the benchmark. Benchmarks of sufficient size for MSM may prove challenging. A possible service multiplier is the count of MSM who are registered with Rainbow Bhutan. This number was verbally reported to us as 57 registered MSM.
- **Unique Object Multiplier benchmarks** are counts generated by giving a known number of memorable, small gifts to the KP population shortly before the Brief Intercept Survey. The objects are chosen in consultation with community groups to be appealing to the KP, inexpensive, non-identifying, but notable enough to be remembered by those receiving them (examples from past studies include: make-up kits, mini torches, key chains, bracelets, socks). We will enlist teams of community members working with the HISC and partner NGO to hand out the gifts to peers in their networks approximately 1-2 weeks prior to the Brief Intercept Survey. HISC staff and NGO partners will be instructed to tell peers to: a) give only KP members the gift, b) give only one gift per person, c) and tell persons receiving the gift its study purpose and that they may later be approached and asked if they received one.

- **Sample size for the Unique Object distribution:** The same rationale for the Service Multiplier Method sample size applies for the unique object distribution. Across all sites, a minimum of 87 unique objects need to be distributed. We round this number up to target a minimum of 100 objects. To have ample to distribute through peers and partners at the eight study sites, we will budget for 200 objects for MSM/TG and 200 for HRW. The number of these objects will be distributed across the eight sites according to their relative population sizes of women.
- **Event Multiplier benchmarks** provide another KP count by hosting a notable event, such as a health mobilization forum, and getting a head count of attendees. For the benchmarks for MSM and TG, we will enlist Rainbow Bhutan to promote an LGBT forum with entertainment (e.g., screening of an LGBT documentary or popular movie). The count of MSM and TG will be obtained by having attendees voluntarily complete an anonymous slip to be dropped into an opaque box. The slip has 3 tear-off pieces. One piece asks two questions to tick: “Are you an ally or LGBT community member?” and “If LGBT, indicate which.”). A second piece is a raffle number for door prizes. This is dropped into a second box. The third piece is kept by the attendee for the door prize claim. Of note, there is no linkage of the raffle number to the anonymous response part once torn off. Only one national LGBT event will be held in Thimphu. For HRW, health education events will be held for HRW in each of the eight study sites. The event will provide refreshments, health education, entertainment, and a raffle. The proposed events will be hosted event is usually held 1-2 weeks prior to the Brief Intercept Survey.
 - **Sample size for the Event Multiplier:** The same rationale for the Service and Unique Object Multiplier Methods applies for the Event Multiplier. Across all sites, a minimum of 87 HRW need to attend the health education events across the eight sites. While the numbers of HRW who attend the events cannot be fixed by the investigators, the events should strive for high attendance in all sites with relative numbers attending according to the relative sizes of the towns.

Tier 2 Procedures

Tier 2 procedures involve field observation and data collection from KP community members and other persons associated with hotspots.

Primary and Secondary Key Informant Mapping with Hotspot Size Estimation. Key informants will be interviewed to expand upon the maps and size estimations of the HISC teams.

- **Recruitment and enrollment of primary key informants.** Primary key informants (i.e., KP community members) will be recruited from the networks of the peer outreach workers with the HISC. To further enrich the sample, these key informants will be ask to refer other community members from their acquaintances. Additional community key informants may be referred by NGO working with KP populations, by clinicians with patients willing to participant, and during field observations to verify hotspots.
- **Primary key informant in-depth interviews (IDI).** After providing oral informed consent,a semi-structured IDI guide will be used to:

- Verify hotspots previously identified by stakeholder key informants are still active and the KP are present.
- Identify additional hotspots not previously known to the stakeholder key informants, including physical and online locations.
- Determine the boundaries of specific hotspots, including which how many different venues or establishments constitute the same hotspot.
- Solicit their estimates of the number of KP present in the hotspots.
- Solicit their estimates of the numbers and types of KP who do not visit hotspots.
- Determine the peak hours of attendance at the hotspots.
- Describe mobility patterns between hotspots.
- Alert staff to security concerns when visiting hotspots.
- Disclose concerns or barriers to participation in this study by KP.
- Direct staff to secondary key informants (e.g., entertainment venue owners, taxi drivers, bouncers, etc.).

IDI will take place at a location preferred by the primary key informant. These may be the study offices (HISC), a venue within a hotspot, or a neutral location other than these places (e.g., café or restaurant).

- **Sample size for primary key informant IDI:** The number of key informant IDI required for mapping is guided by the principal of “saturation” in qualitative research. Additional key informants should be sought until no new information is obtained. Nonetheless, we make a projection of the number of key informants needed based on triangulation. At least three key informants need to be interviewed per population per town, including at least one primary and secondary key informant. For MSM and HRW, the number of key informants projects to 24 each (8 sites x 3 KP). We anticipate challenges in reaching 3 TG in each study site, but will target to enroll 1 in each site (n=8).
- **Focus group discussions (FGD).** Two national-level FGD will be held, one for MSM and one for TG. The FGD will be hosted by Rainbow Bhutan, reaching out to participants from all of Bhutan. For HRW, each study site will convene an FGD in each study site. Persons wishing to participate will provide oral consent after having the purpose and procedures explained, with focus on maintaining confidentiality. A semi-structured FGD guide similar to the IDI guide above will be used to direct the conversation.
 - **Sample size for FGD.** In qualitative research, 6 to 8 FGD participants generate a synergy of ideas beyond what would be obtained by IDI while not being unwieldy to manage and ensure all have a chance to speak. From experience, not all invitees show up. We will therefore plan on inviting 10 MSM and 10 TG for the two national FGD and 80 HRW to the 8 FGD in each study site. The interviews may go more or may be less depending upon the data saturation.
- **Field scouting and observation.** Once saturation appears to be achieved with primary key informants, field scouting and observation will be done on some potential hotspots by study staff. Not all named hotspots necessarily need to be visited at this stage. For example, known Entertainment venues need not be scouted. This exercise is to confirm any doubts about hotspots being currently active, or any signs that the location is not a KP hotspot. The purpose is to exclude inactive sites from the map to be later used for Census and Enumeration. Field scouting and observation will also be used to recruit and interview secondary key informants.

- **Recruitment and enrollment of secondary key informants for IDI.** Secondary key informants (i.e., persons who are not KP community members but have special information about KP and hotspots) will be interviewed to complete the triangulation of mapping information. Secondary key informants may be identified or referred by stakeholder and primary key informants, NGO partners, other secondary key informants, or approached during field scouting and observation. IDI with secondary key informants will be done in a private area of their choice after providing oral informed consent. A structured interview guide similar that administered to primary key informants will be used.
 - **Sample size for secondary key informant IDI.** The number of secondary key informant IDI is driven by saturation as well as field observation, depending on who is encountered in when scouting hotspots. Nonetheless, using the triangulation framework we will plan for 3 IDI in each of the eight study sites (n=24).
- **Analysis of key informant information.** The approach for analyzing primary and secondary key informant information will be by triangulation or corroboration. For example, a hotspot will be considered verified for inclusion in the final map if there is agreement by all 3 types of key informants (i.e., stakeholder, primary, and secondary). If there is disagreement between key informants about a hotspot having KP, field scouting and observation by the team will make the final determination to include in the map. The key informant size estimations for KP affiliated with each spot will be done by examining the high, low, and midpoint estimate. The aggregate of the median estimate for all hotspots will constitute the key informant size estimation, with the noted range given by the other responses. Information on peak attendance days and hours will seek agreement on the top 3 most mentioned days and times. These hours will be used for the Mapping with Census and Enumeration as described below. Other information pertinent to the mapping (e.g., security concerns, mobility patterns, barriers to participation) will be summarized and shared with the field teams.

Census and Enumeration of Hotspots for Size Estimation. The final hotspot map with associated KP size estimates will result from the direct observation and counting by field teams visiting all verified hotspots. The principles of the Mapping with Census and Enumeration Method are: a) to count as systematically as possible attempting to visit all hotspots; if there are too many hotspots to visit all, then a random sample can be visited and extrapolated; b) to visit hotspots at peak days and hours to avoid under-counting; c) to make the count as rapidly as possible to avoid duplicated counting. The steps are:

- Based on a matrix that lists all hotspots against their days and 4-hour increments of peak KP attendance, the field team will develop a written plan to efficiently visit all hotspots over a 3-day period. Flexibility is allowed in terms of:
 - Adding more days if needed to complete the plan
 - Substituting one hotspot for another if the first is unattended
 - Moving to another hotspot if no further KP appear
 - Change the plan according to weather or other external conditions
 - Modify the boundaries of the hotspot as observation warrants
 - Adding new hotspots not named by key informants but identified while in the field; such hotspots may be enumerated at the moment or added to the matrix to visit later

- Any modifications to the plan must be documented in writing and approved by the field team lead
- In some sites, two field teams may be needed to cover all hotspots mapped in the time required (e.g., Thimphu).
- The role of the team lead is to oversee field activities. The team lead will be responsible for making the observed count of all KP present at the venue, assessing duplicate counts at the same or different hotspots, and monitoring the time and progress. She or he will direct the interviewers for the Brief Intercept Survey.
- Interviewers are responsible for recruitment at the venues for the Brief Intercept Survey, identifying private areas for interviewing, conducting informed consent, and administering the questionnaire.
- At the end of each day, the field teams will debrief on the numbers of KP counted at the hotspots, the numbers interviewed, identify any duplicate counts among persons seen at the current and other hotspots, discuss any doubts or discrepancies in information, fill in any incomplete information, and trouble-shoot any problems and possible solutions for subsequent hotspot mapping. Data quality assurance will be done on site by having interviewers cross review each other's completed surveys, and later at the study site with the team lead reviewing all completed surveys.
- In addition to collection of the attendance counts and reviewing the questionnaires, field notes will be taken by the team lead with contributions from the interviewers.

Reverse Tracking Correction. The Reverse Tracking Method uses an independent count of the KP associated with each the hotspots to correct the estimates given by the key informants and enumeration above. These independent counts can be done in conjunction with the Capture-Recapture Method (see below), or by self-report of hotspots attended elicited during the RDS surveys (see below). Of note, the RDS surveys can also obtain the proportion of the KP population that attends no hotspots. The second count is compared to the first to see if the numbers are over- or under- estimated. An average correction factor is calculated, then applied to all hotspots for adjustment. The formula for the Reverse Tracking Correction is:

$\hat{S} = \frac{1}{n} \sum_{i=1}^n \frac{N_i}{M_i} * M$	<p>Where \hat{S} is the correction factor, n is the number of hotspots visited, N_i is the count at each hotspot, M_i key informant estimate of the count at each hotspot, and M is the total count.</p>
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Brief Intercept Survey. A cross-sectional survey on demographics, sexual risk behaviors, HIV knowledge, use of prevention services, and information related to the population size estimation methods will be implemented in conjunction with the Mapping with Census and Enumeration. The methods for this Brief Intercept Survey are based on those used by Khandu *et al.* for their study of Drayang women in Thimphu, Paro, and Phuentsholing in 2015 [1]. The study successfully interviewed 245 HRW on their sexual risk behavior. The following details the steps and procedures:

- **Sampling methods.** The sampling design entails systematic, consecutive recruitment of KP present at the hotspots during the Mapping with Census and Enumeration field activities. As the team lead makes the overall count of KP present during the entire field period, the interviewer staff will consecutively approach all potential KP present over the period of enumeration (e.g., ~4 hours). Efforts will be made to include all those present

and potentially eligible; however, in the event of high attendance only a percentage of persons present might be enrolled.

- **Recruitment and enrollment.** Upon approaching the potential participant, study staff will explain the purpose of their visit, gauge the person’s willingness to participate in the survey, and make an initial assessment of their eligibility (i.e., HRW, MSM, TG). If apparently eligible and willing to participate, staff will find a private place within or near the hotspot. The staff will confirm eligibility and obtain oral consent to participate.
- **Brief Intercept Questionnaire.** The staff will administer a face-to-face structured questionnaire that includes demographics, standardized indicators of sexual risk behaviors, use of services, and data needed for the population size estimation calculations described in this protocol. These include use of services for the Service Multiplier Method, receipt of the gift for the Unique Object Multiplier Method, attendance at the event for the Event Multiplier Method, and asking their perceptions of their numbers for the Wisdom of the Crowd Method. The Brief Intercept Survey is also the first capture for the Capture-Recapture and Multiple Sample Capture-Recapture Methods. The Brief Intercept questionnaire (and RDS questionnaire) builds upon questions used in prior studies in Bhutan [1,3]. An estimated 20-30 minutes will be required, including screening, consent, questionnaire, debrief, education, and referrals.
- **Sample size for the Brief Intercept Survey.** The sample size project for the number of HRW to be included in the Brief Intercept Survey is based on achieving sufficient statistical precision for key measures of sexual risk behavior (i.e., point estimates with small margins of error). The publication on Drayang women by Khandu *et al.* and the 2016 IBBS provide a basis for projecting expected point estimates for several key variables [1,3]. We choose five indicators covering a wide range of point estimates (table below). We choose an acceptable margin of error of $\pm 5\%$ and a 95% confidence level (i.e., an alpha of 0.05). A final consideration is that sampling from small, finite populations requires a correction factor compared to large populations. The correction factor lowers the sample size needed for the same precision. Since the population size is not known, we will use a range, from 654 HRW (initial conservative guess of HISC stakeholders, meeting 9 August, 2019) to 1,235 (which is 0.8% of adult women seen in urban areas in Asia [12]). The following table illustrates the range of sample sizes required varying the above parameters. We select the most conservative scenario of N=289 as the minimum sample size. We round this figure to 300 to account for non-response on some measures.

Table 2. Sample size scenarios for the Brief Intercept Survey of HRW, assuming an alpha of 0.05 (95% confidence interval), varying finite population sizes for HRW, and a range of point estimates for key measures of sexual risk behavior with a precision of $\pm 5\%$

Measure	Level in IBBS 2016 or *Khandu <i>et al.</i>	Sample size without finite population correction	Sample size for small finite population (654)	Sample size for moderate finite population (1,235)
Multiple partners, 12 mo.	83%	217	164	185
Cash for sex, 12 mo.	73%	302	208	244
Tested for HIV, 12 mo.	57%	376	240	289

*Multiple partners, 1 mo.	58%	373	239	288
*Transactional sex, 1 mo.	28%	309	211	248

- **Distribution of sample size across the eight study sites.** Rounding the minimum sample size of 289 to 300, the numbers of HRW to be enrolled in each town are apportioned according to their relative adult female population sizes [22]:

Table 3. Numbers of HRW to be recruited per site, Brief Intercept Survey and random 1 in 4 re-visit sample

Site	Percent of female population of eight sites	Sample size per site	Sample size for re-visit
Thimphu	30%	91	23
Phuentsholing	15%	45	11
Gelephu	10%	30	8
SamdrupJongkhar	8%	23	6
Bumthang	4%	12	3
Paro	10%	31	8
Wangdue-Punakha	14%	43	11
Monggar	9%	26	7
Total	100%	300	77

- **Estimated field staff needed to enroll sample size.** The brief survey, including obtaining oral consent is estimated to take 20-30 minutes. Field teams of 3, including 2 interviewers and 1 team lead, are expected to conduct the survey for 4 hours over 3 days during peak hours. Therefore, at maximum pace each team is expected to conduct: 2 interviewers x 2 interviews per hour x 4 hours per day x 3 days = 48 interviews per team. This volume can achieve the sample size for all sites, with the exception that Thimphu will require 2 teams to reach the 96 HRW needed.
- **Analysis of Brief Intercept Survey data.** Analysis of the Brief Intercept Survey data will be primarily descriptive, presenting the proportions of the KP who engage in key sexual risk behaviors (e.g., multiple partners, commercial sex, transactional sex, lack of condom use, etc.). Correlates of risk behaviors can also be examined to identify groups at particularly high risk for HIV and STI (e.g., associations with engaging in transactional sex). Statistical analysis can adjust for the achieved sampling fractions (i.e., using enumeration counts) and for cluster of characteristics by hotspot.

Service Multiplier, Unique Object Multiplier, and Event Multiplier Methods Data Collection. The Brief Intercept Surveys also gather data needed to complete the calculation of population size estimates using the Service, Unique Object, and Event Multiplier Methods. Namely, participants are asked if they received the service or the object or attending the mobilization event. Those who say “yes” constitute the recapture count.

- **Analysis of the Service, Unique Object, and Event Multiplier data:** The formula to calculate the population size using the Multiplier Methods is given by:

$$N = C/P$$

Whereby N is the population size estimate; C is the benchmark count (e.g., HRW clients receiving services, being given the unique object, or attending the event); P is the percent of survey participants who also are in the benchmark count.

As a hypothetical example, to estimate the number of HRW using the Service Multiplier Method, imagine we have 75 HRW clients counted in the HISC registry for 2019 (January to August), and 27 out of 300 HRW in the Brief Intercept Survey reported being tested for HIV at the HISC in 2019, then:

$$N = C / P$$

$$N = 75 / (27/300) = 75 / 0.09 = 833 \text{ HRW total in the eight study site towns.}$$

Wisdom of the Crowd Method. The Brief Intercept Surveys will include questions to provide the Wisdom of the Crowd Method for size estimation. Participants will be asked to give their “best guess” of the number of HRW on several levels: a) within their social networks, b) in their hotspot area, c) in the town, and d) in Bhutan. The section of questions begins with defining the term HRW and clarifying that their responses are only their perception, opinion, or guess and encouraging them to respond regardless of their certainty. For analysis, data from all respondents is summarized using the median response, rather than the mean, to dampen the effect of outliers in either direction.

Capture-Recapture Method: Re-visits to a Random Sample of Hotspots. A second field visit will be made to a random sample of the venues for several purposes: a) to complete the second capture of the Capture-Recapture Methods, b) to continue Brief Intercept Surveys to increase the sample size if needed (only including those HRW who did not previously do the survey), and c) further refinement of the Census and Enumeration and Reverse Tracking Corrections.

- **Sample size for the re-visited hotspots.** The sub-sample to re-visit will include approximate 1/4th of hotspots, randomly chosen from the list of all hotspot on their peak attendance periods. As calculated for the multiplier methods above, the overlap between the 1st and 2nd visit is geared to be ≥ 20 HRW. The re-visits will therefore intercept a total of 75 HRW, apportioned across the sites as for the Brief Intercept Survey (see Table 2 above).
- **Analysis of the Capture-Recapture data:** The formula to calculate the population size using the Capture-Recapture Method is given by:

$$N = M * C / R$$

Whereby N is the population size estimate; M is the number of HRW captured at both visits; C is the number captured at the second visit; and R is the number capture in the first visit.

Tier 3 Procedures

Tier 3 activities comprise the implementation of respondent-driven sampling (RDS) surveys among MSM/TG and HRW.

Respondent-Driven Sampling (RDS). RDS produces cross-sectional surveys of KP through peer-to-peer recruitment. Initial KP “seeds” are incentivized enroll and also to recruit 5-10 of KP acquaintances in their social circles. These recruits in turn are incentivized to recruit 5-10 of their peers, and so on. As the long chains of recruitment grow into different social networks, all parts of the population are included (even those not directly accessible to researchers). The longer chains become independent of their starting points and the composition of the recruited sample stabilizes with respect to demographic and risk behavior characteristics. RDS is held to produce more inclusive and representative samples of hidden populations by capitalizing on peers to recruit others known to be members of the population. The recruitment method can be highly efficient, exponentially growing, as long as the target population trusts the researchers because their peers vouch for their legitimacy. The added contributions of RDS to the current protocol are:

1. RDS will measure the proportion of the MSM, TG, and HRW who do not attend the hotspot venues. This estimate may be particularly important for MSM in Bhutan who may not attend venues at all [6].
2. RDS provides a third capture for the Multiple Sample Capture-Recapture Method for population size estimation allowing for statistical adjustments to correct for bias that is common in the two-sample Capture-Recapture Method, namely non-independence between any two captures.
3. RDS provides another theoretically independent method for KP population size estimation, the Sequential Sampling Method. The theory holds that the size of the hidden population can be determined by the rate of drop in the social network size of participants from early waves of recruitment (when persons are well-connect to others) to the later waves (when persons are less connected to other KP).
4. RDS provides another opportunity to measure sexual risk behaviors among MSM, TG, and HRW, including those who do not attend hotspots. The data from the Brief Intercept Survey can be combined with the RDS data to increase sample size, with statistical adjustments.

The previous 2016 IBBS in Bhutan employed RDS to recruit HRW and MSM/TG [3]. RDS successfully recruited 287 HRW, which is a sample size comparable to that needed for the current proposed study. RDS therefore appears likely to work for HRW in Bhutan. However, the previous RDS succeeded in recruiting only 30 MSM and 12 TG. The investigators concluded that the MSM and TG populations may not have been sufficiently networked, that their communities remained in small isolated groups, they were unwilling participate and to refer other MSM and TG, or insufficient time was given for promotion and referral diffusion. To address these potential problems, our proposal will add several modifications to enhance participation in the RDS, including: a) anonymity, including oral consent only; b) no biological testing; c) working through Rainbow Bhutan with pre-launch promotion (e.g., the mobilization events), d) longer time for KP to respond, e) providing different modes of completing the questionnaire, including online, in-person at the Rainbow Bhutan or HISC offices, or by appointment at a neutral location of the respondent’s choice.

The following are the steps for conducting RDS:

1. **Formative phase.** Before launching RDS recruitment, a formative phase is conducted to establish that the required theoretical assumptions of RDS are met and to answer logistical questions. The primary key informants (i.e., community members) contributing for the mapping methods as described above will also be sources of data for the formative phase of RDS. Specific topics key informants will be asked are:
 - a. What are the different social networks of MSM, TG, and HRW in Bhutan? In this town? How large are they? How are these social networks interconnected? Which groups are more separate or isolated from others? Can we treat MSM and TG as interconnected social networks?
 - b. Would KP members be willing to recruit their peer? What incentives are appropriate for participating in the RDS survey? What incentives are appropriate for recruiting peers to the RDS survey?
 - c. What other logistical considerations would make the survey successful? Where should the study offices be located? Who should be the interviewers? Who would be willing and capable to be initial promoters and “seeds”?
 - d. Key informants can also pilot test the sexual behavioral questionnaire, providing feedback on the appropriate language, content, length, and mode of administration.
2. **Recruitment Phase I and Phase II.** The RDS study will be done in two stages. Phase I will be done in Thimphu, Paro, Phuentsholing, and Wangdue-Punakha by selecting seeds from these towns. The RDS dedicated team will use Phase I for training, promotion, seeds selection, and recruitment launch. The RDS team will staff the study office in Thimphu for six weeks with interviews arranged in the other towns by scheduling appointments or directing respondents to the survey link on the Rainbow Bhutan website. Because recruitment of peers can occur regardless of residence, MSM throughout Bhutan are eligible to participate throughout the entire RDS. Online completion of surveys will also continue throughout the study period. Phase II will launch after six weeks of Phase I with promotional efforts and seed selection in SamdrupJongkhar, Bumthang, Gelephu, and Monggar. Phase I will establish an office in the eastern region for 2 weeks. Interviews will be done primarily by directing respondents to the online survey.
3. **Seed selection.** RDS launches with the purposeful selection of initial participants who are called “seeds”. The characteristics of effective seeds are they are well respected and trusted in the KP community, they know many other members of the community, are willing to recruit them to the study, and they are in enthusiastic agreement with the aims of the research. Additionally, several seeds (approximately 8 to 12) are selected from different demographic groups to ensure rapid recruitment from across the spectrum of the community. More seeds are added if recruitment is slow. Seeds are eligible to participate in the study and undergo all procedures. At the end of the risk behavior survey, seeds are instructed how to recruit others through distributing study coupons to their peers.
4. **Study coupons.** A non-identify card is used to recruit KP peers to the study. The card includes the title of the study (not specifying the KP population, but with imagery recognized by the community), the ways to contact the study site (i.e., online, phone numbers for appointments, address of the study offices for drop-in using maps), and a non-identifying study code. The study code links the recruiter to their recruits permitting statistical adjustments for analysis as well as a means of visualizing the social network interconnections. The code is also used to unduplicate respondents and to provide incentives.

5. **Sampling/recruitment methods.** Seeds and subsequent participants are instructed and trained on how to refer their peers to the study. The number of recruits allowed per participant depends on the density of social networks. In high density populations such as large cities, peers are instructed to recruit up to three others. In low density populations, as is our assumption for Bhutan, up to 10 recruits per peer is proposed for recruitment chains to grow.
6. **Screening and oral informed consent.** Persons logging on to the website or presenting in person are first asked a set of screening questions to determine eligibility. If responding as eligible, the screen or interviewer provides the respondent with an information sheet that is the consent form. If they click to continue or verbally provide acceptance, the screen or interviewer proceeds to the questionnaire. The respondent may choose to download or retain a copy.
7. **Questionnaire.** We provide two modes for questionnaire administration: online and face-to-face. Online completion entails using the link indicated on the recruitment coupon, entering the unique code, and reviewing the informed consent page. Face-to-face interviews are arranged by calling the number on the coupon to set an appointment at the study offices or at a neutral location of the respondent's choice. The questionnaire will be the same as implemented in the Brief Intercept Survey. As discussed above, topics include demographic information, sexual risk behaviors, access to and use of HIV/STI services, social network characteristics, stigma and discrimination experiences, and items related to the population size estimation methods (e.g., participation in other study activities for Capture-Recapture Methods; Service, Unique Object, and Event Multipliers, and Wisdom of the Crowd). After completing the questionnaire, online or in-person, the participant is provided a code for their air time incentive. Completion also gives them 10 coupons, each assigned a unique number. For the online version, the participant can download, print, or photograph the coupons. These are used to recruit peers to the study and to provide the participant with their incentive for each recruited peer, also managed online by entering the coupon codes or in person by calling the study to confirm an appointment.
8. **Incentives.** Because participation may require traveling to the study site, time to complete the interview and procedures, and willingness to refer peers to the study, incentives or reimbursements are needed in RDS. Two types of incentives are included. The primary incentive is reimbursement for their completion of the survey. The secondary incentive is given for each successful referral of a peer to the study. The formative phase is used to determine the appropriate value and types of these incentives (i.e., enough to reimburse and motivate participation, but not so much as to be coercive). We propose Nu 500 in cell phone air time for the primary incentive and Nu 200 for the secondary incentive.
9. **Analysis of RDS data.** RDS data is typically, although not always, adjusted using weights based on relative network sizes as differential probabilities of being recruited. In the present study, we anticipate the potential need to combine the RDS data with the Brief Intercept Survey data, particularly if recruitment of MSM and TG is low. The hybrid data will be adjusted for recruitment source in the analysis. Analysis will focus on descriptive statistics for the key indicators of sexual risk behavior (e.g., multiple partners, unprotected sex, engagement in commercial sex), engagement in prevention (e.g., HIV testing, STI screening, sources of information), and on the population size estimation methods described above, as well as the Multiple Sample Capture-Recapture and Sequential Sampling Method that is specific to RDS described below.

10. **Sample size considerations.** The same sample size considerations described above for the Brief Intercept Survey apply to the number of participants required for RDS. That is, ideally we will target 300 RDS participants for MSM/TG (combined) and 300 HRW.

Sequential Sampling Method for population size estimation. RDS provides a unique method for KP population size estimation called the Sequential Sampling Method. The theoretical underpinnings are: 1) that persons with large social networks of peers have greater probability of being recruited to the study compared to persons with smaller social networks, and 2) the rate of decrease in mean social network size over the successive recruitment waves is proportional to the total population size. For example, in large populations, there are many persons with large social networks of other KP. Therefore the mean network size can remain large throughout recruitment. In small populations, however, there are only a few persons who are connected to large numbers, while most have smaller social networks of peers. Therefore the mean network size drops more rapidly. The rate of drop is modeled using statistical software that have been incorporated within the free RDS-Analysis software and described in the literature [23].

Multiple Sample Capture-Recapture Methods. A major potential bias in the Capture-Recapture and Multiplier Methods for size estimation is non-independence. Non-independence results when the probability of being in one sample or capture is highly correlated with being in another sample or capture. The correlation can be positive (e.g., if HRW agreeing to be in the Brief Intercept Survey at the hotspot venues are also more likely to participate in the RDS survey) or negative (e.g., if HRW participating in the Brief Intercept Survey want to avoid also being in the RDS survey). Positive correlations result in under-estimation of the total population size (i.e., high likelihood of being in both samples makes the population appear small); conversely, negative correlations result in over-estimation.

The theory of the Multiple Sample Capture-Recapture Methods is that a 3rd capture (or, better, many more captures) permits the modeling of the biases of being in multiple captures through interaction terms. That is, multiple captures determine the added probability of being in both samples given the joint probabilities of being in one or the other. More captures provide more interaction terms to identify and adjust for these biases. The present study therefore seeks to include a minimum of three captures: 1) the Brief Intercept Survey during the hotspot field mapping, 2) the re-visit to a random sample of hotspots, and 3) the RDS survey. As these are sequential, in each capture, participants are asked if they were included in the previous captures. We recognize there are other possible recaptures, namely including the Service, Unique Object, and Event Multiplier benchmarks. Thus, there are up to six captures to provided robust data for the Multiple Sample Capture-Recapture Methods. Analysis of the data is done through Log-Linear Modeling or Bayesian approaches as described in the literature [20].

DATA SYNTHESIS AND EXTRAPOLATION

Upon completion of data collection and initial analysis, we will be confronted with two additional challenges:

- 1) How do we synthesize all the results of the diverse methods, especially if they appear to be in disagreement?

- 2) How do we arrive at KP population size estimates for the 11 districts where the study was not conducted, and arrive at national estimates?

We philosophically take two different approaches to answer these questions. One incorporates stakeholder input through the Delphi Method; the other is statistical - based Bayesian methods and linear regression analysis.

Synthesis by Stakeholder Delphi Methods. As explained above, the Delphi Method uses local experts to elicit and incorporate their experiences, perspectives, and opinions on KP size estimates. The process is iterative by design to allow for new information to change results. Therefore, the Delphi panel will be reconvened during a 5-day analysis workshop to weigh in on the population size estimates calculated from the various methods above. The process will entail:

- 1) An initial vote on the KP population size estimates for their districts will be held. This new vote will be on the wake of their participation in the study activities described above and therefore size estimates may be quite different from their estimates prior to field implementation.
- 2) A presentation will be made to the group on the calculations of KP population size estimates resulting from each of the methods described above.
- 3) A facilitated discussion will be held on the potential biases of each method, with insight provided from the teams' experiences in the field.
- 4) A second vote on the KP size estimates that takes into account recognized biases in addition to a central tendency of the multiple methods (e.g., median results). The second vote will be on their own and other teams' district estimates. The anticipation is that the second vote will achieve consensus or near agreement on the "best estimates" for all the districts.
- 5) A facilitated discussion will be held on the upper and lower acceptable population size estimates (e.g., the values at which all agree the KP numbers cannot be higher or lower).
- 6) The estimated numbers for the districts are converted to rates per adult males (for MSM and TG) and adult females (for HRW).

Synthesis of Multiple Results by the Bayesian Anchored Multiplier Method. A complementary approach to combine the results of the different methods uses Bayesian statistics, called the Anchored Multiplier. The Anchored Multiplier considers an initial best estimate (i.e., from the Delphi panel above) and the point estimates and confidence intervals of each calculation from the methods described above. The free online calculator [24], generates multiple scenarios for the size estimate and assesses which number and confidence interval is the best fit that accounts for the most data included in the process. Because the Delphi process is iterative, results of the Anchored Multiplier can be presented back to the Delphi panel for their interpretation and incorporation into final estimates.

Extrapolation by Stakeholder Delphi Methods. A 2-day meeting will be held at the end of the analysis workshop that will include the Delphi panel and extend the invitation to a wider group of participants (n=10 more for 25 total). These additional participants will include community members, NGO staff, and persons from other MOH units. The meeting will present findings of the study up to the Delphi panel conclusions. The wider stakeholder group will weigh in on these estimates, then proceed to the discussion of extrapolation. The process will seek consensus on the methods to extrapolate the data from the nine towns, to the districts as a whole, to the 11 districts

not included in this study, and to Bhutan as a whole. A facilitated discussion will consider the following questions:

- 1) What accounts for the variation in the KP size estimates across the nine districts?
- 2) Are all KP in your district located in the towns or parts of towns where the study was implemented? What fraction of the KP in your district can be found in the study areas? What fraction is outside the study area?
- 3) Are there hotspots in other towns or parts of the district outside the main town? Along transport routes, resort areas, barracks, or other points? Are there hotspots in rural areas?
- 4) What data sources or indicators can suggest which districts have high or low numbers of KP?

The process will culminate in a set of agreed upon rules for how to interpret the study data in terms of:

- 1) How to extrapolated the data collected to as a whole (e.g., the “80/20” rule suggesting 80% of the population is concentrated in the mapped hotspots, while 20% is outside the map)
- 2) How the 9 districts with data align with the 11 districts without data (e.g., can we apply rates per adult female and male population calculated from this study to similar other districts?)
- 3) What set of proxy variables may reflect relative KP population sizes by district (e.g., percent of the population that is urban, percent by education, relative numbers of HIV or STI cases, location at borders or on major roads).
- 4) The study team will apply these rules to present an initial extrapolation back to the stakeholders.
- 5) The stakeholders will discuss the extrapolation results, offer any modifications, and examine recalculation of the extrapolation.
- 6) The stakeholders will vote on final best estimates for all districts and for Bhutan as a whole, and identify upper and lower plausible bounds for estimates.

Extrapolation by Proxy Indicator Linear Regression. A statistical approach can be used for the extrapolation from the nine study districts to the 11 districts not included in this study. The method is based on data available for all districts which are correlated with KP size estimates among the districts included in the study. These data are called “proxy” or “indicator data”. Proxies may be based on the national census, using measures of such things as percent of the population in the district that is urban, or percent with secondary education, or total adult males or females. Proxies may be geographic such as location of the districts on borders or along transportation corridors. Proxies may be based on public health surveillance, such as the number of HIV or STI cases diagnosed. Proxies may also be based on local knowledge, such as the presence or absence of hotspots. Finally, proxies can be combined into a scale or index that uses multiple measures (e.g., a “vulnerability index” as done in the 2013 MSM/TG size estimation [6]).

Selection of the best proxy data can be decided upon by the Delphi panel or wider stakeholder group (as described above) or by analysis of correlations among the districts with data. For example, we can assess the correlation of the KP size estimates for the nine districts with each of the proposed proxies or combinations of proxies using Linear Regression Analysis. The strongest correlations among the nine districts determines the proxies to use to extrapolate to the 11 districts not included in the study. A caveat is that the effective sample size is small (N=6).

Once the proxy or composite proxy is selected, a Linear Regression Model is generated that produces coefficients of the proxy's or index's relation to KP population size. Each of the 11 districts is then "fitted" to a modeled KP population size by applying the coefficient to their adult male and female population sizes.

DISSEMINATION PLAN

To ensure the highest transparency, buy-in, and ultimate use of the KP size estimates and measures of sexual risk behavior, we envision multiple avenues to disseminate findings of this study:

1. **Forums with partnering institutions, NGO, and other government of Bhutan agencies.** We propose the dissemination of preliminary results in meetings with select representatives of the different agencies who have a stake in the findings of this study. Their input at an early stage will help identify biases and challenges not previously considered with potential modifications to conclusions and recommendations. Their early input will also foster transparency, ownership, and ultimate buy-in on findings.
2. **Forums reaching KP community members and their representatives.** With agreement from the above stakeholders, early dissemination of findings will be done through public forums with KP community members and their representatives. These may include in-face public meetings inviting key persons, or online by posted results on websites reaching the KP (e.g., Rainbow Bhutan) using PowerPoint presentations. These forums can elicit public commentary that can be included in the final comprehensive report.
3. **Comprehensive report.** The study itself concludes with a comprehensive report that incorporates all relevant background, methods, results, interpretations, limitations, conclusions, and recommendations.
4. **Factsheets, posters, and abstracts.** Once the comprehensive report is accepted, further dissemination can occur through written materials, such as factsheets for distribution by the HISC and peer outreach workers, posters to hang in HISC, DiC, and NGO offices, and abstracts submitted to present in national, regional, and international conferences.
5. **Publications in the scientific literature.** We envision that this study's findings will contribute to the scientific literature by sharing methodological adaptations, lessons learned, and conclusions with researchers and public health officials facing similar challenges. Under the leadership of the PI, the team will decide upon topics for publication, authorship, and timelines for submission. The *Bhutan Health Journal* is likely to be an important vehicle for reaching the local and regional audience. Other international journals will be considered.

REBH SLN017. RESEARCH ETHICS

Ethical review. This protocol will be reviewed and monitored by the Research Ethics Board of Health (REBH) of Bhutan. For the protection of anonymity of participants, we will seek approval for oral informed consent.

Potential Harms and Means to Mitigate Them. A potential severe risk to participants that may occur in several parts of this study is the unwanted and inadvertent disclosure of their KP status (MSM, TG, HRW) or engagement in stigmatized sexual behaviors to persons outside the study team. As in most of the world, members of these communities face potential stigma, discrimination, and violence if their sexual orientation or behaviors are found out. Repercussions can include loss of job, rejection by family and friends, different treatment with services, loss of financial support, injury, and severe pervasive stress. Compounding the situation, Bhutan is a small country and the study sites are located in small towns (relative to Asia). People have a high likelihood of being acquainted with participants.

We take several measures to reduce the risk of inadvertent disclosure of sensitive information about participants. First, the study will be conducted anonymously. At no point will identifying information (e.g., names, addresses, phone numbers, national identity card numbers) be asked for or recorded. Second, we will request approval to use oral consent as written consent would constitute the only instance that could reveal the participant's identity. Third, data collection will be done by trained health professionals working with KP or specifically trained peer outreach workers. These staff have undergone training on research ethics and professional conduct concerning privacy of information. Fourth, we will implement a refresher training on research ethics and privacy to the study staff in preparation for field work. Fifth, interviewers will ensure privacy when interviewing key informants and survey respondents in the field. Sixth, mapping data will avoid exact venue locations within hotspots (i.e., GPS coordinates will not be recorded), referring them to code numbers in any public reports or documents. Lastly, any breach of confidentiality will be reported to the REBH along with measures to ensure such occurrences do not happen in the future.

Another potential harm that may occur is the psychological stress resulting from discussing personal behavior with study staff. The interviews on sexual risk behavior, for example, may trigger recollection of interpersonal violence and other traumatic events. To mitigate this potential harm, study staff are certified counselors with professional training and experience. A refresher training will be done prior to field activities, including training on sensitivity to gender and sexual minorities.

Finally, acute health and social welfare needs may arise in the course of field activities and data collection. For example, the sexual abuse of minors and indicators of trafficking must be reported to social service authorities. Other acute health issues, include high concern for HIV or STI infection will result in referrals or escort to the nearest health facilities.

Potential Benefits to Participants and Society. There are no direct benefits to participants of this study. At the end of the Brief Intercept and RDS interviews, participants will be counseled on their risk for HIV and STI, informed of means to prevent and treat infections, and be referred or guided to the HISC as appropriate. To reimburse participants for their time, and their transport in the case of the RDS survey, they will be offered small non-monetary tokens of appreciation, such as cell phone air time. The gifts to be distributed for the Unique Object Multiplier Method will be of nominal value.

The main benefits of KP participation in the various components of the study accrue to the communities and society at large. The proposed study will generate data to strengthen the national HIV response on several levels. The numbers of KP provide an evidence basis to prioritize populations and programs, appropriately allocate limited resources, and set targets for the delivery of services. The risk behavior data provide a better understanding of the drivers of HIV transmission in Bhutan and points for future prevention interventions. The survey data also provide a baseline for the reach and coverage of programs for KP as part of monitoring and evaluation. Added benefits of the project are the capacity building opportunities in the theory and implementation of research among KP through hands-on training to public health practitioners, program staff, and KP peer outreach workers. Finally, the project will help advocacy efforts for the equal treatment of all Bhutanese as the most rigorous documentation of the existence of MSM, TG, and HRW across the whole of society.

REBH SI.No18. PROTOCOL AMENDMENTS

Any considered important protocol modifications will be submitted to the REBH for review and approval prior to implementation.

REBH SI.No19. INFORMED CONSENT

Informed consent for the key informant IDI, Brief Intercept Survey, and RDS Survey (in-person option) will be obtained by the study field staff by reviewing the consent form with the participant. The staff will review the purpose of the study, the procedures, the potential harms, potential benefits (including incentives), who is the PI and investigators, and who to contact if they have complaints. Sufficient time will be given to answer participant questions. Participants will also be given options to find the final report of the study (e.g., via Rainbow Bhutan office or website, MoH address, PI contact information). Participants may choose to keep a copy of the consent/information sheet. Informed consent for FGD participants will entail providing copies of the consent/information sheet upon arrival to the venue, giving dedicated time for them to read and review, and group and individual time with on-hand staff to ask questions. For the online option of the RDS survey, the consent/information sheet appears prior to proceeding to the questionnaire. The form may be downloaded and printed.

Justification for oral informed consent. As discussed above, a principal risk to participants in the proposed study is the disclosure of their status as a KP or engaging in stigmatized behaviors. To ensure that no personally identifying information is collected by this study, we will seek authorization to obtain oral consent. Participants will be given an oral consent form/information sheet that explains the procedures, the potential harms, potential benefits of the study as well as who they can contact if they have any complaints. They may choose to keep this information sheet with them.

REBH SI.No20. CONFIDENTIALITY

We take several measures to maintain participant confidentiality:

1. The study is entirely anonymous. At no time do we ask or collect any personally identifying information (e.g., name, phone number, address, CID) or information that can be used to link identifying information (e.g., medical record number, exact date of clinic visit).
2. Oral consent is obtained rather than written consent as the participant's signature would be the only identifying connection to the study.
3. Interview privacy
4. Dissemination materials will not name or show hotspot locations.
5. Computer based files will only be made available to personnel involved in the study through the use of access privileges and passwords.
6. Records will be kept in a secured location and only accessible to personnel involved in the study.
7. Before collecting or accessing to any study-related information, personnel have to sign statements agreeing to protect the security and confidentiality of participants interviewed or persons seen in the field.
8. Staff will receive ethical training prior to data collection, including protections for special populations and maintaining confidentiality.

REBH SI.No21. DECLARATION OF INTERESTS

All investigators listed in this protocol declare they have no conflicts of interests, financial or other competing interests, for the overall study and each study site.

REBH SI.No22. ACCESS TO DATA

Please see section REBH SI.No 20: CONFIDENTIALITY above.

REBH SI.No23. ANCILLARY AND POST-TRIAL CARE

Not applicable

REBH SI.No24. SPONSOR / FUNDING

This study is funded by Global Fund for HIV/AIDS Program and the Ministry of Health of Bhutan.

REBH SI.No 25. TRIAL REGISTRATION

Not applicable

REBH SI.No26. APPENDICES

Appendix A. Information Sheet (Consent) for Focus Group Discussion and In-Depth Interview (community members)

Appendix B. Information Sheet (Consent) for Respondent-Driven Sampling Study

Appendix C. Information Sheet (Consent) for Visiting Hotspots and Interview with Secondary Key Informants

Appendix D. Information Sheet (Consent) for Event Management

Appendix E. Focus Group Discussion and In-Depth Interview Guides

Appendix F. Brief Intercept Survey and Respondent-Driven Sampling Survey Questionnaire

Appendix G. Training Agenda for Mapping with Census and Enumeration and Brief Intercept Survey Methods

Appendix H. Training Agenda: Why and How to Conduct Respondent-Driven Sampling (RDS) Surveys

Appendix I. Training Agenda for Analysis of Brief Intercept Survey Data, RDS Survey Data, and Calculation of Population Size Estimates

Appendix J. Agenda for Stakeholder Consensus Meeting for Population Size Estimates for MSM, TG, and HRW in Bhutan

Appendix K. Venue Elicitation Tool

Appendix L. Census and Enumeration Tool

Appendix M. Budget

Appendix N. APPLICATION FORM for INITIAL REVIEW

REBH SI.No27. FACILITIES

The study will be conducted with HISC, Lhaksam, Rainbow Bhutan under the supervision of the HIV/AIDS Program of the Ministry of Health Bhutan. All necessary supports (e.g., computers, offices, etc.) are in place.

REBH SI.No28. STUDY TIMELINE

S/No	Activities in 2019	Aug	Sept	Oct	Nov	Dec
1	Protocol development					

2	Ethical approval					
3	Training and pilot testing					
4	Collection of data					
5	Data Entry and analysis					
6	Final Report					
7	Dissemination of study findings					

REBH SI.No29. REFERENCES

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Annex B.

Questionnaire

Brief Intercept Survey and Respondent-Driven Sampling Survey Questionnaire

Kuzuzangpola, I am _____ currently doing a research activity for the Ministry of Health. The main objective of the research is to find out the number of number of FSW, TGM, TGW, MSM (may define the key populations if required) and their health risk behavior, so that the MoH can develop programmatic interventions. If you permit, it may take around 15-30 minutes. It is completely voluntary, information you provided will be strictly confidential. I will ensure that your identity will not be revealed to anyone and information gathered from here will not be used for any other purposed other than for this research purpose.

Do you have any questions?

Will you be willing to participate, please? Yes No

Thank you for agreeing to participate in this study

These questions will be asked to MSM, TGM, TGW, HRW who are above 18 years old and who provided verbal consent

Complete questions A through J before you start the interview:

A) This questionnaire is for (circle answer): 1) Brief Intercept Survey 2) RDS

B) This questionnaire is for (circle answer): 1) HRW 2) MSM/TGW/TGM 3) CSW/FSW

C) Study ID No. (RDS ID No. is coupon; Brief Intercept ID No. is consecutive for date):

D) District: _____

E) Interviewer Name: _____

F) Venue name: _____

G) Date: _____

H) Time started interview: _____

I) Eligibility verified (Please circle): 1. Yes 2. No (if No, stop interview)

J) Consent Verified (Please circle): 1. Yes 2. No (if No, stop interview)

Demographics: I will first ask few question on your demographics.

Please circle the appropriate answer and write notes wherever applicable			
Q. No.	Questions and Filters	Coding Categories	Skip to
1	Which part of Bhutan you are from?	1. District _____ 2. Village/Municipality _____ 3. Non-Bhutanese (Specify country) _____	
2	Where do you live now?	1. District _____ 2. Name of town _____	
3	How old are you?	1. Age in completed years _____ 2. Don't know, Can't say	
4	What is your education level?	1. No Education 2. Primary (Grade PP-6) 3. Middle Sec School (Grade 7-10) 4. Higher secondary school (Grade 11-12) 5. University 6. Others (specify) _____	
5	May I know your marital status?	1. Married 2. Living together, not officially married 3. Single never married 4. Divorced 5. Widowed	

Please circle the appropriate answer and write notes wherever applicable			
Q. No.	Questions and Filters	Coding Categories	Skip to
		6. <i>Others (specify)</i> _____ -	
6	May I know your occupation?	1. <i>Civil servants</i> 2. <i>Housewives</i> 3. <i>Religious body</i> 4. <i>Unemployed</i> 5. <i>Students/trainees</i> 6. <i>Farmers</i> 7. <i>Entertainment/bar workers</i> 8. <i>Migrants worker</i> 9. <i>Driver</i> <i>(taxi/trucker/govt/corporate)</i> 10. <i>Corporate employee</i> 11. <i>Prisoner</i> 12. <i>Others</i> <i>(specify):</i> _____	
7	What was your sex assigned to you at birth?	1. <i>Male</i> 2. <i>Female</i> 3. <i>Intersex</i> 4. <i>Don't know</i> 5. <i>Other, specify:</i> _____	
8	What is your current gender identity?	1. <i>Male</i> 2. <i>Female</i> 3. <i>Transwoman</i>	

Please circle the appropriate answer and write notes wherever applicable			
Q. No.	Questions and Filters	Coding Categories	Skip to
		4. Transman 5. Don't know 6. Other, specify: _____	

BEHAVIOR (Now let me ask you some questions regarding your lifestyle)

Q. No.	Questions and Filters	Coding Categories	Skip to
9	Do you drink alcohol (whiskey, beer, wine, local, etc)?	1. Yes 2. No	If No go to 12
10	Did you ever have sex under the influence alcohol? (anal, vaginal sex)	1. Yes 2. No 3. Don't know	If No/ Don't know go to 12
11	Did you use condom during the last sexual intercourse you had under the influence of alcohol?	1. Yes 2. No 3. Can't remember 4. Don't know	
12	May I know your sexual identity? How do you identify? (If asked explain)	1. Straight, heterosexual 2. Gay 3. Bisexual 4. Lesbian 5. Other identity (queer, questioning, non-binary, etc.), enter: _____	
13	At what age did you have your first sex (meaning vaginal or anal)?	1. Age (age in years) _____ 2. Never had sex so far 3. Had sex, but can't remember age	If never skip to 19

Q. No.	Questions and Filters	Coding Categories	Skip to
14	<i>In your lifetime, what gender have been your sexual partners?</i>	1. Men only 2. Women only 3. Both women and men.	
15	<i>Have you ever had sex with a transgender person?</i>	1. Yes 2. No 3. Don't know <i>If yes, were they:</i> a. Transwoman b. Transman c. Both	
16	<i>In the last 30 days, how many different sexual partners did you have sex with? (include vaginal and anal)</i> <i>Circle and write numbers for each partner type</i>	1. Total number of all partners _____ <i>(if >0, complete below, numbers below should add to total, if 0 skip)</i> 2. Number of steady or regular partners: _____ 3. Number of casual partners: _____ 4. Number of paying partners (cash): _____ 5. Number of transactional partners (other goods, help, services exchanged): _____	<i>If 0 partners, skip to 18</i>
17	<i>Did you always use condom with your sexual partners each time you had sex with them in the last 30 days?</i> <i>Answer for each partner type</i>	1. Spouse: a. Always b. Not always c. Never 2. Regular partners: a. Always	

Q. No.	Questions and Filters	Coding Categories	Skip to
		<p>b. Not always</p> <p>c. Never</p> <p>3. Casual partners:</p> <p>a. Always</p> <p>b. Not always</p> <p>c. Never</p> <p>4. Paying partners:</p> <p>a. Always</p> <p>b. Not always</p> <p>c. Never</p> <p>5. Transactional partners:</p> <p>a. Always</p> <p>b. Not always</p> <p>c. Never</p>	
18	<p><i>In your lifetime, have you ever provided sex for _____?</i></p> <p><i>Answer all questions</i></p>	<p>1. Cash</p> <p>a. Yes</p> <p>b. No</p> <p><i>If Yes, when was the last time? Day, month, year: _____</i></p> <p>2. Gifts, goods, help, services exchanged):</p> <p>a. Yes</p> <p>b. No</p> <p><i>If Yes, when was the last time? Day, month, year: _____</i></p>	

HIV/STI TESTING AND PREVENTION PROGRAMS: Now I will be asking about HIV testing and support services. BUT I do not want to know your TEST RESULTS

Q. No.	Questions and Filters	Coding Categories	Skip to
19	Do you know a place where people can get tested for HIV?	<ol style="list-style-type: none"> 1. Yes 2. No 	If No go to 21
20	Where is that place?	<ol style="list-style-type: none"> 1. Referral Hospital 2. District Hospital 3. Basic Health Unit (BHU) 4. HISC 5. Private Hospital 6. Other (Specify)_____ 	
21	Have you been ever tested to see if you have HIV?	<ol style="list-style-type: none"> 1. Yes 2. No <ol style="list-style-type: none"> a. If Yes where did you get your most recent test done:_____ 	If No, skip to 24
22	When was the last time you were tested?	<ol style="list-style-type: none"> 1. Less than 12 months ago 2. Between 12 – 23 months ago 3. 2 or more years ago 	
23	I don't want to know the result; did you get the result of the test?	<ol style="list-style-type: none"> 1. Yes 2. No 3. Don't know 	
24	Have you ever attended any HIV educational events?	<ol style="list-style-type: none"> 1. Yes (specify):_____ 2. No 3. Don't know <p>If yes, was this in 2019?</p> <ol style="list-style-type: none"> a. Yes b. No 	

Q. No.	Questions and Filters	Coding Categories	Skip to
25	Has an outreach worker ever talked to you about HIV prevention?	1. Yes 2. No 3. Don't know If yes, was this in 2019? c. Yes d. No	
26	Have you ever got tested for sexually transmitted diseases (STI)?	1. Yes 2. No 3. Don't Know If yes, was this in 2019? a. Yes b. No	
27	Have you ever had following symptoms? <i>Multiple answer possible, answer both</i>	1. Genital ulcers a) Yes b) No If yes, was this in 2019? Circle: Yes / No 2. Discharge from genitals c) Yes d) No If yes, was this in 2019? Circle: Yes / No	

Stigma and discrimination: Now I am going to ask you some questions about stigma and discrimination that you may have experienced

Q. No.	Questions and Filters	Coding Categories	Skip to

28	Do people know that you are [CSW, MSM, TGW, TGM – as indicated]?	1. No, no one knows this but me 2. Only a few friends, family or people know this about me 3. Many people know this about me 4. Don't know if people know this about me	
29	Have you experienced stigma because of people knew or thought you are [CSW, MSM, TGW, TGM – as indicated]?	1. Often 2. Sometimes 3. Never 4. Don't Know	
30	Did you experience discrimination when accessing health services because people knew or thought you are [CSW, MSM, TGW, TGM – as indicated]?	1. Often 2. Sometimes 3. Never 4. Don't Know	
31	Have you experienced violence because people knew or thought you are [CSW, MSM, TGW, TGM – as indicated]?	1. Yes 2. No If yes, what type of violence? Circle all that apply: a) Verbal violence b) Physical violence c) Sexual violence d) Other, specify: _____	

Now I am going to ask some question about key population in Bhutan

Q. No.	Questions and Filters	Coding Categories	Skip to

32	<p>How many other [circle: MSM, TGW, TGM, CSW/FSW] do you personally know?</p> <p>Only ask for their own population</p> <p>By knowing, I mean you know their name, face, or have a way to get in touch (e.g., phone number, Facebook, email address, WhatsApp, etc), they also know you, and you know them</p>	<p>Only ask of CSW/FSW: 1. CSW/FSE _____</p> <p>Only ask of MSM, TGW, or TGM: 2. MSM _____ 3. TGM _____ 4. TGW _____</p>	
33	<p>If you had to guess, how many (MSM, TGW, TGM, CSW) do you think there are in Bhutan?</p> <p>Only ask for their own population</p>	<p>Only ask of CSW/FSW: 1. CSW/FSE _____</p> <p>Only ask of MSM, TGW, TGM: 2. MSM _____ 3. TGM _____ 4. TGW _____</p>	
34	<p>Did you receive one of these [show gift chain object]?</p>	<p>1. Yes 2. No 3. Not sure</p> <p>If yes, who gave it to you?</p> <p>a. Peer b. Outreach Worker c. Not sure who</p>	
35	<p>Did you attend an event called in by [event], that was held at [name and place of venue], on [date held]?</p>	<p>1. Yes 2. No 3. Not sure</p>	
36	<p>Did you use the drop-in HIV testing services at the HISC in _____ (state location) any time in 2019? It is located at: _____</p>	<p>1. Yes 2. No 3. Not sure</p>	

37	Did you get tested by the outreach services of the HISC in _____ (state location) any time in 2019? It is located at: _____	1. Yes 2. No 3. Not sure	
38	Are you a member of the Lhaksam/Rainbow Bhutan? Ask both	1. Lhaksam a. Yes b. No 2. Rainbow Bhutan a. Yes b. No	
39	Did you participate in our other survey where outreach workers interviewed you in a bar, club, restaurant, street, entertainment venue, or other public venue? It would have been around [provide week or month of survey].	1. Yes 2. No 3. Not sure	
40	Did you participate in our other survey where a peer gave you this coupon [show coupon] to invite you to participate? It would have been around [provide week or month of survey]	1. Yes 2. No 3. Not sure	
41	Please list three entertainment venues that you have visited in last 30 days	List by name of venue, district: 1. _____ — 2. _____ 3. _____ —	

THANK YOU FOR YOUR TIME