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A Systematic Review of Published Respondent-Driven Sampling Surveys Collecting Behavioral and Biologic Data

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Abstract

Reporting key details of respondent-driven sampling (RDS) survey implementation and analysis is essential for assessing the quality of RDS surveys. RDS is both a recruitment and analytic method and, as such, it is important to adequately describe both aspects in publications. We extracted data from peer-reviewed literature published through September, 2013 that reported collected biological specimens using RDS. We identified 151 eligible peer-reviewed articles describing 222 surveys conducted in seven regions throughout the world. Most published surveys reported basic implementation information such as survey city, country, year, population sampled, interview method, and final sample size. However, many surveys did not report essential methodological and analytical information for assessing RDS survey quality, including number of recruitment sites, seeds at start and end, maximum number of waves, and whether data were adjusted for network size. Understanding the quality of data collection and analysis in RDS is useful for effectively planning public health service delivery and funding priorities.

Keywords

HIV/AIDS; Key populations; Respondent driven sampling; RDS; Biological and behavioral surveillance

Introduction

The first respondent-driven sampling (RDS) surveys to assess HIV prevalence in addition to risk behaviors were conducted in 2004 [1–3]. Since then hundreds of surveys have been conducted worldwide to capture data from populations considered at higher risk for HIV exposure, including people who use and/or inject drugs (PWUD, PWID), men who have sex

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with men (MSM), female sex workers (FSW), and other populations considered “hard-to-reach” due to stigma and the practice of illegal behaviors [4–6]. Over the past decade RDS has been widely used, with the endorsement of organizations such as the US Centers for Disease Control and Prevention, UNAIDS, WHO, Global Fund and others, to establish baseline and trend measurements of HIV and other infections prevalence, risk behaviors, and program impact through biological and behavioral surveys [6–9].

RDS is an important recruitment and analysis tools for sampling populations that have no sampling frames and that are linked through social networks. Beginning with a set number of participants, “seeds”, selected purposefully by the research team from the target population, RDS builds a sample through the passing of a coupon from one peer to another. Using a limited number of coupons for each participant limits overrepresentation of those with a higher number of ties to others in the population network. Coupons also limit participants having to provide personal information about their recruits and allows researchers to monitor the recruitment process. Providing ‘incentives’ for those participating in and for recruiting peers into the survey helps ensure ongoing participation and recruitment. Ideally, this process results in long recruitment chains made up of numerous “waves” of recruits [10, 11]. As recruitment chains lengthen, the structure of the sample becomes less dependent on the purposefully selected seeds and increasingly similar to the population being sampled. Once the sample is gathered, statistical adjustments for differential network sizes and recruitment effort are used to produce estimates representative of the sampled population’s network [10–14].

RDS is premised upon several assumptions, most importantly, random walk models [10]. Briefly, these assumptions include (1) reciprocal ties between respondents (i.e., know one another as members of the sampled population); (2) respondents are connected by a single network component; (3) sampling occurs with replacement; (4) respondents provide accurate personal network sizes (i.e., number of relatives, friends, and acquaintances they know from the sampled population); (5) peers are recruited randomly from the recruiter’s network; and, (6) each respondent can recruit at least one peer [11].

Methodologically appropriate RDS surveys are vital for developing national and international policies, guiding service delivery, informing budgets and dictating funding priorities. Quality reporting of data collected and analyzed using RDS methods allows users to assess their usefulness in decision making. However, there is ample potential for bias when using this method, many of which are related to implementation and analytical failures [15–20]. The allure of RDS as a more robust alternative to convenience snowball sampling methods has resulted in partial incorporation of RDS techniques (i.e., the use of coupons) while ignoring some of the more complex aspects which ensure the mitigation of chain referral-related biases [13]. Indeed, numerous published surveys report having used RDS, but present insufficient methodological and analytical information to support this assertion [21].

Building upon the STROBE RDS guidelines [22] which recommend improvements in the reporting of survey data, we extracted peer-reviewed literature that reported using RDS for collecting biological(HIV and other infections) and behavioral data through September,

2013. Specifically, we evaluate a set of general and RDS-specific survey indicators based on the STROBE RDS guidelines [21, 22] to describe the extent, consistency, and changes over time for planning, implementation, and analysis as reported in peer reviewed journals. In addition, we provide reasons why some published surveys were not included in the extraction and examples of surveys that reported using RDS when, in fact, they did not. We hope to build upon other efforts to increase accuracy in conducting RDS and to encourage more thorough and standardized reporting of RDS methods and analysis [4, 22] (Table 1).

Methods

Literature Search

We examined peer-reviewed literature published in physical or on-line journals that reported using RDS and were either accessible through September, 2013, or were identified from a previously conducted search [22]. Searches were conducted using MEDLINE (1997–2013), EMBASE (1997–2013), and Global Health (1997–2013). Search terms included “respondent driven”, “respondent-driven” or “RDS”. The original extraction included surveys in any country, in any language, and among any survey population that reported using RDS (n = 4562). Articles excluded in the initial extraction were those that were duplicates (n = 2360), irrelevant (e.g., protocols, presentations, flyers, etc.; n = 1716) and either reviews, opinion pieces, editorials, commentaries and papers strictly addressing RDS methodology (n = 44, i.e., those not intending to report population based estimates). This resulted in a total of 442 articles and abstracts. We further refined our search by eliminating abstracts (n = 58) and publications that were either duplicated (n = 3), non-English (n = 40), without biological data (n = 167), or claimed to, but did not, use RDS (n = 23). When there were a number of publications for a single survey, all related publications were reviewed to update the extraction sheet. This resulted in 151 articles representing 222 surveys (Fig. 1).

Categorizing Documents and Extraction

We selected and extracted key data from 151 journal articles and entered them into a master table in Excel® into rows specific to the survey(s) described. Journal data entered into the table were organized into seven sub-tables based on WHO categorizations of regions: Africa, Eastern Mediterranean (EM), Europe, Latin America and the Caribbean (LAC), North America, South-East Asia (SEA), and Western Pacific. We extracted information considered essential for assessing RDS-specific survey quality as reported in Malekinejad et al. [4], Montalegre et al. [5] and White et al. [21, 22]. The indicators reviewed included those informing survey design and implementation and analysis. Indicators informing survey design and implementation are the survey year, eligibility criteria, specimen type collected for biological testing, whether pre-survey research was conducted, number of recruitment sites, interview method, number of seeds at the start and end (and whether seeds were added or failed during data collection) of the survey, amount or type of primary and secondary incentives (USD), calculated target and final sample size, design effect used for sample size calculation, maximum number of waves, duration of data collection (in weeks), and maximum number of coupons distributed to each recruiter. Indicators informing analysis are whether equilibrium or convergence was assessed, whether data were adjusted for network size, software used, and the citation and estimator used for adjustment. The rationale for

selecting these indicators, including their usefulness in any survey versus specifically for RDS surveys, are provided in Table 2.

Analysis

Frequencies were used to characterize the surveys and their contents. We conducted robust and logistic regressions of survey start year and pre-survey research, eligibility age, number of seeds at the start and end of survey, survey duration, final sample size, estimated design effect, length of longest recruitment chain, and adjustment of RDS to assess linear trends in the value (and for reporting having conducted pre-survey research or adjusted RDS data) of these indicators over time. Design effects were calculated for surveys that presented a point estimate for HIV prevalence, 95 % confidence intervals and the final sample size. The calculation for design effects consisted of dividing the widths of the confidence interval by two, dividing again by 1.96 (the standard normal value corresponding to a central area of 95 %), and squaring the final number.

Results

The identified published articles of RDS surveys were conducted in the following WHO regions: 21 from Africa (28 surveys), 12 from EM (11 surveys), 30 from Europe (44 surveys), 17 from LAC (37 surveys), 41 from North America (45 surveys), 12 from SEA (32 surveys), and 18 from the Western Pacific (25 surveys). Extracted surveys included 85 among PWID, 78 among MSM and 38 among FSW. Surveys of other groups included people who use and/or inject drugs (n = 2), male sex workers (n = 3), high-risk heterosexuals (n = 7), transgender (n = 2), and youth (n = 3). The remaining surveys were of mixed groups such as youth PWID (n = 2), people who use and/ or inject drugs together (n = 1) and MSM who use and/or inject drugs (n = 1).

Assessing Reports of Survey Quality

Survey data extracted from published articles included in this review were used to assess whether RDS recruitment and analysis were conducted, but the details provided for these surveys varied across articles. For instance, all published surveys reported basic implementation information such as the city, country and the population sampled, and 99 % reported the survey year (Table 2). Over 90 % of surveys reported the interview technique (e.g., face-to-face questionnaire, computer-assisted self-interviews, etc.) (94 %), final sample size (95 %) and at least the behavioral component of the eligibility criteria (97 %). Eighty-four percent reported the primary and 80 % reported the secondary incentive amounts or types, and 73 % reported the maximum number of coupons given to each recruiter. Sixty-three percent reported the data collection duration, 40 % reported whether pre-survey research was conducted, 43 % reported the number of recruitment sites used and the maximum number of waves, 40 % reported the target sample size, 22 % reported the design effect used for calculating the sample size. For those surveys that presented both calculated and final sample sizes (n = 77, 35 %), the median percentage difference was 1.0 (range 0.2–1.6). There was no significant difference in this measure over time by population or among all populations combined.

Seventy percent reported whether data were adjusted for network size, 73 % reported the type of software used to adjust data (74 % of which used RDS Analysis Tool [RDSAT]) and 26 % cited the statistical adjustment, among which 47 % cited Salganik and Heckathorn [12], 32 % cited Heckathorn [10] and/or 2002, 17 % Heckathorn [11], 12 % Volz and Heckathorn [13] and 7 % Gile [14, 154]. Only 20 % of surveys reported whether equilibrium or convergence was assessed and 4 % reported which estimator was used for their statistical adjustment. Thirty-one surveys (14 %) specifically reported discarding seeds from their analysis.

Design Effects for HIV

Of the 222 publications reviewed, 185 reported HIV prevalence point estimates above 0, 136 included 95 % confidence bounds, and 210 reported final sample sizes. Ninety-five surveys (42.7 %) included all three elements to enable calculation of the estimated design effect for HIV prevalence. Four (4.2 %) had a design effect less than 1.0, 28 (29.5 %) had a design effect of 1.0, 46 (48.4 %) had a design effect of 2. The remaining design effects were as high as 5.9, indicating that a larger sample size was needed to estimate HIV prevalence.

Assessing Changes over Time

In assessing changes over time (Table 3), we found significant decreases in values for eligibility age, final number of seeds, and final sample size ($p < 0.01$, for all) and significant increases in the reporting of pre-survey research and values of design effects to calculate the target sample size ($p < 0.01$). There were no significant changes in values for survey duration even when adjusting for target population and final sample sizes. Nor were there significant changes by year for survey duration, length of longest recruitment chain and reporting of having adjusted RDS data.

Discussion

Reporting on details of survey design, implementation, and analysis is essential for assessing the quality of RDS surveys and findings. It is important to adequately describe both the methodological and analytical aspects of RDS in any publication. The majority of surveys reported the most essential information such as survey city, country, year, population sampled, interview method, and final sample size. Given that all surveys reported collecting biological specimens, it is surprising that 13 % did not provide information about specimen collection and testing methods. Gaps in reporting RDS methodological and analytical information made it difficult to assess survey quality and the strength of results. RDS does not work in all situations and challenges in meeting assumptions should be described. For instance, only 43 % of surveys reported the maximum number of waves and 20 % reported assessment of equilibrium or convergence, information needed to assess potential biases. Among those surveys reporting their maximum number of waves, some reported having only a maximum of three waves, indicating that the survey results were likely biased by the non-randomly selected seeds.

Pre-survey research has become increasingly cited as being essential to conducting RDS surveys [7, 15, 22, 155], and more publications over time were found to provide information

about having conducted some pre-survey research. Because RDS samples a social network, pre-survey research is imperative to understand the underlying network structure of the sampled population. If the sampled network is fragmented or has isolated sub-groups, the chances of sampling more than one network are higher, possibly resulting in unstable estimates [15]. Furthermore, pre-survey research data can help investigators plan survey logistics (i.e., types and number of seeds) and encourage participation by learning about which survey procedures are most acceptable to the target population [7]. We recommend that all surveys using RDS conduct pre-survey research to evaluate social networks, as well as to assess the feasibility of using RDS in a particular population.

Although 70 % of surveys reported whether data were adjusted for network size and 73 % reported the software used to adjust those data, few cited the adjustment procedure and even fewer reported the estimator used. There are currently at least five different estimators for adjusting RDS data [156]. Given that many of the reviewed articles were written before the existence of some estimators, it is understandable that earlier publications did not cite the estimator used for analysis. Forthcoming publications should cite the estimator since knowing this information will allow readers to know how adjustments were made, if they were made properly, and the assumptions supporting those adjustments.

Several publications reported discarding seeds from analysis. While it has been written that “seeds are eliminated from analysis” [13, 153], this is not to say that seeds should be manually eliminated from a dataset. The RDS-I and RDS-II estimators [11–13, 153] use a matrix of recruits and recruiters whereby data from the recruits are necessary for calculating inclusion probabilities used to derive final estimates. Even though the seeds do not technically show up in the probability matrix since they were never recruited by their peers, their data are nonetheless necessary for establishing the placement of the seeds’ recruits in the matrix. We recommend that seeds remain in the dataset during all analyses and that the final reported sample includes the seeds.

We found an increase over time in surveys reporting design effects, an element in the sample size calculations to account for RDS not being a simple random sample. Although recent publications have found that design effects of 3 or 4 would be optimal, in most situations, a design effect of 2 is often recommended [16, 151, 152]. Because operational constraints, such as limited financial resources, often preclude large sample sizes for some RDS surveys, using a design effect greater than 2 may result in unfeasibly large sample sizes. Post-hoc design effects on key variables can help determine if sample sizes were large enough for the analysis and inform sample size calculations for follow-up surveys of the same population. As such it is useful for publications to include point estimates, 95 % confidence intervals and final sample sizes to allow for the post hoc estimation of design effects.

Equilibrium or convergence was reported in only 20 % of the articles reviewed. Equilibrium, the term most often used when referring to RDS surveys, measures the progression of waves to determine when the proportion for a characteristic approaches and remains stable in relation to the final sample statistic [10]. Convergence, a more sensitive measurement, measures the progression of enrolling subjects to determine when the proportion for a characteristic approaches and remains stable in relation to the adjusted estimate [15].

Nevertheless, the assessment of either equilibrium or convergence is useful for determining seed dependence, a typical bias found in chain referral sampling methods, and should be reported for publications reporting population estimates from RDS surveys [22].

While most surveys reported a minimum eligibility age of 18 years (n = 150), we found the minimum age decreased over time. Collecting HIV and other biological and behavioral data from younger key populations is important given they are disproportionately affected by HIV worldwide and are comprising a high percentage of new HIV infections [9, 157].

Our review has limitations. As in any systematic review, we are restricted by the completeness of our publication search and whether investigators published their surveys in peer-reviewed journals. Furthermore, we only included surveys that collected biological data leaving room for further evaluation of those surveys that reported using RDS and did not collect biological data. The number of peer-reviewed articles of RDS surveys is far fewer than the actual number of surveys conducted. Key data were missing from articles, an important finding in itself which supports the need to uniformly report results from RDS surveys, which limited the scope of our analyses and introduced uncertainty into some of our other findings [22]. We excluded articles clearly stating they either used RDS ‘recruitment’ only or did not fulfill necessary features of the method; however, we may have included some surveys that did not incorporate all RDS methodological and analytical features, given their incomplete reporting. In those instances, we classified the surveys as using RDS and included them in the extraction. Several of the 23 articles claiming to use RDS, but did not, reported using a ‘modified’ or ‘mixed methods’ RDS. However, they did not provide conclusive evidence such as the collection and use of personal network size data, recruitment ties (who recruited whom), coupon quotas, and multiple recruitment waves. In several extracted publications, significant limitations were reported, including unprepared staff, numerous ineligible persons trying to participate, closing or moving survey sites during data collection, overly high (possible indication of enrollment of ineligible participants) or low incentives, overcrowding at the interview site, failure to recruit important population subgroups (i.e., females in PWID surveys, older MSM), incorrect or no social network question, and early survey termination due to finances or community disturbances [3, 34, 41, 55, 86, 127, 158]. Presenting key limitations is useful for interpreting findings and should be included in all publications presenting data from RDS surveys.

The majority of published surveys were from North American and Europe; it would be useful to see more publications of RDS survey results from other regions. Not only could experiences from these different settings help researchers improve survey methods and analysis, but the results themselves could help policy makers, donors, and service providers to improve responses to HIV and other infection risk. Future publications of biological and behavioral surveys using RDS should provide a minimum set of parameters in order for readers to assess specific methodological, analytical and testing procedures, and to make determinations of the overall quality of these surveys.

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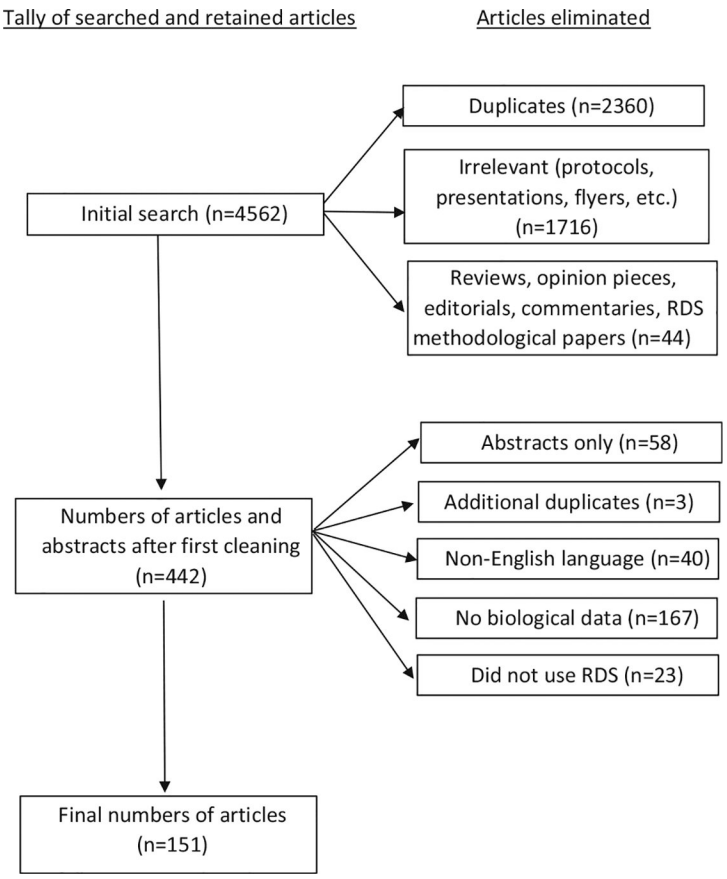

Fig. 1.
RDS extraction process

Table 1

Methodological and analytical data from extraction of published articles

Location of study, citation	Year of study	Population	Pre-survey assessment	Sites (num)	Interview method[a]	Seeds at start (num)	Final seeds (num)	Primary incentive of value[b]	Secondary incentive of value[b]	Target sample size	Final sample size	Max. number of waves	Data collection duration, weeks	Data adjusted[c]
Africa														
Kenya, Kisumu [23]	200S	FSW	Yes	1	ACASI	15	NR	4.00	1.25	480	481	6	12	Yes
Nigeria, Abuja [24]	2010	MSM	NR	NR	ACASI/SA	NR	NR	NR	NR	NR	194	8	NR	Yes
Nigeria, Cross River [25]	2007	MSM	NR	1	IA	10	10	4.00	NR	293	293	8	NR	Yes
Nigeria, Cross River [26]	2010	PWID	NR	>1	IA	10	10	4.00	4.00	266	273	9	8	Yes
Nigeria, Federal Capital Territory [26]	2010	PWID	NR	>1	IA	10	10	4.00	4.00	266	271	13	8	Yes
Nigeria, Ibadan [27]	2006	MSM	NR	NR	IA	38	38	4.00	NR	NR	1125[e]	NR	12	Yes
Nigeria, Ibadan [24]	2010	MSM	NR	NR	SA ACASI/SA	NR	NR	NR	NR	NR	210	8	NR	Yes
Nigeria, Kaduna [26]	2010	PWID	NR	>1	IA	10	10	4.00	4.00	266	196	8	8	Yes
Nigeria, Kano [26]	2010	PWID	NR	>1	IA	10	10	4.00	4.00	266	270	12	8	Yes
Nigeria, Kano [25]	2007	MSM	NR	1	IA	10	10	4.00	NR	293	315	9	NR	Yes
Nigeria, Lagos [25]	2007	MSM	NR	1	IA	10	14	4.00	NR	293	297	10	NR	Yes
Nigeria, Lagos [26]	2010	PWID	NR	>1	IA	10	10	4.00	4.00	266	191	9	8	Yes
Nigeria, Lagos [27]	2006	MSM	NR	NR	IA	38	38	4.00	NR	NR	1125[e]	NR	12	Yes
Nigeria, Lagos [24]	2010	MSM	NR	NR	SA ACASI/SA	NR	NR	NR	NR	NR	308	8	NR	Yes
Nigeria, Oyo [26]	2010	PWID	NR	>1	IA	10	10	4.00	4.00	266	273	8	8	Yes
Mauritius [28]	2009	PWID	Yes	2	IA	6	6	7.00	3.50	500	511	13	12	Yes
Mauritius [29]	2010	FSW	NR	2	IA	5	5	17.50	7.00	NR	299	8	2	Yes
Somalia, Hargeisa, Somaliland [30]	2008	FSW	Yes	1	IA w/HAPI	6	NR	4.00	3.00	146	237	NR	8	Yes
South Africa, Durban [31]	2011	MSM	Yes	1	SA	4	15	5.00 and 5.00 voucher	5.00 and 5.00 voucher	200	81	11	17	NR
South Africa, Johannesburg [31]	2011	MSM	Yes	1	IA or SA	5	14	5.00 and 5.00 voucher	5.00 and 5.00 voucher	200	204	15	21	NR
South Africa, Soweto [32]	2008	MSM	NR	1	IA	15	15	NR	NR	NR	378	NR	30	Yes
South Africa, W. Cape Province [33, 34, 35]	2006	Heterosexualmen	Yes	1	IA	8	20	8.00 phone voucher	2.70 phone voucher	430	421	13	15	Yes

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South Africa, W. Cape Province [36]	2008	Heterosexualmen	Yes	1	IA	19	19	8.50 phone voucher	2.85 phone voucher	430	423	20	12	Yes
South Africa, W. Cape Province [37]	2007	Young women	Yes	1	SA	5	5	8.00 make-up voucher	2.50	270	259	12	NR	Yes
South Africa, W. Cape Province [38]	2011	Heterosexual women	Yes	1	ACASI	15	15	7.50 grocery voucher	7.50 grocery voucher	756	845	19	17 (weekend only)	Yes
Sudan, Khartoum [39]	200S	FSW	NR	1	IA	NR	NR	10.00	10.00	NR	321	NR	8	Yes
Tanzania, Zanzibar [40, 41]	2007	MSM	Yes	1	IA	10	10	3.00	1.50	500	509	10	12	Yes
Uganda, Kampala [42]	2008–09	MSM	Yes	1	ACASI	8	14	3.00	1.00	600	300	11	44	Yes
Eastern Mediterranean														
Egypt, Cairo [43]	2006	PWID	Yes	1	IA	28	NR	7.00	5.30	406	413	NR	12	Yes
Iran, Kerman [44]	2010	FSW	NR	1	IA	8	12	4.00	2.00	NR	177	NR	16	Yes
Lebanon, Beirut [45, 46]	2007–08	FSW	NR	NR	NR	NR	NR	6.60	2.00	NR	135	NR	NR	Yes
Lebanon, Beirut [45]	2007–08	MSM	NR	NR	NR	NR	NR	6.60	2.00	NR	101	NR	NR	Yes
Lebanon, Beirut [45, 47]	2007–08	PWID	NR	NR	NR	NR	NR	6.60	2.00	NR	81	NR	NR	Yes
Libya, Tripoli [48]	2010	PWID	Yes	1	IA	7	7	20.00	9.00	NR	328	10	8	Yes
Libya, Tripoli [49]	2010	MSM	Yes	1	IA	NR	14	NR	NR	NR	227	15	NR	Yes
Libya, Tripoli [49]	2010	FSW	Yes	1	IA	NR	13	NR	NR	314	69	10	20	Yes
Morocco, Agadir [50]	2010–11	MSM	NR	NR	IA	NR	10	7.00	3.50	NR	323	12	12	Yes
Morocco, Marrakesh [50]	2010–11	MSM	NR	NR	SA	NR	8	7.00	3.50	NR	346	23	12	Yes
Palestine, East Jerusalem [51]	2010	PWID	Yes	1	IA	NR	7	NR	NR	NR	199	12	NR	Yes
Europe														
Albania, Tirana [52]	2005	PWID	Yes	3	IA	15	15	12.00	7.00	NR	225	NR	8	Yes
Albania, Tirana [53]	2008	MSM	NR	1	IA	12	NR	10.00	5.00	NR	189	NR	5	Yes
Croatia, Zagreb [54, 55, 56]	2006	MSM	NR	1	SA	8	10	18.00	9.00	400	360	13	14	Yes
Croatia, Zagreb [54]	2012	MSM	Yes	1	SA	10	15	None	9.60	370	402	13	19	Yes
England, Bristol [57, 58]	2006	PWID	NR	NR	CASI	7	7	15.00	10.00	NR	299	17	6	Yes
England, Bristol [57]	2009	PWID	NR	NR	NR	6	6	NR	NR	NR	292	NR	NR	Yes
Estonia, Kohtla Jarve [59, 60]	2005	PWID	NR	NR	SA	NR	NR	NR	NR	NR	100	NR	NR	No
Estonia, Tallinn [61–63]	2007	PWID	Yes	1	SA	5	5	10.00 food voucher	5.00 food voucher	NR	350	16	7	No
Estonia, Tallinn [63, 64]	2005–06	FSW	Yes	1;; other	SA	6	43	10.00 shop voucher	11.00 shop voucher	NR	227	8	28	Yes

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Estonia, Tallinn [60, 65]	2005	PWID	NR	NR	SA	6	NR	NR	NR	NR	350	8	NR	Yes
Estonia, Tallinn [62]	2009	PWID	NR	NR	SA	6	6	10.00 food voucher	5.00 food voucher	NR	327	NR	NR	No
Kazakhstan, Almaty [66]	2010	MSM	Yes	NR	IA	4	4	10.00	2.50	400	400	NR	16	Yes
Moldova, Balti [67]	2009–10	FSW	NR	NR	IA	5	5	7.00	5.00	350	359	6	16	Yes
Moldova, Balti [68]	2007–08	PWID	Yes	NR	IA	NR	NR	Items, cash (value NR)	NR	NR	350[e]	NR	NR	No
Moldova, Balti [69]	2010	MSM	Yes	NR	IA	5	5	8.30	5.80	250	209	6	20	Yes
Moldova, Chisinau [68]	2007–08	PWID	Yes	NR	IA	NR	NR	Items, cash (value NR)	NR	NR	350[e]	NR	NR	No
Moldova, Chisinau [67]	2009–10	FSW	NR	NR	IA	5	5	16.00	12.00	350	299	6	16	Yes
Moldova, Chisinau [69]	2010	MSM	Yes	NR	IA	8	8	8.30	5.80	250	188	6	20	Yes
Moldova, Tiraspol [68]	2007–08	PWID	Yes	NR	IA	NR	NR	Items, cash (value NR)	NR	NR	350[e]	NR	NR	No
Montenegro, Podgorica [70]	2008	PWID	NR	1	SA	5	NR	20.80	7.00	NR	322	NR	12	Yes
Montenegro, Podgorica [71]	2005	PWID	NR	1	ACASI	NR	NR	13.00	6.00	NR	328	NR	5	Yes
Russia, Ivanovo [72]	2010	PWID	NR	NR	IA	11	11	Items, food (value NR)	Items, food (value NR)	NR	300	NR	24	No
Russia, Novosibirsk [72]	2010	PWID	NR	NR	IA	10	10	Items, food (value NR)	Item, food (value NR)	NR	293	NR	24	No
Russia, St. Petersburg [73–75]	2005–08	PWUD/PWID	NR	NR	CASI	48; 108	156	10.00 (items)	items (value NR)	NR	631; 689	14	124	No
Russia, St. Petersburg [74, 75]	2005–06	PWID	NR	NR	CASI	35	NR	10.00 (items)	NR	NR	387	NR	56	No
Serbia, Belgrade [76]	2010	Youth	Yes	NR	IA	8	8	13.00	6.00	371[d]	270	NR	8	Yes
Serbia, Belgrade [71]	2005	PWID	NR	1	ACASI	NR	NR	13.00	6.00	NR	432	NR	6	Yes
Serbia, Kragujevac [76]	2010	Youth	Yes	NR	IA	4	4	13.00	6.00	370[d]	141	NR	8	Yes
Ukraine, Poltava [77]	2011	PWID	NR	NR	SA	4	4	3.00	2.00	NR	200	NR	NR	Yes
Ukraine, Khmelnitsky [77]	2011	PWID	NR	NR	SA	7	7	3.00	2.00	NR	200	NR	NR	Yes
Ukraine, Dnipropetrovsk [77]	2011	PWID	NR	NR	SA	6	6	3.00	2.00	NR	113	NR	NR	Yes
Ukraine, Cherkasy [77]	2011	PWID	NR	NR	SA	3	3	3.00	2.00	NR	175	NR	NR	Yes
Ukraine, Donetsk [77]	2011	PWID	NR	NR	SA	6	6	3.00	2.00	NR	400	NR	NR	Yes
Ukraine, Kharkov [77]	2011	PWID	NR	NR	SA	5	5	3.00	2.00	NR	175	NR	NR	Yes
Ukraine, Kherson [77]	2011	PWID	NR	NR	SA	4	4	3.00	2.00	NR	225	NR	NR	Yes
Ukraine, Kirovograd [77]	2011	PWID	NR	NR	SA	4	4	3.00	2.00	NR	175	NR	NR	Yes
Ukraine, Kyiv [77]	2011	PWID	NR	NR	SA	8	8	3.00	2.00	NR	400	NR	NR	Yes

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Ukraine, Lugansk [77]	2011	PWID	NR	NR	SA	6	6	3.00	2.00	NR	200	NR	NR	Yes
Ukraine, Lutsk [77]	2011	PWID	NR	NR	SA	4	4	3.00	2.00	NR	175	NR	NR	Yes
Ukraine, Lviv [77]	2011	PWID	NR	NR	SA	7	7	3.00	2.00	NR	175	NR	NR	Yes
Ukraine, Mykolaiv [77]	2011	PWID	NR	NR	SA	6	6	3.00	2.00	NR	260	NR	NR	Yes
Ukraine, Odesa [77]	2011	PWID	NR	NR	SA	6	6	3.00	2.00	NR	400	NR	NR	Yes
Ukraine, Simferopol [77]	2011	PWID	NR	NR	SA	5	5	3.00	2.00	NR	265	NR	NR	Yes
Ukraine, Sumy [77]	2011	PWID	NR	NR	SA	5	5	3.00	2.00	NR	173	NR	NR	Yes
Latin America and Caribbean														
Argentina, Buenos Aires [78, 79]	2009	MSM	NR	NR	SA web-based	16	16	NR	NR	NR	500	NR	NR	No
Brazil, Belo Horizonte [80–82]	2009	MSM	Yes	NR	IA	6	NR	10.00	6.67	350	NR	NR	NR	Yes
Brazil, Belo Horizonte [17, 83]	2008–09	FSW	NR	NR	ACASI	5–10	NR	Misc. (value NR)	4.00	300	289	NR	52	No
Brazil, Brasilia [80–82]	2009	MSM	Yes	NR	IA	6	NR	10.00	6.67	350	NR	NR	NR	Yes
Brazil, Brasilia [17, 83]	2008–09	FSW	NR	NR	ACASI	5–10	NR	Misc. (value NR)	4.00	300	308	NR	52	No
Brazil, Campinas [84]	2005–06	MSM	NR	NR	ACASI	10	30	NR	NR	NR	658	NR	52	Yes
Brazil, Campo Grande [80–82]	2009	MSM	Yes	NR	IA	6	NR	10.00	6.67	350	NR	NR	NR	Yes
Brazil, Campo Grande [17, 83]	2008–09	FSW	NR	NR	ACASI	5–10	NR	Misc. (value NR)	4.00	150	147	NR	52	No
Brazil, Curitiba [80–83]	2009	MSM	Yes	NR	IA	6	NR	10.00	6.67	350	NR	NR	NR	Yes
Brazil, Curitiba [17, 83]	2008–09	FSW	NR	NR	ACASI	5–10	NR	Misc. (value NR)	4.00	200	201	NR	52	No
Brazil, Fortaleza [85]	2008	Transvestite	Yes	NR	IA	6	NR	6.00 food voucher	3.00	NR	304	NR	16	Yes
Brazil, Fortaleza [86]	2005	MSM	Yes	2	IA	10	10	5.00	5.00	400	406	NR	NR	Yes
Brazil, Itajai [80–82]	2009	MSM	Yes	NR	IA	6	NR	10.00	6.67	350	NR	NR	NR	Yes
Brazil, Itajai [17, 83]	2008–09	FSW	NR	NR	ACASI	5–10	NR	Misc. (value NR)	4.00	100	90	NR	52	No
Brazil, Manaus [80–82]	2009	MSM	Yes	NR	IA	6	NR	10.00	6.67	350	NR	NR	NR	Yes
Brazil, Manaus [17, 83]	2008–09	FSW	NR	NR	ACASI	5–10	NR	Misc. (value NR)	4.00	200	199	NR	52	No
Brazil, Recife [80–82]	2009	MSM	Yes	NR	IA	6	NR	10.00	6.67	350	NR	NR	NR	Yes
Brazil, Recife [17, 83]	2008–09	FSW	NR	NR	ACASI	5–10	NR	Misc. (value NR)	4.00	200	237	NR	52	No
Brazil, Rio de Janeiro [80–82]	2009	MSM	Yes	NR	IA	6	NR	10.00	6.67	350	NR	NR	NR	Yes
Brazil, Rio de Janeiro [17, 83]	2008–09	FSW	NR	NR	ACASI	5–10	NR	Misc. (value NR)	4.00	600	601	NR	52	No
Brazil, Salvador [80–82]	2009	MSM	Yes	NR	IA	6	NR	10.00	6.67	350	NR	NR	NR	Yes
Brazil, Salvador [17, 83]	2008–09	FSW	NR	NR	ACASI	5–10	NR	Misc. (value NR)	4.00	300	260	NR	52	No

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Brazil, Santos [80–82]	2009	MSM	Yes	NR	IA	6	NR	10.00	6.67	350	NR	NR	NR	Yes
Brazil, Santos [17, 83]	2008–09	FSW	NR	NR	ACASI	5–10	NR	Misc. (value NR)	4.00	150	191	NR	52	No
Dominican Rep., Barahona [87]	2008	MSM	Yes	NR	IA	8	NR	9.00	3.00	300	281	12	8	Yes
Dominican Rep., La Altagracia [87]	2008	MSM	Yes	NR	IA	7	NR	9.00	3.00	300	270	11	8	Yes
Dominican Rep., Santiago [87]	2008	MSM	Yes	NR	IA	6	NR	9.00	3.00	300	327	13	8	Yes
Dominican Rep., Santo Domingo [87]	2008	MSM	Yes	NR	IA	7	NR	9.00	3.00	500	510	15	8	Yes
El Salvador, San Miguel [88, 89]	2008	MSM	Yes	NR	CASI w/interviewer	5	5	4.00 as items	2.70 (items)	200	195	19 (2 cities)	16	Yes
El Salvador, San Salvador [89]	2008	FSW	NR	1	CASI w/interviewer	10	10	Items (value NR)	Items (value NR)	NR	787[e]	NR	NR	No
El Salvador, San Salvador [88, 89]	2008	MSM	Yes	NR	CASI w/interviewer	11	11	4.00 as items	2.70 (items)	600	596	19 (2 cities)	16	Yes
El Salvador, Sonsonate [89]	2008	FSW	NR	1	CASI w/interviewer	5	5	Items (value NR)	Items (value NR)	NR	787[e]	NR	NR	No
Honduras, Comayagua [90]	2006	FSW	Yes	1	ACASI	5	5	Purse (value < 2.00)	Items (value 3.50)	200	182	11	8	Yes
Honduras, La Ceiba [90]	2006	FSW	Yes	1	ACASI	7	7			200	211	7	8	Yes
Honduras, San Pedro Sula [90]	2006	FSW	Yes	1	ACASI	7	7			200	198	13	8	Yes
Honduras, Tegucigalpa [90]	2006	FSW	Yes	1	ACASI	5	5			200	204	7	10	Yes
Peru, Lima [91]	2012	Transwoman	Yes	6	SA	8	11	7.00	NR	420	450	NR	16	Yes
North America														
Mexico, Juarez [92–96]	2005	PWID	NR	1	SA	NR	NR	NR	NR	NR	204	NR	8	Yes
Mexico, Juarez [97]	2005	PWID	NR	1	SA	9	17	20.00	5.00	200	197	8	2	Yes
Mexico, Tijuana [92–96]	2005	PWID	NR	3	SA	15	15	10.00	5.00	200	207	8	8	Yes
Mexico, Tijuana [92–102]	2006–07	PWID	NR	NR	SA	32	NR	20.00	NR	NR	1056	NR	52	Yes
USA, Appalachia [103]	NR	PWUD	NR	NR	NR	NR	NR	50.00	10.00	NR	503	NR	NR	No
USA, Atlanta [6]	2005–06	PWID	NR	NR	SA	8–10	NR	25.00	10.00	NR	561	NR	NR	Yes
USA, Baltimore [104]	2002–04	Youth PWID	NR	NR	ACASI, w/w/out interviewer	NR	NR	NR	NR	NR	736	NR	88	No
USA, Baltimore [6]	2005–06	PWID	NR	NR	SA	8–10	NR	25.00	10.00	NR	722	NR	NR	Yes
USA, Baltimore [105]	2006	PWID	NR	NR	CAPI	20	20	20.00	10.00	NR	670	NR	20	Yes
USA, Boston [106, 107]	2008	MSM	NR	2	SA	8	21	50.00	10.00	NR	197	NR	24	No
USA, Boston [6]	2005–06	PWID	NR	NR	SA	8–10	NR	25.00	10.00	NR	475	NR	NR	Yes

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USA, Chicago [104]	2002–04	Youth PWID	NR	NR	ACASI, w/w/out interviewer	NR	NR	NR	NR	NR	586	NR	88	No
USA, Chicago [6]	2005–06	PWID	NR	NR	SA	8–10	NR	25.00	10.00	NR	542	NR	NR	Yes
USA, Dallas [6]	2005–06	PWID	NR	NR	SA	8–10	NR	25.00	10.00	NR	570	NR	NR	Yes
USA, Denver [6]	2005–06	PWID	NR	NR	SA	8–10	NR	25.00	10.00	NR	532	NR	NR	Yes
USA, Detroit [6]	2005–06	PWID	NR	NR	SA	8–10	NR	25.00	10.00	NR	545	NR	NR	Yes
USA, Ft. Lauderdale [6]	2005–06	PWID	NR	NR	SA	8–10	NR	25.00	10.00	NR	384	NR	NR	Yes
USA, Houston [6]	2005–06	PWID	NR	NR	SA	8–10	NR	25.00	10.00	NR	596	NR	NR	Yes
USA, Houston [108]	2006–07	High risk heterosexuals	Yes	1	CAPI	NR	NR	40.00	10.00	750	939	NR	36	Yes
USA, Las Vegas [6]	2005–06	PWID	NR	NR	SA	8–10	NR	25.00	10.00	NR	334	NR	NR	Yes
USA, Los Angeles [6]	2005–06	PWID	NR	NR	SA	8–10	NR	25.00	10.00	NR	602	NR	NR	Yes
USA, Los Angeles [75, 109–111]	2005–06	PWUD/PWID/MSM	NR	1	ACASI	25	25	50.00	20.00	NR	426	21 (both phases)	52	Yes
USA, Miami [6]	2005–06	PWID	NR	NR	SA	8–10	NR	25.00	10.00	NR	607	NR	NR	Yes
USA, Nassau [6]	2005–06	PWID	NR	NR	SA	8–10	NR	25.00	10.00	NR	529	NR	NR	Yes
USA, New Haven [6]	2005–06	PWID	NR	NR	SA	8–10	NR	25.00	10.00	NR	534	NR	NR	Yes
USA, Las Cruces [97]	2005	PWID	NR	1	SA	NR	NR	NR	NR	NR	100	NR	8	No
USA, New York City [6]	2005–06	PWID	NR	NR	SA	8–10	NR	25.00	10.00	NR	508	NR	NR	Yes
USA, New York City [112]	2009	PWID	Yes	NR	SA	NR	3	NR	NR	NR	488	NR	8	Yes
USA, New York City [113–118]	2006–07	High risk heterosexuals	Yes	NR	SA	8	NR	30.00	11.00	NR	850	NR	NR	No
USA, New York City [1, 119, 120]	2004	PWUD	NR	NR	NR	NR	NR	20.00	10.00	NR	448	NR	NR	Yes
USA, Newark [6]	2005–06	PWID	NR	NR	SA	8–10	NR	25.00	10.00	NR	440	NR	NR	Yes
USA, Norfolk [6]	2005–06	PWID	NR	NR	SA	8–10	NR	25.00	10.00	NR	499	NR	NR	Yes
USA, Oakland [121]	2011–12	High risk/HIV pos. African American	Yes	4	SA	48	NR	10.00 gift card	Varied	NR	243	NR	52	Yes
USA, Philadelphia [6]	2005–06	PWID	NR	NR	SA	8–10	NR	25.00	10.00	NR	539	NR	NR	Yes
USA, San Diego [122]	2009–10	PWID	NR	NR	ACASI	NR	NR	NR	10.00	NR	510	NR	64	No
USA, San Diego [6]	2005–06	PWID	NR	NR	SA	8–10	NR	25.00	10.00	NR	539	NR	NR	Yes
USA, San Francisco [123]	2007–08	MSM	Yes	1	CAPI	10	10	40.00	10.00	NR	256	18	24	Yes
USA, San Francisco [6]	2005–06	PWID	NR	NR	SA	8–10	NR	25.00	10.00	NR	581	NR	NR	Yes
USA, San Juan [6]	2005–06	PWID	NR	NR	SA	8–10	NR	25.00	10.00	NR	573	NR	NR	Yes

Location of study, citation	Year of study	Population	Pre-survey assessment	Sites (num)	Interview method[a]	Seeds at start (num)	Final seeds (num)	Primary incentive of value[b]	Secondary incentive of value[b]	Target sample size	Final sample size	Max. number of waves	Data collection duration, weeks	Data adjusted[c]
USA, Seattle [124]	2009	PWID	NR	1	IA	6	6	40.00	10.00	NR	497	16	16	Yes
USA, Seattle [6]	2005–06	PWID	NR	NR	SA	8–10	NR	25.00	10.00	NR	400	NR	NR	Yes
USA, St. Louis [6]	2005–06	PWID	NR	NR	SA	8–10	NR	25.00	10.00	NR	525	NR	NR	Yes
USA, Wash. DC [125]	2006–07	High risk heterosexuals	Yes	1	SA	NR	NR	35.00	10.00	NR	750	NR	44	Yes
USA, Wash. DC [126]	2009	PWID	NR	1	SA	NR	NR	30.00	10.00	NR	553	NR	16	Yes
USA, Texas, El Paso [97]	2006	PWID	NR	1	SA	NR	NR	NR	NR	NR	155	NR	24	Yes
South East Asia														
Bangladesh, Dhaka [127]	2006	MSM	Yes	1	SA	5	8	2.14	1.43	530	531	9	11	Yes
India, Bishenpur District, Manipur [128]	2006	PWID	NR	NR	SA	NR	NR	NR	NR	400	420	NR	NR	Yes
India, Chennai [129]	2008	MSM	Yes	2	SA	NR	19	6.00	None	NR	721[e]	3	8	No
India, Churachandpur District, Manipur [128]	2006	PWID	NR	NR	SA	NR	NR	NR	NR	400	419	NR	NR	Yes
India, Coimbatore [129]	2008	MSM	Yes	1	SA	NR	19	6.00	None	NR	721[e]	3	8	No
India, Dimapur District, Nagaland [130]	2006	FSW	NR	NR	SA	10	10	NR	NR	400	426	11	8	No
India, Dindigul [129]	2008	MSM	Yes	1	SA	NR	19	6.00	None	NR	721[e]	3	8	No
India, Erode [129]	2008	MSM	Yes	1	SA	NR	19	6.00	None	NR	721[e]	3	8	No
India, Goa [131, 132]	2005	FSW	Yes	NR	SA	59	59	2.50	1.50	318	326	6	52	Yes
India, Kanyakumari [129]	2008	MSM	Yes	1	SA	NR	19	6.00	None	NR	721[e]	3	8	No
India, Madurai [129]	2008	MSM	Yes	1	SA	NR	19	6.00	None	NR	721[e]	3	8	No
India, Mumbai and Thane Districts [128]	2006	PWID	NR	NR	SA	NR	NR	NR	NR	400	376	NR	NR	Yes
India, Nagapattinam [129]	2008	MSM	Yes	1	SA	NR	19	6.00	None	NR	721[e]	3	8	No
India, Nilgiris [129]	2008	MSM	Yes	1	SA	NR	19	6.00	None	NR	721[e]	3	8	No
India, Perambalur [129]	2008	MSM	Yes	1	SA	NR	19	6.00	None	NR	721[e]	3	8	No
India, Phek District, Nagaland [128]	2006	PWID	NR	NR	SA	NR	NR	NR	NR	400	440	NR	NR	Yes
India, Pudukkottai [129]	2008	MSM	Yes	1	SA	NR	19	6.00	None	NR	721[e]	3	8	No

Location of study, citation	Year of study	Population	Pre-survey assessment	Sites (num)	Interview method[a]	Seeds at start (num)	Final seeds (num)	Primary incentive of value[b]	Secondary incentive of value[b]	Target sample size	Final sample size	Max. number of waves	Data collection duration, weeks	Data adjusted[c]
India, Ramanathapuram [129]	2008	MSM	Yes	1	SA	NR	19	6.00	None	NR	721[e]	3	8	No
India, Salem [129]	2008	MSM	Yes	1	SA	NR	19	6.00	None	NR	721[e]	3	8	No
India, Sivaganga [129]	2008	MSM	Yes	1	SA	NR	19	6.00	None	NR	721[e]	3	8	No
India, Thanjavur [129]	2008	MSM	Yes	1	SA	NR	19	6.00	None	NR	721[e]	3	8	No
India, Tiruchy [129]	2008	MSM	Yes	1	SA	NR	19	6.00	None	NR	721[e]	3	8	No
India, Tirunelveli [129]	2008	MSM	Yes	1	SA	NR	19	6.00	None	NR	721[e]	3	8	No
India, Thiruvarur [129]	2008	MSM	Yes	1	SA	NR	19	6.00	None	NR	721[e]	3	8	No
India, Tuticorin [129]	2008	MSM	Yes	1	SA	NR	19	6.00	None	NR	721[e]	3	8	No
India, Wokha District, Nagaland [128]	2006	PWID	NR	NR	SA	NR	NR	NR	NR	400	420	NR	NR	Yes
Pakistan, Abbottabad [133]	2007	MTSW	Yes	2	IA	NR	NR	NR	NR	NR	103	NR	8	No
Pakistan, Abbottabad [133]	2007	FSW	Yes	2	IA	NR	NR	NR	NR	NR	109	NR	8	No
Pakistan, Lahore [133]	2007	FSW	Yes	3	SA	3	NR	NR	NR	726	730	5	12	Yes
Pakistan, Rawalpindi [133]	2007	MTSW	Yes	2	IA	NR	NR	NR	NR	NR	812	NR	8	No
Pakistan, Rawalpindi [133]	2007	FSW	Yes	2	IA	NR	NR	NR	NR	NR	431	NR	8	No
Thailand, Bangkok [134]	2007	FSW	NR	3	ACASI, with/w/out interviewer	15	15	11.80	1.50	NR	707	3	12	Yes
Western Pacific														
China, Beijing [135]	2009	MSM	NR	1	ACASI	7	7	4.50	3.00	NR	500	NR	8	No
China, Beijing [3]	2004	MSM	NR	1	SA	1	1	None	2.10	NR	325	15+	14	Yes
China, Beijing [3, 136]	2005	MSM	NR	1	SA	10	10	None	2.10	NR	427	15+	16	Yes
China, Beijing [3]	2006	MSM	NR	1	SA	8	8	None	2.10	NR	540	15+	14	Yes
China, Beijing [137]	2009	MSM	NR	1	CAPI	7	8	5.00	3.20	NR	501	13	8	Yes
China, Chongqing [138]	2009	MSM	NR	NR	CASI	7	7	4.50	3.00	NR	503	14	12	Yes
China, Guangdong [139]	200S	PWID	Yes	1	SA	6	7	7.50	3.00	238	290	11	16	Yes
China, Guangdong [140]	NR	FSW	NR	1	IA or CASI	4	4	NR	NR	NR	320	16	NR	Yes
China, Guangzhou [141]	2008	MSM	NR	1	SA	13	13	5.00, gift/cash	1.50	NR	379	14	16	Yes
China, Jinan [142, 143]	2007	MSM	Yes	1	SA	9	9	None	NR	428	428	NR	20	Yes
China, Jinan [142, 143]	2008	MSM	Yes	1	SA	5	5	None	NR	500	500	NR	12	Yes

Location of study, citation	Year of study	Population	Pre-survey assessment	Sites (num)	Interview method[a]	Seeds at start (num)	Final seeds (num)	Primary incentive of value[b]	Secondary incentive of value[b]	Target sample size	Final sample size	Max. number of waves	Data collection duration, weeks	Data adjusted[c]
China, Jinan [144]	2008	FSW	Yes	1	SA	7	7	7.30	2.90	NR	363	25	24	Yes
China, Jinan [144]	2009	FSW	Yes	1	SA	4	4	7.30	2.90	NR	432	21	20	Yes
China, Liuzhou [145, 146]	2009–10	FSW	Yes	1	SA	7	8	14.00	7.00	380	583	20	13	Yes
China, Nanjing [147]	NR	MSM	NR	1	NR	9	9	4.00 phone card	NA	NR	416	NR	NR	No
China, Shandong [148]	2007–08	Money boys	NR	NR	SA	16	NR	NR	NR	120	118	NR	NR	No
Indonesia, Bandung [149]	2007	PWID	NR	NR	SA	8	NR	NR	4.00	250	250	NR	16	No
Indonesia, Surabaya [149]	2007	PWID	NR	NR	SA	8	NR	NR	4.00	250	250	NR	16	No
Vietnam, Cam Ranh [150]	2005	MSM	NR	1	NR	2	NR	1.90	0.95	300	295	5	12	No
Vietnam, Dien Khanh [150]	2005	MSM	NR	1	NR	2	NR	1.90	0.95	300	295	5	12	No
Vietnam, Hai Phong [150]	2004	FSW	NR	NR	SA	20	25	3.00	1.00	200	215	NR	12	Yes
Vietnam, Ho Chi Minh City [150]	2004	FSW	NR	NR	SA	20	24	4.00	1.50	400	413	NR	12	Yes
Vietnam, Nha Trang [150]	2005	MSM	NR	1	NR	2	NR	1.90	0.95	300	295	5	12	No
Vietnam, Ninh Hoa [150]	2005	MSM	NR	1	NR	2	NR	1.90	0.95	300	295	5	12	No
Vietnam, Van Ninh [150]	2005	MSM	NR	1	NR	2	NR	1.90	0.95	300	295	5	12	No

NR not reported, N/A not applicable, IA interviewer administered, SA self-administered, CASI computer assisted structured interview, ACASI computer assisted structured interview

[a]Unless otherwise stated, ACASI and CASI are self-administered

[b]All figures are in US Dollar

[c]Adjusted is when at least one of the published articles analyzed frequency data using either the reciprocity model based estimator (RDS I) (Salganik and Heckathorn [13]), dual component estimator (RDSI DC) (Heckathorn [12]), probability-based estimator (RDSII) (Volz and Heckathorn, [14]) or successive sampling estimator (Gile [11]). In the cases data were reported as “weighted” but neither cited an appropriate reference nor an appropriate software (RDSAT, RDS Analyst and in some cases Stata 11 [Schonlaau and Liebau, 2012-RDSI Only]), R and Matlab, they were considered not providing sufficient information to determine correct analysis

[d]Target sample size combined for Serbia (2010; Belgrade and Kragujevac)

[e]Final sample size combined for Nigeria (2006; Ibadan and Lagos), Moldova (2007–08; Balti, Chisinau and Tiraspol), El Salvador (2008; San Salvador and Sonsonate), and India (2008;Chennai, Coimbatore, Dindigul, Erode, Kanyakumari, Madurai, Nagapattinam, Nilgiri, Perambalur, Pudukkottai, Ramanathapuram, Salem, Sivaganga, Thanjavur, Tiruchy, Tirunelveli,Thiruvarur, and Tuticorin)

Table 2

Reporting of essential information to interpret survey quality, number, percentage, median and range (2004–2012) and rationale for reporting

Indicators	Percent of publications reporting information		Values of reported information	Rational for reporting
	N (222)	%	Median (range)	
Year of survey	219	99	-	Useful for any survey to identify how current data are, to plan future surveys and to compare data from other surveys
Eligibility criteria (minimum of behavior description)[c]	222	97	-	Useful for any survey to determine the denominator being measured, to know measurement for the construction of the social network question needed for RDS analysis. Provides readers with possible criteria to use in different populations and settings; allows for comparison of data across countries
Type of specimen collected for biological testing[c]	193	87	-	Useful for any survey. Informs readers about the types of testing being conducted in different populations and settings
Pre-survey research conducted	88	40	-	Useful for any survey. Informs readers about the survey planning process, especially whether attempts were made to assess the underlying network structure of the population
Number of recruitment sites per survey area	95	43	1 (1–6)	Especially useful in RDS as it alerts readers to the possible violation of the network being one complete component if participants at each site are not connected; informs readers about the possible clustering (or diffusion) of the sample
Interview method	210	94	-	Useful for any survey. Provides information about the level of confidentiality in the survey (i.e., ACASI may provide more confidentiality) and informs readers about the different types of methods used for interviewing hidden populations in RDS surveys
Number of seeds at the start of the survey	62	28	7.5 (1–48)	Specifically useful for RDS surveys. Informs readers about whether many seeds were added during data collection and the number of seeds in relation to the sample size and number of waves (too many seeds may result in too few waves needed to reduce seed dependence, adding too many seeds may be an indication that the population is not well networked); provides parameters for readers about seeds needed in different populations and settings
Whether seeds were added during data collection	17	8	5 (1–37)	
Whether seeds failed during data collection	14	6	4 (1–24)	
Number of seeds by the end of the survey	121	54	10 (1–156)	
Amount or type of primary incentive (USD)	186	84	3 (1.9–5)[a]	Specifically useful for RDS surveys. Provides readers with parameters about amounts used in different populations and settings; provides an indication of potential bias during recruitment (if incentives are too high, more people may enroll who are not eligible)
Having no primary incentive	6	3	-	
Amount or type of secondary incentive (USD)	177	80	10 (0.95–20)[b]	
Having no secondary incentive	18	8	-	
Calculated target sample size	89	40	300 (100–756)	Useful for any survey. Indicates if an original sample size was calculated and if that sample size was reached in order to ensure sufficient power and confidence for data analysis. Provides readers with parameters about sample sizes used in different populations and settings. Specific for RDS surveys: combining multiple survey sites is often a violation of the network being one network component
Final sample size	212	95	325 (100–1056)[c]	
Final sample size for multiple cities combined	28	12	-	

Indicators	Percent of publications reporting information		Values of reported information	Rational for reporting
	N (222)	%	Median (range)	
Design effect used for sample size calculation[d]	50	22	2 (1.3–3)	Design effects, currently recommended to be at least 2 [16, 151, 152], are important for calculating a sufficient sample size to account for RDS not being a traditional random sample
Maximum number of waves	95	43	9 (3–21)	Specific to RDS surveys: useful to assess seed dependence
Duration of data collection (in weeks)	139	63	12 (2–124)	Informs readers of the time needed to gather samples of different sizes from different populations and settings; alerts readers of unusual recruitment lengths that may impact representativeness of the sample
Maximum number of coupons distributed to each recruiter[d]	163	73	3 (2–7)	Specific to RDS surveys: The number of coupons used are normally three [7], but some surveys have used more or fewer. Analysis does not account for branching induced by the number of coupons provided to each participant so fewer coupons, when possible, is useful to mimic a random walk process
Whether equilibrium or convergence was assessed[d]	44	20		Specific to RDS surveys: Informs readers of seed dependence and is a diagnostic to assess bias
Whether data were adjusted for network size	157	70	-	Specific to RDS surveys: Informs readers of the extent to which RDS was fully utilized, resulting in the ability to assess whether the survey may represent the network of the population from which the sample was gathered
Software used to adjust data[d]	162	73	-	Specific to RDS surveys: There are limited software packages available for analyzing RDS data. Analyzing RDS data in more popular, preexisting software (i.e., STATA, SPSS) may not eliminate RDS specific biases
Citation for adjustment[d]	59	26	-	Specific to RDS surveys: Given the evolvement of the estimators for the analysis of RDS data, this is useful for providing information about the assumptions supporting the adjustments
Heckathorn [10, 153][d]	19	32	-	
Salganik and Heckathorn [12][d]	28	47	-	
Heckathorn [11][d]	10	17	-	
Volz and Heckathorn [13][d]	7	12	-	
Gile [154][d]	4	7	-	
Estimator used for adjustment[d]	10	4	-	
Whether seeds were discarded during analysis	31	14	-	Some studies either did not collect data from seeds or did not include seeds data the analysis, which could likely result in the sample having addition seeds (analysis would assume wave 1 participants are seeds) thereby potentially impacting seed dependence and biasing the final estimate

[a] Among those that reported a value (n = 166)

[b] Among those that reported a value (n = 152)

[c] Among those that reported a sample size for an individual city (n = 185)

[d] Not presented in Table 1

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Table 3

Annual rate of change over time (2004–2012) based on robust regression of values and reported information

Variable	Change (95 % CI)	*p* value
Reporting having conducted pre-survey research	0.04 (0.01, 0.08)	0.01
Reporting having adjusted RDS data	0.03 (0.00, 0.6)	0.09
Lower eligibility age value	−0.14 (−0.20, −0.07)	0.00
Number of seeds at start of survey	−0.14 (−0.43, 0.14)	0.33
Number of seeds at end of survey	−0.31 (−1.86, −0.66)	0.00
Survey durations	0.15 (−0.35, 0.66)	0.55
Final sample sizes	−29.14 (−39.56, −8.73)	0.00
Sizes of estimated design effects	0.07 (0.02, 0.12)	0.01
Length of longest recruitment chain	0.29 (−0.39, 0.97)	0.40