World Health Organization

CONSOLIDATED GUIDELINES ON

PERSON-CENTRED HIV PATIENT MONITORING AND CASE SURVEILLANCE

ANNEX 2.4.6
HIVDR EWI SAMPLING, ABSTRACTION AND REPORTING GUIDANCE

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Annex 2.4.6 HIVDR EWI sampling, abstraction and reporting guidance

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1 EWI sampling guidance

This section presents a method for expanding early warning indicators (EWIs) or other quality of care indicators through a random sampling of ART clinics within a country to facilitate scale up of reporting to all clinics over time in a representative fashion. Use of random sampling allows countries to calculate an aggregated national prevalence estimate for each EWI. In addition, the method can incorporate information from clinics with conveniently available data without sacrificing representativeness. In this annex, primary sampling refers to the sampling of clinics and secondary sampling refers to the sampling of patients within a clinic.

1.1 Primary sampling

Ideally, EWIs should be reported annually from all ART clinics within a country. In countries where it is not possible to report EWIs from all clinics, it is recommended that EWI reporting be progressively expanded using a multiyear scale-up approach. Countries may start by sampling a fixed percentage of clinics and then annually expand EWI monitoring until all clinics report. For example, in Year 1, a country samples 20% of clinics. In Year 2, all clinics reporting in Year 1 plus an additional sample of 20% of clinics report for a total EWI coverage of 40%. Each year, the country expands EWI coverage by an additional 20% of clinics (60% in Year 3; 80% in Year 4) until 100% coverage is achieved in Year 5. The rate of scale up, in terms of the percentage of clinics added per year and total number of years, may be country specific.

In expanding the uptake of EWIs, clinics may be selected using a combination of convenience sampling and random sampling (primary sampling), and their results can be summarized in a nationally representative manner through the use of weighting. Convenience sampling may be used for clinics already reporting EWI data or for clinics with readily available data. Clinics historically reporting EWIs should continue to report and thus should always be included in the sample. Similarly, countries may decide to include clinics with readily available data, such as clinics with electronic medical records (EMR), because of the relatively low cost of data abstraction.

While convenience sampling can be used for clinics such as those described above, it is recommended that the primary mode of clinic selection be via random sampling because this promotes national representativeness. Representative sampling of clinics can be achieved by simple random sampling or stratified random sampling. If stratified random sampling is used, it is recommended not to use more than one strata, e.g. district or province.

An example of simple random sampling of clinics in Country Z is provided. In this example, Country Z monitors EWIs at Clinics A, I, P and R in Year 1, in addition to Clinics U, V, W, X and Y **(Fig. A1 and A2)**.

In Year 2, the country continues to monitor EWIs at Clinics A, I, P, R (randomly sampled in Year 1), U, V, W, X and Y (conveniently sampled), and the country randomly samples four additional clinics to expand EWI uptake by an additional 20%. To identify these four clinics, Country Z creates a new sampling table and randomly samples four clinics, excluding those that are already reporting EWIs either because they were conveniently sampled (Clinics U through Y) or because they were randomly sampled in the previous year (Clinics A, I, P and R). The sampling table also excludes clinics that have been in operation for less than 2.5 years. Clinics previously excluded may be added to the sampling table if they have been in operation for more than 2.5 years at the time EWI monitoring is performed. In this example for year two, Country Z randomly samples Clinics G, M, J and T **(Fig. A3)**. Each subsequent year, the country expands EWI monitoring to additional clinics until all clinics are reporting EWIs **(Fig. A4–A6)**. After Year 5, all clinics in the country continue to report EWIs annually.

Fig. A1–A6 Example of representative scale up of EWIs using random clinic sampling

1.2 Secondary sampling

All EWIs except "drug stock-outs" rely on the collection of patient-level data within clinics. Whenever feasible, patient-level data are abstracted for all eligible patients (census). Where a census is prohibitive, sampling of patients at an individual clinic (secondary sampling) for each EWI achieves a result generalizable to the entire eligible population of interest at the clinic. To determine the necessary sample size for secondary sampling, the clinic should determine the sizes of the eligible patient populations. Note that the eligible patient population is not the same for all EWIs. For example, the eligible patient population for "on-time ARV drug pick-up" (paediatric) is the annual total number of eligible paediatric patients in care or receiving ART at the clinic. For "retention on ART" (adult), the eligible patient population is the size of a cohort of adult patients who initiated ART during a predetermined reporting period. For "viral load suppression" (adult), the eligible patient population is the size of a cohort of adult patients who initiated ART during a predetermined reporting period and who received a 12-month viral load test (i.e. they have not died, transferred out, stopped treatment, or been lost to follow up by 12 months).

Clinics can use **Table 1** to determine the appropriate sample size based on the eligible patient population for each EWI. This is the same as Table 2.8 included in Section 2.6: Periodic review and use of data from the HIV patient monitoring system of the main guidance. Sample size calculations are presented in **Box 1**.

Sample sizes are calculated to achieve 95% confidence intervals of ±7% for clinic-specific results. Once the sample size is determined for a given EWI at a particular clinic, consecutive patient records are sampled until the required sample size is reached. Countries are encouraged to use the clinic-level EWI data abstraction tool developed by WHO, which generates the required sample size automatically and facilitates data abstraction and reporting of data to the national level.

Table 1 Sample size required to estimate EWI and achieve a 95% confidence interval of ±7% at a reporting clinic

Annual number of "eligible patients" at the clinic	Number to be sampled at the clinic
1–75	All
76–110	75
111–199	100
200–250	110
251–299	120
300–350	130
351–400	135
401–450	140
451–550	145
551–700	155
701–850	160
851–1600	175
1601–2150	180
2151–4340	200
4341–5670	210
5671–1000	215
>1000	220

Box 1 Sample size calculations for monitoring early warning indicators

The formula used to calculate the sample size for monitoring WHO HIVDR EWI is in two parts. The first equation calculates a sample size for large populations. The second equation applies a finite population correction factor. This formula produces samples that will allow a 95% confidence interval of ±7% if the true proportion of patients meeting the target for the indicator is 50%. Equation 1 returns the large population sample size, n_0. Equation 2 returns the sample size, n, adjusted for the finite population correction factor.

Equation 1 (large population sample size): $n_0 = 3.48*p*(1–p) / e^2$

Where: p = 0.5 (that is, 50% is assumed as the "true prevalence" of the proportion of patients meeting the target, because this gives the most conservative estimate of the sample size required), e = precision = 0.07 (based on the confidence interval of ±7%)

Equation 2 (finite population correction factor): $n = n_0 / (1 + ((n_0–1)/N))$

Where: N = population size of the eligible individuals at the clinic

In addition to facilitating data abstraction, the tool keeps track of complete entries and reports a grey score if ≥30% of information is missing. The Excel tool will be available at the WHO HIVDR website: http://www.who.int/hiv/topics/drugresistance/en/.

2 ART clinic-level EWI reporting

After data abstraction is complete, each clinic is responsible for calculating the EWIs and assigning the appropriate classification. A point prevalence (numerator/denominator) is estimated for each EWI, and this point prevalence is compared to the EWI-specific thresholds to determine the appropriate classification (red, amber or green). A grey classification is used if there is an excessive amount of missing data for the EWI (≥30%). It is not necessary to calculate a 95% confidence interval for the EWI in order to make a classification. The classifications are illustrated in the example clinic score card **(Fig. A7)**.

Fig. A7 Example of a clinic-specific score card

Clinic: National clinic # 1	
	Score[a]
On-time pill pick-up	82%
ART retention	90%
Drug stock-outs	>0%
Viral load suppression	95%[b]
Viral load completion	50%
Appropriate switch to second-line ART	100%

[a] In this example, the respective point prevalence estimate corresponding to the colour assigned to each EWI is presented in the score box.

[b] While results for EWIs 1, 2 and 3 are representative of the clinic sampled, the viral load suppression indicator only reflects those who had a viral load test result. In this example, only 50% of patients at 12 months had a viral load test result; thus, the prevalence of viral load suppression cannot be generalized to the entire population at the clinic on ART for 12 months. This indicator is reported as grey. For the case of the viral load suppression indicator, the proportion of available data is captured and reported as viral load completion. For all other EWIs, if more than 30% of data are unavailable, a grey score is assigned but no prevalence estimate is reported.

At the national level, it is recommended that countries report the fraction of clinics monitored that achieve green, amber, red and grey classifications for each indicator and for each patient population (adult and paediatric). An example of a table with results reported as the percentage of clinics monitored that achieved a specific colour score is provided in **Table 2**.

Providing strata of performance (score card) allows programme managers to identify areas of greatest need and also grossly monitor for degrees of improvement or decline across these indicators. This technique allows for clear presentation of results to ministries of health and stakeholders, and is easily interpreted. Additionally, the score card will reflect if any of the indicators cannot be measured at a specific ART clinic. An example of a national-level at-a-glance assessment of clinic performance is provided in **Fig. A8**.

Table 2 Fraction of clinics monitored in a given year achieving a specific score

	Green	Amber	Red	Grey
On-time pill pick-up (ART.7)	Target: >90% **50/100**	Target: 80–90% **20/100**	Target: <80% **10/100**	20/100
Retention on ART at 12 months (ART.5)	Target: >85% **84/100**	Target: 75–85% **11/100**	Target: <75% **3/100**	2/100
Drug stock-out	Target: 0% **92/100**	NA	Target: >0% **5/100**	3/100
Viral load suppression (VLS.1)	Target: ≥90% **30/100**	Target: 75–90% **10/100**	Target: <75% **10/100**	50/100
Viral load completion (VLS.2)	Target: >70% **50/100**	NA	Target: <70% **45/100**	NA
Appropriate switch to second-line ART	Target:100% **70/100**	NA	Target <100% **30/100**	NA

NA: For the EWI viral load coverage, a grey score is not possible as this indicator classifies missing information. Classifications of drug stock-out and viral load completion (an assessment of missing data) are binary and no amber classification exists.

Fig. A8 National-level at-a-glance assessment of ART clinic performance by EWI[a]

Clinic	On-time pill pick-up (ART.7)	Retention on ART at 12 months (ART.5)	Drug stock-out	Viral load suppression (VLS.2)	Viral load completion (VLS.2)	Appropriate switch to second-line ART
1	91%	77%	0%	93%	88%	100%
2	76%	92%	0%	95%	90%	100%
3	95%	81%	<0%	85%	95%	90%
4	85%					81%
5	90%	73%	<0%	70%	92%	100%
….	….	….	…..	….	….	….
….	….	….	….	….	….	….
100	96%	91%	0%			81%

[a] In this example, the respective point prevalence estimate corresponding to the colour assigned to each EWI is presented in the score box.

In addition to providing individual clinic-level classifications, EWI monitoring can also provide information on ART programmatic function at the national level. ART programme managers may wish to estimate the average prevalence of each indicator across the country as a summary measure of overall programme performance. Nationally representative prevalence estimates for each EWI can be calculated by data aggregation and weighting.

To aggregate results, it is necessary for all sampled clinics to report a measure of relative size for each EWI (except "drug stock-outs"). **These population sizes are described in Table 3 and are additional information required for national aggregate weighting.** Data analysis should be performed in Stata or another statistical programme, which can handle two-stage clustered survey data. The drug stock-out indicator is not weighted.

The interpretation of the aggregated value for all EWIs except "drug stock-outs" is the proportion of the patient population in the country with the relevant outcome (e.g. adults achieving 12-month viral load suppression among those with an available viral load). The interpretation of the aggregated value for the "drug stock-outs" EWI is the average proportion of months with stock-outs of routinely dispensed antiretroviral drugs among clinics in the country during the reporting period.

Information required for calculation of national weighted estimates for each indicator is provided below in **Table 3**. Weighting is performed unless a census of all patients from all clinics is used to calculate the corresponding prevalence.

Table 3 Clinic-level information required for national aggregate weighting

Clinic name	
Clinic district	
Retention on ART at 12 months (ART.5)	The total number of patients (adults or children) initiating ART 15–27 months prior to the data abstraction start date, by clinic. This number is a count of the total number of records (adult or paediatric) that are eligible to be in the denominator
On-time pill pick-up (ART.7)	Total number of patients (adult or paediatric) on ART at the clinic, by clinic
Drug stock-out	None; this EWI is not aggregated but may contribute to national-level ARV stock-out indicator ART.10
Viral load suppression (VLS.1)	Number of patients (adult or paediatric) who received a viral load test with result available 12 ± 3 months after ART initiation, by clinic
Viral load coverage (ART.8)	Number of patients who by national policy should have received a 12-month viral load test, by clinic
Appropriate switch to second-line ART	Number of patients (adult or paediatric) with confirmatory viral load, by clinic

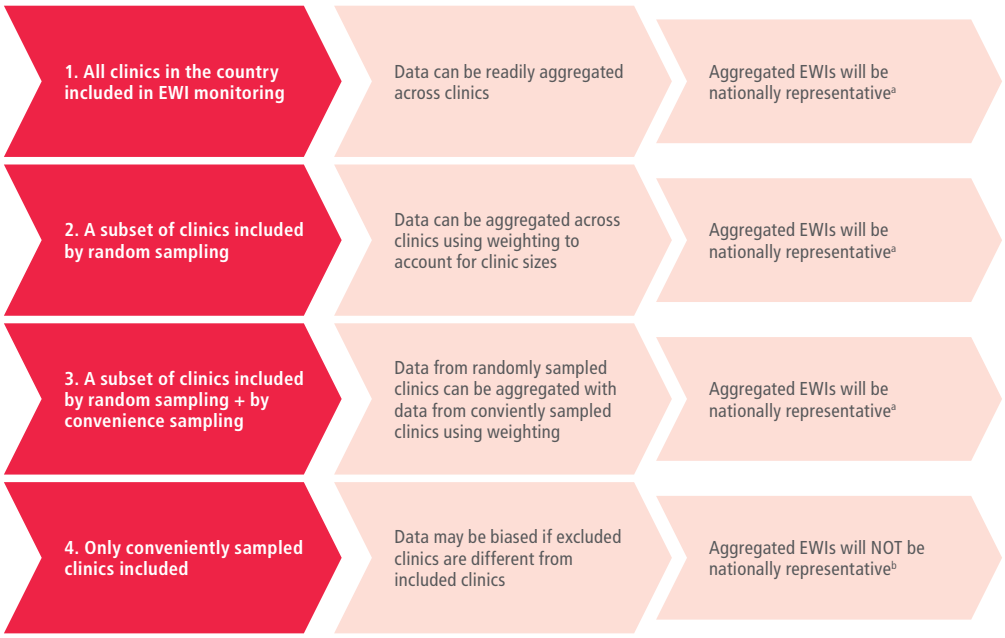
2.1 National aggregate prevalence estimated when all clinics report EWIs or a random sample of clinics reports EWIs

If all clinics report EWIs or if random sampling is used to select clinics for EWI scale up, results can be aggregated across sites to generate nationally representative statistics. When aggregating, clinics with greater patient burdens are weighted more heavily than smaller clinics. For each EWI, a country can calculate the aggregate point prevalence and 95% confidence interval. An excessive amount of missing (grey) data may complicate or prohibit the interpretation of the aggregated point prevalence. As aggregate analysis will be used for benchmarking and reporting, it is important that results are representative of the respective eligible population. If less than 70% of data are available for the nationally eligible population monitored by a specific indicator, aggregation should not be performed.

2.2 National aggregate prevalence estimated when a combination of randomly sampled clinics and conveniently sampled clinics report EWIs

Estimating a nationally representative point prevalence using a combination of randomly sampled clinics and conveniently sampled clinics can be achieved through appropriate weighting. As long as random sampling is used to select a portion of the clinics, the aggregated point prevalence will be nationally representative even if some clinics are sampled by convenience. As an excessive amount of missing (grey) data may complicate or prohibit the interpretation of aggregate point prevalence; it is advised to ensure that the results will be representative of the respective eligible population. If <70% of data are available for the nationally eligible population monitored by a specific indicator, aggregation should not be performed. A flowchart designed to aid in assessing the feasibility of aggregation at the national level is provided in **Fig. A9**.

Fig. A9 Flow diagram to assess feasibility of data aggregation at the national level



[a] Aggregated EWIs should be reported only if data availability exceeds the 70% threshold.

[b] If only conveniently sampled clinics included, data may be considered nationally representative if conveniently sampled clinics represent >70% of the eligible patient population for each indicator.

3 Data abstraction from ART clinics

Paper-based medical records. If paper-based records are in place, clinic staff trained in EWI of HIVDR should abstract data at their respective sites. Generally, data are abstracted retrospectively, once per year. Whenever possible, countries should combine EWI data abstraction with other indicators and patient monitoring activities taking place in country. EWI monitoring may also be used as, or combined with, a quality assurance assessment of record-keeping at ART clinics. For the purpose of manual data abstraction, the WHO EWI data abstraction tool can be printed. The tool will be available at: http://www.who.int/hiv/topics/drugresistance/en/.

Electronic medical records. If electronic medical records are in place, a programme to abstract data for EWI monitoring should be guided by experts from the national programme. Generally, it is not feasible to obtain EWI information from summary reports already produced by electronic record-keeping systems; feasibility may be limited by varying definitions of an indicator, or varying methods of applying a definition. If electronic medical records are used to produce EWIs, validation procedures that use abstraction from paper records should be set up. When electronic query programmes are written, they should keep track of available data and classify clinics with >30% missing data for a particular indicator as "grey". Electronic query programmes should also keep track of the proportion of missing data at each clinic for the purposes of assessing the feasibility of national aggregation of a specific EWI.

4 Data quality assessment

Data quality should be assessed throughout the EWI monitoring process. During the data abstraction process, data quality assessments provide critical information for ensuring that the correct data are abstracted in the appropriate way. After the data are analysed and reported, data quality assessment provides programme and clinic managers with a level of confidence that can be placed in the results, and how robust the data are for use in operations, planning and decision-making.

Three elements of data quality should be considered: data reliability, data completeness and data consistency.

Data reliability. This element assesses the reliability of data abstracted for each indicator. Assessing the quality early in the monitoring process will identify problems that can be addressed through additional support or training.

Data completeness. Some missing data are anticipated. However, a large percentage of missing information in patients' records at any clinic, for any EWI, presents challenges for achieving the required sample size and for interpretation of results. Monitoring of data completeness should occur during the data abstraction process, and clinics with <70% available data for any indicator should report a "grey" score for that indicator. A "grey" score is not punitive but signals that the clinic requires support in record-keeping before it can fully benefit from EWI monitoring. Aggregation should not be performed unless ≥70% data are available from all sites sampled.

Data consistency. Data consistency refers to consistency of patient information across different record systems within the same clinic. Clinic and pharmacy records are the primary sources of information used for EWI monitoring. Some clinics use both paper-based and electronic systems for clinic and pharmacy records. A records assessment process prior to data abstraction for EWI monitoring should be done to evaluate the consistency of information across these different sources. This is a crucial step in assessing which sources provide the most accurate information.

While not specifically designed to address the data used for EWI monitoring, data quality assessments identify strengths and weaknesses of existing record systems in the participating clinics. Incompleteness and inconsistency of data generally indicate more systemic problems in record-keeping that should be addressed. Thus, the results of data quality assessments can inform changes that will improve patient monitoring systems and clinic practices.