Quality Indicators for HIV Rapid Testing Algorithms

HIV Serology and Incidence Team

CDC/GHC/DGHT/International Laboratory Branch

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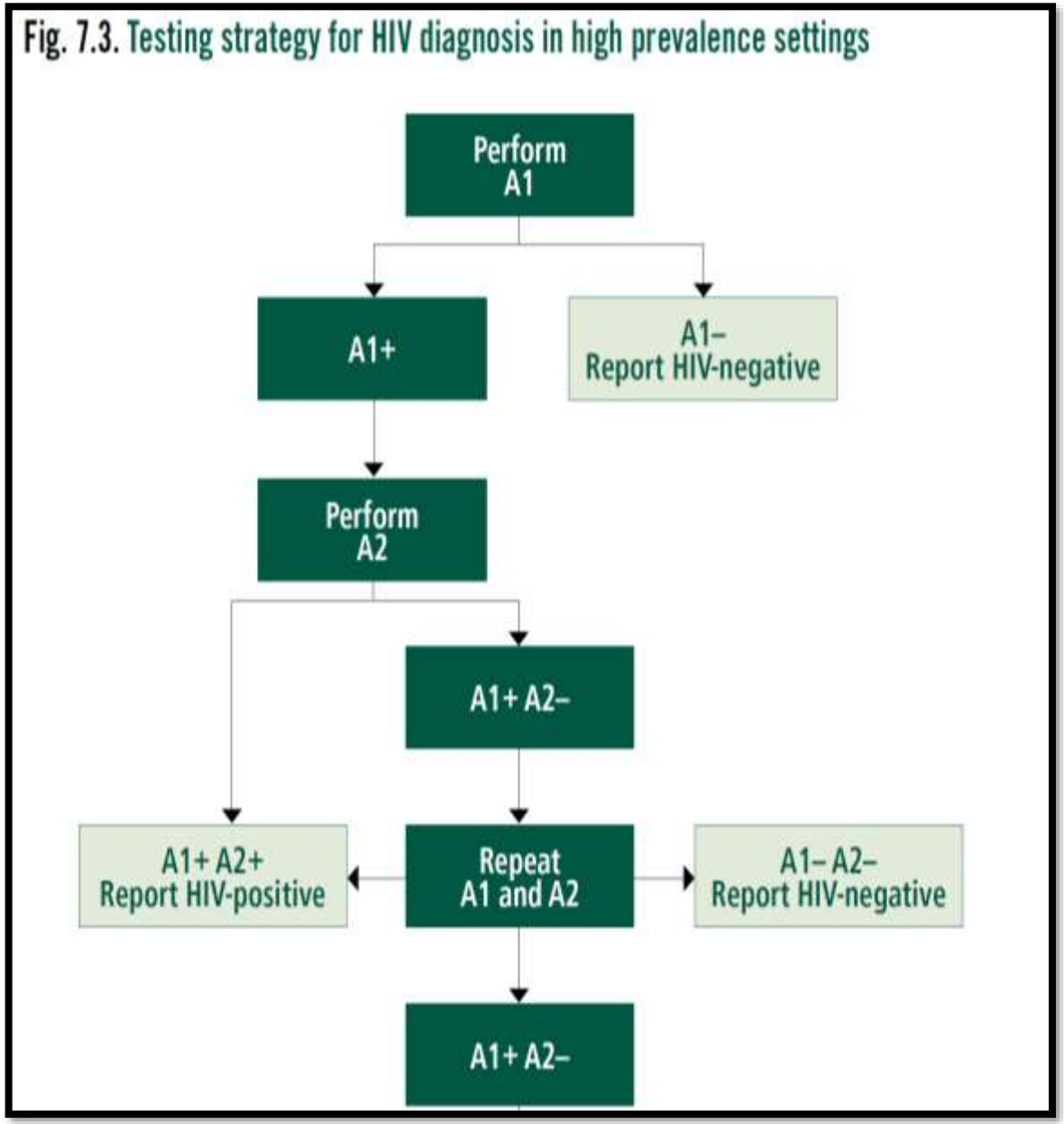
Presentation Outline

- Overview of the HIV rapid testing algorithms
- Define practical quality indicators for the algorithms
- Indicator thresholds for monitoring testing quality
- Data Quality Analysis and Review Process
- Steps to Take When Problems Arise

2015 HIV Rapid Test Testing Algorithm



HIV-Negative result:

- Test 1, (A1): Non-reactive

HIV-Positive result:

- Test 1 & Test 2, (A1+;A2+): Reactive

HIV-Inconclusive result:

- A1 & A2 are discordant
- Record result and retest in 14 days

Quality indicators being monitored:

- Invalid
- Inconclusive

	Overall Agreement	Positive Agreement
Definition	Percentage of **all test results (reactive and non-reactive)** that are concordant between the 2 tests.	Percentage of **reactive results** on one test (A1) that are also reactive on the next test (A2).
Formula	$= \frac{(\text{A2 Reactive} + \text{A1 Nonreactive})}{\text{Total Tested}} \times 100$ * Total Tested: A1 Reactive + A1 Nonreactive	$= \frac{\text{A2 Reactive}}{\text{A1 Reactive}} \times 100$
Impact	Monitor performance of the national testing algorithm	Specific measure of how well the tests agree on positive results
Example	***1,000 clients are tested for HIV. A1 reactive = 55 and A2 reactive = 53.*** $= \frac{(53+945)}{1000} \times 100 =$ **99.8%** * A1 Nonreactive = 1000-55 = 945	$= \frac{53}{55} \times 100 =$ **96.4%**

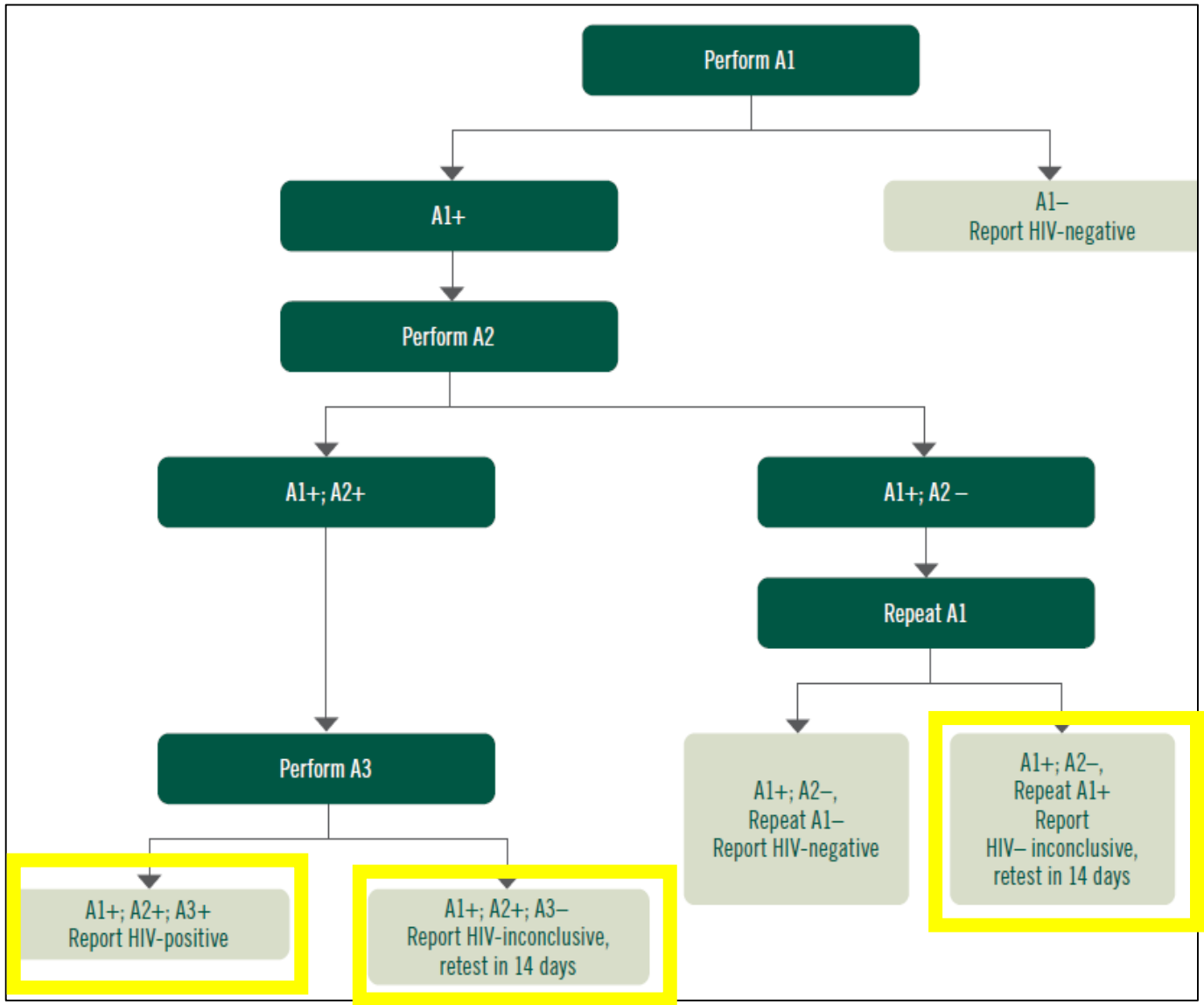
2019 Global Testing Strategy

- **Global 2019 HIV testing guidelines recommended 3-test HIV testing strategy in countries**
  - 3 consecutive reactive tests for an HIV-positive diagnosis
  - Ensure ≥99% positive predictive value (PPV) of individual being classified as HIV-positive

- **Undiagnosed HIV prevalence has declined below 5% in almost all countries.**
  - The lower the prevalence and positivity rate, the more likely the chance of a false-reactive result.

Source: WHO 2019

2019 HIV Rapid Test Testing Algorithm



HIV-Negative result:

- A1 → If non-reactive

HIV-Positive result:

- A1+;A2+;A3+ → reactive

HIV-Inconclusive result:

- Discordances between the tests
- A1+;A2-;A1+ **OR** A1+; A2+;A3-
- Retest in 14 days

Consolidated guidelines on HIV

Programmatic Implications

Because this is a relatively new strategy, countries have limited guidance on how to monitor its quality.

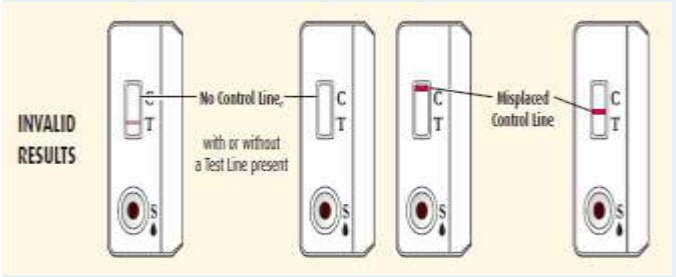
Routine monitoring of testing indicators ensures **accurate HIV diagnosis**:

- Detects problems in the testing process early
- Helps identify underperforming test kits or algorithm steps
- Supports algorithm optimization and policy decisions
- Improves supply forecasting
- Strengthens trust in test results among providers and clients

	Overall Agreement	Positive Agreement
Definition	Percentage of **all test results (reactive and non-reactive)** that are concordant between three tests.	Percentage of **reactive results** on one test that are also reactive on the next test.
Formula	$= \frac{(\text{A3 Reactive} + \text{A1 Nonreactive})}{(\text{Total Tested})} \times 100$	A1 vs A2: (A2 Reactive / A1 Reactive) × 100 A2 vs A3: (A3 Reactive / A2 Reactive) × 100 A1 vs A3: (A3 Reactive / A1 Reactive) × 100
	$= \frac{52+945}{1000} \times 100 = 99.7\%$	A1 vs A2 = $\frac{53}{55} \times 100 = 96.4\%$ A2 vs A3 = $\frac{52}{53} \times 100 = 98.1\%$ A1 vs A3 = $\frac{52}{55} \times 100 = 94.5\%$

1,000 clients are tested for HIV.

A1 reactive = 55, A2 reactive = 53, and A3 reactive = 52

	Inconclusive	Invalids	Retesting for Verification
Definition	Percentage of inconclusive results	Percentage of invalid results	Results agreement between Tester 1 and Tester 2
Formula	$= \frac{\#\text{ of Inconclusives}}{\text{Total \# tested}} \times 100$	$= \frac{\#\text{ of Invalids}}{\text{Total \# tested}} \times 100$	$= \frac{\text{Retesting for Verification}}{\text{Initial Testing Result*}} \times 100$ *Initial Test Result: Positive
Impact	Inform procedural, systematic and/or biological issues.	Inform procedural or systematic issues.	Inform procedural or systematic issues.
	A1+;**A2-**;A1+ **OR** A1+; A2+;**A3-**		 

Monitoring Quality Indicators

1. Testing algorithm overall agreement: **>98%**
2. Test positivity agreement between tests:
    - A1 and A2: **>99.0%**
    - A2 and A3: **>99.0%**
    - A1 and A3: **>98.0%**
3. Invalids: **<5.0%**
4. Inconclusives: **<2.0%**
5. Re-testing for verification agreement: **100%**

Where to obtain this information: Example of a Standardized HTS Test Register page

	Serial No.	Patient/Client Code	Age (Years)	Sex	Date Tested (dd/mm/yy)	HIV Test-1* Kit Name / Lot No. / Expiration Date __/__/__ (Circle one)	HIV Test-2* Kit Name / Lot No. / Expiration Date __/__/__ (Circle one)	HIV Test-3* Kit Name / Lot No. / Expiration Date __/__/__ (Circle one)	Final Results** (Circle one)	Tester	Mark if sent for Confirmation or EQA	Confirmation or EQA Results (Circle one)	Comments
1				M F	/ /	NR R INV	NR R INV	NR R INV	NEG POS IND		☐	NEG POS IND	
2				M F	/ /	NR R INV	NR R INV	NR R INV	NEG POS IND		☐	NEG POS IND	
3				M F	/ /	NR R INV	NR R INV	NR R INV	NEG POS IND		☐	NEG POS IND	
4				M F	/ /	NR R INV	NR R INV	NR R INV	NEG POS IND		☐	NEG POS IND	
5				M F	/ /	NR R INV	NR R INV	NR R INV	NEG POS IND		☐	NEG POS IND	
6				M F	/ /	NR R INV	NR R INV	NR R INV	NEG POS IND		☐	NEG POS IND	
7				M F	/ /	NR R INV	NR R INV	NR R INV	NEG POS IND		☐	NEG POS IND	
8				M F	/ /	NR R INV	NR R INV	NR R INV	NEG POS IND		☐	NEG POS IND	
9				M F	/ /	NR R INV	NR R INV	NR R INV	NEG POS IND		☐	NEG POS IND	
10				M F	/ /	NR R INV	NR R INV	NR R INV	NEG POS IND		☐	NEG POS IND	
11				M F	/ /	NR R INV	NR R INV	NR R INV	NEG POS IND		☐	NEG POS IND	
12				M F	/ /	NR R INV	NR R INV	NR R INV	NEG POS IND		☐	NEG POS IND	
13				M F	/ /	NR R INV	NR R INV	NR R INV	NEG POS IND		☐	NEG POS IND	
14				M F	/ /	NR R INV	NR R INV	NR R INV	NEG POS IND		☐	NEG POS IND	
15				M F	/ /	NR R INV	NR R INV	NR R INV	NEG POS IND		☐	NEG POS IND	
16				M F	/ /	NR R INV	NR R INV	NR R INV	NEG POS IND		☐	NEG POS IND	
17				M F	/ /	NR R INV	NR R INV	NR R INV	NEG POS IND		☐	NEG POS IND	
18				M F	/ /	NR R INV	NR R INV	NR R INV	NEG POS IND		☐	NEG POS IND	
19				M F	/ /	NR R INV	NR R INV	NR R INV	NEG POS IND		☐	NEG POS IND	
20				M F	/ /	NR R INV	NR R INV	NR R INV	NEG POS IND		☐	NEG POS IND	

	Total non-reactive/negative
	Total reactive/positive
	*Total invalid
	**Total indeterminate
	Total tests

* Test is considered invalid (INV) if control line does not develop, irrespective of presence or absence of client line. If invalid, please record and repeat using the same test on a new row.

Examples of frequent comments:
- *kit expired*
- *IND specimen sent to reference lab*
- *asked patient to return in 1 month*

https://www.rtcqi.org/pillars/scaling-up-standardized-hts-register

Aggregate Logbook Data into Monthly Summary Report

HIV Test-1*	HIV Test-2*	HIV Test-3*	Final Results** (Circle one)
Kit Name _____	Kit Name _____	Kit Name _____	
Lot No. _____	Lot No. _____	Lot No. _____	
Expiration Date ___/___/___	Expiration Date ___/___/___	Expiration Date ___/___/___	
(Circle one)	(Circle one)	(Circle one)	
NR R INV	NR R INV	NR R INV	NEG POS IND

Total non-reactive/negative				
Total reactive/positive				
*Total invalid				
**Total indeterminate				
Total tests				

* Test is considered invalid (INV) if control line does not develop, irrespective of presence or absence of client line. If invalid, please record and repeat using the same test on a new row.

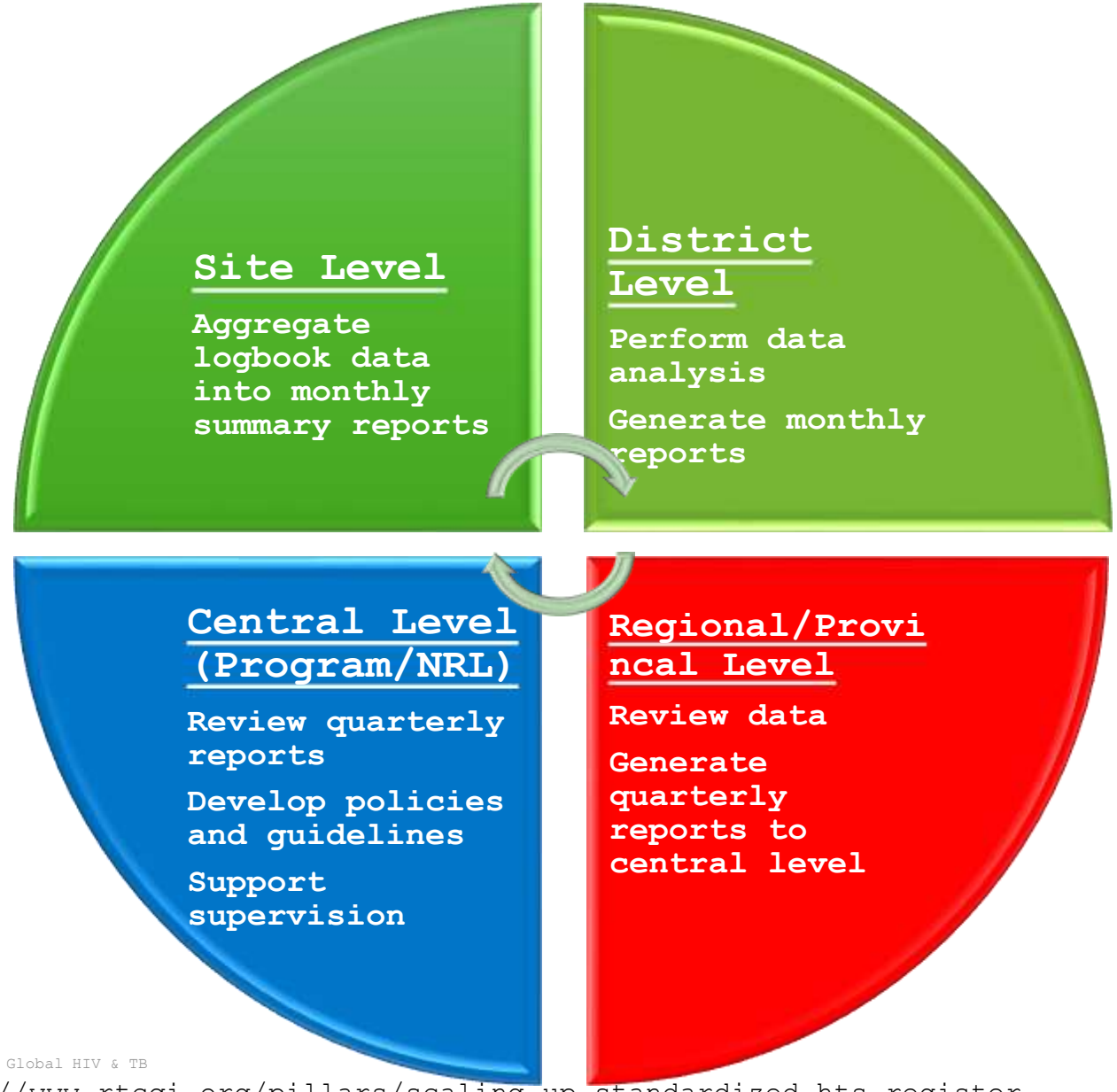
Monthly Summary Report for HIV Logbook

Month/Year		Site Type		District		Contact Information (name, number, email)	
Facility Name		Site Address		Province Region		Logbook Number Page Number Range	
Site Name		City		Longitude Latitude		Start Date End Date	

Data Entry for 1st Lot Number of the Month	Test 1 Name:				Test 2 Name:				Test 3 Name:				Final Results (Enter the total number of NEG, POS and IND)		
	Lot #:				Lot #:				Lot #:						
	Exp. Date:				Exp. Date:				Exp. Date:						
	NR	R	INV	W	NR	R	INV	W	NR	R	INV	W	NEG	POS	INC
	45	14	1		2	12	0		1	11	0		45	11	3

https://www.rtcqi.org/pillars/scaling-up-standardized-hts-register

Proposed Flow of Data Management



A simple routine review process should:

1. Summarize monthly totals for each test and outcome type
2. Calculate the quality indicators (agreement, invalids, inconclusives)
3. Look for unexpected trends, such as rising discordance or invalid rates
4. Initiate with follow-up call or on site

https://www.rtcqi.org/pillars/scaling-up-standardized-hts-register

Troubleshooting Testing Quality Issues

- **Data:** Verify data entries are accurate and complete, and results are interpreted correctly
- **Procedure:** Confirm that the testing and algorithm was followed correctly
- **Test Kit:** Investigate test kit performance and storage conditions
- **Personnel:** Confirm that testers were trained and certified to perform testing
- **Quality Assurance Activities:** Review results from re-testing for verification data, QC records, and PT results

Overall Summary

- 2019 Global guidance suggested transitioning to a 3-test algorithm to improve on PPV (>99%) based on declining positivity.

- Monitoring this new strategy is essential for accurate HIV diagnosis

- Implementation and routine review of testing quality indicators help detect early issues and guide corrective action.

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