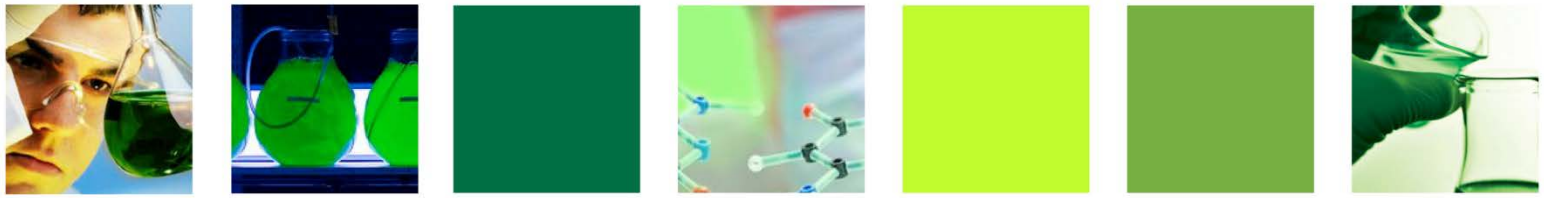


Incremental costs of implementing automated EIA for cryptococcal antigenaemia detection compared to a lateral flow assay at a high-volume public-sector laboratory in South Africa

Naseem Cassim, Lindi M. Coetzee, Keshendree Moodley, Kathryn Schnippel, Nelesh P. Govender and Deborah K. Glencross

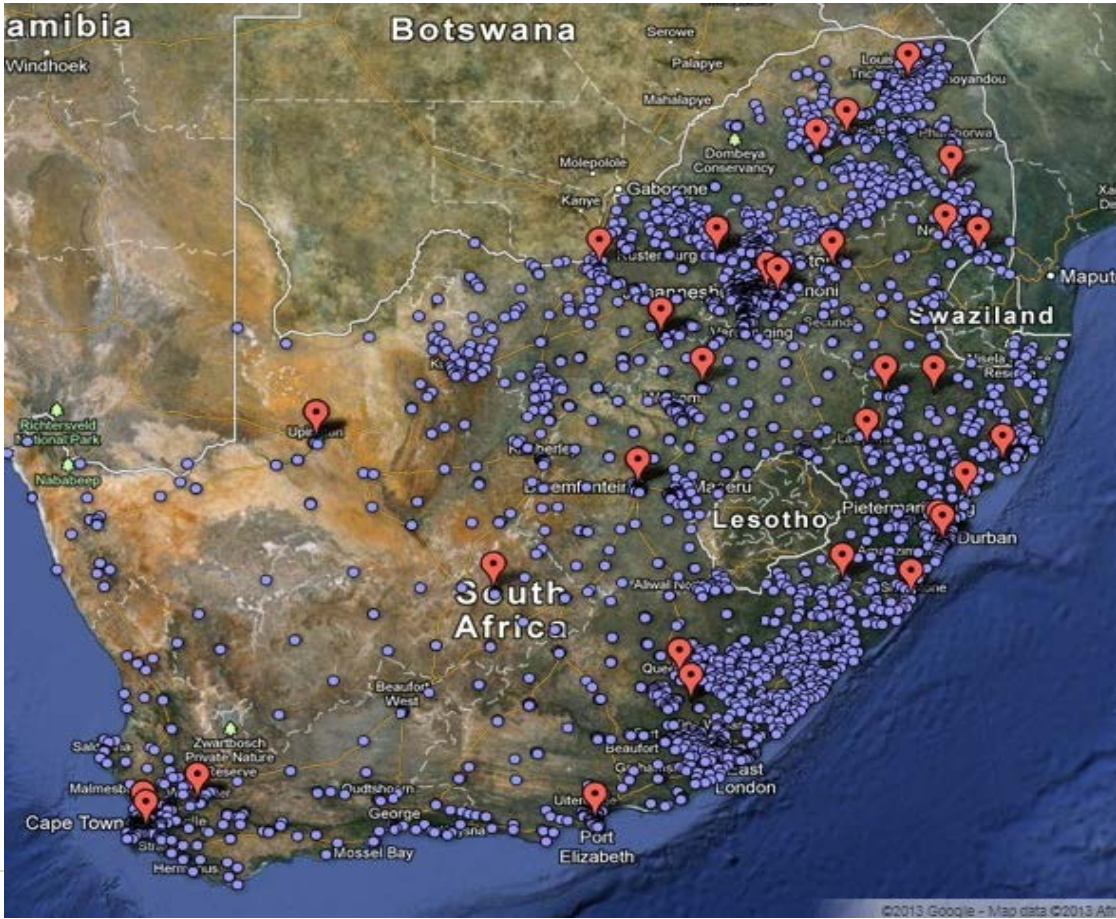
Introduction

- Cryptococcal meningitis (CM) is a major cause of HIV-related morbidity and mortality in Africa
- It could be prevented by early-detection of patients with sub-clinical cryptococcal antigenaemia (CrAg) followed by fluconazole treatment.
- Current laboratory testing for CrAg include:
  - India Ink Microscopy, Latex Agglutination Test and ELISA
- New Point-of-Care lateral flow assay (LFA) (IMMY, Norman, OK) used for early detection in South African/CDC pilot study (2 CD4 testing laboratories)
  - As reflex test on HIV+ patient samples with CD4 count < 100 cells/µl

CD4 Laboratory Infrastructure in South Africa

- The NHLS currently offers CD4 testing at 61 laboratories spread throughout the country
- In line with the Integrated Tiered Service Delivery Model (ITSDM)

Province	n=	%Total
Kwazulu-Natal	23	38%
Gauteng	6	10%
Eastern Cape	8	13%
Mpumalanga	4	7%
Western Cape	6	10%
Limpopo	5	8%
North West	3	5%
Free State	2	3%
Northern Cape	4	7%
Total	**61**	**100%**



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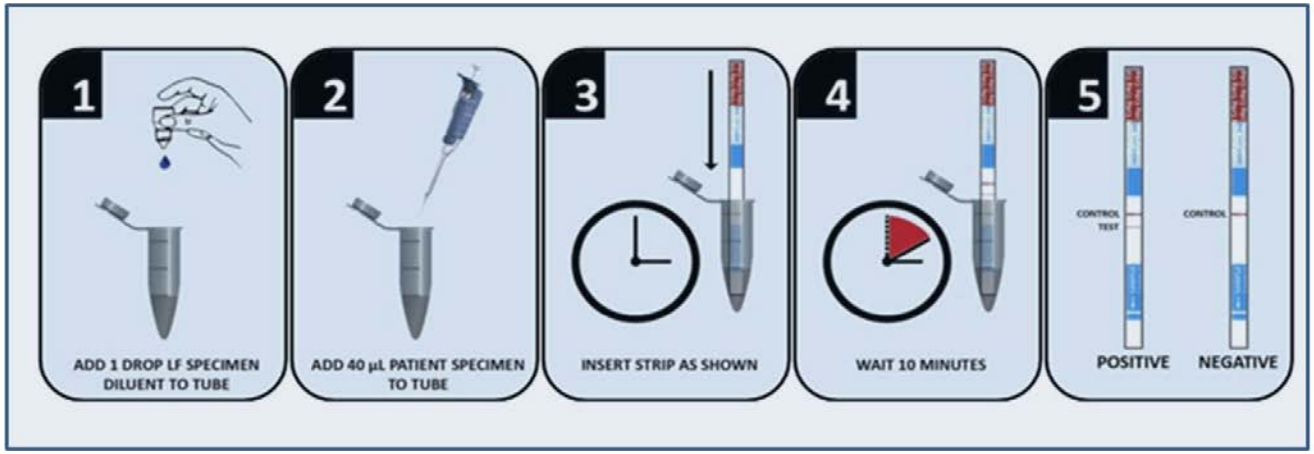
CrAg Pilot Study

- 2 busiest CD4 laboratories selected
  - Perform between 13 329 (Site 1) and 21 420 (Site 2) samples per month
  - 10-14% have a CD4 count <100 cells/µl
  - Equates to between 1500 and 2700 samples per month per site
    - Daily average of between 75 to 125

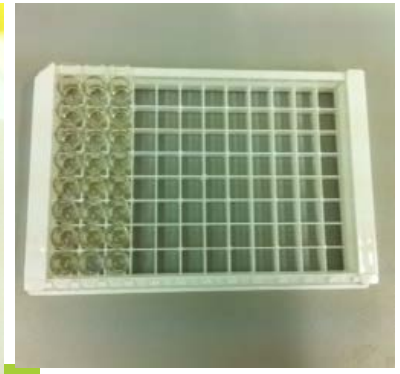
- The LFA test is a manual test
  - Takes on average 3-4 minutes per test
  - Equates to between 1.5 and 2 hours per 30 sample batch (based on technologist proficiency)

- Alternative testing platforms:
  - EIA (semi-or fully automated)
    - Currently only used for R&D purposes

LATERAL FLOW ASSAY (LFA)



IMMY EIA (SA & FA)



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Objective of Study

- Investigated initiatives to compare performance of higher throughput enzyme immunoassay (EIA) platforms for cryptococcal antigen detection (Poster 18) against LFA:-
  - EIA Platforms:
    - Titertek Berthold : Crocodile -Semi-Automated (SA)
    - Adaltis : NexGen four – Fully Automated (FA)
  - EIA Reagents:-
    - IMMY Alpha CrAg EIA
    - Meridian Premier CrAg EIA
- Costing analysis of LFA vs. EIA platforms
  - Using a high-volume CD4 testing laboratory as reference

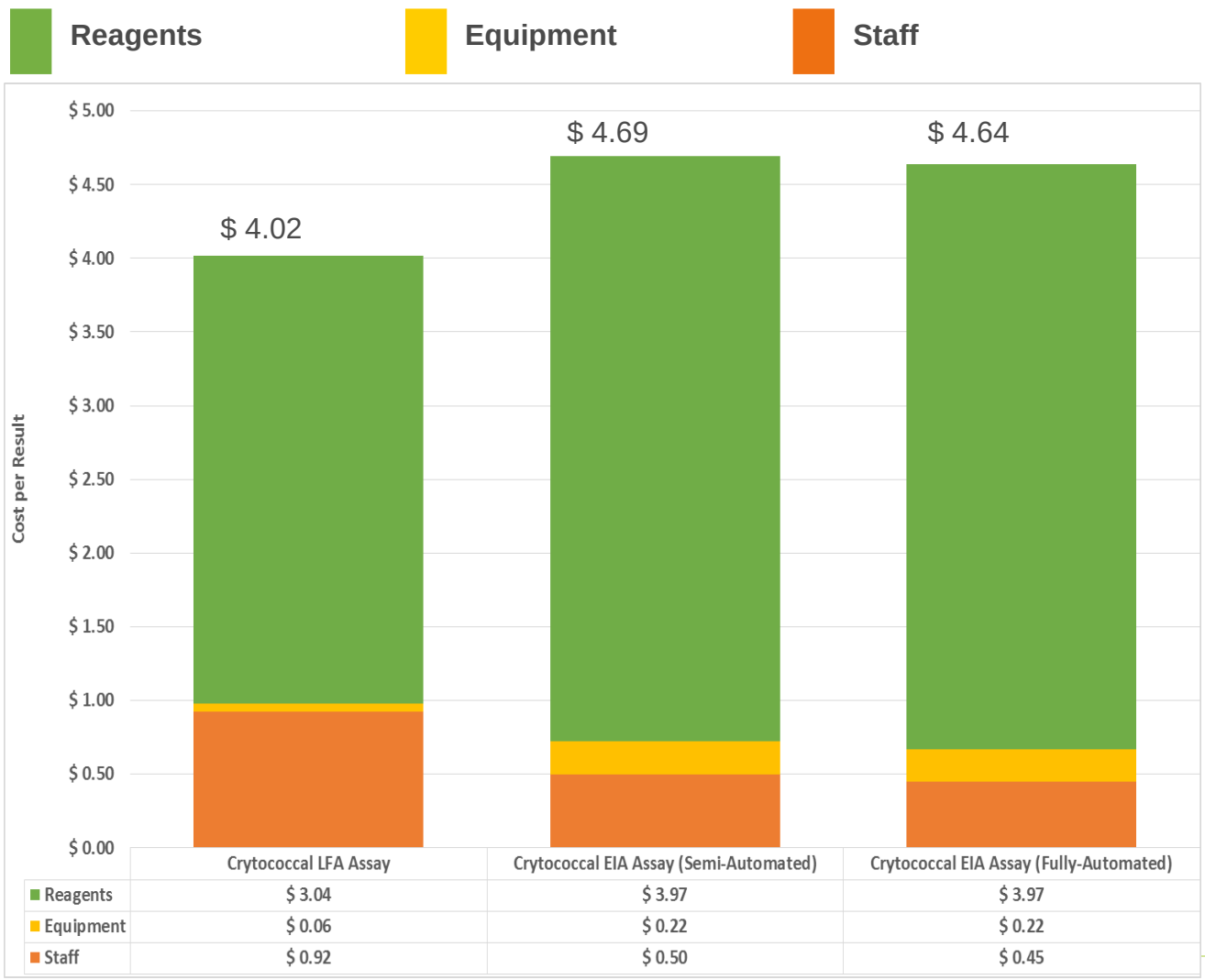
Costing Methods

- LFA and EIA test costs assessed using standard ingredients-based costing techniques.
- Excluded costs:
  - Costs above the facility level: e.g. management and overheads
  - Laboratory infrastructure
  - Costs assumed to be the same for both types of testing: e.g. related to EQA, medical waste management, sample transport, and LIMS
  - Costs with limited data: instrument failure, instrument downtime, and testing errors

Costing Assumptions

- Costs were collected in ZAR and are reported in USD (ER of 10.80 as at 07-03-2014)
- Discount rate: 0.04
- Working Life: 5 years
- For FA EIA-based testing, the two-hour run time was excluded from labour costs as it was assumed that laboratory staff would be able to continue with CD4 testing during this interval
- CrAg EIA instrument purchased with a service contract

Total Cost per Result



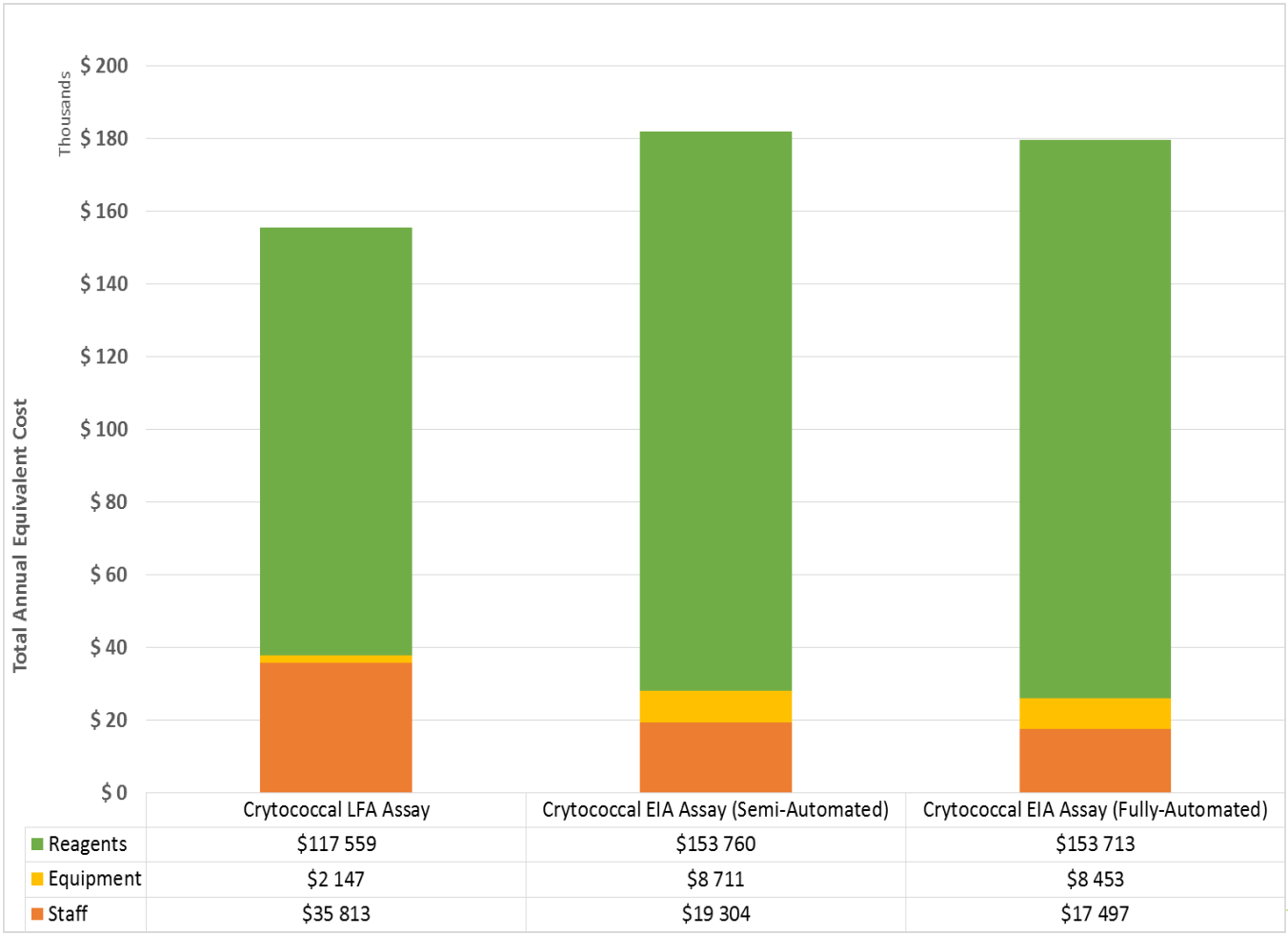
Cost Contribution

Reagents:
LFA $3.04 (76%)
EIA $3.97 (85%)

Staffing:
LFA $0.92 (23%)
EIA (SA) $0.50 (11%)
EIA (FA) $0.45 (10%)

Equipment:
LFA $0.06 (1%)
EIA $0.22 (5%)

Total Annual Equivalent Costs



	Crytococcal LFA Assay	Crytococcal EIA Assay (Semi-Automated)	Crytococcal EIA Assay (Fully-Automated)
Reagents	$117 559	$153 760	$153 713
Equipment	$2 147	$8 711	$8 453
Staff	$35 813	$19 304	$17 497

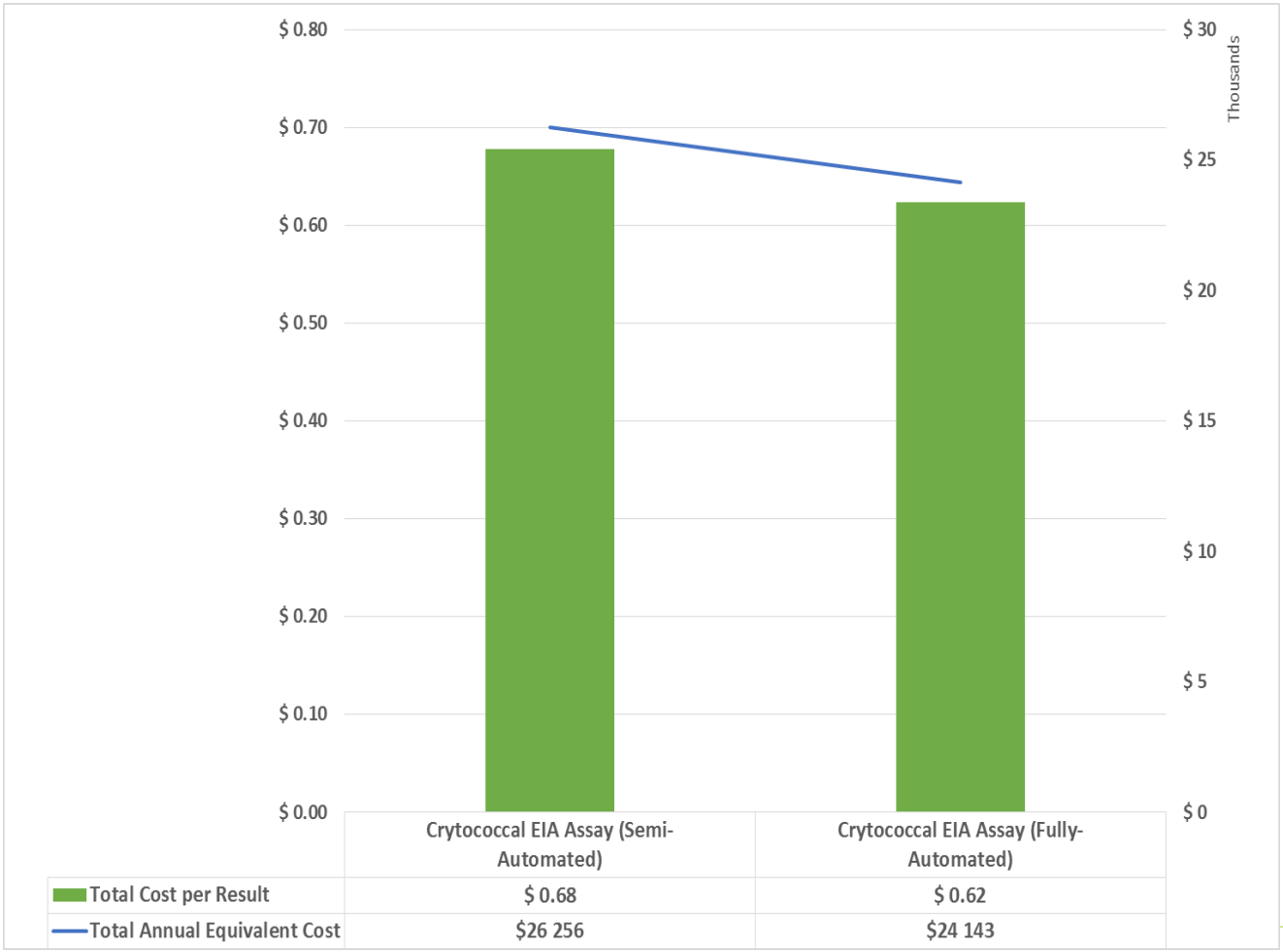
Total annual equivalent costs:

LFA $155 thousand

EIA (SA) $181 thousand

EIA (FA) $179 thousand

Incremental Cost



Incremental costs per test result:

EIA (FA) $0.62
EIA (SA) $0.68

Annual incremental costs:
EIA (FA) $24 thousand
EIA (SA) $26 thousand

13% of Total Annual Cost: EIA (SA)

Findings

- CrAg LFA is a very manual, labor intensive test, not suited for high volume laboratories
- EIA platforms showed lower staffing costs due to automation
- EIA platforms however has higher reagent and equipment costs per test
- Overall, the incremental cost of a fully automated or semi-automated CrAg EIA is $0.62 and $0.68 respectively, approximately 15% more expensive than manual LFA

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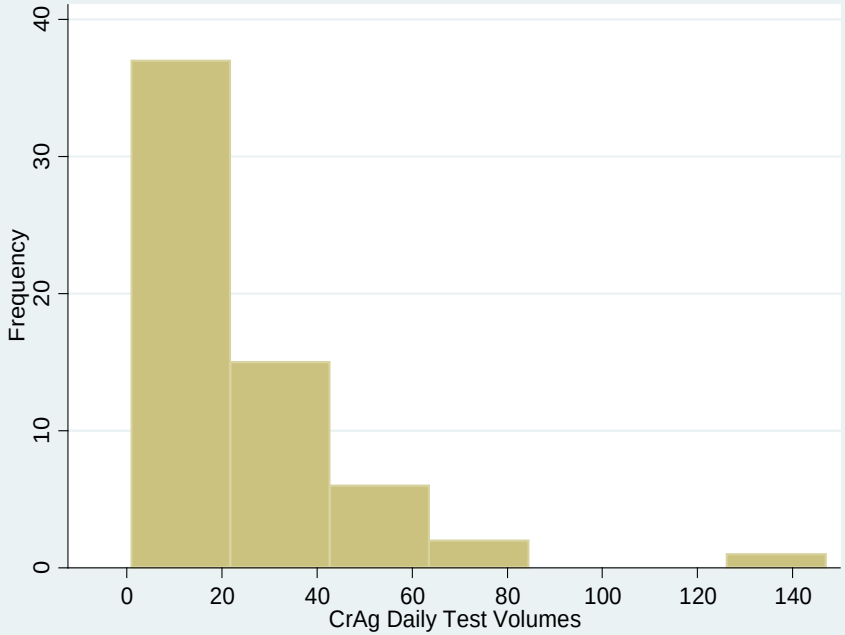
Findings

- Automation of testing in the context of higher workload offers significant benefit by streamlining service efficiency
- Testing automation reduced turn-around-times especially in the context of reflexed testing.
- Automated EIA-based systems improved laboratory workflow, utilizing “walk-away” time for multi-tasking.

CrAg early detection for a national program



- Combination of platforms for optimal testing
  - Restrict LFA testing to laboratories with lower daily test volumes (<30samples)
  - Use EIA platforms for medium to high volume testing laboratories

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Conclusion

- Cost is driven by volume and staff requirements
- Need to find best combination of testing platforms to fit into current CD4 testing facilities with minimal impact on staff numbers and time spent on CrAg testing
  - “one-system-fits-all” may not be ideal
- Cost of reagents and equipment could be contained through a tender process for national program