

## INTRODUCTION OF AN INNOVATIVE SYSTEM TO ASSIST MALARIA RAPID DIAGNOSTIC TESTING AND REPORTING IN THE PRIVATE SECTOR IN WAKISO DISTRICT, UGANDA

Elizabeth Streat<sup>1</sup>, Geoffrey Ssvenvuma<sup>2</sup>, Robert Mugerwa<sup>2</sup>, Grace Nakanwagi - Sekabira<sup>1</sup>, Ebenezer Baba<sup>1</sup>, Zahra Hirji<sup>3</sup>, Max Schiff<sup>4</sup>, Ferro Santiago<sup>3</sup>

<sup>1</sup>Malaria Consortium Afro, Kampala, Uganda, <sup>2</sup>Malaria Consortium Uganda, Kampala, Uganda, <sup>3</sup>Fio Corporation, Toronto, ON, Canada, <sup>4</sup>Fio East Africa, Nairobi, Kenya

### BACKGROUND

- Rapid diagnostic tests (RDTs) allow healthcare providers to offer accurate diagnostic services at the point of care.
- RDT effectiveness is reduced when used incorrectly or followed with inappropriate treatment.
- There is a need to promote and monitor proper use of RDTs and antimalarials, and capture reliable surveillance data, especially in the private sector where 40-60% of people in endemic countries seek malaria care.
- Technology can play a transformative role incentivizing the private sector to incorporate quality control and reporting mechanisms into RDT-based case management.

### OBJECTIVES

- To assess the acceptability of the Fionet™ system among private healthcare providers in Uganda over 6 months.
- To observe the impact of the introduction of the Fionet™ system on malaria case management and reporting.

### METHODS

- The Fionet™ system (developed by Fio Corporation) works with mobile companion devices for health workers, including Fio's intelligent diagnostic device called the Deki™ Reader, to provide step-by-step guidance through their routine activities and transmit information to a secure web portal (see Figure 1).
- The Deki™ Reader automates the analysis of RDTs and helps health workers detect and correct errors so that their case management decisions and records are based on accurate diagnostic results.
- The Fionet™ system was implemented in Wakiso District, Uganda from December 12th, 2014 to June 12th, 2015.
- 13 health workers (1 clinical officer, 2 laboratory technicians and 10 nurses) from 5 sites were trained over 2 days to use RDTs with barcodes and the Deki™ Reader in the management and documentation of suspected malaria cases.
- Health workers visually interpreted the RDT results and were blinded to the Deki™ Reader's automated reading.
- The Deki™ Readers sent the test result records to the Fionet™ web portal, along with a post-test image of each RDT, demographic and case management data.
- An experienced technician in Toronto visually reviewed each post-test image uploaded to the Fionet™ web portal and compared the health worker's visual read with the Deki™ Reader's automated analysis of the test results.
- 11 health workers were surveyed on the usability and operability of the Deki™ Reader.
- Implementing partners were trained to use the Fionet™ web portal to monitor and evaluate the feasibility, utility and impact of the Deki™ Readers and Fionet™ system, including such aspects as:
  - Total number of tests performed on a daily, weekly and monthly basis
  - Number of tests performed by facility and by health workers
  - Quantity of positive, negative and invalid RDT results (total and by site or health worker)
  - Positivity rates by sub-county (within Wakiso District)
  - Record upload speed
  - Accuracy of health workers' reading of RDTs
  - Health workers' prescription habits

### RESULTS

- A total of 1,194 records were uploaded to the Fionet™ web portal during the assessment period (see Figure 2).
- Each record included:
  - Health worker and patient identity
  - Date, time and location of interaction
  - Patient age, sex and pregnancy status
  - High-resolution pre- and post-test images of malaria RDT, including barcode
  - Health worker's visual interpretation of test results and Deki™ Reader's automated analysis of test results
  - Completed symptom and treatment forms
- 91% of completed records were available within 24 hours and 98% within 1 week (see Figure 2).
- Of the 1,194 images analyzed, the Deki™ Reader detected an error in 209 instances (see Table 1);
- The most common error was "CL (Control Line) absent or line intensity too low" (142/209, 67.9%); as confirmed by the technician in Toronto, 81 of these 142 images were unused or blank RDTs that the health worker had recorded with either a positive or negative malaria test result.
- Test result data was automatically segmented by pre-defined populations (see Table 2).
- Cross-analysis of test result and treatment data revealed 6% of cases were left untreated despite a positive RDT result and 2% of negative cases were treated with antimalarials (see Figures 3-5).
- Health workers surveyed reported the following feedback:
  - The Deki™ Reader made it easier to manage patients and record RDT results, demographic and case data.
  - Client satisfaction and confidence in test results improved with the Deki™ Reader.
  - The Deki™ Reader was beneficial to business efficiency and in some cases helped to attract more clients.
  - 9 out of 11 healthcare providers said they would pay to use the Deki™ Reader in their facility.



Figure 1: The Fionet™ system (developed by Fio Corporation) provides real-time access to reliable data captured during healthcare delivery.

Figure 2: Total records uploaded to the Fionet™ system over time

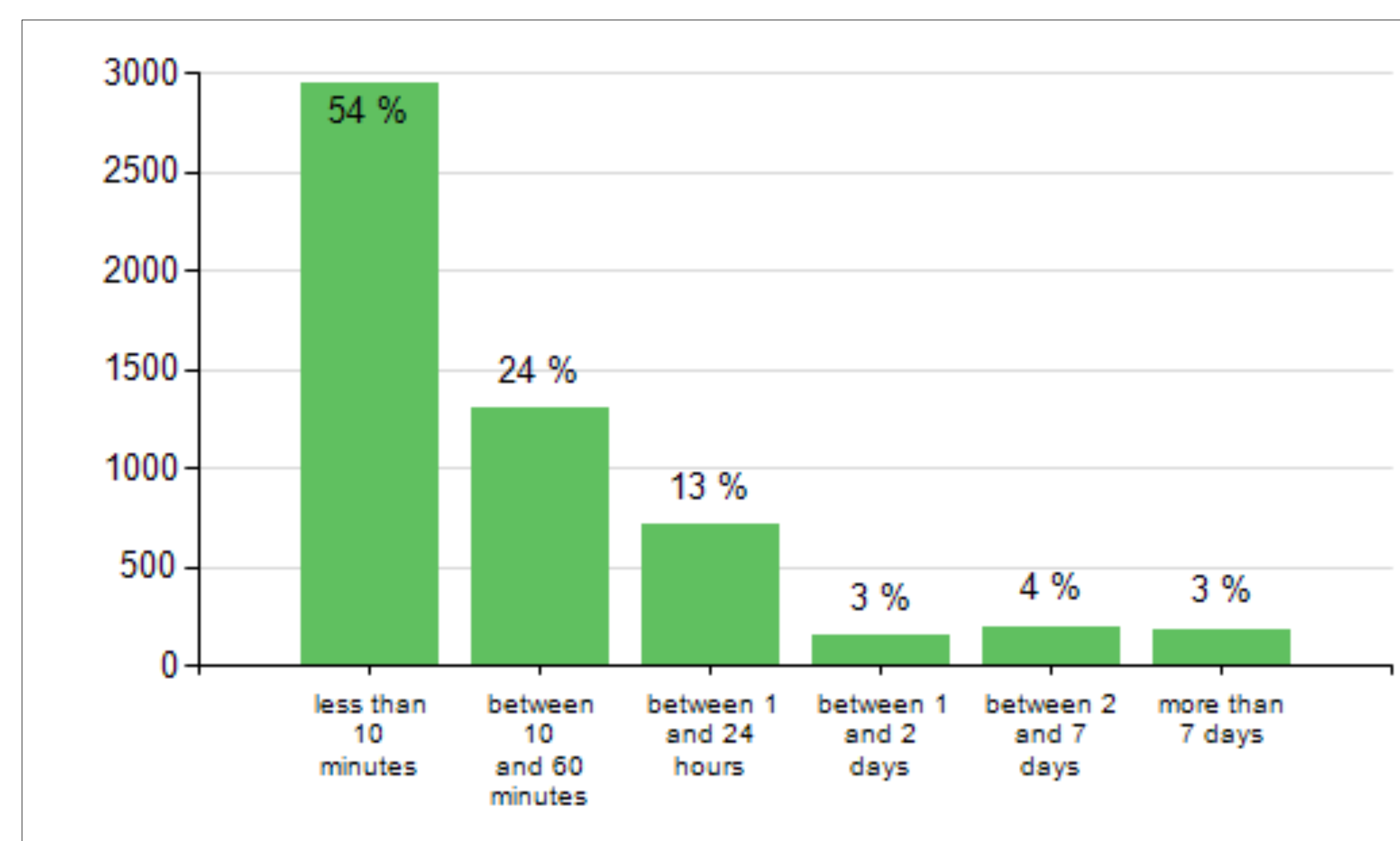


Table 1: Total errors detected by the Deki™ Reader

Error conditions (total)	Count
Faint or no control line	142
Un-processed RDT	81
True invalid (No CL)	61
RDT not supported	29
Too much blood	20
Too much blood in blood well	4
Blood in buffer well	6
Smearred, unreadable	4
Unexpected line	2
Incorrect RDT position	2

Table 2: Test result records by key populations

Patients	Tests	Results		
		Positive	Negative	Invalid
Under 5	Males	241	12 (5.0%)	222 (92.1%) (2.9%)
	Females	216	14 (6.5%)	197 (91.2%) (2.3%)
Over 5	Males	304	26 (8.6%)	270 (88.8%) (2.6%)
	Females (non-pregnant)	407	38 (9.3%)	355 (87.2%) (3.4%)
	Females (pregnant)	26	4 (15.4%)	22 (84.6%) (0.0%)
<b>Total</b>	<b>1194</b>	<b>94 (7.9%)</b>	<b>1066 (89.3%) (2.8%)</b>	

Figure 3: Malaria diagnostic results (interpreted by health worker)

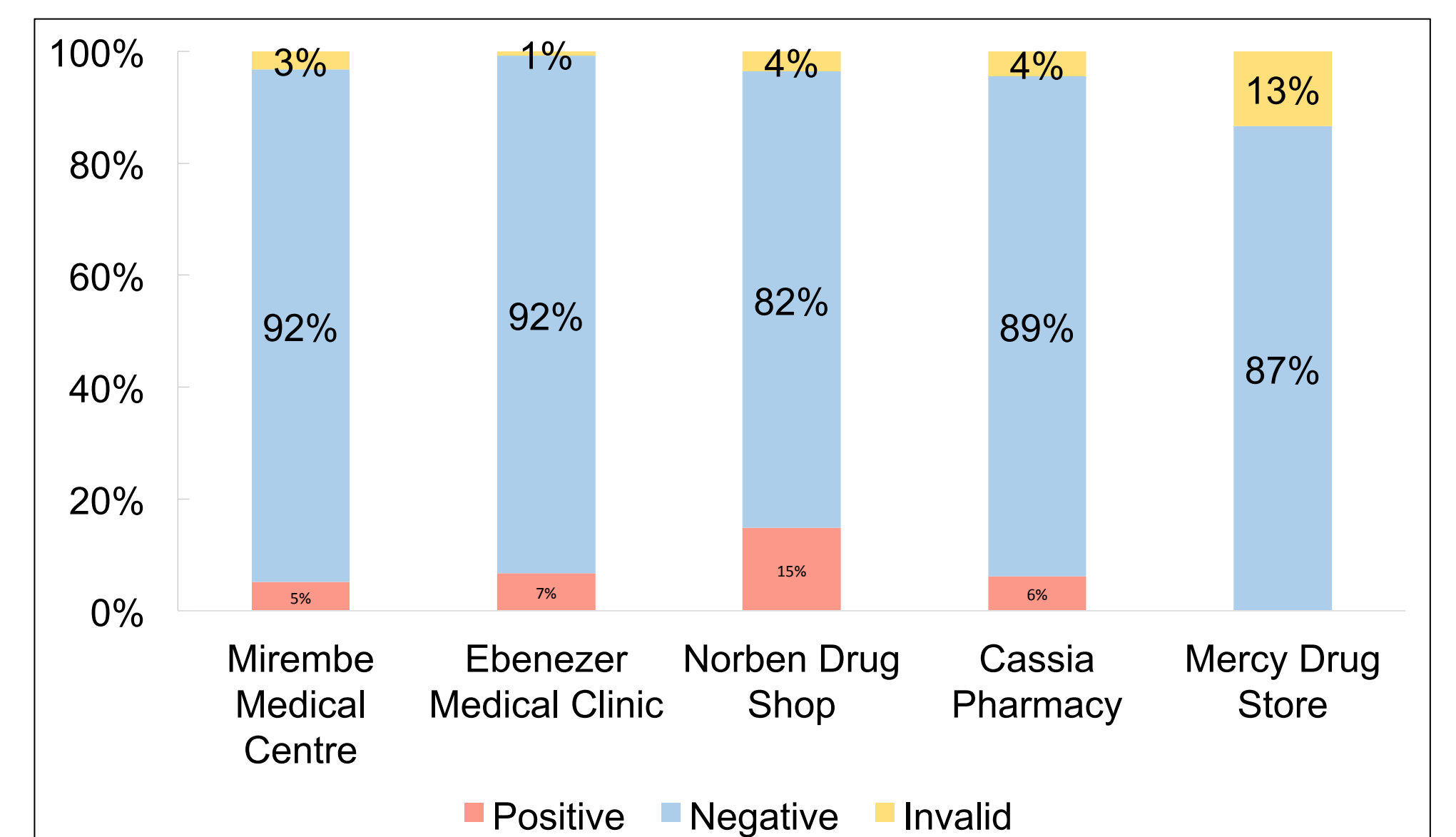


Figure 4: Antimalarial treatment following positive test results

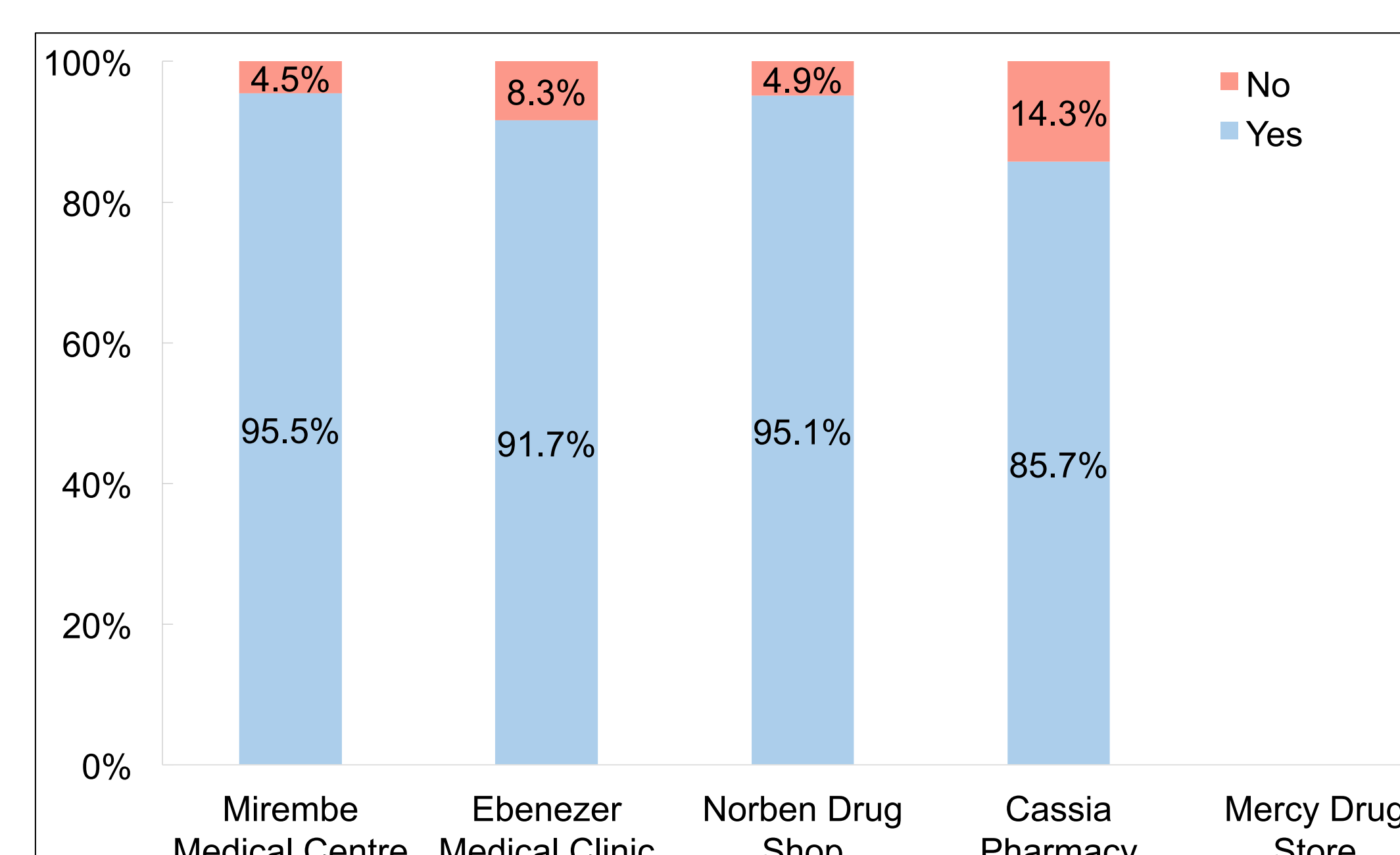
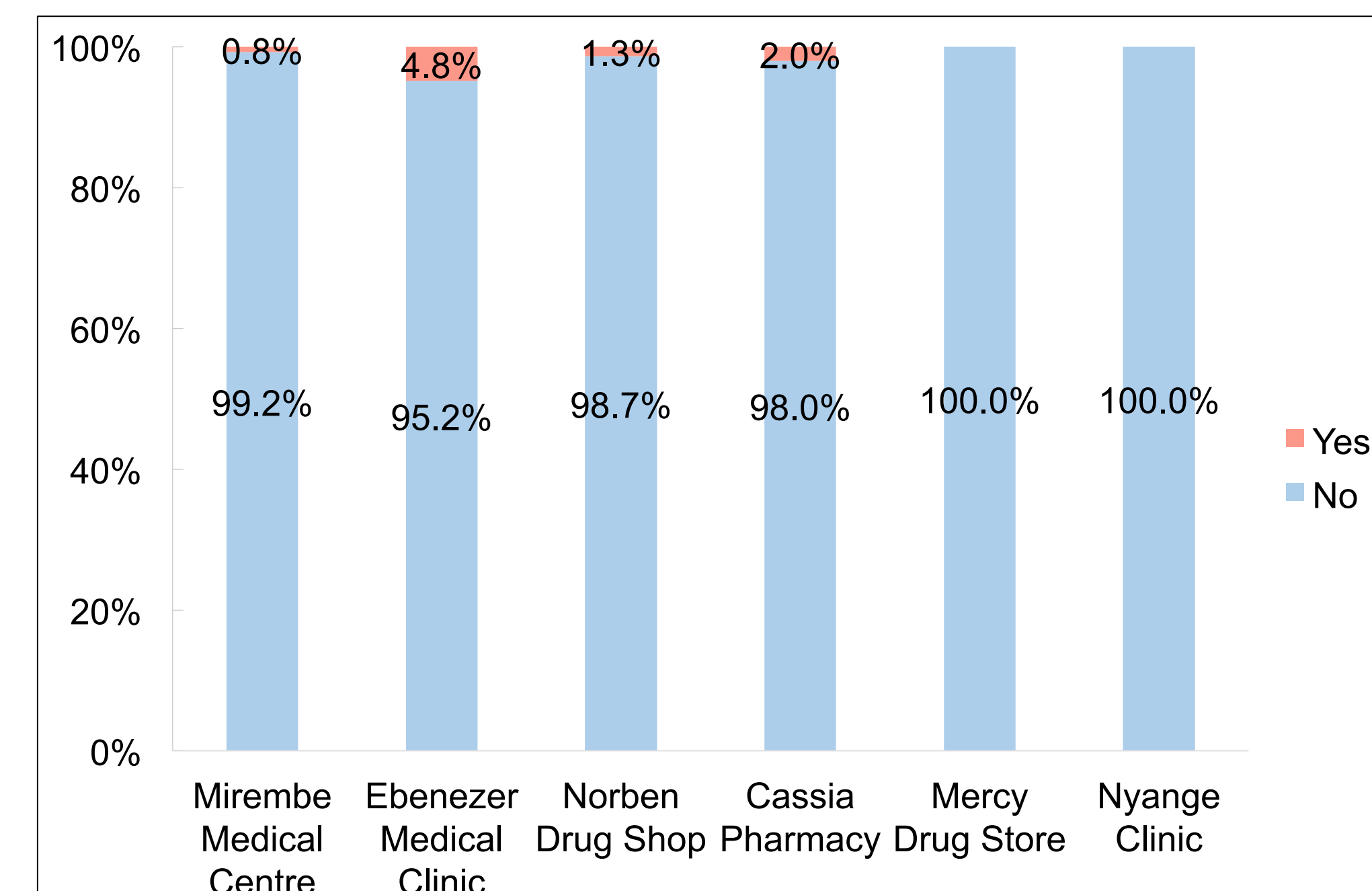


Figure 5: Antimalarial treatment following negative test results



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### CONCLUSIONS AND FUTURE DIRECTIONS

- Implementing the Fionet™ system to assist with RDT-based case management and reporting in the private sector is feasible.
- Acceptability and perceived direct and indirect benefits of the Deki™ Reader were reflected in health worker survey results.
- Public health authorities at all levels would greatly benefit from accurate and timely records of suspected malaria cases managed by private healthcare providers.
- RDT quality control and provider competency indicators can be captured by the Deki™ Reader during the RDT procedure and transmitted to the Fionet™ web portal to be used as a remote supervision tool.
- Large-scale implementation of the Fionet™ system among private healthcare providers in malaria-endemic countries is warranted based on the results of this assessment.

### For more information contact:

Elizabeth Streat:  
e.streat@malariaconsortium.org  
Malaria Consortium AfRO  
Plot no. 25, Upper Naguru East, Rd  
Kampala, Uganda

OR  
Santiago Ferro  
sferro@fio.com  
Fio Corporation  
111 Queen Street East, Suite 500  
Toronto, ON, M5C 1S2, CANADA