DiaDev
Investigating Diagnostics in Global Health

Report

Report on the DiaDev study at 34th Military Hospital

Dr Mohamed Boie Jalloh

Wide shot of laboratory at 34th Military Hospital, Freetown, 20.09.19

All images by Olivia Acland

Objective

The DiaDev research project was conceived to investigate the design and use of diagnostic devices (or, more specifically, point-of-care rapid diagnostic test [RDT] kits) in order to understand how such test kits are contributing to the transformation of the health system in Sierra Leone. The DiaDev study at 34th Military Hospital mapped the behaviour of patients and healthcare workers in the context of RDT use and explored how patient experiences were affected when seeking healthcare, as well as the way RDTs influenced the prescription patterns of clinical officers. Did RDTs influence treatment decisions in any way, and what did patients feel about the diagnostic methods used?

The secondary objective of the DiaDev study included the investigation of the environment in terms of the procurement, regulation, and waste management of RDTs. Finally, the study sought to identify and understand local priorities regarding laboratory systems strengthening at the facility and national levels.

Dr Jalloh interviews a lab technician at the Infectious Disease Prevention Centre, 34th Military Hospital, Freetown, 14.09.19

Project timeline at the 34th Military Hospital

1. Preparing for the study

April to September 2018: Email correspondence between study PI and study site team to discuss collaboration and finalize study protocol.

September 2018: Submission of the protocol to Sierra Leone Ethics and Scientific Review Committee (SLESRC) for approval.

September 2018: The first in-person meeting of Research Fellow Eva Vernooij and Kings Sierra Leone Partnership on the one hand and 34th Military Hospital (MH 34th) research team on the other to further discuss the research collaboration.

October 2018: Approval of the study protocol by SLESRC.

Mid-March 2019: A meeting to finalise the memorandum of understanding (MOU) attended by the MH 34th team, a representative of the University of Edinburgh (Research Fellow Eva Vernooij), and Kings Sierra Leone Partnership's finance officer, Martha Thorpe. The discussion focused on the issues of data collection tools, target population, timelines, and resource allocation.

Late March 2019: The signing of the MOU for the project.

Late March 2019: Induction training on qualitative research and use of the tools developed for the DiaDev project. Research Fellow Eva Vernooij delivered this training at 34th MH.

April 2019 to January 2020: I contributed as an author to the opinion piece generated in the Expert Review meeting for publication in the African Journal of Laboratory Medicine (AJLM).

2. Rolling out the study

Early March 2019: Participation in and presentation at the DiaDev-organised Expert Meeting, where national experts shared their experiences with point-of-care devices during outbreaks like the 2014–2016 West African Ebola outbreak.

April 2019: Project progress review meeting (via Skype) with the principal investigator (PI).

Mid May 2019: Training provided on the use of online platforms for education and data exchange at the University of Edinburgh. Covered data management issues concerning naming files when saving; storage; policies governing the sharing and exchange of collected data; equipment required; and the training of all investigators on the utilisation of exchange platforms that guarantee the confidentiality of information collected.

Late September 2019: Training of MH 34th staff in international partnerships in health research as part of the capacity building commitment of the DiaDev project at 34th MH. Additionally, PI Dr Alice Street, in a special session with investigators, trained them in data analysis. In the end, a tour of 34th MH along the usual patient pathway was conducted for the PI.

Late September 2019: Preliminary findings disseminated to health sector stakeholders in Freetown, Sierra Leone. The feedback obtained from the stakeholders helped the investigating team refine their data collection techniques and analysis approach to ensure the generalisability of the study's findings.

September 2019: Local investigators were followed and photographed by a professional photographer, Olivia Ackland, who was writing a piece on the DiaDev project.

Late September 2019: Participation in a data analysis and academic writing workshop organised and led by the PI, Alice Street, in Freetown, Sierra Leone.

April to December 2019: Data collection, preliminary analysis, and presentation to stakeholders in Freetown. During this period, the PI provided mentorship to a local investigator, Dr M. B. Jalloh, on project choice and available PhD opportunities.

3. Sharing preliminary findings and post-study

Late September 2019: Participation and presentation of preliminary findings at the DiaDev dissemination workshop organised for stakeholders in Freetown, Sierra Leone.

Early December 2019: A meeting (via Skype) between the PI and local investigators to discuss progress on the DiaDev project and possible avenues forward.

December 2019 to February 2020: Report produced on the DiaDev study at the 34 MH.

Input, process, and output for the DiaDev study at 34th Military Hospital

Input: Material and human resources allocated to the DiaDev project at the 34th Military Hospital.

Stuff: Two computers, two audio recorders, and data collection tools.

Staff: Two medical doctors with master's-level training in public health and a nurse with a master's degree in public health.

Process: Continuous mentoring and training on the utilisation of data collection tools and the use of online platforms for collaboration with the University of Edinburgh. Progress reports and vital feedback are pending (as of October 2020).

Output resulting from the work of one of the investigators:

- Eighteen structured observations
- Sixteen interviews (Eight with patients and eight with laboratory staff)
- Process map for TB diagnostics using the GeneXpert machine
- Process map on the use of the CD4 machine in the management of people living with human immunodeficiency virus (PLHIV)
- Presentations at the Expert Review and Data Dissemination meetings in Freetown, Sierra Leone
- Transcribing two interviews and editing the transcriptions of the other 14 interviews
- Data analysis
- Writing this report

Methodology

After obtaining ethical approval from the chain of command of the Republic of Sierra Leone Armed Forces (RSLAF) in March 2018 and from the Sierra Leone Ethics and Scientific Review Committee (SLESRC) in October 2018, the data collection process began. This involved the structured observations of interactions between patients and healthcare worker and interviews of laboratory staff and patients until saturation was achieved.

Initially, the idea was to investigate and come up with a process map based on structured observations of tuberculosis (TB) diagnostic trajectories at 34th Military Hospital. However, given that patients who presented with fever were to be followed up with as little interference to their treatment as possible, there was no way of knowing who was going to be investigated for TB. Thus, the process map generated for TB was based on separate observations and interviews of laboratory technicians

(who performed the test procedure routinely in the lab). The remaining points outlined in the process map were based on informal interviews of staff working at the TB testing and Drug Dispensing Department of 34th Military Hospital.

The structured observation involved accompanying patients as they moved from one department of the hospital to the other, using a tool adapted for 34th Military Hospital to document the process (see Appendix I). Key exchanges noted included interactions between patients and staff, patients and other patients, and staff and other staff. Investigators observed, for example, waiting times in the waiting area, the thoroughness of clinicians in assessing patients in the consulting room, and the assertiveness of patients during consultations. Investigators looked out for privacy and safety issues during lab investigations, safety issues during the dispensing of drugs at the hospital's pharmacy, and finally the impact of patients' lab results on the decisions of clinicians in modifying pre-lab treatment regimens. Attention was also paid to the role of cost in allowing access to services and how that affected patients' choices.

The observed patients were randomly selected when they presented at the Screening & Triage department of the hospital. Each consented to participate after being screened by the nurses for presenting complaints (during which they must have cited fever as a symptom or have had it confirmed by a nurse to qualify for enrolment in the study) and having their vitals taken.

Patients who were observed during their primary visit were prioritised for follow-up interviews or, if they could not be reached or did not consent to an interview, other patients who were visiting the outpatients department or being discharged were interviewed instead.

One of the three approaches listed below was used for each interview. Interviewers were assisted by

Boie Jalloh sees a patient in his consultancy room, Infectious Disease Unit, 34th Military Hospital, Freetown, 14.09.19

an interview guide (See Appendix III, Appendix IV, & Appendix V).

1. A face-to-face interview in a quiet and confidentiality-guaranteed office in 34th MH's Infectious Disease Prevention and Control Centre.
2. A phone interview, after ensuring that the patient felt comfortable and secure, with no risk to his/her privacy.
3. A face-to-face interview with a patient in his/her home because he/she could not come to the 34 MH for an interview.

During these interviews, the investigator sought to understand patients' backgrounds, their expectations of healthcare providers, and whether the use of RDTs in their treatment met their expectations (see Appendix VI).

The eight interviews conducted with laboratory staff took place on a face-to-face basis at 34th MH.

The lab staff were interviewed in one of the two laboratories of 34th MH or, if the lab was deemed to constitute a privacy risk or source of distraction, in a quiet office. Signed informed consent was obtained from (and copies provided to) all interviewees.

The laboratory staff were asked to explain the role that RDTs play in their work and how their use affects their relationships with patients and clinicians. Additionally, they were asked how the use of RDTs affected investment in laboratory infrastructure during and following the 2014–2016 West African Ebola outbreakk (see Appendix VI). All interviews were audio recorded and securely stored both locally (on the research computer) and on ownCloud for later use.

Dr. Jalloh interviews a lab technician for DiaDev at the Infectious Disease Prevention Centre, 34th Military Hospital, Freetown, 14.09.19

Key findings

The findings reported here are preliminary but vital; they underlie the significance of the DiaDev study. A total of 18 patients consented to participate in the structured observations, of whom 11 were female and seven were male (with none declining to participate). The period from the moment of consent to the final consultation, during which results become available, was normally around 24 hours; this was followed by an average of four hours face-to-face follow-up/direct observation (see details in Appendix II).

The 34 Military Hospital has two laboratories. The main hospital laboratory provides services to all the departments, while the Infectious Disease Prevention Centre (IDPC) has its own laboratory that primarily runs tests to investigate infectious diseases. The IDPC was launched in late 2018 as a collaboration between the Republic of Sierra Leone Armed Forces and the People Liberation Army of China.

In all, the deputy laboratory services manager of the 34 Military Hospital and seven other laboratory technicians were interviewed. All laboratory staff were invited to participate, and the eight were chosen on a first-come-first-served basis. All but one was male. Three of the interviewed laboratory technicians worked at the IDPC lab primarily, but from time to time were also on-call at the main hospital laboratory.

The following are themes that were brought to the fore by the structured observations and interviews.

The Main (old) lab of the 34th Military Hospital, Freetown, 20.09.19

Brief consultations

The time taken by clinicians to assess patients varied, but was, on average, brief (less than 15 minutes). Clinicians (doctors and clinical health officers [CHOs]), in most instances, did not examine the patients

and hardly provided any explanations on the rationale for the lab investigations requested or the drugs prescribed. Clinicians routinely requested HIV tests without seeking the patient's consent, and patients were made aware of and consented to HIV testing only when they arrived at the HIV test section. Patients asked very few questions, if any.

Use of rapid diagnostic test kits

The use of RDTs was observed to be common. All the RDTs were administered by laboratory technicians at one of the hospital's two laboratories (mostly at the main lab) and not at the bedsides of the patients (except for random blood sugar). The lab staff expressed confidence in the results provided by the RDTs but acknowledged that they would prefer the gold standard tests to the RDTs. Examples of tests completed using RDT kits include urinalysis, hepatitis B, h. pylori, and HIV. The fact that the lab relies on RDTs for these tests did not appear to reduce turnaround times for test results. The administrative processes associated with the documentation and release of test results led to delays and, for most, the turnaround time was at least 24 hours. Such processes include the acquisition of the signature of the head of the lab, who signs all tests (completed on the previous day) on the following morning, including those conducted using RDTs. Patients who consented to HIV testing received a verbal result as soon as the test was conducted, but were mostly asked to return to the lab on the following day to collect the printout of their results.

The centrality of laboratory services at 34th Military Hospital

Almost all the observed patients, as they sought care after presenting with fever as their chief complaint, were sent in for laboratory investigations. Most of these investigations were performed at 34th Military Hospital, with an average turnaround time of 24 hours (for tests both using and not using RDTs). The cost of investigations was not observed to be a barrier in getting these tests done. Most of the patients utilising these services belonged to one or more of patient categories entitled to free care—for example, actively serving military personnel and their dependents (wife and up to four children under the age of 18 years), retired military personnel, and people entitled to free care as part of the national free healthcare policy launched in 2010 (pregnant women, lactating mothers, and children under five years old). The laboratory tests conducted at the IDPC, however, were conducted for a fee. Haemoglobin level, malaria, typhoid/Widal, hepatitis B, urinalysis, and HIV tests were routinely requested and carried out, as well as full blood counts.

Complex pathway for tuberculosis diagnostics

The current pathway for the diagnosis of tuberculosis was noted to be disjointed, confusing, time-consuming, and resource-intensive for outpatients. The Screening & Triage department is located in a different part of the hospital, away from the TB testing coordinating office (where two sputum cups are provided to each patient and the detailed TB testing form completed), as is the lab within which the test is carried out. The hospital does not have signage to provide direction to the offices.

Instead, patients are given verbal instructions on where to go next, but are usually not accompanied

by a member of staff. A review of the lab registers and an interview of the lab staff indicated that, since the arrival of the GeneXpert machine (please refer to Gene Xpert Process Map for details), clinicians no longer request sputum microscopy tests.

Lab technician uses the GenXpert machine, 34th Military Hospital, Freetown, 14.09.19

Using the GenXpert, 34th Military Lab, 14.09.19

Prescription culture in the context of RDT

The clinicians almost always gave pre-lab drug prescriptions to patients. The clinicians mostly maintained the pre-lab treatment regimen even after reviewing test results. The treatment regimen for most patients included an antimalarial drug (an injectable to start, followed by a three-day oral course), a painkiller, one or two broad-spectrum antibiotics, and multivitamins.

Laboratory strengthening post-Ebola

The hospital currently relies on its main (and oldest) lab and the new modern laboratory, which forms part of the infectious disease prevention centre that was built post-Ebola. The two laboratories are run independently of one another by two different administrators. Unlike the old lab, which provides free services to members of the public who are entitled to free care at the 34 Military Hospital, the new modern lab provides its services for a fee. There is no collaboration between the two laboratories except for the fact that some laboratory technicians work in both laboratories. It is no surprise therefore that the prevailing perception is that the laboratory is a neglected arm of the hospital. Inadequate lab investment by policymakers has resulted in the failure to expand the lab infrastructure since its inception. The high-end pieces of equipment installed during the Ebola outbreak were for research, and were not intended to improve the clinical capacity of the lab. Among these were machines intended to determine which health workers had developed Ebola antibodies. For the few pieces of repurposed high-end equipment that do see use, such as the Fortress Diagnostics biochemistry analyser, maintenance was a considerable challenge. Most of the machines were not working either due to the absence of local capacity to fix them or else because reagents were too expensive to keep them operational. Laboratory staff also expressed their disappointment that opportunities for further studies abroad were usually not offered to laboratory staff. The procurement of laboratory equipment and reagents were noted to be a politically sensitive subject; many staff members expressed off the record that the procurement process lacked transparency and was fraught with corruption.

Three out-of-use machines in this photo, Lab at 34th Military hospital, Freetown, 20.09.19

Trust in lab results

A strong theme that frequently arose during the interviews with lab workers was the frustration directed at the fact that results generated by the lab were viewed with suspicion by clinicians and other members of staff. The lab technicians expressed their wish that clinicians would be open to discuss results instead of criticising them in front of patients when results did not match their clinical suspicions. Most patients were observed to be unaware of this reality and none of those interviewed expressed any doubt about their diagnoses. The clinicians, on the other hand, were observed to request a specific number of tests for almost every patient and to prescribe treatment regimens before reviewing lab results. On most occasions (more than two-thirds of the time), patients were told to continue and complete the pre-lab course of treatment, which typically included antimalarials (61 percent of the time), one or two broad-spectrum antibiotics (72 percent of the time), and analgesics (83 percent of the time). Very few patients (16 percent) had another antibiotic added post-lab, and none had their treatment regimen completely altered. An interview with the clinicians throws light on the question of whether this was due to their distrust of the lab (as indicated by the lab technicians) or other reasons.

Discussion

The following discussion is based on a preliminary reading of the data and indicates potential lines of enquiry for a more systematic thematic analysis, which will be carried out during the next stage of the project.

Investigators were expected not to interfere with the patients' pathways while collecting data. Not

being perceived as judgmental of staff and patient choices during their interactions was essential to avoid bias. To a large extent, investigators were able to meet these expectations. However, at some points, it was observed that other healthcare workers gave preferential treatment to the patients that were followed; similarly, it was at other times impossible not to provide support to the patients followed (for example, investigators were asked bluntly to provide directions or explain the reasoning behind the tests requested or the drugs prescribed).

The brief consultation times may be attributed to the high patient load, but this habit persisted even when, on some occasions, there were few patients. The failure of the clinicians to seek patient consent for HIV testing may have been due to either ignorance of the national HIV voluntary counselling and testing policy; time pressure; confidence that the lab staff would request consent from patients; or the assumption that the patients would consent to whatever the clinician decided (I did not interview any clinicians to explore this question further).

The high utilisation rate of the laboratory services of 34th Military Hospital could have been due to the fact that most of the patients were entitled to free testing or to the clinicians' attempts to fulfil the unsaid but broadly understood desire of patients to get tested when they reported sick. The utilisation rate of the hospital lab's services, on the other hand, does not demonstrate trust on the part of the clinicians in laboratory services; in fact, they frequently prescribed treatment plans before consulting the investigations' results and, on a good number of occasions, maintained the same pre-lab treatment regimens. This practice may also reflect the frustration of clinicians regarding the long turnaround times of tests and investigations.

The indiscriminate routine requests for tests for almost all patients may reflect the low value assigned to these tests by the clinicians, their lack of expertise in using the national guidelines to manage febrile patients, or the limited number of tests available at 34th Military Hospital. The complete laboratory shift from sputum microscopy to the GeneXpert machine may be an indication that clinicians lack knowledge concerning the appropriate use of the GeneXpert machine, which is mainly reserved for testing for drug-resistant TB, or that they doubt the ability of the laboratory technicians to conduct microscopy-based bacilli detection procedures. The complex patient pathway for TB testing may explain the significant decline in the number of suspected TB patients who receive follow-up treatment, as reported in other studies. It may also reflect the complexity surrounding TB care in the hospital, which may itself be responsible for the lack of follow-up care after testing or during treatment. To summarise, a failure in leadership, capacity, or human and material resources in the TB program of the hospital may be responsible for these complex TB pathways.

The indiscriminate use of antimalarials and antibiotics may reflect an adaptation of clinical practice in a context of poor diagnostic capacity, or a lack of knowledge among clinicians regarding clinical guidelines on the management of endemic diseases. It may also indicate the overconsumption of medical countermeasures (which are, after all, provided free of cost), which would explain the frequent stock-outs of essential commodities in the hospital pharmacy and the catastrophic health expenditures experienced by patients and their families. Finally, it constitutes a major contributing factor to antimicrobial resistance.

Poor procurement practices were noted to undermine the availability of resources required for quality-assured diagnoses of patients. The low technical capacity of lab staff, compounded by poor communication between clinicians and lab staff, limited their ability to provide accurate and timely reports of a given patient's diagnostic status.

Conclusion

In conclusion, preliminary analysis of results suggests that there is a need for greater integration between clinical and laboratory services and for greater investments in laboratory infrastructure so as to speed up testing turnaround times and increase trust in test results. The next steps of this investigation include systematic thematic coding and an analysis of the interviews and structured observations; the development of a process map for diagnostic pathways in 34 Military Hospital; the identification of key recommendations for government and hospital management; and the development of a co-authored research article for submission to a peer-reviewed social science or public health journal.

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The laboratory staff of the 34 Military Hospital

Appendix I: Structured observation tool adapted for 34th Military Hospital

Structured observation: patient presenting with fever

Department:	Patient ID number	Observer:	Observation number:	Date: Time of arrival:

Initial encounter

What was the first thing the health worker asked?

Presenting complaints:

Please summarise here any other questions posed by the health worker and how the patient responded (verbal and physical):

Vital signs:

BP:

Temperature:

Pulse: NA

RR: NA

SPO2: NA

Explanation offered to patient? ☐ Yes ☐ No

If yes, what?

Does the patient ask any questions about vitals? ☐ Yes ☐ No

If yes, what question (s)?

Answer provided:

Time at the end of vitals:

Time ushered into consulting room:

Cadre of health workers collecting vitals:

Please tick all that apply. The waiting area is:

☐ Full to capacity ☐ Full beyond capacity ☐ Empty ☐ Noisy ☐ Quiet ☐ Tense ☐ Tidy ☐ Untidy

Are patients talking to each other?

If yes, summarise what they are discussing:

Are patients talking to staff?

If yes, summarise what they are discussing

Please tick all that apply. While waiting, the patients

☐ Sit on chairs ☐ Sit on benches ☐ Sit on the floor ☐ Stand ☐ Lie on the floor ☐ Lie on a stretcher

☐ Lie on a bed

Is the patient asked to pay any money? ☐ Yes ☐ No

If yes, how much..... for what..... to whom.....

Any receipt issued? ☐ Yes ☐ No

Consulting Room

Patient seen by: ☐ Doctor ☐ CHO ☐ Nurse

Please tick all that apply. The consulting room is:

☐ tidy ☐ untidy ☐ has an examination couch ☐ has seating for patient ☐ admits relative of the patient

Please summarise here questions posed by the health worker and how the patient responded (verbal and physical)

(for instance, questions about previous health provider visits, current use of medication, and previous adverse effects to medications):

Does the health worker do a physical exam? ☐ Yes ☐ No

If yes:

What does she/he look at?

Does she/he give any verbal explanations as she/he examines the patient or at the end on her/his examination?

☐ Yes ☐ No

If yes, what verbal explanation does she/he give to the patient for what she/he is doing?

Does she/he use any equipment? ☐ Yes ☐ No

If yes, what kind of equipment is used during the physical exam? Please state them below:

Does the health worker offer any tests? ☐ Yes ☐ No

If there are no diagnostic tests offered or available, what advice is given to the patient?

If yes, what kind of tests does the health worker offer? Please list them below:

Does she/he offer any explanations for the tests? ☐ Yes ☐ No

If yes, what explanations do they provide?

Does the patient ask questions about the test? ☐ Yes ☐ No

If yes, what kind of questions does the patient ask?

Does the patient request any particular test(s)? ☐ Yes ☐ No

If yes, which test(s)?

Initial diagnosis (according to health provider/as described in the file):

Transactions/notes about lab investigation

Please complete the table below.

Lab requested	Cost	To whom money was paid	Where was money paid	Receipts given?
				☐ Yes ☐ No
				☐ Yes ☐ No
				☐ Yes ☐ No
				☐ Yes ☐ No
				☐ Yes ☐ No
				☐ Yes ☐ No
				☐ Yes ☐ No
				☐ Yes ☐ No
				☐ Yes ☐ No
				☐ Yes ☐ No
				☐ Yes ☐ No

Lab investigations requested:	Lab test performed?	If not done on site, specify where test was completed or explanation for why test wasn't done?	Turnaround time for results	Lab results RDT (pos/neg)
	☐ Yes ☐ No			
	☐ Yes ☐ No			
	☐ Yes ☐ No			
	☐ Yes ☐ No			
	☐ Yes ☐ No			
	☐ Yes ☐ No			
	☐ Yes ☐ No			
	☐ Yes ☐ No			
	☐ Yes ☐ No			

Where do the diagnostic tests that are carried out take place?

Describe the steps involved in the test, from sample taking to disposal of any equipment:

If there is a test done onsite, how is the result communicated to the patient?

What next step is taken after the results are given?

What records are made in relation to the tests?

Diagnosis/post-lab results

Did lab investigations inform and/or change (presumptive) diagnosis?

Medication prescribed: **pre-lab** investigations	Medication given on-site?	Medication prescribed: **post-lab** investigations	Medication given on-site?
	☐ Yes ☐ No		☐ Yes ☐ No
	☐ Yes ☐ No		☐ Yes ☐ No
	☐ Yes ☐ No		☐ Yes ☐ No
	☐ Yes ☐ No		☐ Yes ☐ No
	☐ Yes ☐ No		☐ Yes ☐ No
	☐ Yes ☐ No		☐ Yes ☐ No

Does the healthcare worker provide explanations regarding any of the drugs prescribed? ☐ Yes ☐ No

If yes, please summarise here what is said about the prescribed drugs:

Does the patient pose any question(s) about the prescribed drugs? ☐ Yes ☐ No

If yes, what is/are the question(s):

What information/transactions/people are involved if a patient purchases a drug?

What paperwork or other transactions are involved in the case of free drugs?

Treatment/follow-up plan:

Is there a referral made to another health worker of the health facility? ☐ Yes ☐ No

If yes, what kind of paperwork is needed for a referral?

What other information/people/transactions are part of the referral process?

Appendix II – Structured observations

Eighteen structured observations were completed, with all but one focusing on patients who were attended to on an outpatient basis. For each, I sought their consent to be observed after they reported fever as a primary complaint in the waiting room of the Screening and Triage department of the hospital.

After obtaining informed written consent, I observed the waiting time before the consultation and the atmosphere in the waiting room (whether it was quiet, busy/crowded, etc.). Were patients and staff talking to each other? Were patients talking to each other?

I then followed each patient into the consulting room, where he/she would be evaluated (history and physical examination) by a clinical officer (medical doctor or community health officer). The patient's demeanour in the presence of the clinical officer, the kind of questions he/she posed to the clinical officer, and the kind of responses he/she received were all noted. If the clinician performed a physical exam, I noted what was examined and for how long. I also noted whether clinical officers were in the habit of explaining to patients what their clinical suspicions were and why they'd decided on a particular course of action (these courses of action being to treat without testing, to treat and test later, or to test now and treat later). I also observed how and when money changed hands during these visits.

At the end of the consultations, I accompanied the patient (if they'd been referred for laboratory tests) to the laboratory. I observed the treatment of the patient by lab staff, the money collected, and the nature of documentation during the transaction (for instance, the issuance of a receipt). I sought answers to other questions too: how and where were samples collected? Was the patient comfortable or did they have concerns regarding privacy or the cost of the requested laboratory tests? Was the patient adequately informed about the sample collection process? Did he/she have fears of invasive procedures, and what did the lab staff do to reassure him/her? Was the patient given a clear indication of the turnaround time for his/her results?

For patients who were referred to the hospital pharmacy to collect drugs, I accompanied each to understand what kind of medications were available at the pharmacy. Was he/she required to pay, how much, and how was the transaction documented? I also noted the waiting time and the information provided to the patient about drugs that were not available in the pharmacy. I observed pharmacy staff, paying particular attention to whether they provided directives to the patient on how to take the medications, what side effects to expect, and how to treat side effects.

The 18 structured observations I conducted allowed me to map out the behaviours of staff and patients and to note how these were situated in the context of the laboratory investigation. I also noted high patient–healthcare provider ratios.

Guide for semi-structured interviews with patients with fever

Start by explaining the project, and stress that we keep the information interviewees provide confidential; we don't put any names in reports, we are simply here to learn from the experiences of patients and relatives and, with that information, make recommendations for improving care and diagnostic processes in the hospital setting.

We would like to ask a few questions to get to you know a bit better before we ask about your experience in the hospital.

Opening/personal background

- Please can you tell me a bit about your background: how old are you, where did you grow up, where do you live, and are you married or in a relationship? Do you have any children (and if so, how many?)? do you live with children and/or a partner? What are your ethnicity and religion?
- Please tell me a bit about your daily life: what do you do on an everyday basis? What do you do to make money?

Before coming to 34th Military Hospital

Now we would like to ask some questions about your experiences before coming to 34th Military Hospital, during your stay at 34th Military Hospital, and after you left 34th Military Hospital.

- Can you describe what brought you to 34th Military Hospital when we met?
- What kind of symptoms did you have that made you come to the hospital?
- Why did you come to this particular hospital?
- Did you go anywhere else before coming to 34th Military Hospital? For example, home, a pharmacy, a health facility, a church, or a traditional healer? Why did follow these steps? Please tell me about your experiences with the previous healthcare provider/facility.
- Were there other people involved in making decisions about where to seek care? Please tell me who they are and about your experience.
- Were you referred from another hospital to come to 34th Military Hospital? If so, how did you feel when you were told that you would be transferred to 34th Military Hospital?
- What mode of transport did you use to come to 34th Military Hospital, and how long did the trip take?

During your time in 34th Military Hospital

- Can you describe what happened to you at 34th Military Hospital? What did the doctors and nurses do for you?
- When you came to 34th Military Hospital, what did you most want to see happen? (probe for satisfaction with services provided in this facility.)
- What did the doctor tell you about what was causing you to be ill?
- Did the doctor tell you to do any tests? Were you able to do the tests? Why/why not? (probe to find out whether they went up to the lab and inquired about the costs. Please ask the patient/relative to show you the lab request form or any forms they have and take a picture of them. Also, take a picture of their yellow patient card.)
- What kind of medication were you given? (Please ask the patient to show the medication and ask to take a

picture.)

- How much money did you spend in 34th Military Hospital? Who paid your bills? (Please ask the patient/relative to tell you how much money they spent on registration/tests/medicine/other things. Itemise this account.)
- Why/how did you decide to leave the hospital?

Post-34th Military Hospital

- What happened after you left the hospital? Did you go to another health provider? Were you able to get the care you needed from the other health provider?
- Please show me the medication you are currently using, if any. (Ask to take a picture of this.)
- How is your health now?
- What will you do if you fall ill again with fever?
- Would you go back to 34th Military Hospital? Why/why not?

Fever-based illnesses

Now we have some more general questions about fever; we are trying to understand what kind of decisions people make about where they seek care when they have fever.

- What are the common reasons for fever?
- What types of fever exist?
- What kinds of fevers need hospital treatment? (Probe to find out what different fevers are called in local languages.)
- What symptoms require hospital treatment?
- When you are ill with fever, what are the methods that you can use to find out the cause?
- What do health workers/healers do when they make a diagnosis?
- Are there any diagnostic tests available in the community outside of health centres/hospitals? What kinds of tests are available? Do you sometimes get tested by nurses at their homes? What influences your decision of where to go for testing?
- Do you prefer to seek diagnostic tests (lab investigations) at government hospitals, private hospitals, or pharmacies? Please explain your reasons.
- When is it good to have tests, and when are they not needed?
- Can you describe different tests to find out the cause of fever?
- What are some measures you can take to prevent fever-based illnesses? (Probe for malaria, typhoid, Ebola, dengue, TB, HIV.)
- There have been radio advertisements for hepatitis B screening and vaccination. Have you heard about it? What do you know about hepatitis B? How serious is the disease? Would you be willing to be vaccinated?
- Do you have any questions for me?

Thank the person for their time and information.

DiaDev guide for semi-structured interviews with laboratory workers – hospital

Place:

Date:

Interviewer:

Interviewee code:

1. Professional background

- Can you tell me a little about your background? Where are you from?
- Where did you go to school? What was your training?
- What motivated you to go into laboratory work?
- Can you tell me a little about your work experience? How long have you worked in this facility? Where did you work before your current job?
- What is your current position in the lab?
- What are your responsibilities in the lab? Please describe what you do on an average day of work.
- Are you a volunteer or on a formal pay grade?
- Are you working for any other institution?

2. Diagnostic systems

Availability/supply system

- Which tests/devices are available in your laboratory? Can you name the tests/pieces of equipment? (Ask if you can take pictures of the tests.)
- Which of these tests are provided by the government?
- What is the supply system like for government-supplied tests (such as the malaria RDT)? Who orders them? How do the tests get delivered to the laboratory? Who is responsible for overseeing the supply?
- Are the government-supplied tests/devices always available/supplied to you when you request them? How long do they take to arrive?
- Where do you get the non-government-supplied tests/devices from? Who orders them? Who collects/brings the test kits? Who is responsible for overseeing the supply?
- Are the non-government-supplied tests/devices always available/supplied to you when you request them? How long do they take to arrive?
- What happens when the reagents or test kits are depleted? (Probe: are patients/samples sent to other labs?)
- Do you know how tests are stored/distributed?
- Do you know how much the non-government-supplied tests cost?
- Do you know what processes are involved in the selection/procurement/purchasing processes? (To person in charge, ask: how do you decide on which tests you purchase for the lab?)

- What needs to be done to improve the availability of tests and diagnostic equipment in this laboratory/facility?

Use

- Can you show me a device you use often and how it works? Does it require additional equipment or infrastructure (e.g., electricity, reagents, running water)? Is it always available? Why/why not?
- What is your experience with the functionality/reliability of this test/device?
- Do you trust the results the device provides? Why/why not?
- Can you show me a device you rarely use? Why don't you use it often?
- Are there specific conditions required to store these tools? Where are they stored?
- How long does it take to get results from the tool(s)?
- Are they used for specific patients only?
- How are test results communicated to the patient?
- How do test results get recorded? Who can access the results (e.g., staff, donors, ministers)?

Quality assurance

- Are you aware of any quality assurance systems in place for the diagnostic tests you use? (Probe for role of health providers in quality assurance.) If so, how are they performed, and approves them?
- Are you trained to use specific tools? Can you tell us about that training? (When, where, what it consisted of, how useful you felt it was.)
- Are there specific times of the year when you must perform more lab investigations/tests? When, and for what conditions?
- Are there any limitations preventing you from doing more or fewer investigations in a day? If so, what are these limitations?

Maintenance & disposal

- How is laboratory equipment maintained? Can you give us any examples of a maintenance issue you have had in relation to laboratory equipment? Was this issue resolved? If so, how?
- What happens to the test kits/samples after they are used? How are they disposed of?
- Do you sometimes use kits after their expiration dates? For what kinds of test?

4. Working conditions

- Do you feel safe working in this lab/clinic/area? Please explain why or why not.
- What is your experience of working in this facility in terms of biosafety procedures?
- Have you received any kind of training in biosafety and/or biosecurity? Can you explain to me what the training consisted of? Have you been able to put this training into practice?
- How effective do you consider the current level of communication between laboratory and clinical staff regarding laboratory test results?
- What kind of refresher training sessions have you had in the last year?

5. Laboratory strengthening

- What kinds of changes have you experienced since you began work here in terms of diagnostic capacity? (Probe

to find out about new equipment, tests, processes, SOPs/guidelines, people/staff, infrastructure.)

- What kinds of changes in diagnostic procedures have you experienced since the Ebola outbreak? (Probe for safety/cautionary procedures.)
- How did the renovation of 34th Military Hospital lab affect your work and the trust that people have in 34th Military Hospital lab?
- How and by whom were these changes prescribed? (Probe to find out whether they were instigated by the government or lab personnel.)
- Have there been any restrictions post-Ebola in terms of performing certain procedures or releasing results without review or authorisation?
- What do you suggest to strengthen the diagnostic capacity in this laboratory?
- What is your opinion on the use of rapid diagnostic tests (for malaria, hepatitis, typhoid, etc.) in this laboratory?

6. Experience with outbreaks

- How did your work change during and since the Ebola outbreak?
- How did your work change during and since the cholera outbreak?
- Have you received any kind of training in outbreak emergency preparedness? What did the training consist of? Have you been able to put this training into practice?
- What steps would be taken in this facility if a patient shows symptoms of Ebola? What would be the role of laboratory workers in the case of a suspected Ebola patient?
- Have you ever witnessed an outbreak of another acute febrile illness (such as malaria or typhoid)? When is something considered an outbreak? If you have witnessed such an outbreak, how did your work change during it?

Conclusion

- Do you have any comments/questions about anything we have not addressed?

Guide for semi-structured interviews with laboratory management

Date:

Place:

Interviewer:

Interviewee code:

Professional background

- Please could you tell me about your current position and your professional background?
- What motivated you to go into laboratory work?
- Can you tell me a little about your work experience? How long have you worked in this laboratory? Where did you work before?

Laboratory strengthening

- How has the response to Ebola affected laboratory capacity in Sierra Leone? (Probe for details on training, manuals, algorithms, lab staff.)
- What kind of changes in laboratory capacity have you experienced during and since the Ebola outbreak? What kind of changes would you like to see that have not yet happened?
- During the post-Ebola refurbishment of the laboratory, how were decisions made? What were the priority areas for investment? Which donors supported this decision making?
- Are there any diagnostic devices still in use in Sierra Leone that were introduced during the Ebola epidemic? Where, why/why not? GeneXpert? RDTs?
- What was your experience with the rapid test? How were you involved? What makes it a good test? What happened after the validation study? What was the role of the lab's technical working group in such research studies? Which tests have continued to be used?
- If there were to be a suspected case of Ebola, what kind of diagnostic test would be used and where would the specimen and patient be taken?
- What kinds of diagnostics are needed in 34th Military Hospital that are currently unavailable? What qualities should such diagnostics have?
- What kind of training or capacity building do you think would be most useful for your laboratory staff?
- What is your opinion on the use of rapid diagnostic tests (for malaria, hepatitis, typhoid, etc.) in this laboratory?
- What is your perspective on the use of manual versus semi-automated versus fully automated machines in 34th Military Hospital lab? What are the pros and cons?
- Do you have any other suggestions to strengthen diagnostic capacity in this laboratory?

Supply system

- What is the supply system like for government-supplied tests (such as the malaria RDT)? Who orders them? How do the tests get delivered to the laboratory? Who is responsible for overseeing the supply?
- Are non-government-supplied tests always available when you request them? How long do they take to arrive?

- Which parties are involved in the diagnostic supply system? (Probe for information on the central medical stores and district medical stores.)
- Are you consulted when new devices/equipment are purchased for the lab (e.g., a BIOBASE haematology analyser)?
- What is the status of the referral system being established among the tertiary clinical and reference laboratories (Connaught, Makeni, Kenema, PCMH, Ola During, and Bo)? According to the National Laboratory Strategic Plan, this was supposed to be established by the end of 2017.
- What do you see as the main challenges facing the national public laboratory system? (Probe for information on private sector donors.)
- What do you see as the main challenges facing 34th Military Hospital laboratory? What needs to be done to improve/overcome these challenges?
- Have you heard about the WHO essential diagnostics list? How will it be implemented in Sierra Leone? Do you anticipate any issues regarding its implementation?

Quality control and assurance

- How is the quality of diagnostic devices and tests regulated in Sierra Leone and, in particular, in 34th Military Hospital?
- Are you aware of any challenges that exist around quality assurance systems for laboratories and diagnostic tests?
- What support is 34th Military Hospital receiving with regards to quality assurance from NGOs, the WHO, development agencies, and national public health laboratories?
- What needs to happen at a policy level to improve quality assurance for diagnostic testing?

Surveillance

- What is happening in terms of surveillance at 34th Military Hospital? The National Laboratory Strategic Plan states there is only weak collaboration between laboratories and surveillance (p. 54).
- Do you know if there are any surveillance methods being implemented to seek out Ebola cases at present? If there are, are they active or passive? What roles do diagnostic tools and protocols play in such surveillance?
- What kinds of surveillance methods are being implemented to seek out cholera cases? What roles do diagnostic tools and protocols play in such surveillance?
- What kinds of surveillance methods are being implemented to seek out antimicrobial resistance (AMR)? (Probe for specific focus.)

Conclusion

- Do you have any comments/questions about anything we have not addressed?

Appendix VI – Interviews

In order to enrich the interviews, I carried out all structured observations before commencing the interviews. This way, I was able to tailor my questions, with the help of the interview guides, to the patients and lab staff so as to bring out as many crucial issues around patient pathways as possible.

My task was to understand the expectations of patients visiting the hospital and the extent to which hospital staff met these expectations. My questions were as follows:

- How have the experiences of patients seeking care at the hospital changed over time in the context of the growing utilisation of RDTs in the lab?
- Are waiting times shorter and are clinicians better at managing patients because of the results produced by the lab?
- Do patients think that the hospital staff as a team pursued a single agenda that promoted a good outcome for them, or do they feel that the different health workers pursued different agendas?

In the interviews with laboratory workers, I sought to understand what they thought of patients' expectations and what they did to satisfy those expectations given the limited resources at their disposal and the high workload. I asked questions I thought laboratory staff would find important:

- How do laboratory staff view the introduction of RDTs into their field of work?
- Do these RDTs relieve the pressure on them to produce results, or do they represent policymakers' neglect in investing appropriately in the central laboratory's infrastructure and personnel?
- What do laboratory technicians think about the pros and cons of increased investment in single disease testing?

I also explored the impact of the drive to strengthen the health sector following the 2014–2015 Ebola outbreak on the infrastructure of 34th Military Hospital, as well as the lasting legacies in the laboratory in terms of equipment, training, and practice.

- How many of the fruits of the investment in 34th Military Hospital's lab during and after the outbreak is still in use?