



MINISTRY OF HEALTH AND SANITATION

SIERRA LEONE

**NATIONAL RAPID ASSESSMENT OF
LABORATORY CAPACITY AND SYSTEMS**

JULY 2015

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List of Abbreviations

AFB	Acid-fast Bacilli
BPEHS	Basic Package of Essential Health Services
CDC	United States Centers for Disease Control and Prevention
CHC	Community Health Centre
CHP	Community Health Post
COMAHS	College of Medicine and Allied Health Sciences
CPD	Continuous Professional Development
DFID	UK Department for International Development
DHMT	District Health Management Team
DOT	Directly Observed Therapy
EPK	Eastern Polytechnic, Kenema
EQA	External Quality Assurance
FBO	Faith-based Organisation
GFATM	Global Fund to Fight AIDS, Tuberculosis and Malaria
GLRA	German Leprosy and TB Relief Association
GPS	Global Positioning System
hCG	Human Chorionic Gonadotrophin
HIV	Human Immunodeficiency Virus
HMIS	Health Management Information System
IDSR	Integrated Disease Surveillance Response
IQC	Internal Quality Control
LIMS	Laboratory Information Management System
LTWG	Laboratory Technical Working Group
MCHA	Maternal and Child Health Aide
MCHP	Maternal and Child Health Post
MLA	Medical Laboratory Assistant
MLS	Medical Laboratory Scientist
MLT	Medical Laboratory Technician
MMET	Milton Margai College of Education and Technology
MoHS	Ministry of Health and Sanitation
NERC	National Emergency Response Centre
NGO	Non-governmental Organisation

NHP	National Health Policy
NPHLS	National Public Health Laboratory System
NPPU	National Pharmacy Procurement Unit
NRA	National Revenue Authority
PHE	Public Health England
PHU	Peripheral Health Unit
PPE	Personal Protective Equipment
RDT	Rapid Diagnostic Test
RPR	Rapid Plasma Reagin
SLIPTA	Stepwise Laboratory Improvement Process Towards Accreditation
SOPs	Standard Operating Procedures
SWOT	Strengths, Weaknesses, Opportunities and Threats
TB	Tuberculosis
TPHA	Treponema pallidum haemagglutination assay
WHO	World Health Organization

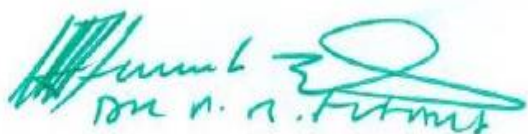
Foreword



Sierra Leone is just emerging from one of the most challenging public health epidemics in its history with the outbreak of the Ebola epidemic. It has stretched our medical and social services to the limit. A strong, responsive and functional health system is crucial to detect, control and prevent future public health outbreaks. Medical laboratories are essential in the health system and the delivery of services to the people of Sierra Leone. The provision of quality medical laboratory services that provide accurate, timely and reliable diagnostic tests facilitates the effective treatment of patients, early detection of conditions and effective prevention of potential outbreaks. Medical laboratories can play a crucial part in the more efficient use of scarce resources.

Cognisant of the need to strengthen Sierra Leone's medical diagnostic laboratory services, the Ministry of Health and Sanitation (MoHS) has initiated a review of the National Laboratory Strategic Plan (2011–2015), which will provide a framework for strengthening laboratory services in the country. To ensure that the laboratory review is informed by current evidence and the prevailing context in Sierra Leone, a Rapid Assessment of Laboratory Capacity and Systems was undertaken by the Directorate of Hospitals and Laboratory Services, with technical support from Options Consultancy Services Ltd and funded through the UK Department for International Development (DFID). The findings contained in this report will provide insight into existing laboratory capacity in the country, and factors that need to be addressed for the long-term improvement of the laboratory system. This report will contribute to our continued aim of building a more resilient health system in Sierra Leone.

This Ministry wishes to commend leadership provided by the Directorate of Hospital and Laboratory Services and would like to thank all partners that supported the development of this document. We are confident that this document will prove to be an essential resource in developing a National Laboratory Strategic Plan which, when implemented, will benefit the health and well-being of people in Sierra Leone.



Dr Abu Bakar Fofanah
Minister of Health and Sanitation
Freetown, Sierra Leone
July 2016

Remarks



It is critical for the Sierra Leone health system to be able to provide services to those that need them most. Medical laboratories are an essential part of the health system, playing key roles in the diagnosis and treatment of patients. The medical laboratory system in the country has however faced significant challenges including financial, human resources and the availability of reagents. The need to strengthen medical laboratory services was demonstrated by the recent Ebola outbreak. Our laboratory system was stretched and unable to make timely diagnosis to enable us defeat this terrible disease.

It is therefore crucial for us to continue making improvements in the medical laboratory system in order to strengthen our health system. We need to use the lessons we have learned from the Ebola epidemic to continue improving the lives of Sierra Leoneans. It is with this in mind that the Ministry of Health and Sanitation has decided to evaluate the current laboratory capacity and systems. We will use this to develop a roadmap towards a well-functioning medical laboratory system that is responsive to the needs of Sierra Leone.

We are grateful to the Directorate of Hospital and Laboratory Services of the Ministry of Health and Sanitation for taking the leadership in finalising this evaluation, and we also thank our development partners, particularly The UK Department of International Development (DFID) for their timely support. We look forward to continually improving health services in Sierra Leone in general and the provision of high quality medical laboratory services in particular.



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Acknowledgements



This Rapid Assessment of Laboratory Capacity and Services would not have been possible without the commitment of a wide range of national and international stakeholders and partners. In particular, we would like to thank DFID for providing funding and technical support through Options Consultancy Services Ltd.

Key advisory support was provided through the Laboratory Technical Working Group (LTWG), the World Health Organization (WHO), and selected national laboratory experts. The National Emergency Response Centre (NERC) was essential in ensuring that logistics were provided to enable data collectors to cross difficult terrains to reach health facilities. Other agencies that have provided invaluable contributions to this assessment are Public Health England (PHE) and the United States Centers for Disease Control and Prevention (CDC).

Finally, but most importantly, we are grateful to all health facilities that took the time to provide vital information that informed this assessment. We encourage all stakeholders to make sure that their valuable insights are used to improve medical diagnostic services at facilities.



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Executive Summary

Background

This report presents the findings from the National Rapid Assessment of Laboratory Capacity and Systems that was led by Ministry of Health and Sanitation (MoHS), with support from Options Consultancy Services, and funded through the UK Department for International Development (DFID). Other agencies that have made invaluable contributions to performing this assessment are the National Emergency Response Centre (NERC), the Laboratory Technical Working Group (LTWG) and the World Health Organization (WHO), with key input from Public Health England (PHE) and the United States Centers for Disease Control and Prevention (CDC).

The national rapid assessment was conducted between June and July 2015, and covered all 14 districts in Sierra Leone.

The findings from the assessment will contribute to a clear understanding of the current capacities and limitations of laboratories at district level. The report will provide the MoHS and stakeholders with factual data that will inform the imminent review of the National Laboratory Strategic Plan and development of an action plan to strengthen laboratory services.

Methodology

The assessment adopted a mixed-methods approach with quantitative data collected through a quantitative questionnaire; qualitative data from the questionnaire consisted of explanatory notes, and additional qualitative data was obtained through focus group discussions with data collectors who included Laborarians, and through feedback from stakeholders in validation meetings. The main survey tool comprised of 14 sections, and was partially modelled on the WHO identification of key elements in a laboratory system:

Laboratory Profile

- | | |
|--|---|
| 1. Human Resources | 8. Specimen Management |
| 2. Infrastructure | 9. Biosafety |
| 3. Transport and Referral | 10. Public Health Functions |
| 4. Management of Consumables and Stock | 11. Organisation and Management |
| 5. Maintenance of Equipment | 12. Data Management |
| 6. Testing Performance | 13. Supplies of Consumables and Equipment |
| | 14. Basic Testing Capability |

In addition, a qualitative facility observation report was provided to each data collection team. A focus group discussion was held with a select number of key stakeholders, consisting of ten laboratory representatives from all regions of the country. The resulting qualitative data were used to triangulate data and to add contextual information to the quantitative data.

There are an estimated 1,200 laboratory facilities across Sierra Leone. Our sampling frame focused on laboratories that provide basic laboratory testing in line with the Basic Package of Essential Health Services (BPEHS) 2010¹. We have also added notes to analysis to highlight changes between this and the newly revised BPEHS published in August 2015. It excluded any reference laboratories and laboratories focusing solely on Ebola diagnosis. The assessment thus includes a total of 315 laboratories (non-Ebola laboratories) in the sampling framework, which represents 26% of all public health facilities in the country.

A total of 315 facilities were sampled, with between 22–24 facilities per district. Of those, 131 (42%) facilities visited do not have a laboratory staff member or Tuberculosis (TB)/Directly Observed Therapy (DOT) worker or laboratory facility. Laboratory capacity was assessed among 184 facilities that have either a dedicated laboratory or TB/DOT worker.

¹ Ministry of Health and Sanitation (2010) Basic Package of Essential Health Services

Key Findings:

Human Resources

- There are insufficient numbers of appropriately trained laboratorians and inadequate evidence of standardised training/qualifications.
- There is no formal, clear scheme of service for laboratories. As a result, those with a good laboratory education are sometimes less well remunerated than those who are educated to secondary or lower levels.
- Capacity among higher education institutions that train laboratory staff is hampered by poor resources and a lack of standardised curricula
- Many laboratory workers conduct microscopy for TB, but are without a formal mandate to perform other clinical laboratory diagnostics.

Testing Services

- With laboratory testing available at Community Health Centres (CHCs), testing services are relatively accessible for communities.
- Thirteen percent (13%) of the 184 lab facilities providing laboratory testing were able to deliver a selected number of eight essential basic tests (blood glucose, faecal microscopy, Glucosuria, haemoglobin, Human Chorionic Gonadotrophin (hCG) pregnancy test, malaria microscopy/Rapid Diagnostic Test (RDT), proteinuria determination and urine microscopy/dipstick testing).

Transport and Referral

- Government hospitals are the facilities most likely to receive specimens from other facilities. However, 26% of CHCs and Community Health Posts (CHPs) transported samples to a higher-level facility, and 83% of all facilities did not have guidelines on how to transport specimens.
- The main samples referred are: blood, serum or plasma samples of highly contagious diseases; TB smear samples; biopsy; pap smears; and dried blood spots.

Infrastructure

- Poor supply of water and electricity remain the key infrastructural impediments to the provision of 24-hour curative services as laid out in BPHEs. Two-thirds (65%) of laboratories have no dedicated water supply, one-quarter (27%) of all CHCs no source of electricity.
- Many laboratories lack the workspace necessary to enable the proper organisation of equipment and testing.

Reagents and Equipment Procurement and Supply Chain

- Laboratory supply chains are inadequate, leading to delays in supply and frequent stock-outs.
- Essential test kits, laboratory reagents, and consumables and equipment are often unavailable in many government facilities with laboratories.
- Laboratories lack adequate equipment inventories, maintenance and repair plans.

Quality Management

- No Standard Operating Procedures (SOPs) are in place across the vast majority of public and private laboratories in Sierra Leone.
- External Quality Assurance (EQA) and Internal Quality Control (IQC) mechanisms are in place at some facilities for basic tests, including malaria Rapid Diagnostic Test (RDT), and Tuberculosis (TB), pregnancy and HIV testing.

Information Management Systems

- Although standardised data reporting exists for a selected number of diseases, there is no integrated Laboratory Information Management System (LIMS).
- There are no national-level standardised laboratory forms or reporting mechanisms that are implemented across laboratories in the country.

Bio-risk management

- About one-tenth (11%) of all facilities had health and safety protocols in place that defined and documented roles and responsibilities related to health and safety.
- One-half (51%) of all laboratory facilities had been visited in the last year for health and safety checks (supervisions).
- Only 40% of facilities had staff in place that were trained in health and safety.
- Shortages in supplies of essential biosafety and waste disposal equipment exist at all facility levels.

Laboratory governance

- No laboratory accreditation, registration and licensing systems are currently in place for laboratories, which is an important condition for improving laboratory service quality.
- Laboratories and TB/DOT centres are funded through a mix of different sources, requiring strong coordination between government and donors.

Key priority areas for strengthening the laboratory system

1. Human resource systems for laboratory personnel need to be strengthened, including the provision of high-quality training programmes for all levels of laboratory staff, to enable Sierra Leone to become self-sufficient in generating laboratory personnel at all levels.
2. Biosafety policies and procedures should be established and laboratories should be enabled to comply with these, to ensure that the safety of medical laboratory personnel, the communities and environment surrounding the laboratory.
3. Infrastructure at key laboratories needs to be upgraded, with priority given to government hospitals and CHCs to enable them to provide safe and comprehensive testing services. Priority should be given to addressing power shortages, water supplies, cold storage and biosafety facilities.
4. To increase access to testing services, referral networks needs to be established and supported by safe specimen transport methods.
5. The laboratory supply chain system needs strengthening, to prevent interruption of services as a result of insufficient equipment or reagents.
6. A Laboratory Information Management System (LIMS) needs to be established to ensure that improved availability and use of laboratory data.
7. Quality management systems need to be strengthened with the introduction of accreditation mechanisms and implementation of EQA schemes.
8. Essential laboratory practice, biosafety, quality, service, and equipment standards need to be agreed. Current laboratory governance structures needs to be supported by a regulatory agency with the authority to implement and enforce these laboratory standards.
9. Laboratory funding mechanisms need to be strengthened and coordinated, and investment decisions informed by and channeled to priority needs.

Next Steps

As part of the implementation of the national strategic plan it is recommended that:

- Clear milestones that are easily trackable be included in the national strategy. This will ensure that the strategy goes beyond setting policy and can have a sustained impact on the improvement of laboratory services;
- The laboratory strategy be incorporated at the highest level, mainstreamed through the Presidential Delivery Unit, with implementation lead by the Directorate of Hospitals and Laboratory Services;
- Frequent updates on the attainment of the strategy be made available to the Minister of Health and the Chief Medical Officer;
- A group of laboratory experts be appointed that will support the MoHS in reviewing progress in attainment of the National Laboratory Strategic Plan, provide suggested improvement, and make necessary changes to the strategy to ensure that it reaches its objectives;
- The national strategy be considered as a live policy document that can respond to the fluid situation on the ground and utilisation of all available resources;
- The strategy and its enactment should be disseminated to all the district medical officers, District Health Management Teams (DHMTs), and hospital and laboratory leads. This will ensure that the strategy is followed up at local level.

1. Background

1.1 Introduction

This report presents the findings from the National Rapid Assessment of Laboratory Capacity and Systems that was led by Ministry of Health and Sanitation (MoHS) with support from Options Consultancy Services and funded through the UK Department for International Development (DFID). Other agencies that have made invaluable contributions to performing this assessment are the National Emergency Response Centre (NERC), the Laboratory Technical Working Group (LTWG) and the World Health Organization (WHO), with key input from Public Health England (PHE) and the United States Centers for Disease Control and Prevention (CDC).

The national rapid assessment was conducted between June and July 2015, and covered all 14 districts in Sierra Leone.

The findings from the assessment will contribute to a clear understanding of the current capacities and limitations of laboratories at district level. The report aims to provide the MoHS and stakeholders with factual data that will inform the imminent review of the National Laboratory Strategic Plan and development of an action plan to strengthen laboratory services.

1.2 Context

The provision of an efficient laboratory service is an essential part of a functioning healthcare system. Reliable and timely laboratory tests are often critical to the efficient treatment of patients at all levels of the health system. Medical laboratories are essential for the investigation of disorders, providing confirmation of clinical diagnoses, facilitating improved management of diseases and generating essential public health information. Medical laboratories play a substantive role in disease surveillance and epidemic preparedness at the grassroots², which is particularly important during the post-Ebola recovery phase and to counter possible future outbreaks and provide an effective response.

The 2011–2015 National Health Laboratory Strategic Plan identified that laboratories in Sierra Leone were ‘not able to provide adequate support to the clinical care services and as a result laboratory results are not trusted and laboratory diagnostic services are underutilised’³. The challenges faced by Sierra Leone’s laboratory system were highlighted further by the 2010–2015 National Laboratory Strategic Plan. Further, the outbreak of Ebola, in particular, exposed the inherent weaknesses of the laboratory system in Sierra Leone. The existing laboratories were unable to cope with increased demand, unable to ensure that early detection, and could not provide timely and safe testing services to diagnose patients. This contributed to the difficulties in the control of the epidemic, as confirmation of cases was severely delayed. The Ebola outbreak has revealed the need for increased investment in the laboratory system to ensure that diagnostic services are available to all patients.

In cognisance of the need to strengthen laboratory services, a new National Laboratory Strategic Plan is being developed that will provide the policy and framework for improving medical laboratory testing services in Sierra Leone.

1.3 Rationale

Although efforts by the Directorate of Hospitals and Laboratory Services and partners are commendable, particularly considering the limited available resources, there are some prevailing weaknesses in the laboratory system in Sierra Leone. The National Laboratory Strategic Plan that was developed in 2011 provided a strong framework for strengthening laboratory services. This plan now needs to be updated to reflect the current capacities and needs of Sierra Leone’s laboratory system. MoHS in Sierra Leone will lead the strategic planning process, and oversee the review of a policy that will govern laboratory system

² Petti CA, Polage CR, Quinn TC, Ronald AR, Sande MA. Laboratory medicine in Africa: a barrier to effective health care. *Clin. Infect. Dis.* 2006; 42:377-82

³ Executive Summary page vii, National Health Laboratory Strategic Plan (2011–2015), Ministry of Health and Sanitation.

provision. The national laboratory assessment will support and inform decision-making for the National Laboratory System by presenting a thorough and recent evidence base from which to understand the current laboratory capacity in the country following the Ebola epidemic. The assessment also identifies the areas that require most urgent investment and advice on allocation of resources to ensure that equitable access to routine diagnostics and surveillance across the country. In addition, the assessment reviews supporting functions and referral networks that would enable the establishment of a functional laboratory network.

1.4 Challenges and Limitations

While this assessment is the most recent survey of all laboratories in the country, there are several challenges and limitations that are related to it, which are reflected in the conclusions and recommendations.

This assessment evaluates available human resources capacity for delivering laboratory services in facilities with a laboratory. Although it provides insight into the skills, training and education levels of laboratory staff, capacity at laboratory training and education institutes was not assessed.

The sampling frame for the assessment was based on the need to provide the most pertinent information for the national laboratory strategic planning process. Thus, considering that this assessment focuses on laboratory capacity to provide essential testing services against the Basic Package of Essential Health Services (BPEHS), only clinical and analytical laboratories were considered. Reference/public health laboratories were excluded from the sample frame.

Additionally, the original sample frame selected several facilities to be included that were expected to have some testing capacity. Upon arrival and physical assessment, it was found that some facilities in the sampling frame did not have any laboratory staff able to perform tests: these laboratories were non-functional. In total, 184 of the 315 facilities visited and in the sampling frame were found to be able to provide testing services. Of the 184 facilities, 59 had laboratories and the others had Tuberculosis (TB)/Directly Observed Therapy (DOT) centres. As a result, the sampling frame that was used for the assessment analysis focused on the 184 facilities able to provide testing services.

The assessment also faced some challenges in reaching facilities. Many were very difficult to access as a result of bad terrain; some facilities were not accessible by vehicle, and data collection teams needed to take a boat or ferry. In some cases, teams had to use a bike or walk to a given facility.

Laboratory staff were not always available at the facility when data collectors arrived. This necessitated repeat visits in order to collect data. In some cases, responses to the questionnaire eventually had to be provided by a Community Health Officer; in others, a different facility where staff were present was selected. Meanwhile, some facilities that were supposed to be performing laboratory testing did not have any testing facilities, while other laboratories were being closed as a result of the Ebola epidemic.

Despite these challenges, the data collected are of consistently high quality, representative of the overall state of the laboratory system in Sierra Leone and sufficiently robust to enable the drawing of valid conclusions from the results.

2. Methodology

This section provides a summary of the methodology used for this assessment.

2.1 Tools

A mixed-methods approach was used to obtain data to inform this assessment. This included conducting a quantitative survey of health facilities across the country; qualitative semi-structured assessments and interviews with laboratory personnel; and a focus group discussion among Medical Laboratory Scientists. These structured methods were supplemented by feedback obtained through verification meetings.

Although multiple methods were used, most the data gained for the assessment was collected through a quantitative assessment survey, allowing some space for qualitative explanatory notes. The tool comprised 14 sections, and was partially modelled on the WHO identification of key elements in a laboratory system:

Laboratory Profile

- | | |
|---|--|
| 1. Human Resources | 7. Specimen Management |
| 2. Infrastructure | 8. Biosafety |
| 3. Transport and Referral | 9. Public Health Functions |
| 4. Management of Consumables and Stock | 10. Organisation and Management |
| 5. Maintenance of Equipment | 11. Data Management |
| 6. Testing Performance | 12. Supplies of Consumables and Equipment |
| | 13. Basic Testing Capability |

In addition, a qualitative facility observation report was provided to each data collection team. A focus group discussion was held with a select number of key stakeholders, consisting of ten laboratory representatives from all regions of the country. The resulting qualitative data were used to triangulate data and to add contextual information to the quantitative data.

2.2 Sampling

There are an estimated 1,200 laboratory facilities across the country. Our sampling frame focused on laboratories that provide basic laboratory testing in line with BPEHS. It excluded any reference laboratories and laboratories focusing solely on Ebola diagnosis. The assessment thus includes a total of 315 laboratories (non-Ebola laboratories) in the sampling framework, which represents 26% of all public health facilities in the country. These sampled facilities include all government hospitals, though findings for two hospitals were excluded, as Lumley Government Hospital was visited for testing the survey tools. Since most facilities with testing capacity are designated as Community Health Centres (CHCs), these make up the most significant proportion of the facilities sampled: the assessment included 78% of all CHCs in Sierra Leone (See Table 1 over page).

From each district there are a minimum of two MCHPs, three CHPs, eight CHCs and two private and/or faith-based laboratories, each of which was selected randomly from all public health facilities and private/mission laboratories in each district. At least 22 selected (General Hospitals, private facilities) and randomised facilities (CHCs, CHPs and MCHPs) were aggregated per district to allow for statistical generalisability.

See table 2 for the number and type of facilities were included from each district/region, over page. In addition, A digital map of all participating facilities was produced, which can be found online: <https://www.google.com/maps/d/edit?mid=zaSqVUe8fJfE.kg0pZZYWobN8>

Table 1, Percentage of all public health facilities included in the sample

	Government hospital <i>n</i> (% coverage)	CHC <i>n</i> (% coverage)	CHP <i>n</i> (% coverage)	MCHP <i>n</i> (% coverage)
Bo	1 (100%)	14 (50%)	3 (13%)	1 (1%)
Bombali	1 (100%)	14 (93%)	4 (13%)	2 (4%)
Bonthe	1 (100%)	13 (93%)	4 (15%)	2 (13%)
Kailahun	1 (100%)	13 (100%)	5 (9%)	4 (27%)
Kambia	1 (100%)	13 (100%)	5 (33%)	2 (5%)
Kenema	1 (100%)	14 (54%)	3 (9%)	2 (3%)
Koinadugu	1 (100%)	9 (90%)	8 (44%)	2 (5%)
Kono	1 (100%)	15 (94%)	3 (12%)	2 (5%)
Moyamba	1 (100%)	15 (83%)	3 (12%)	2 (4%)
Port Loko	2 (100%)	12 (80%)	4 (19%)	2 (3%)
Pujehun	2 (100%)	13 (100%)	5 (36%)	2 (4%)
Tonkolili	1 (100%)	11 (92%)	5 (33%)	3 (4%)
Western Rural	0 (100%)	14 (100%)	5 (31%)	1 (5%)
Western Urban	6 (85%)	11 (46%)	2 (17%)	3 (19%)
Total	20 (95%)	181 (78%)	59 (18%)	30 (5%)

Table 2, Number of facilities included in the sample per region/district

Regions /Districts	Government hospital	CHC	CHP	MCHP	Private/ FBO/NGO	Total
Northern	6	59	26	11	9	111
Bombali	1	14	4	2	2	23
Kambia	1	13	5	2	1	22
Koinadugu	1	9	8	2	2	22
Port Loko	2	12	4	2	2	22
Tonkolili	1	11	5	3	2	22
Southern	5	55	14	7	6	88
Bo	1	14	3	1	3	22
Bonthe	1	13	4	2	2	22
Moyamba	1	15	2	2	1	22
Pujehun	2	13	5	2	0	22
Eastern	3	42	11	7	5	68
Kailahun	1	13	5	3	2	24
Kenema	1	14	3	2	2	22
Kono	1	15	3	2	1	22
Western	6	25	7	4	5	47
Western Rural	0	14	5	1	3	23
Western Urban	6	11	2	3	2	24
Total	20	181	58	29	25	315 *

* 315 facilities were visited but reliable information on facility type and region were only obtained for 313 (ie. District & region not known for 2 facilities, one of which was known to be an MCHP).

2.3 Quality Assurance

A series of steps were undertaken before the survey tools were finalised. The survey questionnaire was shared and validated with partners for input and feedback. This included government counterparts, donors including DFID, WHO, PHE and CDC, and laboratory experts in Sierra Leone. The tool was then pre-tested at two hospitals: Lumley Government Hospital and Arab Clinic Lumley. The tools were carefully designed and clearly phrased in a way that would be appropriate to the Sierra Leonean context, so as to reduce error in interpretation. Verification questions were included in the tool to confirm responses that were recorded. A large number of the questions provided prompt visual verification through observation of evidence to confirm positive responses.

The data collectors were drawn from the MoHS and all underwent training on how to obtain reliable responses and record them. They were also provided with job aids and access to supervision teams for support throughout the data collection period. In addition, supervision and oversight of the data collectors was provided by key MoHS and LTWG staff.

During data collection, Global Positioning System (GPS) coordinates were collected to provide a level of assurance that data collectors visited the correct facilities. Supervisors conducted spot checks using the same tool to verify consistent responses. Three facilities per district were selected for supervision. Supervision visits were scheduled after the data collectors conducted the initial assessment. In addition, spot checks were conducted by an oversight team, consisting of key MoHS and LTWG staff.

Verification of data quality took place after all data had been collected. A rejection criterion of more than 5% discrepancy was set. There were no data forms that contained discrepancies above the rejection criterion from the data collected by the initial team and the supervisory team. The data were captured using Epidata software, with the resultant database ready for analysis.

2.4 Data Analysis

The final data set was analysed using STATA and SPSS statistical software packages. Information from the focus group discussion was organised (coded) in line with the domains of the final assessment tool to enable crosschecking of main findings.

To evaluate availability of essential testing capacity, laboratory capacity is assessed against the BPEHS, which details the laboratory diagnostic services that should be available at different facility levels. As the most current version of the BPEHS is still being agreed, we used the most recently available copy (see Annex 1).

The data collection and analysis frameworks for this assessment were adapted from the 13 key elements identified in the WHO Laboratory Assessment Tool (2011) as being essential for laboratories to be functional.

The primary analysis was validated by a small group of experts consisting of data collectors, laboratory experts and MoHS staff. A final validation meeting was held, in which government partners, key experts and donors with laboratory and public health expertise were drawn together to review, contribute to and ensure verification of findings.

2.5 Ethics

Due care was taken to ensure that all data collected for this assessment was conducted in adherence with international ethics standards for health systems research. Confidentiality of all the contributors was paramount, and none of the aggregated data has any individual identifier data. All Laboratory Leads were asked for permission to take photographs where required. No names or personal identifying data of respondents are included in this report. Those participating in the focus group discussion underwent an informed consent process and were asked to sign a consent form confirming this and granting permission to record the interview (and store transcripts safely and anonymously). The conduct, methods and processes of the assessment were agreed with MoHS prior to commencement.

3. SWOT Analysis

This analysis of strengths, weaknesses, opportunities and threats (SWOT) has been drawn from an analysis of the findings reported in section 4 of this assessment report.

3.1 Strengths of the Sierra Leone Laboratory System

Country-wide coverage

The Sierra Leonean government's commitment to providing comprehensive health care services to all citizens, based on the primary health concept, is evident from the availability of clinical diagnostic laboratories in all district hospitals and many CHCs. This has ensured that diagnostic testing services are available across the country. In addition, there are many private, faith-based and non-governmental facilities that offer laboratory services.

Testing services available at primary facilities

Ensuring that laboratories are not only available at hospitals, but also at CHCs, has brought clinical diagnostic services closer to (and therefore relatively accessible for) people in communities. Accessibility to basic testing services, such as Malaria, TB, pregnancy tests and HIV, is also facilitated through the availability of TB and DOT centres.

Laboratory policy and strategy

The MoHS launched the National Health Policy (NHP) in October 2002, revising it in 2009. The NHP sets out the broad direction of the health sector, which aims to maintain and improve the health of all Sierra Leoneans resident within the country. Within the framework of the NHP, policies exist for environmental health, immunisation, drugs, health education, malaria, Lassa fever, influenza A (H1N1) 2009, national blood safety and HIV/AIDS.

The Sierra Leone National Laboratory Policy was published in 2010. The policy outlines necessary governance, coordination and collaboration structures and defines the environment and infrastructure required for the delivery of the laboratory results to facilitate management of patients and public health interventions, in line with MoHS priorities

The policy provided a platform for the development of a strong National Laboratory Strategic Plan (2011–2015). Unfortunately, resources in the country have been insufficient to ensure that the policy and strategic plan were implemented. However, these are strong documents that provide a strong base for the development of a new National Laboratory Strategic Plan.

Laboratory management structures

Laboratory services are managed by the Directorate of Hospitals and Laboratory Services, under the MoHS. Under this directorate, a Laboratory Service Manager was appointed, responsible for overseeing clinical laboratories. Laboratory technical assistance and advice is provided through the LTWG.

Training institutions

Sierra Leone has institutions in place that provide education in Biological Sciences to degree level, basic training in Medical Laboratory Science to diploma level, and training for laboratory technologists for both medical and science teaching laboratories. Institutions that offer such education include: Four Bay College; College of Medicine and Allied Health Sciences (COMAHS); Njala University; Milton Margai College of Education and Technology Eastern Polytechnic, Kenema ; Northern Polytechnic, Makeni; and Makeni University.

3.2 Weaknesses of the Sierra Leone Laboratory System

Shortage of qualified laboratory personnel

There is a chronic shortage of qualified laboratory personnel. The quantity of adequately and formally trained personnel, particularly laboratory scientists and technicians, is insufficient to meet the country's clinical diagnostic testing needs. This limits the country's ability to investigate and infectious and non-infectious diseases that are of public health importance.

The courses offered by existing Sierra Leonean training institutions produce neither the quantity nor the quality of graduates necessary to meet the country's need for skilled laboratory staff. In the absence of a

recognised scheme of service, professional titles given to laboratory staff often do not reflect their skills educational level or responsibilities in the laboratory. In addition, there are no systems for Continuous Professional Development (CPD), progression of career or remuneration, which negatively impacts staff motivation.

Weak laboratory infrastructure, power and water supply, waste disposal facilities

Whilst some laboratories have an adequate workspace in many cases this is too small or not designed to serve laboratory purposes thereby dangerously inhibiting delivery of quality diagnostics and safe working practices. Electricity supply is often unreliable. For many laboratories, water is not always available and often of poor quality. Waste disposal is often a challenge, with proper waste management procedures rarely in place or implemented. There is a lack of incineration equipment and absence of proper drainage for waste water. In some cases, these conditions pose a risk to laboratory staff and the community and the environment in which the laboratory is situated.

Weak laboratory regulatory processes and standardisation

There is a need for an authoritative body that sets minimum standards and regulates laboratories. Current systems for laboratory registration and licensing procedures are weak. Service and equipment standards and Standard Operating Procedures (SOPs) are required to ensure minimum quality standards. A regulatory body would be essential to making sure these are enforced.

Unavailability of testing services against the BPEHS

Although some basic testing services, such as TB, are often available as a result of support to the TB Programme⁴, few facilities visited by this assessment were able to offer all – or in many cases, any – services as set out in the BPEHS. Availability of such testing services is often affected by irregular funding streams, delays in supply of equipment and reagents, and availability of skilled staff at the facility. In addition, weak quality monitoring systems and inadequate supervision of staff affect the quality of services and laboratory performance against the basic package.

Laboratory service quality

Few laboratories employ consistent internal quality control in their analysis. Only the TB and HIV reference laboratories implement systematic Internal Quality Control (IQC) and External Quality Assurance (EQA) schemes. SOPs are not in place at most laboratories, as there are no national laboratory standards. The low education levels of staff and lack of adequate training are negatively impacting services.

Weak transport and referral

Specimens are often not referred to higher-level facilities for further testing. Reasons include: laboratories not knowing which facility to refer to; the absence of a well-coordinated transport system; the shortage of safe transport methods; the lack of equipment for safe storage of the sample during transport; and the absence of dedicated and trained transport personnel.

Insufficient resourcing of laboratories

The laboratory system requires greater prioritisation by decision-makers at every level of the health system, and allocated budgets for laboratories need to be protected. Resources need to be efficiently directed to address key laboratory needs, informed by existing evidence and involving key experts. This could be through, for example, a technical advisor dedicated to supporting the Directorate of Hospital and Laboratory Services in collating and using available data to guide planning and decision-making.

Intermittent supply of equipment and reagents

Delays in supply of equipment, reagents and consumables are affecting the availability of testing services against the basic package. Laboratory supply chains need strengthening at every stage: procurement, allocation, distribution, receipt, storage and maintenance. As a result of poor specifications, inappropriate supplies are sometimes procured, leading to wastage. There is inadequate local technical support for regular (preventive) equipment maintenance and calibration. This poses a risk to any current or future equipment that is provided, which is likely to retire from use sooner than necessary.

Absence of Laboratory Information Management Systems (LIMS)

Laboratory data collection, analysis, reporting and utilisation are weak. The absence of standardised laboratory data reporting could affect treatment of patients and their effective referral to higher levels of care.

⁴ The TB programme has been in place for over 25 years, managed by JLRA with some support from the Global Fund.

It prevents effective surveillance and monitoring of diseases, posing public health risks. In addition, decision-making on laboratory investments is rarely informed by a solid evidence base.

3.3 Opportunities for the Sierra Leone Laboratory System

Laboratory education and training

The government is currently developing a scheme of service that will provide laboratory staff (for Medical Laboratory Technicians, MLT, and Medical Laboratory Assistants, MLA) with officially recognised professional status and will enable career progression. This creates an opportunity to improve human resource systems that might positively affect staff morale and retention.

Upgrading existing training institutions

With support from government and donors, courses at existing training institutions could be restructured and facilities could be upgraded to produce more and better-skilled laboratory graduates. A Medical Laboratory Scientist (MLS) curriculum is already available. The government is currently in the process of developing MLT and MLA training curricula and has developed key SOPs which are about to be distributed. These are efforts that partners could leverage.

Strengthening of referral systems and transportation

The population of Sierra Leone is well served in physical presence of CHCs, CHPs and MCHPs across the country; these facilities have potential to serve as effective entry points to more advanced testing services, if referral systems could be improved. This way, instead of the resource-intensive undertaking of establishing many additional laboratories, existing resources at hospitals and CHCs with strong laboratories could be used more effectively.

Strengthening existing laboratory supply chain

Existing procurement systems at the National Pharmacy Procurement Unit (NPPU) and at district level can be strengthened with improved quantification, procurement, distribution, storage and standardised specification. Input from laboratory professionals, appointed by the Directorate of Hospitals and Laboratory Services, on equipment specifications and needs would reduce wastage of allocated resources.

Leverage existing skills and knowledge

Sierra Leone has many graduates from affiliated sciences, such as Biology or Chemistry, who, if given additional opportunities for professional development, could be trained to become laboratory staff.

Increased donor attention

During the past years, laboratories have received important disease-focused support from donors such as the German Leprosy and TB Relief Association (GLRA) who were later supported by GFATM. The Ebola epidemic has drawn donors' attention to the urgent need to address overall systemic challenges and has brought about a realisation that weak health systems in Sierra Leone could impact public health on an international scale. It is important to galvanise current interest from donors and gain their support to fund the implementation of the National Laboratory Strategic Plan.

3.4 Threats to the Sierra Leone Laboratory System

Reliability of laboratory testing

If health facilities are unable to provide reliable laboratory testing services (e.g. because staff are insufficiently trained or reagents are of poor quality) there is a risk that patients will be incorrectly diagnosed and therefore not provided with the treatment that they need. This affects both the treatment of the patient and disease control and could lead to wastage of resources.

Reduced health system performance

Provision of efficient laboratory services is an essential part of a functioning healthcare system. Medical laboratories provide confirmation of clinical diagnoses, facilitate improved management of diseases, generate essential public health information, and with adequate government funding, they can facilitate disease surveillance at the grassroots⁵.

Laboratories will play an important role in reducing the burden on Sierra Leone's health system, which has been significantly weakened following the Ebola outbreak. Enabling appropriate prioritisation of patients with

⁵ Petti CA, Polage CR, Quinn TC, Ronald AR, Sande MA. Laboratory medicine in Africa: a barrier to effective health care. Clin Infect Dis. 2006; 42:377-82

other essential health needs is fundamental to the optimal utilisation of limited resources: early diagnosis will reduce the length of treatment and therefore the use of resources.

Outbreak of epidemics

If Sierra Leone's Laboratory System is not strengthened, it will not be able to respond effectively prevent potential future wide-spread epidemics that will have significant public health impact includes Ebola, measles, new and emerging infectious diseases and potentially re-emerging highly infectious diseases including Ebola. The Laboratory systems needs to function as a whole with excellent communication and referral systems as well as quality diagnostics to ensure effective detection of infectious diseases that are endemic, and negatively impacting health outcomes.

Inefficient allocation of resources

The Ebola epidemic has brought about a recognition of the urgent need to strengthen Sierra Leone's health system, and particularly its laboratory system. As Sierra Leone's laboratory system is resourced through different funding streams, coordination and prioritisation of investments is of vital importance. The National Laboratory Strategic Plan will be an essential tool for facilitating this and will outline key priorities in strengthening the country's laboratory system as set by MoHS. It is important that all those supporting MoHS align to these priority areas and form part of a coherent response, coordinated by the Directorate of Hospitals and Laboratory Services.

Biosafety and biosecurity

Insufficient availability and implementation of biosafety procedures, equipment and absence of proper drainage and waste disposal equipment can pose a threat to the health and safety of laboratory staff and the community and the environment in which the laboratory is situated.

Human resources attrition

It is important that weaknesses in the current human resource system for laboratory personnel, such as the lack of a scheme of service, timely remuneration and CPD, are addressed before or alongside provision of training. If not, there is a high risk that, once trained, graduates will become demotivated or leave to work else in search of better remuneration and professional opportunities.

4. Findings

This section outlines key assessment findings that inform the SWOT analysis and recommendations in this report. Not all collected data is reflected in this section. A full analysis of quantitative findings can be found in the 'data analysis supplement' to this report.

4.1 Facility Analysis Framework

Key findings

- This assessment includes 20 out of 21 government hospitals and 78% of CHCs across the country; this represents high coverage of the public health facilities that are expected to provide clinical diagnostic services with laboratory workers.
- Among the 181 CHCs sampled, nearly one-third (30%) did not have a single laboratory worker.
- The two districts with the fewest facilities with laboratory staff were Bonthe (15/22, 68%) and Pujehun (12/22, 55%)
- Following support provided through the Global Fund National TB Control Programme, 125 facilities across the country (40% of all facilities sampled) were staffed with laboratory workers who conduct microscopy for TB, but without a formal mandate to perform other clinical laboratory diagnostics.

This section describes the characteristics of the facilities sampled and explains the framework for analysis. This framework aids analysis of the capacities of the different categories of facilities against the clinical laboratory diagnostic facilities set out in the government's BPEHS⁶ (see Table 3). This report is structured by key components required for laboratories to be functional as described in the Government's National Strategic Plan (2011)⁷ and WHO Laboratory Assessment Tool (2011)⁸.

Table 3, Categories of facilities included in the analysis framework

Categories of facilities sampled (n=315)	Categories of facilities with laboratory staff (n=184)
i. Govt Hospitals: government hospitals ii. Private/FBO/NGO: health facilities managed privately or by a faith-based or non-governmental organisation iii. CHCs iv. CHPs v. MCHPs	i. Govt Hospitals: government hospitals ii. Private/FBO/NGO: health facilities managed privately or by a faith-based or non-governmental organisation iii. CHC/CHP with TB/DOT: CHP or CHC with a TB/DOT facility or worker iv. CHC/CHP with Lab: CHP or CHC with a laboratory staff member but no TB/DOT facility

All facilities sampled: A total of 315 facilities were sampled, with 22–24 facilities per district. Of those, 131 (42%) facilities visited had neither a laboratory staff member, a TB/DOT worker nor a laboratory facility⁹. One-hundred and eighty-four facilities had either a dedicated laboratory or TB/DOT worker. These groups are described in more detail below (see *Facilities with laboratory staff*).

The majority of facilities (n=181) sampled were CHCs; one-fifth were CHPs (n=59); 30 were MCHPs, 25 were private or faith-based hospitals and 20 were government hospitals (see Figure 1 for more detail).

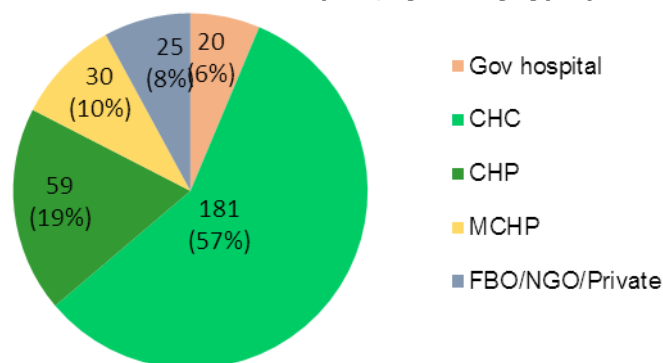
⁶ Ministry of Health and Sanitation (2015) Basic Package of Essential Health Services; Draft from March 2015

⁷ Ministry of Health and Sanitation national strategic plan 2011-2014

⁸ WHO (2012) Laboratory Assessment Tool http://www.who.int/ihr/publications/laboratory_tool/en/

⁹ Hereafter, these facilities are referred to as facilities with no laboratory worker

Figure 1, Proportion and number of facilities sampled, by facility type (n = 315)



Facilities were re-categorised into two categories: those with and those without a laboratory worker or member of laboratory staff. Among all 315 facilities in the sample, 184 facilities had at least one laboratory staff member and 131 facilities did not have a laboratory staff member.

For the purposes of this report, laboratory staff are defined as members of the health facility team whose primary function is to perform clinical diagnostic tests. Laboratory staff include laboratory superintendents, scientists, technicians, assistants, volunteers and microscopists. Facility health workers who have primary roles that extend to other patient services, such as Maternal and Child Health Aides (MCHAs) and nurses, are not included in this category.

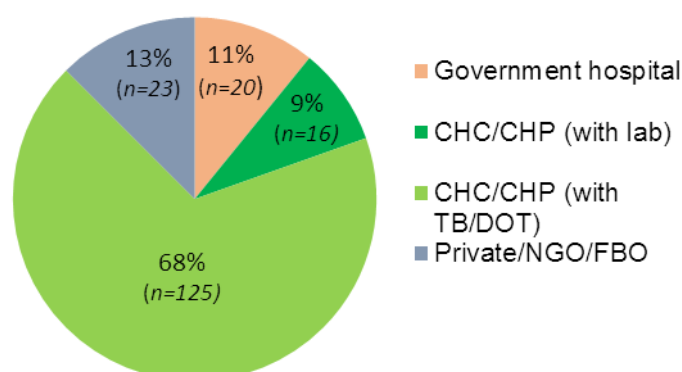
Summary of number of facilities sampled

315	facilities sampled in total, of which:
131	were not staffed with any laboratory workers,
184	were staffed with at least one laboratory worker

Facilities with laboratory staff: In total, 184 facilities (58% of the 315 sampled) had at least one laboratory staff member. Included among the facilities with laboratory staff are 20 government hospitals, 125 CHCs and CHPs with a TB/DOT facility, and 16 CHCs and CHPs without a TB/DOT facility¹⁰; 23 facilities were privately owned or managed by a FBO.

Figure 2 shows the proportions of the 184 facilities that this report describes in more detail.

Figure 2, Facilities with laboratory staff, by facility type (n=184)



Sixty-eight per cent of facilities with laboratory staff (25 facilities) carried out TB/DOT services, where laboratory workers conduct microscopy for TB but without a formal mandate to perform other clinical laboratory diagnostics.

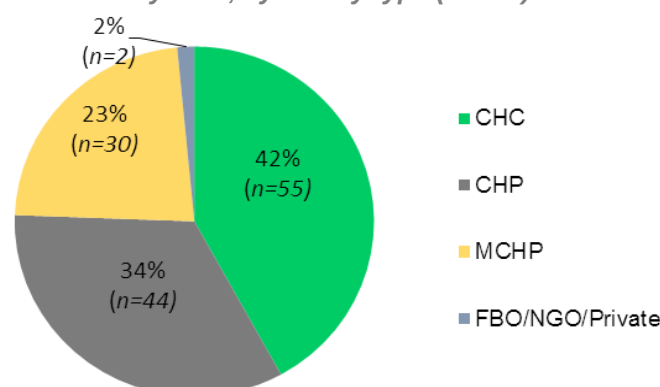
In total, 95% of government hospitals (20 among a total of 21) were included in the sample¹¹ and 78% of all CHCs cross the country, which shows that this was a representative sample.

¹⁰ Among 125 CHC/CHPs with a TB/DOT facility, 112 were CHCs, 13 were CHPs and two were private/FBO/NGO facilities. Among 16 CHC/CHPs without a TB/DOT facility but with a laboratory worker, 15 were CHCs and one was a CHP.

¹¹ Lumley Government Hospital was not included in the final sample: see Section 2.2.

Facilities without laboratory staff: Among the 131 facilities without laboratory staff, most (42%) were CHCs, one-third were CHPs, almost a quarter (23%) were MCHPs, and two were private/FBO/NGO facilities.

Figure 3, Facilities without laboratory staff, by facility type (n=131)

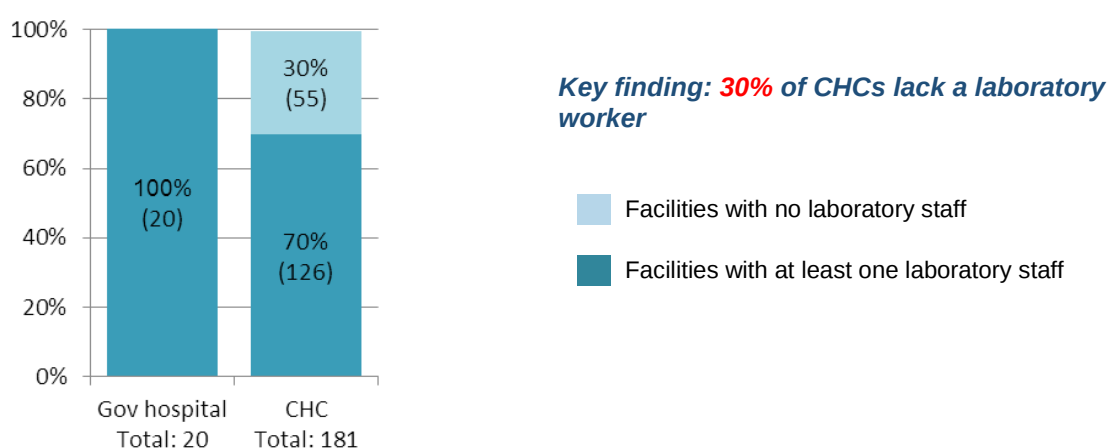


There were between six and fifteen (mean = 8.7) facilities per district without laboratory staff. Bonthe and Pujehun were found to be the districts with the lowest proportion of facilities with laboratory staff: 68% and 55% respectively.

Facilities laboratory staffing against BPEHS staffing norms: As set out in the BPEHS (2015), staffing norms do not require MCHPs or CHPs to have laboratory staff and it is expected that MCHAs in MCHPs and nursing staff in CHPs perform the laboratory diagnostics required at this level¹². CHC staffing norms specify that one Laboratory Technician and one Laboratory Assistant compose part of the health staff, and hospitals are expected to have four Laboratory Assistants and three Laboratory Technicians.

In this sample (n=315), and in line with the BPEHS staffing norms, none of the MCHPs had any laboratory staff. However, while the BPEHS has no laboratory staff specified for CHPs, one-quarter of those sampled (25%, n= 15) had laboratory staff; 14 of these facilities were staffed with a TB/DOT worker/microscopist in facilities given TB/DOT status. In line with this finding, it was found that CHPs in populous areas sometimes go above and beyond their given remit to meet demands in their catchment area. Among 181 CHCs, only 70% had at least one laboratory member of staff.

Figure 4, Proportion and number of hospitals and CHCs with at least one laboratory staff member



4.2 Laboratory Testing Services

Key findings

- Laboratory testing is available at CHCs (primary health care level); testing services are therefore relatively accessible for communities.
- Twenty-four facilities were able to readily deliver a selected number of eight essential tests: blood glucose, faecal microscopy, glucosuria, haemoglobin, Human Chorionic Gonadotrophin (hCG) pregnancy test, malaria microscopy/Rapid Diagnostic Test (RDT), proteinuria determination and urinalysis/dipstick testing.
- The most common tests performed are: sputum for Acid-fast Bacilli (AFB), haemoglobin estimation, blood for malaria parasite, and urinalysis.
- There is an overreliance on manual methods of performing and estimating lab tests, and very few automated methods were being used. Automated methods were more common in hospitals.

The laboratories' ability to test against the BPEHS was assessed. Table 4 shows the types of tests that the BPEHS stipulates should be performed at different classes of facility.

Table 4, Types of tests that should be available at CHPs, CHCs and hospitals as specified in the BPEHS 2010

Test	CHP	CHC	Hospital
Haematology			
Haemoglobin	✓	✓	✓
Blood typing	x	✓	✓
Haematocrit	x	x	✓
Full blood count	x	x	✓
Bleeding time	x	x	✓
Clotting time	x	x	✓
Biochemistry / clinical chemistry			
Glucosuria (urine glucose level)	✓	✓	✓
Blood glucose	✓	✓	✓
Serum bilirubin	x	x	✓
Rapid pregnancy test	✓	✓	✓
Microbiology			
Sputum for AFB (Ziehl-Neelsen stain)	✓	✓	✓
Routine tests for biological testing (eg. urine microscopy)	✓	✓	✓
Gram stain (for gram positive and negative bacteria) *	x	✓	✓
Virology / STI screening			
Hepatitis B rapid test *	x	✓	✓
Hepatitis C rapid test *	x	✓	✓
Rapid Plasma Reagin (RPR) for syphilis	✓	✓	✓
HIV rapid test	✓	✓	✓
Malaria parasite	✓	✓	✓
Proteinuria	✓	✓	✓
RDT for malaria	✓	✓	✓

* BHEHS 2015 stipulates that these tests should now be done at CHPs as well as higher level facilities.

Hospitals have the ability to perform the largest number of tests, and can cover the repertoire of basic tests routinely required at the primary health care level. The CHPs and CHCs could not generally perform tests that are usually highly automated, such as the full blood count. All facilities were, however, able to perform haemoglobin, blood for malaria parasite, sputum for Acid-fast Bacilli (AFB) and urinalysis.

Improvement of the laboratory system requires medium- to long-term investment. The laboratories were assessed on the availability of the most basic laboratory tests needed at primary health level. The basic tests are: blood glucose, faecal microscopy, glucosuria, haemoglobin, hCG pregnancy test, malaria microscopy

RDT, proteinuria determination and urine microscopy/dipstick testing. Twenty-four facilities (13%) were able to perform all the basic tests. Testing for proteinuria (28%) and for blood glucose (27%) were the procedures that the fewest facilities could perform. Private facilities were able to conduct a greater proportion of basic tests than public facilities.

Table 5 (overpage) shows the types of test performed at facilities. Those tests required in the BPEHS for a given class of facility are shaded grey. The test performed by the greatest proportion of facilities was testing sputum for AFB, with nearly 81% of all facilities having done so. The large number of CHCs with TB facilities contributes to this finding. At hospital level, the tests that are most frequently carried out are haemoglobin estimation, blood grouping, malaria parasite test, sickling test, and urine microscopy. Haemoglobin estimation is performed very sparingly in CHCs, with less than 25% carrying out such tests. One-half (50%) the CHCs and 22% of CHCs with TB facilities tested blood for malaria parasite. In private facilities, there was an even spread of tests that were readily performed. The data show that CHCs with TB facilities focus quite heavily on testing sputum for AFB. While this is the main mission of these facilities, building their capacity to perform other tests might yield significant results in the delivery of health care in Sierra Leone.

The laboratories used various methods to perform the most common tests. The method most commonly employed by laboratories (37%) was use of a colour chart to determine haemoglobin. The haemocue was also widely used by around 15% of laboratories. While the colour chart is very useful in skilled hands, it can also easily result in user errors.

The full blood count was mainly determined by manual methods/microscope (43%). However, nearly 38% of all laboratories used automated methods to determine the full blood count; the majority of these were private/faith-based facilities.

Biochemistry was mainly determined by automated methods (22%) and spectrophotometer (11%). However, there were a number of missing variables (56%).

For electrolyte estimation, the laboratories mainly used the spectrophotometer (33%); however, there were a large number of missing variables (50%) limiting the ability to draw firm conclusions.

Table 5, Tests performed, by facility type (n=184) (shaded cells are in BPEHS; see legend for acronyms)

Cells shaded in grey represent tests required at that level of facility as per the BPEHS 2015.

- More than 80% of facilities perform the test
- Between 30% and 80% of facilities perform the test
- Less than 30% of facilities perform the test

Tests	Government Hospitals (n=20)	CHC / CHP (with laboratory) (n = 16, inc. 1 CHP)	CHC / CHP (with TB/DOT facility only) (n = 125, inc. 13 CHPs)	Private / Faith-based Organisations / NGOs (n=23)	Total (n= 184)
Haemoglobin	● 20 (100%)	● 4 (25%)	● 24 (19%)	● 18 (78%)	66 (36%)
Haematocrit	● 9 (45%)	● 1 (6%)	● 2 (2%)	● 9 (39%)	21 (11%)
Full blood count	● 17 (85%)	● 2 (13%)	● 4 (3%)	● 14 (61%)	37 (20%)
Blood grouping	● 20 (100%)	● 4 (25%)	● 9 (7%)	● 17 (74%)	50 (27%)
Platelet	● 5 (25%)	● 0	● 0	● 5 (22%)	10 (5%)
Peripheral Blood Film	● 10 (50%)	● 2 (13%)	● 3 (2%)	● 10 (43%)	25 (14%)
Bleeding Time	● 10 (50%)	● 0	● 2 (2%)	● 5 (22%)	17 (9%)
Clotting Time	● 10 (50%)	● 0	● 2 (2%)	● 4 (17%)	16 (8%)
PTT	● 3 (15%)	● 2 (13%)	● 3 (2%)	● 2 (9%)	10 (5%)
Sickling	● 19 (95%)	● 6 (38%)	● 13 (10%)	● 14 (61%)	52 (28%)
Malaria parasites	● 19 (95%)	● 8 (50%)	● 27 (22%)	● 15 (65%)	69 (38%)
Urine microscopy	● 19 (95%)	● 8 (50%)	● 33 (26%)	● 17 (74%)	77 (42%)
Gram staining	● 7 (35%)	● 1 (6%)	● 4 (3%)	● 6 (26%)	18 (10%)
Sputum AFB- Ziehl Nielsen stain	● 16 (80%)	● 10 (63%)	● 111 (89%)	● 12 (52%)	149 (81%)
Blood Microscopy (tryp, filarial)	● 12 (60%)	● 3 (19%)	● 9 (7%)	● 9 (39%)	33 (18%)
Faecal microscopy	● 17 (85%)	● 9 (56%)	● 31 (25%)	● 16 (70%)	73 (40%)
HVS	● 12 (60%)	● 1 (6%)	● 6 (5%)	● 5 (22%)	24 (13%)
RDT for malaria	● 12 (60%)	● 11 (69%)	● 78 (62%)	● 18 (78%)	119 (65%)
Skin snip (Oncho)	● 17 (85%)	● 7 (44%)	● 27 (22%)	● 13 (57%)	64 (35%)
Widal	● 19 (95%)	● 6 (38%)	● 22 (18%)	● 17 (74%)	64 (35%)
Blood glucose	● 18 (90%)	● 3 (19%)	● 13 (10%)	● 15 (65%)	49 (27%)
Protein	● 11 (55%)	● 3 (19%)	● 6 (5%)	● 9 (39%)	29 (16%)
Rapid pregnancy test	● 18 (90%)	● 9 (56%)	● 43 (34%)	● 16 (70%)	86 (47%)
Bilirubin	● 6 (30%)	● 1 (6%)	● 2 (2%)	● 6 (26%)	15 (8%)
AST	● 4 (20%)	● 0	● 0	● 6 (26%)	10 (5%)
ALT	● 3 (15%)	● 0	● 0	● 6 (26%)	9 (5%)
Urea	● 5 (25%)	● 0 (0%)	● 0	● 7 (30%)	12 (7%)
Creatinine	● 4 (20%)	● 0	● 1 (1%)	● 7 (30%)	12 (7%)
Uric acid	● 4 (20%)	● 0	● 1 (1%)	● 2 (9%)	7 (4%)
Electrolytes	● 3 (15%)	● 0	● 0	● 3 (13%)	6 (3%)
Urinalysis	● 15 (75%)	● 9 (56%)	● 33 (26%)	● 13 (57%)	70 (38%)
HIV Rapid Test	● 15 (75%)	● 11 (69%)	● 80 (64%)	● 18 (78%)	124 (67%)
RPR test for syphilis	● 18 (90%)	● 5 (31%)	● 7 (6%)	● 16 (70%)	46 (25%)
Hepatitis B	● 18 (90%)	● 4 (25%)	● 11 (9%)	● 17 (74%)	50 (27%)
Hepatitis C Virus	● 19 (95%)	● 0 (0%)	● 2 (2%)	● 13 (57%)	34 (18%)
Proteinuria	● 12 (60%)	● 6 (38%)	● 17 (14%)	● 16 (70%)	51 (28%)
Glucosuria	● 11 (55%)	● 6 (38%)	● 19 (15%)	● 14 (61%)	50 (27%)

Legend: PTT - partial thromboplastin time; tryp – Trypanosomiasis; HVS – high Vaginal Swab; Oncho – Onchocerciasis; RDT – rapid diagnostic test; AST - Aspartate Aminotransferase; ALT - Alanine Aminotransferase; Urinalysis – BPEHS 2015 states that all levels of facilities should provide urine glucose level – in the assessment, we asked more broadly about 'urinalysis' tests.

4.3 Specimen Referral

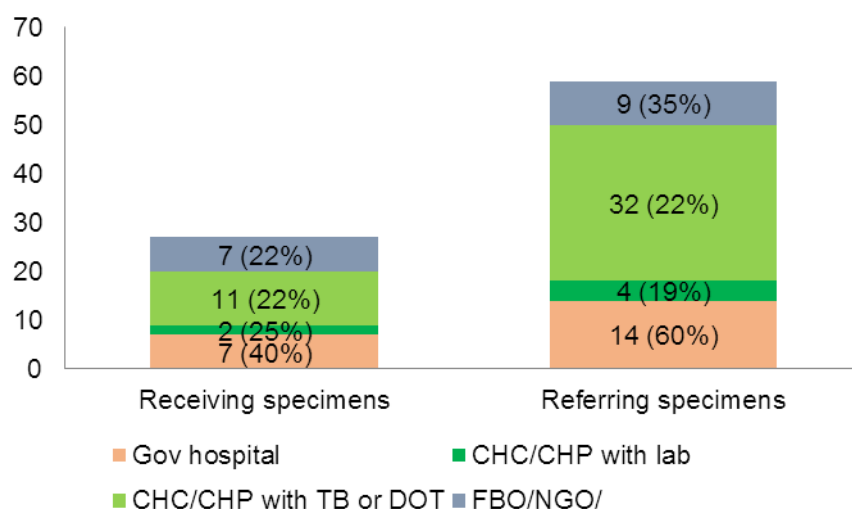
Key findings

- Despite their lack of transport means, 26% of CHCs and CHPs with laboratories or TB/DOT centres refer specimens to a higher-level facility. Hospitals are the main facilities that receive specimen from other facilities.
- The main samples referred are: blood, serum or plasma samples that were suspected to contain highly contagious diseases; TB smear samples; biopsies; pap smears; and dried blood spots.
- Over four-fifths (83%) of all facilities did not have guidelines on how to transport specimens.
- Very few facilities (13%) were able to provide appropriate packaging for specimen transportation.
- Over four-fifths (82%) of all facilities did not have a designated transport method, and relied on private vehicles for transporting specimens.

This section summarises the various methods and modalities of transporting and referring specimens in public health laboratories in Sierra Leone.

Almost 35% of government hospitals receive specimens from other laboratories. The data, however, showed that almost 60% of government hospitals referred specimens to other facilities, while only 19% of CHCs with laboratories and 22% of CHC with TB facilities did so. This could be because there are limited cold storage means available to laboratories (see Section 4.4). Hence, facilities tend to refer patients instead of samples to higher levels of care. The main samples that were sent to other laboratories were whole blood, serum or plasma samples that were suspected to contain highly contagious diseases. This might be explained by the current Ebola epidemic, since blood samples are referred to Ebola molecular laboratories. TB smear samples were transported, mainly from CHC/CHPs with TB facilities. Biopsies, pap smears and dried blood spots were also frequently transported to other laboratories.

Figure 5, Reception and referral of specimens to/from other laboratories, by facility type (n=184)



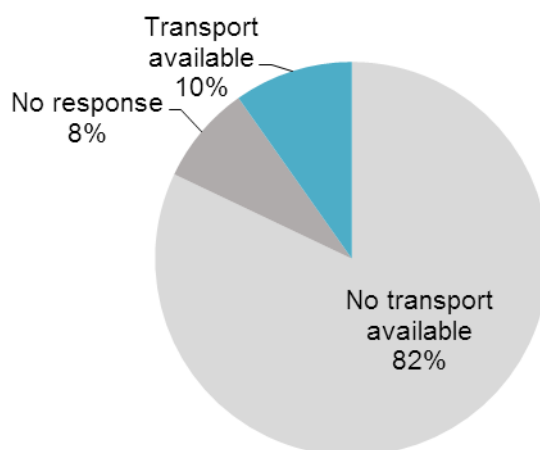
Four-fifths (83%) of all facilities did not have any local regulations, guidelines or recommendations for the appropriate packaging of referred specimens. This included one-half of all hospitals, 81% of all CHCs with laboratories and 90% of all CHCs with TB facilities. Only 5% of all facilities were able to show evidence of guidelines or recommendations, which further highlights that this is a critical area that requires redress.

During the current Ebola epidemic, the highly contagious nature of specimens makes it imperative that the right packaging is used for their transport. Only one-eighth (13%) of all facilities were using appropriate packaging for transporting specimens, i.e. triple packaging, or conforming to local recommendations. Nine-tenths (90%) of CHCs with TB facilities did not have the appropriate packaging for transporting samples. The results also show that 50% of hospitals did not have the appropriate packaging for transporting specimens. This can have a significant impact on the containment of highly infectious diseases and the integrity of transported samples.

Four-fifths (79%) of all facilities did not have a person designated to be in charge of transporting specimens. At the hospitals, 40% of the surveyed facilities did not have a designated person for transporting specimens. This illustrates the challenges that are inherent in ensuring the safe transport of samples. Every hospital that had a designated person in charge of transporting specimen had ensured that the person was fully trained. The data clearly show that there are gaps in the safe transport of specimens and ensuring that safe packaging is maintained.

There is a clear lack of designated means of transporting specimens between laboratories: 82% of all facilities did not have a means of transporting samples. One-quarter (25%) of hospitals were using private motor vehicles, and only 15% were transporting specimens in ambulances. A more robust transport scheme and policy are required to ensure that specimen integrity and test results are secured.

Figure 6, Availability of means to transport laboratory specimens (n=184)



The majority of facilities reported that their laboratory did **not** use appropriate packaging for referral of specimens in conformity with local recommendations; this was the case among half (50%) of government hospitals, 87-90% of CHC/CHPs and among 61% of private/FBO/NGO laboratories. Only between 2-20 % of public facilities with laboratories were able to show evidence of any form of guideline on appropriate packaging of specimens (see table Q.5-10 of Section 4 in *Data Analysis supplement*). Correspondingly, the majority of laboratories reported problems 'sometimes' or 'regularly' with specimens received from outside the laboratory due to inadequate packaging; this was the case as reported by 75% of government hospitals and 80% among private/FBO/NGO facilities (see table Q.7 of Section 8 in *Data Analysis supplement*).

4.4 Infrastructure

Key findings

- All hospitals had at least one source of electricity. All government hospitals could access electricity via back-up sources round the clock.
- Two-thirds (65%) of all laboratories (including more than one-half of government hospitals) did not have a dedicated water supply. Hence, no running water was available at these laboratories.
- One-quarter (27%) of all CHCs had no source of functional electricity, hampering their ability to provide 24-hour curative services, as laid out in the BPEHS.

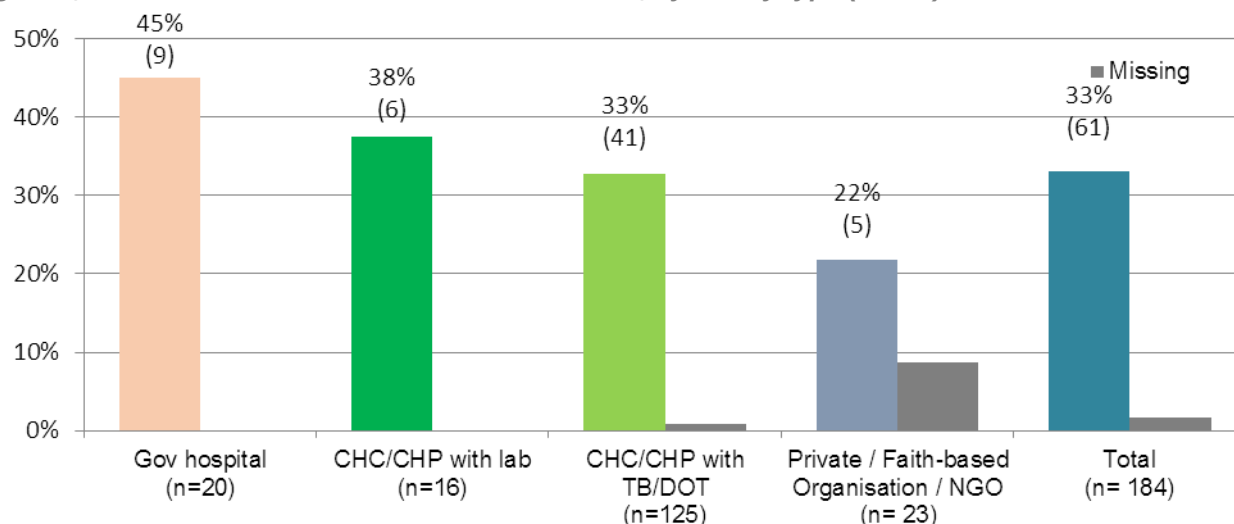
This section outlines some of the basic amenities required for a functional laboratory facility, including water, electricity and cold chain facilities. An appropriate, clean and light workspace is required to conduct clinical diagnostic tests in a safe environment¹³.

¹³ Laboratory capacity to dispose of biomedical waste and avoid biohazards safely is discussed in Section 4.9.

Location and maintenance

Almost all facilities had laboratories within a health facility compound, and one-third (33%) of the laboratories were standalone structures (see Figure 7). Eight laboratories (two based in hospitals, three in CHCs with DOT centres and three in private facilities) were able to provide evidence of having a designated maintenance plan for their buildings and infrastructure.

Figure 7, Laboratories that are standalone structures, by facility type (n=184)



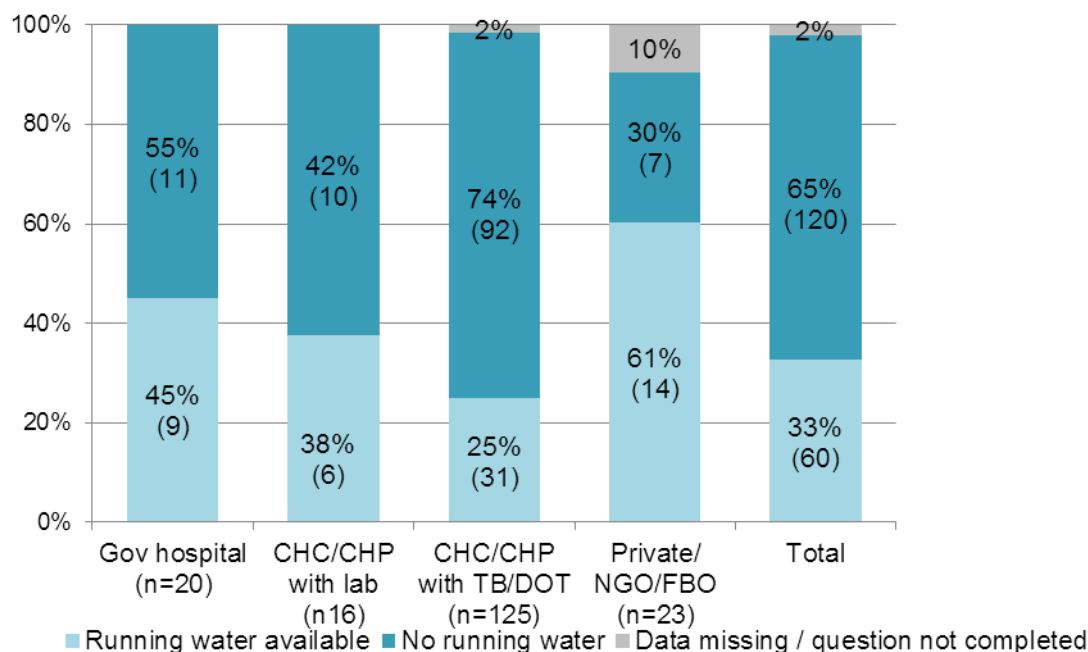
Amenities – water, electricity and cold chain

Laboratories at all levels of health facility require a means to provide running water for hand-washing in the laboratory area, such as sinks and taps or veronica buckets. The BPEHS specifies that in order to meet the BPEHS, laboratories should be equipped with a 7.5 kVA standby generator, and CHPs, CHCs and hospitals should be equipped with solar lights. All levels of facilities should have their laboratories equipped with a solar refrigerator, while hospitals require two deep freezers with capacity for storage at -20°C and -80°C, as well as a solar blood refrigerator. Findings about the availability of amenities are described below.

Water

There was a major gap in availability of running water: the majority of facilities (65%) reported that running water was not available in the laboratory workspace. This included over one-half (55%) of government hospitals, around three-quarters (74%) of CHPs/CHCs with TB/DOT facilities and two-fifths (42%) of CHCs/CHPs with a laboratory. Almost one-third (30%) of private/FBO/NGO facilities did not have running water available in the laboratory (see Figure 8).

Figure 8, Access to running water in laboratories, by facility type (n=184)



Just over one-half (54%) of all facilities relied on a well or borehole for their main source of water; the proportion was higher among CHC/CHPs with a TB/DOT centre (61%). Almost one-third (28%) of all laboratories relied on pipe-borne water, with the proportion significantly higher among government hospitals (55%) and private/FBO/NGO facilities (52%).

Electricity

To deliver the BPEHS, CHCs are mandated to provide a 24-hour curative service; to do this, they require electricity to be available round the clock. However, 27% (n=49) of facilities had no electricity available to them at any time, including seven (44%) of the CHC/CHPs with a laboratory and 42 (34%) of the CHC/CHPs with TB/DOT services. Forty-three of these were CHCs – that represents one-quarter (24%) of all CHCs with laboratory staff (six were CHPs, which are not expected to provide 24-hour services). Of note, information from feedback sessions suggested that facilities may have equipment for electricity but that it may need maintenance – this needs further investigation.

While all hospitals had at least one source of electricity (Figure 10), only 20% (n=4) of them had electricity available 24 hours a day. All government hospitals could, however, access electricity via back-up sources round the clock.

Four-fifths (39%) of facilities relied on generators as their main source of electricity; this was the most common source of power overall. Only 17% of all facilities benefited from electricity from the grid, most of which were government hospitals. Only 15% of CHPs and CHCs (with and without TB/DOT) stated solar power as their main source of electricity.

Figure 9, Availability for the laboratory of running water, cold chain storage and any source of electricity, by facility type (n=184).

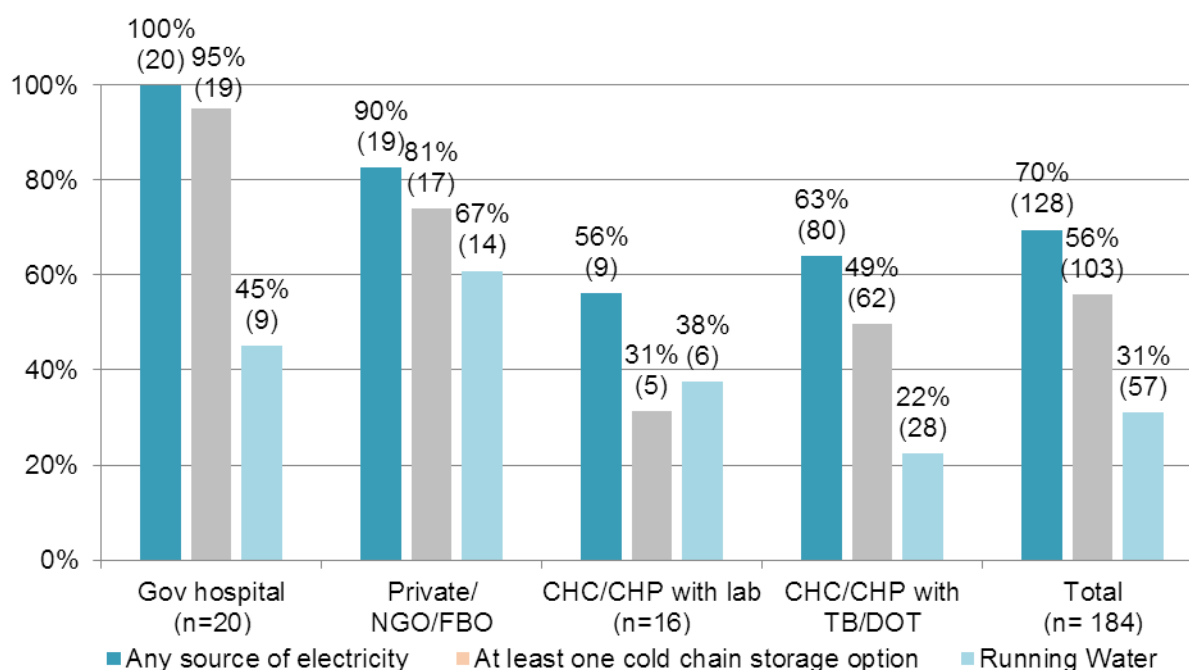
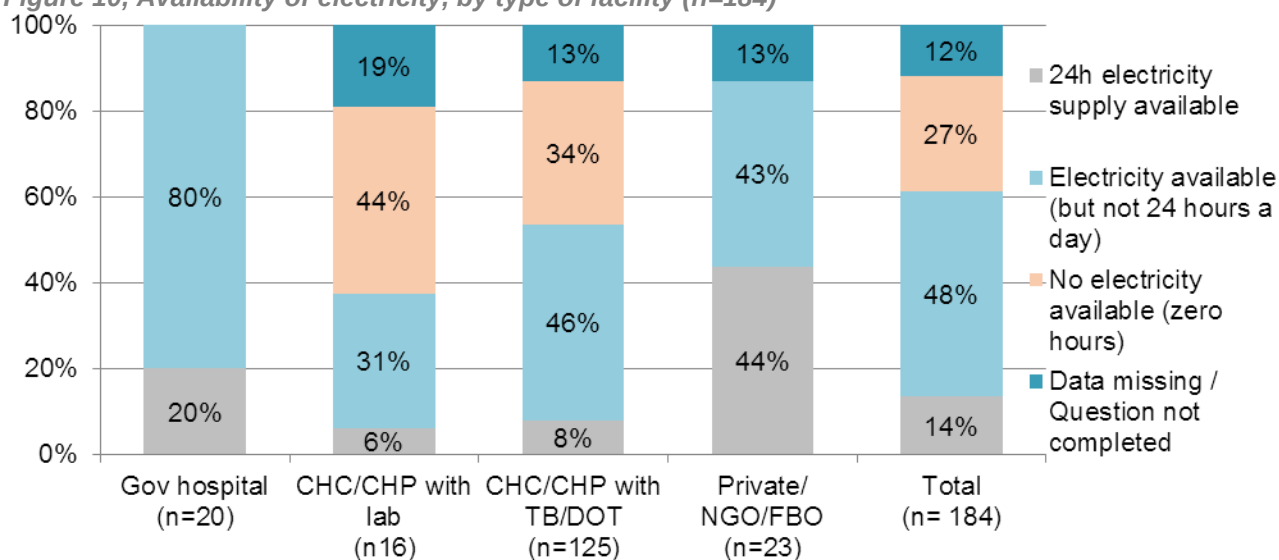


Figure 10, Availability of electricity, by type of facility (n=184)



Cold chain capacity

Close to half (44%, n=81) of facilities with a laboratory reported having no type of cold storage facility available. Only 36% of all facilities had a functional refrigerator available as specified in the BPEHS. These include 15 government hospital laboratories, 42 (50%) CHPs/CHCs, and nine of the 23 private/FBO/NGO facilities. Further, five of the 20 government hospitals did not have any freezers.

Workspace and environment

Laboratory workspace and facilities must be such that the workload can be performed without compromising the quality of work and the safety of the laboratory staff, other health care personnel, patients and the community. Whilst there is a standard design available for the construction of hospitals, no such standard exists for the internal or external structure of laboratories ¹⁴.

¹⁴ The MoHS, at the time of writing, was developing architectural plans for PHUs (information obtained from personal contact during feedback on draft versions of this report)

While most facilities (61%) were assessed as having laboratories designed to allow work to be conducted in a safe and secure way, one-third (33%) were reported as having inadequate design or workspace.

Qualitative data provided through the assessment gave comprehensive insight into conditions in laboratories. Although most facilities with laboratories had laboratories that were spacious, clean and organised, the main challenges with the laboratory environment were:

- **Inadequate workspace:** Some laboratories have good workspaces, particularly those facilities in Western Area, Kambia and Koinadugu and Kailahun: *“the infrastructure is well established with fan , painted inside. The workspace is very spacious and the laboratory is clean and tidy. Maintenance of the building is done by the Government of Sierra Leone”*. However, many were considered too small. In Bonthe district, there is only one facility that has a small dedicated space for TB/DOT centres, others did not have this dedicated space. There were many facilities in which laboratory staff were unable to work in an organised and safe way; in some cases, staff had to perform certain procedures outside the laboratory space, as indicated for this laboratory in Tonkolili District: *“The clinic is more spacious but space provided for lab is small, even the TB staining is done outside the lab”*. Data collectors noted that small working spaces contributed to laboratories’ inability to create an organized working space, which could hamper the quality of diagnostic testing services. After visiting a facility, one data collector explained: *“Staff are regular and the infrastructure is good. However, the testing area is disorganised and the collection area is cluttered, with needles and syringe wraps littered on the work bench”*.
- **Cleanliness:** There were cases where the workspace was reported to be well organised and clean: *“the infrastructure is well established with fan, painted inside. The workspace is very spacious and the laboratory is clean and tidy. Maintenance of the building is done by the Government of Sierra Leone”*. However, for at least as many that were clean, the laboratory was noted to be unclean, which was likely to have a negative impact on laboratories’ ability to perform high-quality testing services. Many data collectors commented that the majority of facilities that they visited were *“filthy”*, and there were occasional cases of pest infestations: *“the facility is suffering from bug, bat and rats”*. Such conditions hamper the ability to perform services in an organised and safe manner.

4.5 Human Resources

Key findings

- There are inadequate numbers of appropriately trained laboratorians. Of the 181 CHCs sampled, nearly one-third 30% did not have a single laboratory worker. The two districts with the highest proportion of facilities without laboratory staff were Bonthe (68%) and Pujehun (55%).
- There is no formal clear scheme of service for laboratory workers, which hampers motivation and career progression.
- Many laboratory workers are performing tasks for which there is inadequate evidence of standardised training/qualifications.
- For one-third (33%) of laboratory workers, the highest form of education achieved is secondary-level education (or lower). Almost one-half of all laboratory workers have a level of education lower than a diploma, and those working in CHCs and CHPs are working in relative isolation, limiting the potential for mentorship and CPD from more experienced colleagues.
- Following support provided through the GLRA and Global Fund National TB Control Programme, 125 facilities (40%) were staffed with laboratory workers who conduct microscopy for TB, but without a formal mandate to perform other clinical laboratory diagnostics.
- The capacity of higher education institutions to provide skilled laboratory workers is hampered by poor resources and lack of standardised curricula.
- Around one-half (51%) of the 452 laboratory staff documented as part of this assessment had obtained a diploma. Four members of staff had a graduate degree, and three a postgraduate degree.
- Many laboratory workers reported that remuneration for their laboratory work was either late or unsatisfactory. In some cases, people had not been paid for up to 14 months.

Number of laboratory personnel in facilities

A total of 452 laboratory workers were reported to be working across the 184 facilities with laboratory staff. However, many of these are working in relative isolation, with a mean of 1.1 trained laboratory staff per CHP/CHC with a TB/DOT facility, and 1.4 per CHP/CHC with a laboratory (see Table 6).

Table 6, Distribution of trained laboratory staff, by facility type (n=184)

	Government hospital (n= 20)	CHC/CHP (with laboratory) (n= 16)	CHC/CHP (with TB/DOT facility) (n=125)	Private/FBO/NGO (n= 23)
Total number of trained laboratory staff (<i>How many trained laboratory staff does your facility have?</i>)				
Mean	12	1.4	1.1	2.5
Min	2	1	0	0
Max	32	2	5	5

Expertise and experience

However, the laboratory system relies heavily on laboratory workers who lack adequate training and qualifications to perform many of the clinical diagnostics specified in the BPEHS for the different levels of health facilities. This potentially undermines the quality and reliability of test results and, thus, patient outcomes.

The qualitative data inform us that many laboratory staff are inadequately skilled and are performing tasks that they are not formally qualified to perform, as the quantitative data shown in Table 7 support. Almost 47% (n=214) of all laboratory workers held a certificate or lower as their highest qualification. In fact, for as many as one-third (34%, n=154) of laboratory workers, the highest form of education achieved was secondary (or

lower) level. Across all facilities, in particular at TB/DOT centres, the majority of Laboratory Leads (68%) had received only on-the-job training for their post. Even among the 20 government hospitals, 85% ($n=17$) of laboratory workers holding the responsibility of the Laboratory Lead had been educated just to school or Diploma level. Seven individuals had a graduate or post-graduate degree.

Table 7, Highest educational level achieved, by designation of laboratory worker, among 176* facilities with laboratory staff ($n=452$)

	Secondary Level Education and Lower	Certificate	Diploma	Graduate	Post- Graduate	
Laboratory Superintendent	1	1	10	2	2	16
Laboratory Scientist	0	0	2	1	0	3
Laboratory Technician	20	10	208	0	0	238
Microscopist	14	0	0	0	0	14
Laboratory Assistant	97	46**	7	1	0	151
Clerical	0	1	0	0	1	2
Auxiliary	5	0	0	0	0	5
Volunteer	17	2	4	0	0	23
	154	60	231	4	3	452

* Eight (8) facilities did not provide detailed information about staff members' names, designations, qualifications or years of service

** Two (2) Laboratory Assistants have State Enrolled Community Health Nurse (SECHN) qualifications

Pre-Service training

Five training institutions¹⁵ in the country provide education in Biological Sciences to degree level, basic training in Medical Laboratory Science to diploma level and training for laboratory technologists for medical and science teaching laboratories. However, qualitative information and interviews with academic staff reveal that training institutions lack the infrastructure and other inputs required to ensure an adequate number of graduates to supply the health system at all levels. Closer cooperation between MoHS and training institutions would be needed to enable government to monitor laboratory training output and quality.

Importantly, a standardised curriculum with entry criteria for the training of medical Laboratory Assistants, Technicians and Scientists has not been put in place¹⁶.

In-Service Training (CPD) and supervision

Around one-third of facilities with laboratories reported that professional training and development was available for laboratory workers (please refer to section 2, on Human Resources, Q.14, in the *Data Analysis Supplement* accompanying this report for more details on topics). The qualitative data revealed that respondents had a strong desire and need to have greater access to CPD, to enhance or formalise their laboratory skills to enable them to perform their roles to a higher standard.

However, there is a lack of standardised nationally approved training plans or they are not implemented widely (one-third, 35%, of facilities with laboratory staff reported availability of a standardised form of training). Further, there is a lack of standards against which to set training objectives (see Section 4.7).

The government recognises these deficiencies and hence is addressing them through a new scheme of service. This scheme of service would ensure that entry and graduation criteria are standardised. This will be

¹⁵ Fourah Bay College, FBC; the College of Medicine and Allied Health Sciences, COMAHS – University of Sierra Leone; Njala University; Milton Margai College of Education and Technology, MMCET; and Eastern Polytechnic of Kenema, EPK.

¹⁶ At the time of writing, the COMAHS confirmed that they have developed a curriculum for MLS, which is awaiting verification and finalisation (as of July 2015). A curriculum for MLTs has been verified by a working group for COMAHS, and a curriculum for MLA is pending validation in September 2015.

encouraging to those who currently feel demotivated as they see peers in their allied health services being rewarded.

In addition for formalizing CPD, feedback from key informants revealed a need for supportive supervision and mentoring (particularly of newer entrants to the work force) is required. The survey data revealed that in the 2 years preceding the assessment, between 0 -45% of government laboratories had received some kind of partial or full audit or assessment. See section 4.10, 'Laboratory Accreditation' for more information.

Motivation

Despite the aforementioned challenges, which limit laboratory workers' ability to carry out their duties, staff commitment to their roles is strong. This commitment is reflected in the length of service among those interviewed: three-quarters (75%) of the 184 respondents had served as laboratory staff workers for at least three years and nearly one-half (46%) had served for more than ten years.

About 30% of the laboratories had staff who were on the government payroll, and over one-third of these (36%) had more than one laboratory worker on the government payroll. Also, about two-thirds of laboratories had workers receiving other stipends: the majority of these workers (69%) received stipends from the GFATM.

However, qualitative data revealed that there were frequent concerns expressed about slow and late remuneration of those laboratory workers; during the data validation meeting with data collectors, there were several reports of laboratory staff who

had not been paid or given incentives for many months – in one case, a laboratory worker had not been paid for up to 14 months. In some cases, this had led to workers abandoning their posts to seek other opportunities. Further, qualitative data reveal that laboratory staff performing similar roles or with the same titles were on differing remuneration packages. Quantitative data support this finding, revealing variability among what Microscopists report as their stipends.

"There is a scheme but it has not been implemented. And in fact instead of upgrading the laboratory technicians, they degrade the technicians."

"I was staying with a nurse in the same place, two years back we were in the same grade, that guy went for just one local training and after that training that guy was promoted to another level but I also went for another training in another country but still I am in the same level as before."

(Source: focus group discussion)

4.6 Reagents and Equipment Procurement and Supply Systems

Key findings

Laboratory logistics systems require strengthening:

- Laboratory supply chains are inadequate, leading to delays in supply and frequent stock-outs. This is compounded by the lack of adequate stock management in many facilities, and the weakness of those systems that are in place.
- The vast majority of facilities do not have the capacity to purify or distil water: 82% of facilities lack a water distillation unit and 80% lack chemicals or a filter to purify water.
- Key items of test kits, laboratory reagents, and consumables and equipment are missing from many government facilities with laboratories.
- Laboratories lack adequate equipment inventories and maintenance and repair plans, while many facilities, particularly those based in rural settings, have inadequate local maintenance and repair capacities. These failings were more prevalent in government facilities, although some private facilities also suffered gaps in these areas.

This section examines the management of consumables and stock, exploring the extent of delays in supplies, the systems in place for managing reagents and the maintenance management of equipment. The section includes a summary of the availability of equipment, consumables and personal protective equipment that were present in the facilities at the time of the assessment.

Source of reagents and delays in supplies

Laboratories receive their consumables and reagents from a mix of different sources, as shown in Table 8. Central government is the main provider, followed by donors (predominantly the GFATM and European Union) for other supplies.

Table 8, Source of consumables and reagents for laboratories (n=184)

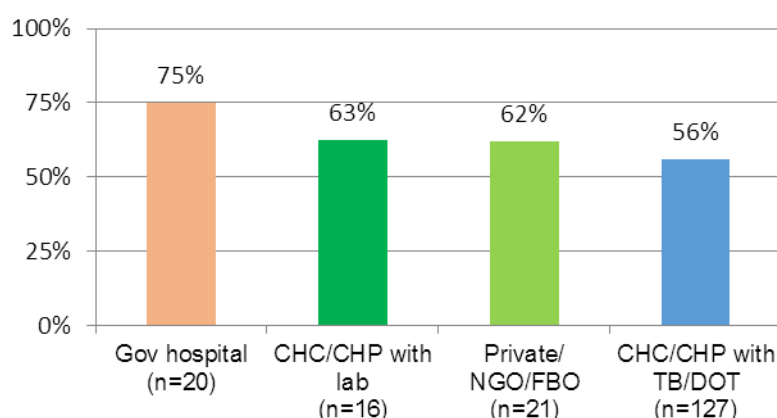
Central Government	100 (54%)
Local Government	31 (17%)
Hospital Funds	30 (16%)
Donations	51 (28%)
Others (specify)	58 (32%)
Response missing	4 (2%)

(note some facilities are supplied from multiple sources)

Qualitative data revealed that the reliance on multiple sources of reagents, including some supplies allocated solely for users of the free health care initiative, was problematic. A lack of coordination among donors contributed to respondents' perceptions of additional delays.

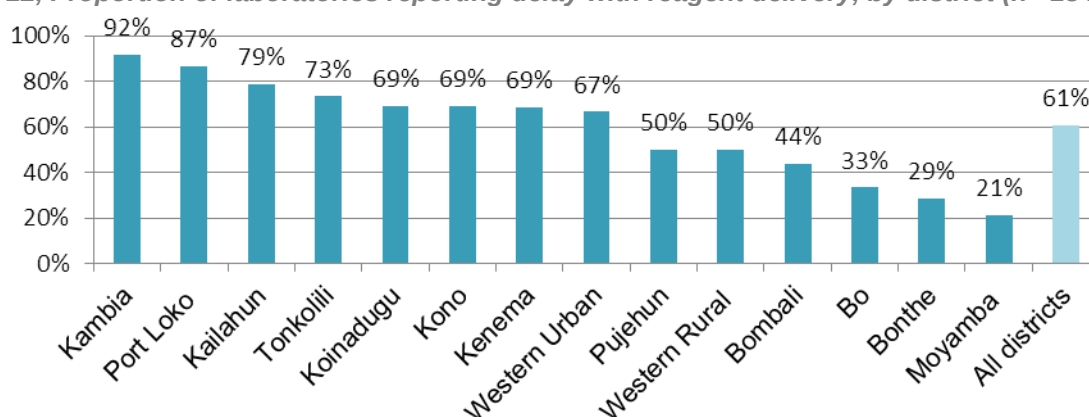
The majority of laboratories (59%) reported experiencing delays in the delivery of reagents; hospitals fared worst, with 75% (n=15) reporting delays, while 56% (71) of facilities with TB/DOT services reported similar problems (see Figure 11).

Figure 11, Proportion of laboratories experiencing delays with reagent delivery, by facility type (n=184)



In Kambia, Port Loko and Kailahun, around 80% or more of facilities reported delays in the delivery of reagents (see Figure 12).

Figure 12, Proportion of laboratories reporting delay with reagent delivery, by district (n =184)



Management of reagents, consumables and equipment

The majority of facilities (53%) demonstrated that they had expiry dates of reagents clearly written on the reagent containers or kits – the proportion was higher among government hospitals and private/FBO/NGO facilities, where over third of facilities labelled expiry dates clearly (75% and 70%, respectively), and lower among CHCs (50% of those with a laboratory and 46% of those with TB/DOT). However, data collectors also reported that reagents were sometimes stored in old bottles that had expired long ago, without relabeling these with the correct expiry dates.

Less than one-half of facilities (41%) validated new reagents against reference materials before use. Furthermore, one-fifth of all facilities admitted reusing disposable supplies (such as plastic pipettes and gloves), and a small number (7%) to using expired reagents. This proportion was higher among government hospitals and private/NGO/FBO facilities (15% and 17%, respectively).

Qualitative data and feedback from data collectors revealed a lack of adequate storage capacity in certain facilities, contributing to cluttered workspaces and difficulties in safe use of reagents. There was a significant intersection between such facilities and those which respondents had described as having inadequate workspace. Further, qualitative feedback highlighted the need for standardization of kits being used; this will enable standardisation and alignment of training for the use of diagnostic testing and use of reagents and equipment.

Responses indicated a need to establish or strengthen systems for managing reagents and consumables: less than one-quarter (24%) of facilities had an inventory system, only one-quarter (25%) of facilities had a system for accurately forecasting the need for reagents and consumables and only one-third (35%) had a dedicated person for managing stock levels and ordering supplies.

It is notable that very few laboratories had the capacity to distil or purify water: only 10% of laboratories had a water distillation unit and only 13% had water purification chemicals or a filter. This included only 55% (n=11) of government hospitals, while just two CHCs had a water distillation unit.

Facilities that were expected to provide certain tests were missing the necessary reagents and test kits. For example, less than one-half (45%) of hospitals had rapid tests kits available for HIV, and only 20% had RDTs for malaria (although arguably, they would likely be able to provide microscopy diagnosis). A far smaller proportion of CHCs and CHPs had HIV rapid tests available: 56% of CHCs/CHPs with a laboratory and only 24% of CHCs/CHPs with a TB/DOT facility.

Many government laboratories were lacking stocks of basic consumables and equipment: for example, around one-half of government facilities had soap, while only 63% of CHC/CHPs with a laboratory, 46% of those with a TB/DOT facility, and 80% of hospitals had a sharps bin.

Table 9 shows the proportion of facilities with a selection of test kits and reagents, consumable reagents, other laboratory consumables and equipment. It has been colour-coded to show 'red' where items were present and functional in fewer than 40% of facilities, 'yellow' where items were present and functional in 40–74% of facilities, and 'green' where items were present and functional in 75% or more of facilities. Facilities that lack functional items are indicated by the yellow and red traffic lights shown.

Table 9, Key consumables available and functioning in laboratories, by facility type (n=184)

Key:

Less than 30% available and functional

Between 30%-80% available, functional

More than 80% available and functional

	Hospital (n=20)	CHC/CHP (with Laboratory) (n=16, incl. 1 CHP)	CHC/CHP (with TB/DOT facility only) (n=16, incl. 13 CHPs)	Private/Faith- based Organizations/NG Os (n=23)
Equipment				
Balance	40%	6%	4%	35%
Bunsen Burner	30%	6%	11%	26%
Haemocue machines	40%	0%	2%	48%
Haemoglobin Meters	30%	6%	4%	26%
Laboratory scale and weights	35%	6%	8%	35%
pH Meter, pH tester	20%	0%	3%	22%
Spirit lamp	25%	31%	21%	26%
Staining jars	45%	44%	26%	35%
Stopwatch	30%	25%	28%	26%
Storage tank	10%	25%	10%	26%
Thermometer	20%	6%	6%	26%
Timer	35%	44%	39%	39%
WHO Haemoglobin colour match	15%	6%	12%	35%
Waste bin	70%	63%	42%	52%
Sharps container	80%	63%	46%	61%
Consumables				
Blood collection tubes	55%	38%	15%	61%
Blood Lancet	60%	25%	37%	70%
Biohazard bin	55%	50%	30%	52%
Capillary tubes	40%	13%	6%	57%
Cotton wool	65%	50%	52%	70%
Haemocue cuvettes	20%	13%	3%	48%
Microscope slides & cover slips	50%	69%	62%	70%
Needles	60%	44%	16%	70%
Syringes	60%	38%	17%	70%
Rexoguard Antiseptic Disinfectant	20%	44%	26%	39%
Soap	55%	56%	47%	70%
Test kits and reagents				
Determine,SD Bioline & Unigold (rapid test kits HIV)	45%	56%	24%	52%
HBsAg Dipstrip	40%	13%	6%	52%
HCV Dipstrip	35%	13%	3%	39%
Malaria RDT kit	20%	69%	41%	57%
Mutistix for urinalysis	35%	31%	9%	61%
Consumables, reagents				
Field stain A&B,	25%	13%	6%	39%
Ziehl-Neelsen stain	60%	75%	56%	52%
Xylene	40%	69%	38%	43%
Giemsa Stain Solution	55%	25%	11%	43%
Immersion oil	35%	56%	62%	57%
Normal saline	60%	44%	26%	61%
Leishman stain (BPEHS specifies for hospitals only)	10%	6%	6%	26%

Maintenance of laboratory equipment

There are several concerns about quality of diagnostic equipment and capacity raised in relation to maintenance of equipment. The majority of facilities (68%) reported that there was no validation of new equipment against reference materials and/or methods when newly introduced, raising concerns about the quality of diagnostic services. Even more (71%) reported no validation against reference materials after equipment had been for service or repair.

Although 66 laboratories reported availability of a fridge, only 11 reported performing daily monitoring and recording of fridge temperature and only five were able to show evidence of so doing.

Laboratories at all types of facilities lacked an equipment inventory: only 15% (n=41) of all laboratories had an inventory. A higher proportion (30%) of hospitals had inventories than other facility types (see Table Section 6, Q.1 in the *Data Analysis Supplement*). Less than one-half (n=19) of facilities with an inventory were able to show evidence of their existence. The level of detail contained within the inventories varied greatly.

Maintenance and repair is mostly the responsibility of the laboratory, with only 12 government facilities reporting that there was an external maintenance or repair contract for laboratory equipment. Almost one-half (11/23) of private/FBO/NGO facilities had such an external contract. There were many laboratories (75%) where defective equipment is not labelled appropriately and a similar proportion (70%) lacked procedures for disposal of obsolete equipment.

Two-fifths (40%) of all facilities did have some user manuals available for equipment. Most (76%) lacked sufficient spare parts such as lamps, fuses or filters to enable quick repairs.

Qualitative information from feedback meetings revealed a desire among stakeholders for selection of a limited number of standard suppliers for equipment who have demonstrated reliability and efficiency in their services.

4.7 Quality Management

Key findings

- The vast majority of public/private laboratories in Sierra Leone have no SOPs in place, although some facilities could provide procedures for a selected number of tests.
- EQA and IQC mechanisms are in place at some facilities for basic tests, including Malaria RDT, and TB, pregnancy and HIV testing.
- Around three-tenths (29%) of facilities reported having an organisational structure in place that defined the lines of authority and responsibility for key laboratory staff.
- Most facilities (55%) organised a meeting when a particular problem occurred, to ensure that it was resolved. One-third of facilities (32% overall, 35% of hospitals and 44% of CHCs with laboratories) provided written reports or minutes of these meetings.

Quality is central to Sierra Leone's mission as described in its National Laboratory Policy (2011). Quality management systems and procedures at the laboratory are important to ensure reliability of test results. An error in any part of the laboratory testing process can produce a poor laboratory result.

The complexity of the laboratory system requires that many factors must be addressed to assure quality in the laboratory. Some of these factors, such as workspace, information reporting, staff training and education, equipment/reagents and bio-risk management, are already included in other sections of this report. Section 4.1 will address accreditation procedures. This section will therefore focus on:

- laboratory procedures
- quality control procedures
- laboratory management.

Laboratory procedures

Although the vast majority of public/private laboratories in Sierra Leone have no established SOPs for laboratory tests, 27% (n=50) of facilities reported having SOPs for some tests. In most cases, these SOPs derived from reagent instruction manuals or were provided through donor agencies. Table 10 gives insight into the availability of SOPs for some key tests at the limited number of facilities that had reported performing such tests. It is important that SOPs are developed and used to ensure that essential laboratory practices and procedures are being followed.

Table 10, Number and proportion of facilities (n=184) performing medical diagnostic tests and proportion with SOPs, by facility type

Tests	Gov hospital	CHC/CHP with lab	CHC/CHP with TB or DOT	FBO/NGO/Private with lab
Haemoglobin	● 4 (20%)	● 2 (50%)	● 5 (21%)	● 5 (28%)
Malaria parasites	● 4 (21%)	● 2 (25%)	● 3 (11%)	● 2 (13%)
Urine microscopy	● 4 (21%)	● 2 (25%)	● 2 (6%)	● 2 (12%)
Sputum AFB- Ziehl Neelsen stain	● 2 (13%)	● 4 (40%)	● 21 (19%)	● 2 (17%)
Blood microscopy (tryp, filarial)	● 1 (8%)	N/A	● 2 (22%)	● 3 (33%)
	● 1 (8%)	● 4 (36%)	● 15 (19%)	● 2 (11%)
Skin snip (Oncho)	● 1 (6%)	N/A	● 3 (11%)	● 1 (8%)
Blood glucose	● 2 (11%)	● 2 (67%)	● 1 (8%)	● 1 (7%)
Rapid pregnancy test	● 2 (11%)	● 2 (22%)	● 7 (16%)	● 2 (13%)
Urinalysis	● 1 (7%)	● 2 (22%)	● 3 (9%)	● 2 (15%)
HIV Rapid Test	● 4 (27%)	● 3 (27%)	● 13 (16%)	● 5 (28%)
RPR test for syphilis	● 3 (17%)	● 1 (20%)	● 1 (14%)	● 2 (13%)

● More than 50% of facilities have SOPs

● 25% - 50% of facilities have SOPs

● Less than 25% of facilities have SOPs

The majority (78%) of laboratories (18 hospitals and 108 CHCs) claimed to inspect consumables and reagents upon receipt. One-ninth (11%) of laboratories (two hospitals and ten CHCs) could demonstrate that they had basic standards and protocols in place, based on which consumables and reagents were accepted/rejected.

Quality control mechanisms

As part of their quality assurance procedures, 18% (n=33) of facilities, of which four government hospitals and three CHCs with laboratories, performed EQA tests to provide the laboratory management with an insight into the quality of the routine work of their laboratories. However, few facilities had documented EQA results available: only 10% for AFB (Ziehl-Nielsen stain), and 6% for HIV rapid test and RDT for malaria. Only Connaught and Kenema hospitals provided EQA for tests in addition to AFB and malaria / HIV RDTs.

Evidence for IQC testing measures (ie. verifying if results generated by a test are correct) was in place for quite a number of tests at Connaught and Kenema hospitals. However, overall, most hospitals did not run IQC for tests, with only 11-25% of hospital labs running IQC for 21 tests, and 14 tests¹⁷ had no IQC performed at any hospitals (see table in *Data Analysis Supplement*, section 7 tables F). At CHC level, IQC was provided for the same basic tests as above: AFB (Ziehl-Neelsen stain) (16%), HIV rapid test (12%) and RDT for malaria (8%).

¹⁷ Tests for which no hospitals conduct IQC include: Platelet, PTT, blood microscopy, HVS, RDT for malaria, AST, ALT, Urea, Creatinine, Uric acid and Electrolytes.

Laboratory management

Organisational management structures and procedures at the laboratory are essential for maintaining quality. Three-tenths (29%) of facilities (50% of hospitals and 25% of CHCs with laboratories) reported having an organisational structure in place that defined the lines of authority and responsibility for key laboratory staff.

Most facilities (55%) said they had organised a meeting to solve a particular problem that had occurred. And 32% (35% of hospitals and 44% of CHCs with laboratories) provided written reports or minutes of these meetings.

4.8 Information Management

Key findings

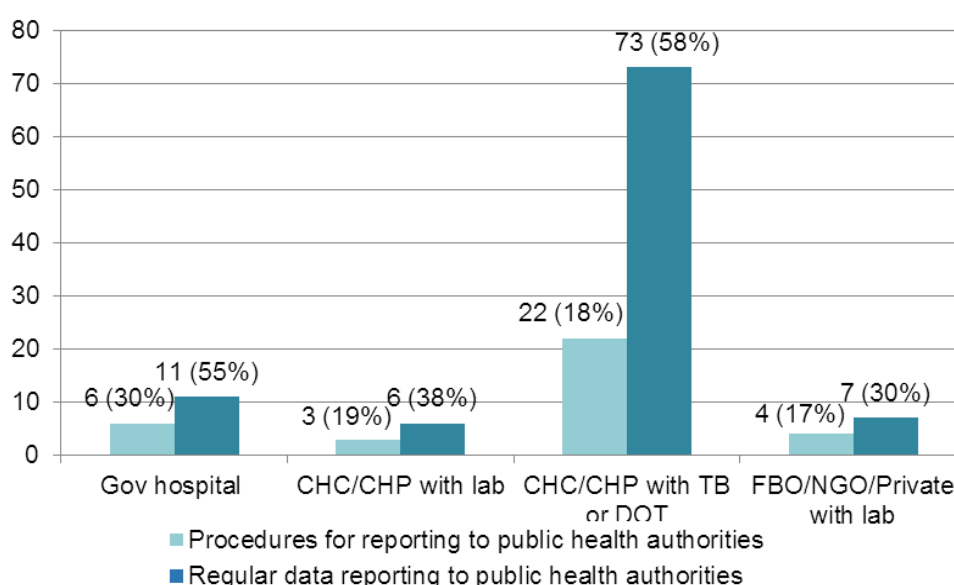
- Although the Global Fund National TB Control Programme and MoHS surveillance processes provide some standardised data reporting relating to TB and DPC, there is no overall LIMS. Such a system would need to be linked to the national Health Information Management (HMIS) System.
- There are no national standardised laboratory forms or reporting mechanisms. The absence of forms that capture essential clinical and patient data is likely to impact on the quality of laboratory services.
- The absence from laboratories of designated phones and computers with access to the Internet will need to be addressed to facilitate improved data reporting.

This section provides an analysis of existing laboratory information systems against key requirements for an effective information management system, among the 184 facilities with laboratories. A LIMS incorporates all processes needed for managing data, both incoming and outgoing patient information. The information management system may be entirely paper-based, computer-based, or a combination of both. Whatever technology is employed, information management is essential for ensuring good-quality service provision at laboratories and has an important public health function. An effective information management system ensures accessibility, accuracy, timeliness, security, confidentiality and privacy of patient information.

Information networks

An integrated LIMS is currently not in place, though there have been initiatives to collect data on specific diseases for surveillance purposes. Previously, data on occurrence of HIV, TB and malaria were collected through a small-scale information network, set up by GFATM. This data collection network was integrated, and is currently performed by the MoHS as part of the paper-based surveillance system which focuses on nine focal diseases, namely: polio, cholera, Lassa fever, acute respiratory infection, measles, yellow fever, HIV, TB and malaria. Occurrence of these diseases is reported at Peripheral Health Unit (PHU) level and then sent to the District Health Management Team (DHMT) for collation. This system focuses on primary-level health facilities. Therefore, CHCs with TB/DOT centres were most likely to report data to public health authorities (see Figure 13).

Figure 13, Regular reporting, and procedures for reporting, to public health authorities, by facility type (n=184)



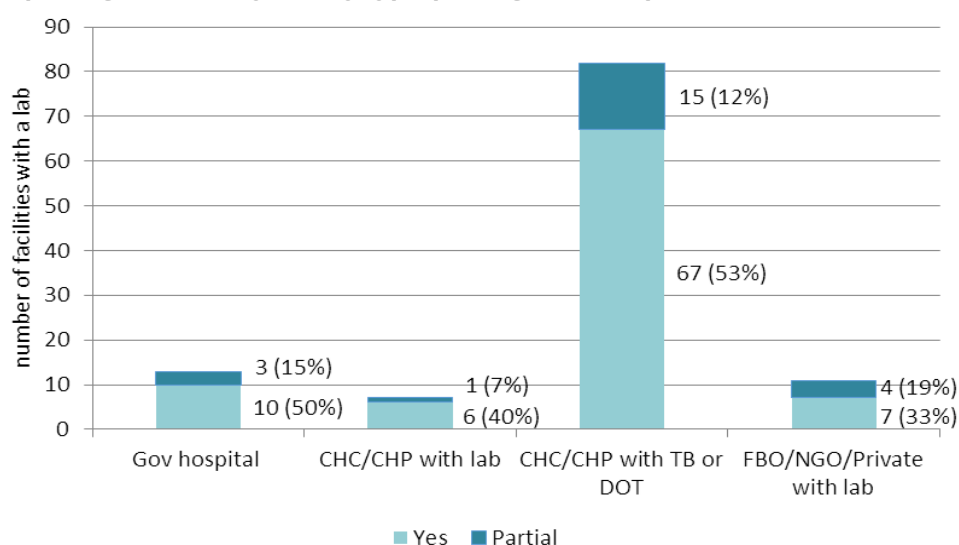
Standardised reporting

Standardised reporting is important to ensure accuracy and correctness of test results and findings and allows collation and analysis of data and to ensure that reports contain essential information. Two-thirds (65%) of the 184 facilities recorded specimens in a book, worksheet, computer or other comparable system. Of these, 81% recorded a unique ID number, 84% data of specimen receipt and 33% time of specimen receipt.

Standardised forms, such as a test request form, are an essential part of an information management system. Currently, 49% of facilities report using a standardised test request form. Of all health facilities that provided laboratory testing services, TB/DOT centres (53%) were most likely to use a standardised reporting format (see Figure 14). However, information captured in this form varies significantly, and essential information is often not included on the form: 37% of the standardised patient request forms used by laboratories recorded patient information, 34% specimen details and 29% clinical information. This indicates a need for standardisation of specimen request forms, to ensure that these contain essential data.

Insufficient standardised reporting can have many consequences, which is evident from the fact that 33% of facilities, including eight hospitals reported problems with collecting specimens as a result of incorrect patient identification.

Figure 14, Number and proportion of facilities with laboratories that reported full or partial use of standardised reporting formats, by facility type (among all n=184)



Information technology

Effective and timely communication of information is another essential requirement for a management information system. Technology, such as computers and phones, facilitate this. Only a few laboratories (8) reported having a designated phone at the laboratory, with many using their personal mobile phone. Most facilities had no systems in place for recording test results. If recorded, results were kept in a paper-based logbook, instead of entered into a digital database, as only eight facilities that perform laboratory tests reported having a computer with Internet access.

Information provision to patient

One-quarter (26%) of the 184 facilities analysed provide information to patients prior to collection (e.g. on fasting blood sugar). One-third (32%) of facilities, of which 12 government hospitals and three CHCs with laboratories, provide relevant information on costs and turnaround time for test results to patients. Two-fifths (40%) of facilities, of which 12 were government hospitals, provide timely notifications to patients when a delay is anticipated (e.g. owing to machine breakdown or interruptions in power supply).

4.9 Bio-risk Management

Key findings:

- One-ninth (11%) of facilities have health and safety protocols in place that define and document roles and responsibilities related to health and safety.
- One-half (51%) the facilities (including seven hospitals and seven CHCs) reported having received a visit during the last year from someone to assess health and safety at the facility.
- Staff at 40% of facilities had staff in place are trained on health and safety. One-quarter (27%) of facilities have laboratory staff who had received training in 2015.
- Over half (54%, $n=100$) of facilities could provide evidence of waste management procedures being in place.
- Shortages in supplies of essential biosafety and waste disposal equipment exist at all facility levels.

Laboratory safety is important in order to protect the lives of employees, patients and the community, and to protect the environment. Section 4.4 has highlighted the need for careful design of laboratory layout and facilities, to provide a proper and safe environment both for those conducting laboratory activities and for people in the community. This section will focus on the following aspects of safety:

- Health and safety policies/guidelines
- Health and safety assessment and control
- Implementation and operation
- Waste management procedures
- Biosafety and waste disposal equipment.

Health and safety policy/guidelines

Few facilities have adequate health and safety policy or guidelines in place. One-ninth (11%) of facilities, of which three government hospitals (Pujehun, Magburaka and Koidu Government Hospitals) and two CHCs with laboratories (Njama CHC in Moyamba and UMC Mission CHC in Kono), have health and safety protocols in place that define and document roles and responsibilities. This could be a result of the early onset of Ebola in Koidu (Kono) and Magburaka (Tonkoli)..

Kenema Government Hospital and UMC General Hospital (Western Urban area) were the only hospitals that were able to show guidelines related to accidents, incidents and non-conformities related to health and safety.

Further, information obtained via validation meetings revealed that a National Health and Safety Policy and in draft, but has not been finalised. In addition, a 'national biobanking and biosecurity workshop' was conducted in August 2015 to lay the foundation for a plan and protocols for safe storage of Ebola samples.

Based on this workshop, a policy and implementation strategy for safe storage of Ebola samples is currently under being developed on behalf of MoHS.

Health and safety assessment and control

Among all 184 facilities with a laboratories, there were only a minority who were able to demonstrate ability to identify and tackle bio-hazards. Only a fifth of government hospitals (20%) and none of the CHCs with laboratories had identified and documented hazards associated with their work. Three hospitals had health and safety control measures described in an action plan.

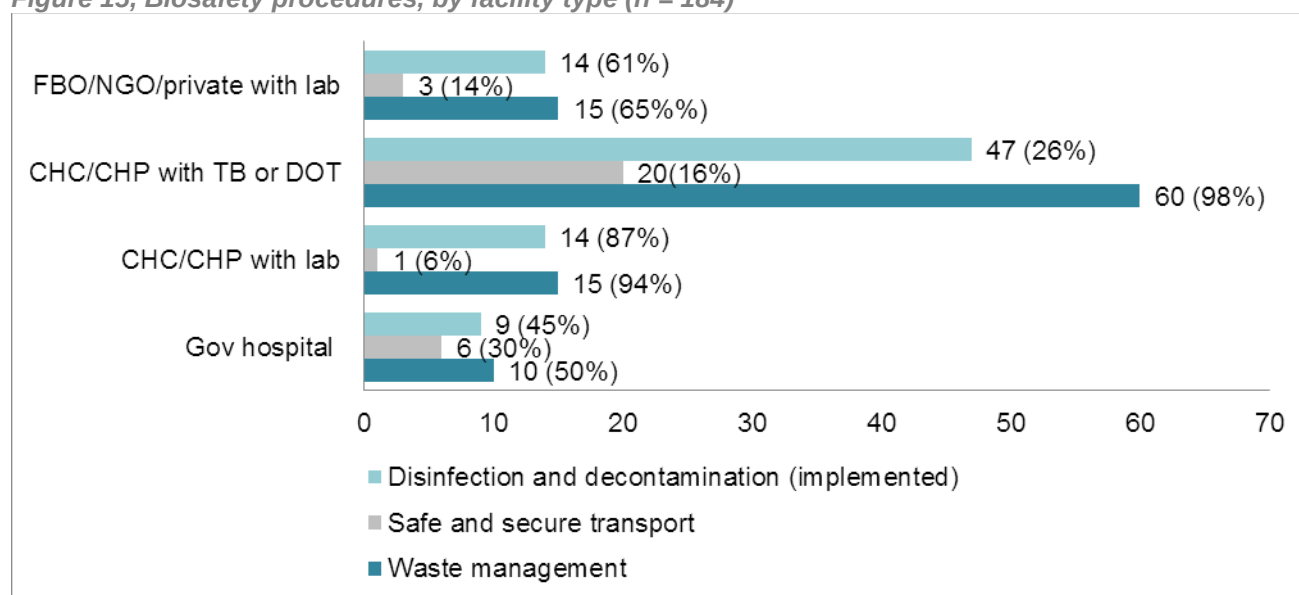
Twelve (7%) facilities were able to demonstrate that they had contingency procedures in place in case of an emergency or unforeseen event, of which Kenema and Connaught were the only government hospitals. Kenema Hospital was the only hospital that was able to provide its personnel with access to prophylactic or emergency treatment in case of exposure to contaminated materials.

Implementation and operation

Greater oversight over health and safety at laboratories is needed to make sure that health and safety procedures are implemented. One-half (51%) of facilities (including seven hospitals and seven CHCs) reported having received a visit during the last year from someone to assess health and safety at the facility. One-sixth (17%) of facilities (of which two hospitals and two CHCs with laboratory) had designated a safety officer to oversee health and safety at the laboratory, whose role was to provide advice on health and safety management. Most of these officers had been given the authority to stop all work at the laboratory if necessary.

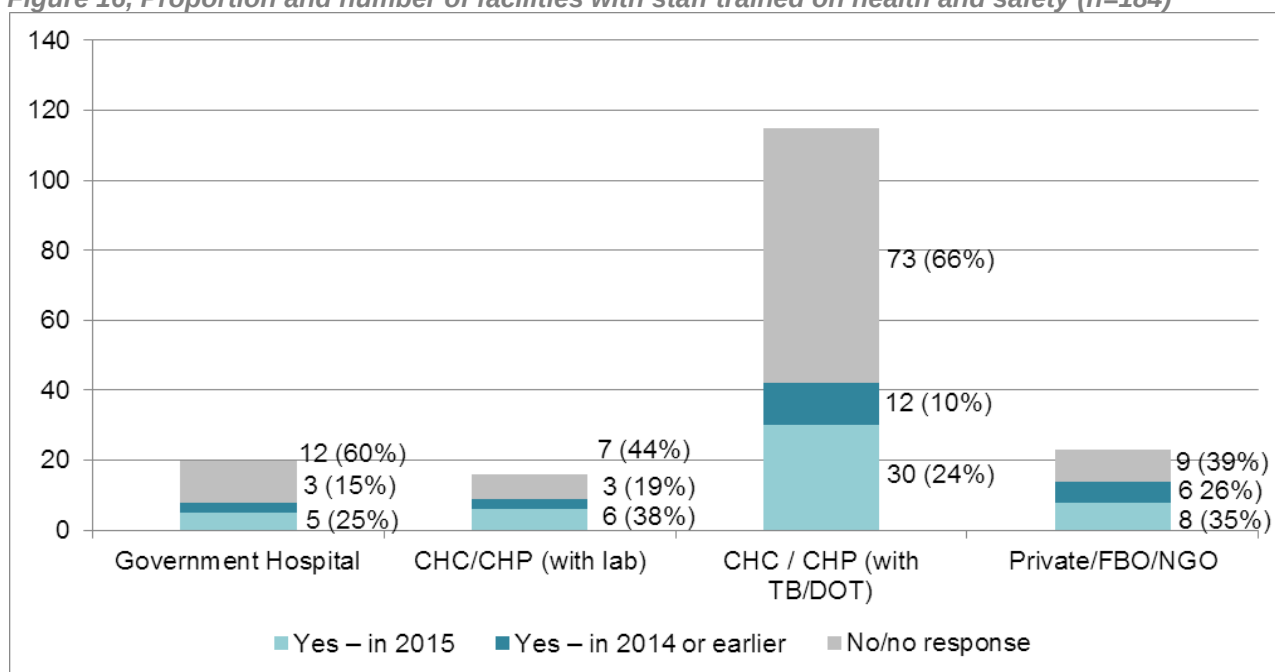
Although there were few facilities with health and safety procedures in place, there was a greater number of facilities with disinfection and decontamination procedures established: 46% of facilities, of which nine were hospitals and 14 were CHCs with laboratories, implemented such measures effectively (see Figure 15).

Figure 15, Biosafety procedures, by facility type (n = 184)



Staff at 40% of facilities had staff in place who were trained on health and safety. One-quarter (27%) of facilities had laboratory staff who had received training in 2015 (see Figure 16). Laboratory personnel in 56% of facilities demonstrated safe behaviour (e.g. no mouth pipetting, no recapping of needles, no smoking/eating in working areas).

Figure 16, Proportion and number of facilities with staff trained on health and safety (n=184)



Waste management procedures

At the time of writing, there is no national biosafety and waste disposal policy in place for medical diagnostic laboratories in Sierra Leone. Nonetheless, 100 (54%) of those with testing services could provide evidence of waste management procedures being in place; TB/DOT centres were the facilities most likely to have such procedures established (98%, see Figure 18).

Biosafety and waste disposal equipment

Shortages in biosafety and waste disposal equipment supplies need to be addressed urgently to protect the health and safety of staff and patients. Sufficient supplies of essential equipment, such as first aid kits, soap/hand sanitiser and gloves, should be available at all facilities. In particular, there is a shortage of first aid kits, which are only available in sufficient quantities at 7% of facilities. Availability of biosafety and waste disposal supplies at facilities with laboratories or TB/DOT centres is summarised in Table 11.

Table 11, Supplies of biosafety and waste disposal equipment, by facility type (n = 184)

Key:

- More than 80% of facilities have equipment available
- 30% - 80% of facilities have equipment available
- Less than 30% of facilities have equipment available

Tests	Gov hospital	CHC/CHP with lab	CHC/CHP with TB or DOT	FBO/NGO/Private with lab
Laboratory boots	55%	50%	34%	52%
Laboratory coats	70%	44%	56%	12%
Laboratory head gear	50%	25%	18%	43%
Laboratory nose mask	85%	69%	62%	82%
Laboratory shower	20%	0%	3%	13%
Protective eye goggles	65%	50%	46%	65%
First aid kit	5%	13%	5%	17%
Gloves	95%	75%	80%	87%
Hand sanitizer	70%	56%	40%	74%
Laboratory tissues	25%	31%	27%	52%
Soap/disinfectant	90%	75%	70%	83%
Water bath	65%	25%	11%	39%
Water distillation unit	55%	6%	1%	26%
Water purification chemicals or filter	10%	0%	12%	26%
Three-bucket system for decontamination	25%	6%	4%	17%

4.10 Laboratory Governance

Key findings:

- Some important laboratory management structures are in place, including a Directorate of Hospitals and Laboratory Services.
- There are insufficient guidelines that outline minimum requirements, standardisation and national systems to enable improved laboratory governance.
- No laboratory accreditation, registration and licensing systems are currently in place for laboratories; their establishment is an important condition for improving laboratory service quality, and most facilities lack audit mechanisms.
- Laboratories receive insufficient priority during government and facility-level planning and budgeting processes. Laboratory government budgets have not been allocated or protected.
- Laboratories and TB/DOT centres are funded through a mix of different sources, requiring strong coordination between government and donors.

This section outlines findings relating to laboratory governance systems and regulatory frameworks. These are essential to establish authority for the development, implementation, sustainable operation and quality management of laboratory services in Sierra Leone and to define standard procedures for all aspects of medical laboratory practice.

The previous sections indicate a need for guidelines that outline minimum requirements and national systems for:

- Essential tests and techniques, which require SOPs (Section 4.2)

- Specimen storage and referral guidelines (Section 4.3)
- Laboratory infrastructure, including essential facilities (Section 4.4)
- A scheme of service, certification and training for laboratory personnel (Section 4.5)
- Laboratory commodity procurement, supply and distribution (Section 4.6)
- Quality systems and standards (Section 4.7)
- LIMSs, including standardisation of specimen management and testing forms (Section 4.8)
- Biosafety and public health procedures and guidelines (Section 4.9)

In addition to these, the assessment raises/highlights key findings related to accreditation, licensing and registration of laboratories and TB/DOT centres.

Laboratory accreditation

Laboratory accreditation is a process by which an authoritative body gives formal recognition that a laboratory is competent to carry out specific tasks in a reliable, credible and accurate manner. Other benefits of a laboratory accreditation process include:

1. Standardisation of laboratory processes and tools
2. Provision of tools for guiding continuous improvement of laboratories
3. Recognition of compliance with a rigorous process of quality assurance
4. Quality management initiatives
5. Recognition of compliance with international standards.

Qualitative rapid assessment data indicated that, in the absence of a regulatory body, no government-approved accreditation process is currently in place for medical laboratories in Sierra Leone.

Audit mechanisms were lacking across the laboratory system; in Hospitals, half (60%) reported some kind of full or partial active laboratory internal audit programme and just over half (65%) had undergone some of audit by a third party in the previous 2 years. Only between 13 – 15% of CHC/CHPs with a laboratory with or without DOT/TB had an internal audit mechanism and between 0 – 13% had undergone an audit or assessment by a third party in the previous 2 years. (See table titled 'Licensing / Supervision / Accreditation' in section 11 of the *Data analysis Supplement*).

Registration and licensing

Public laboratories are registered with MoHS. Most private laboratories and TB/DOT centres currently register with the Medical and Dental Council of Sierra Leone and are required to register at the National Revenue Authority (NRA), to which they have to pay tax. A clear licensing system for private laboratories that is governed by an authoritative regulatory body is currently not in place. As a result, many laboratories were unable to answer whether or not they were licensed and/or instead presented the facility's registration certificate with the NRA as proof of registration or licensing.

Of the private facilities, 14 (61%) indicated that they were provided with a licence or were registered with MoHS. Of these, five (22%) could provide proof (see Figure 17), most often a tax certificate from the NRA. This indicates a need for improved regulation of private facilities.

Laboratory financing

Laboratories and TB/DOT centres are currently funded through different sources (see figure 18, over page). Most 132 (72%) of facilities with either laboratories or TB/DOT centres receive funding through the government (see Figure 18). User fees are collected in 9% (n=16) of facilities, as laboratories charge fees for services that are not part of the free maternal and child health package. Few non-governmental laboratories or TB/DOT centres are funded by user fees as many are faith-based and therefore rely mainly on donor funding. The main donors that fund laboratories and TB/DOT centres are the European Union, GFATM and religious organisations. Laboratories and TB/DOT centres rely to a certain extent on donor funding, with 70 (38%) receiving donor (or other) funds. This mix of different funding sources, with often more than one funding source per laboratory, necessitates coordination mechanisms between funding streams.

Feedback from participants in the focus group discussion and those attending the first round validation meeting revealed that laboratory experts in the country felt that they did not have adequate opportunities to participate in government planning meetings where decisions were made about resource allocation, and that budgets allocated to laboratories were not ring-fenced. As a result, the laboratory system was significantly underfunded, with other health departments being prioritised.

Figure 17, Private laboratories that indicated that they had a licence or were registered with MoHS (n=23)

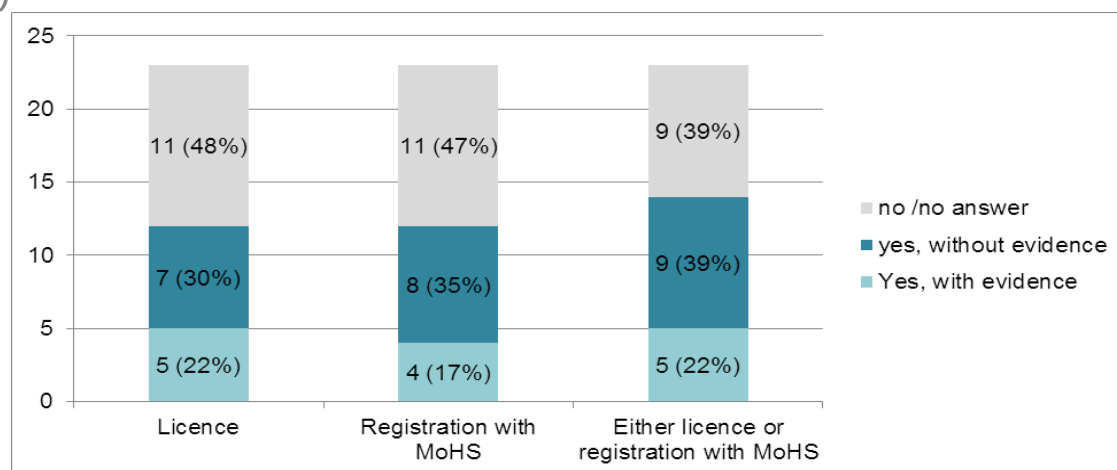
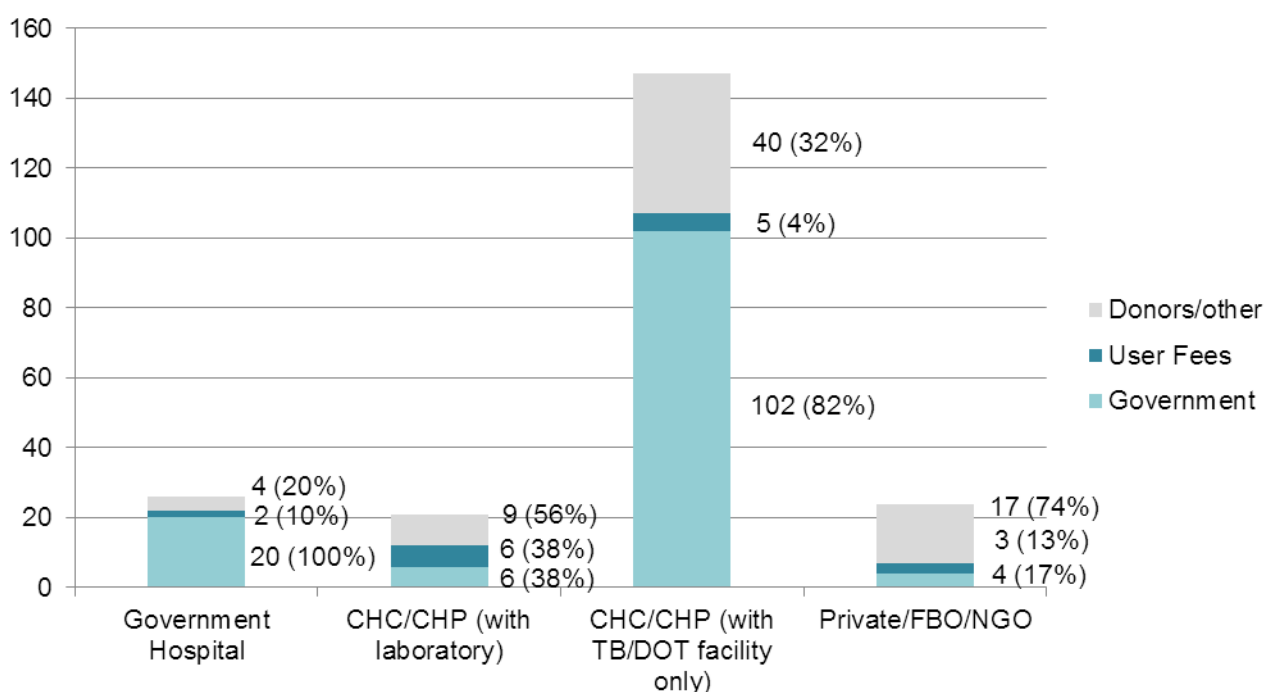


Figure 18, Funding sources, by facility type (n = 184)



5. Recommendations

This section provides recommendations to MoHS and partners on which elements in Sierra Leone's laboratory system require most urgent investment, based in the information as outlined in previous sections. In particular, it advises on how these findings should inform the National Laboratory Strategic Plan.

Recommendations provided include essential steps to achieve the mission statements, as outlined in the 2011 laboratory policy: *'To establish an integrated NPHLS [National Public Health Laboratory System] that will provide quality laboratory system management to support accurate diagnosis, treatment, prevention, surveillance, research and forensic service. To continually improve laboratory infrastructure, resource management, appropriate laboratory information systems and continued professional development to maintain an efficient and sustainable laboratory support service in Sierra Leone.'*

5.1 Key Priority Areas for Strengthening the Sierra Leone Laboratory System

The SWOT analysis has highlighted key priority areas for strengthening the country's laboratory system, which are presented here, thematically. Priority is given to each recommendation, by indicating if these are short term, medium term or long term.

1. Human resource systems for laboratory personnel need to be strengthened, including the availability of high-quality training programmes for all levels of laboratory staff, to enable Sierra Leone to become self-sufficient in generating laboratory personnel at all levels.
 - As soon as the National Scheme of Service for laboratory staff is finalised, stakeholders need to support the MoHS Health Service Committee in assessing and securing what resources are required to enable its implementation. Official designations should be reviewed against responsibilities and qualifications to ensure that all staff are clear on roles. A plan should then be developed to up-skill those performing tasks above their level of training/qualification to counter possible loss of motivation (short term).
 - In-Service training programmes need be developed to ensure regular and frequent continuing professional development of the laboratory work force .In the medium term, this will require that they are delivered in such a way that existing laboratory staff spend the minimum time away from their facility, so that available laboratory services are interrupted as little as possible (short t term).
 - To strengthen institutional training capacity of the laboratory work force, an in-depth assessment of training capacity and need in each district could be conducted that would help guide efforts to strengthen national laboratory training and education capacity. (short term),
 - Remuneration challenges require further investigation, followed by the development of a national remuneration scheme and implementation plan (short term).
 - All medical laboratory staff should be insured and vaccinated to protect their health and well-being. (short term)
 - A mapping of supervision mechanisms would help reveal the extent to which laboratories have some degree of supportive supervision (short term) and a systematic mechanism needs to be established to implement regular supportive supervision (medium term)
 - The capacity of existing training institutions needs to be built and their facilities upgraded to enable them to provide high-quality training pre-service programmes for all levels of laboratory staff, particularly Laboratory Technicians and Scientists. Close collaboration with the MOHS will be required to ensure training programmes deliver what is required in the public laboratory system. This could include training a core team of experts within MoHS to become Master Trainers. (Long term)
 - A dedicated and large-scale training programme for graduates needs to be implemented to support strengthening a skilled human resource base of laboratarians (long term).
 - As part of the above, recruitment efforts should target the country's science graduates (including chemistry and biology graduates) (medium term)
 - Well-equipped designated training facilities for medical laboratory personnel need to be established, in which laboratory graduates can obtain practical skills (long term).

2. Biosafety policies and procedures should be established, which laboratories should be enabled to observe, to ensure the safety of medical laboratory personnel, and the communities and environment surrounding the laboratory.
 - A national biosafety policy and associated protocols need to be established. Laboratories should be provided with biosafety equipment and health and safety training to ensure that they are able to adhere to these policies. Priority should be given to currently functional laboratories at government hospitals and CHCs (short term).
 - Health and safety protocols need to be developed for laboratories, including continuous training for laboratory staff on how to make sure that these are implemented (short term).
 - Standardised waste management procedures need to be developed. Laboratories should be enabled to implement these procedures, by provision of adequate waste management equipment and drainage systems(short term).
 - Clear guidance needs to be developed to specify hygiene and environmental standards for laboratories. Future plans for construction need to ensure adequate and ample working space for laboratory equipment and staff to reduce risk of biohazards (medium term).
 - Systems need to be established for regular external monitoring of laboratories' compliance with biosafety policies and protocols (medium term).
3. Infrastructure at key laboratories needs to be upgraded, with priority given to government hospitals and CHCs to enable them to provide safe and comprehensive testing services. Priority should be given to addressing power shortages, water supplies, cold storage and biosafety facilities.
 - The laboratory assessment data can be used to identify which laboratories are in most urgent need for renovation, taking into account: current laboratory infrastructure; laboratory capacity; population density in catchment area; burden of disease; and distance to other laboratories (short term).
 - An in-depth assessment of safe water supply among all hospitals and CHCs needs to be prioritised, with a plan to invest in a dedicated safe, running water supply for laboratory facilities (short term).
 - CHCs without electricity need to be equipped with standby generators, solar panels or power inverters, to enable 24-hour curative services to manage emergencies at night and the functioning of key laboratory equipment, such as cold storage equipment (short to medium term).
 - The laboratory assessment data can be used to conduct a 'gap analysis', identifying which priority facilities needs improvements in cold storage. It is advisable to prioritise hospitals and CHCs with testing capacity and reliable power sources. At facilities with insufficient energy supply, it is advisable to provide rapid testing kits until such sources are made available (short term).
 - Guidelines must be established that outline standards for the appropriate design and set-up of the laboratory, allowing ample and sufficient workspace to organise the work area and reduce risk of biohazards (medium term).
4. To increase access to testing services, referral networks needs to be established and supported by safe specimen transport means.
 - Investment is needed into transport, enabling the safe transport of specimens (short term as this can build on work underway in Ebola response).
 - There is a need for a national specimen transport policy. Specimen couriers should be monitored by their laboratory and provided with instructions to enable them to perform their role in line with the policy (short term, as this can build on work underway in Ebola response).
 - A referral system needs to be specified and disseminated so that each health facility or post – from community, MCHPs, CHPs and up to CHCs and hospitals – as well as laboratories need to be provided with referral guidelines and the details of their reference laboratory (short and medium term).
5. The laboratory supply chain system needs strengthening, to prevent interruption of services as a result of insufficient equipment or reagents.

- The laboratory assessment data can be used to conduct a 'gap analysis' that provides a list of the essential equipment that each facility needs to perform testing services as per the BPEHS, prioritising hospitals and CHCs with testing capacity (short term).
 - Sierra Leone's laboratory supply chain system needs a dedicated unit that can ensure the timely procurement and supply of good-quality laboratory equipment, consumables and reagents. The NPPU needs to be strengthened to perform this role and become the only centralised channel for procurement for all laboratories (long term).
 - Minimum specifications must be developed that supplement the itemised list provided in the BPEHS to encourage standardisation and quality of equipment used for providing clinical diagnostic testing services (short term).
 - A standardised equipment inventory and maintenance tools must be developed to ensure that laboratories can function in line with the BPEHS (short term).
6. A LIMS needs to be established to ensure improved availability and use of laboratory data. This will need to be designed in order to support both paper-based and computerised systems can be collated as many laboratories lack computing capability, and it will need to be a step-by-step process to support full computerisation of the LMIS.
- A data unit at the Directorate of Hospitals and Laboratory Services will need to be established that can lead overall management and administration of the LMIS, including the collation, analysis and appropriate exploitation of laboratory data, and make sure that findings are linked to broader health systems data to support evidence-based planning (short term) .
 - Data capturing tools need be developed and implemented that are context-specific (medium term)
 - Train specified personnel at the National Hospitals and Laboratory Directorate and at district level on data management and build their capacity to make sure that good-quality data are collected, analysed and used to inform decision-making (medium term).
 - A LIMS system should be established that feeds into the Integrated Disease Surveillance Response (IDSR) and HMIS. This will include the need to support collation and translation of results at different levels of the laboratory system (e.g. lab level, district level, national level) (long term).
7. High-quality management systems need to be strengthened with the introduction of accreditation mechanisms and implementation of EQA schemes.
- SOPs need be designed and implemented – to facilitate immediate implementation, a set of standardised SOPs at National level are suggested (short term).
 - In support of establishing monitoring of quality / readiness of laboratories establish a monitoring system which could include development and implementation of quality management tools that summarise key or proxy status of laboratory readiness and availability, drawing on models (such as scorecards) already implemented by MOHS for other spheres of the health system and that allow fast turn-around of findings to support evidence-based prioritization and planning (short term).
 - A laboratory accreditation system would facilitate improvements in laboratory service quality. An example of a document that can guide laboratory accreditation is the 'Stepwise Laboratory Improvement Process Towards Accreditation' (SLIPTA)¹⁸, which describes key elements of the laboratory quality improvement process. A similar accreditation process and checklist could be introduced, although this would need significant modification to ensure its effective application in the Sierra Leonean context, with lower minimum standards. (long term)
 - Scale-up of IQC and EQA schemes should be supported (medium term).
8. Essential laboratory practice, biosafety, quality, service, and equipment standards need to be agreed. Current laboratory governance structures need to be supported by a regulatory agency with the authority to implement and enforce these laboratory standards.
- Laboratory management and oversight capacity must be strengthened at regional level (short term).

¹⁸ WHO Regional Office for Africa, 2015. *WHO Guide for the Stepwise Laboratory Improvement Process Towards Accreditation in the African Region (SLIPTA)*. [Click here](#) for link to URL.

- The Directorate of Hospitals and Laboratory Services, which performs an essential oversight and coordination role, needs to be sufficiently resourced and supported by strong technical and laboratory leadership to play its key stewardship function effectively (short term).
 - A laboratory regulatory body should be established that will be responsible for setting and overseeing adherence to minimum laboratory safety-, quality-, infrastructure-, equipment – and human resource standards (medium to long term).
 - Laboratory registration and licensing procedures should be strengthened and implemented (medium term).
9. Laboratory funding mechanisms need to be strengthened and coordinated, and investment decisions informed by and channelled to priority needs.
- Considering the different laboratory funding sources, laboratory investment would benefit from improved coordination between government and donors. The National Laboratory Strategic Plan that will require a jointly developed and costed plan, outlining which investments will be funded by which partners. This would facilitate more efficient and transparent funding of laboratories and would ensure that donor support is aligned to government priorities (short term).
 - A 'Laboratory Revolving Fund' could be put in place to ensure that a core amount of funding is available and that laboratory managers have some control of their finances. Through the fund, laboratories would be required to record funds received through user fees and how funds are used (medium term).
 - To improve funding allocation, laboratories need to have adequate representation at planning and budget forums and the opportunity to input into district, regional and national government planning mechanisms; this would help ensure adequate prioritization in planning processes (medium to long term).
 - Laboratories need to receive dedicated and protected funds to ensure that they are sufficiently prioritised by decision-makers (medium to long term).

5.2 Next Steps

It is clear that the laboratory system is essential and crucial to the delivery of effective primary health care services in Sierra Leone. While the current laboratory system has some very strong points, for instance its reach to the most inaccessible communities through CHCs and CHPs, there are several enduring challenges that must be met if the laboratory system is to become more effective.

The upcoming National Laboratory Strategic Plan offers a prime opportunity to carry on the momentum that has been built throughout the Ebola epidemic and position laboratories as key components of both the recovery phase and the long-term health system in Sierra Leone. It is imperative that the strategy has clear and distinct milestones that can track the progress in the improving the laboratory system.

As part of the implementation of the national strategic plan it is recommended that:

- Clear milestones that are easily trackable be included in the national strategy. This will ensure that the strategy goes beyond setting policy and can have a sustained impact on the improvement of laboratory services
- The laboratory strategy be incorporated at the highest level, mainstreamed through the Presidential Delivery Unit, with implementation led by the Directorate of Hospitals and Laboratory Services.
- Frequent updates on the attainment of the strategy be made available to the Minister of Health and the Chief Medical Officer.
- A group of laboratory experts be appointed that will support the MoHS in reviewing progress in attainment of the National Laboratory Strategic Plan, provide suggested improvement and make necessary changes to the strategy to ensure that it reaches its objectives.
- The national strategy be considered as a live policy document that can respond to the fluid situation on the ground and aid utilisation of all available resources.
- The strategy and its enactment should be disseminated to all the district medical officers, DHMTs, and hospital and laboratory leads. This will ensure that the strategy is followed up at local level.

Definitions

Clinical diagnostic laboratories: provide laboratory diagnosis to support clinical management of patients.

Clinical analytical laboratories: undertake testing of non-clinical samples relevant to the maintenance of health or the detection of causes of disease.

Competency: the application of knowledge, skills and behaviours used in performing specific job tasks. Accurate laboratory test results depend on staff being competent in performing a range of procedures that occur throughout the entire examination process.

Continuous Professional Development: an educational programme that brings employees up to date in a particular area of knowledge or skills. Since laboratory medicine is constantly changing, keeping current takes effort on the part of both employee and management.

External Quality Assurance: the term EQA is used to describe a method that allows for comparison of a laboratory's testing to a source outside the laboratory. This comparison can be made to the performance of a peer group of laboratories or to the performance of a reference laboratory. The term EQA is sometimes used interchangeably with proficiency testing; however, EQA can also be carried out using other processes.

Licensure: granting of ability to practise. It is most often provided by a governmental agency, and is usually based on demonstrated knowledge, training and skills.

Reference/public health laboratories: these monitor the quality of the output of clinical and analytical laboratories by confirmatory testing of samples and isolates, performing specialised testing, and by implementing national quality assurance services. They also provide laboratory support for disease control and prevention including outbreaks and surveillance.

Regulation: any standard that is mandated by a governmental agency or authoritative body.

Standard: an authoritative document setting forth criteria for performance and characteristics. Standards may be issued by national, regional, or international standards bodies. Standards may be developed internationally, nationally or locally. Compliance to a standard may be required by government or another authoritative body, or may be voluntary.

Annex 1: Diagnostics included in this assessment against type of facilities that are expected to provide each test as specified in the 2015 Basic Essential Packages of Health Services, Sierra Leone

This table includes community and MCHP levels for completeness only. Red check marks (✓) highlights differences where tests are included in the 2015 BPEHS where they were not in the 2010 version.

Test	Comm- unity	MCHP	CHP	CHC	Hospital	Ref Centre	Changes in BPEHS 2015 compared to BPEHS 2010
Haematology							
Full blood count					✓	✓	no change
Haemoglobin		✓	✓	✓	✓	✓	no change
Haematocrit or PCV					✓	✓	no change
Blood film (morphology)		✓	✓	✓	✓	✓	Now also required at MCHPs, CHPs and CHCs
Prothrombin time, PTT					✓	✓	no change
Platelet					✓	✓	no change
Bleeding times					✓	✓	no change
clotting times					✓	✓	no change
Malaria RDT	✓	✓	✓	✓	✓		no change
Malaria Parasite		✓	✓	✓	✓	✓	no change
Sickle Cell disease (sickling)				✓	✓	✓	Now also required at CHCs
Blood group typing		✓	✓	✓	✓	✓	Now also required at CHPs
Biochemistry / clinical chemistry							
Random Blood Sugar (from POCT to Lab-based)		✓	✓	✓	✓	✓	no change
Glucosuria (rapid test - with urinalysis)	✓	✓	✓	✓	✓	✓	no change
Electrolytes					✓	✓	no change, but tests listed separately in BPEHS: sodium, potassium, phosphorous, Chloride, Magnesium
Bilirubin					✓	✓	no change
total protein, Albumin, Globulin					✓	✓	no change
aspartate aminotransferase (AST)					✓	✓	no change
alanine aminotransferase (ALT)					✓	✓	no change
Urea				✓	✓	✓	no change
Creatinine					✓	✓	no change
Uric Acid					✓	✓	no change
Pregnancy test (rapid test)	✓	✓	✓	✓	✓	✓	no change
Proteinuria (rapid test - with urinalysis)	✓	✓	✓	✓	✓	✓	no change
Microbiology							
Urine microscopy		✓	✓	✓	✓	✓	New BPEHS lists only 'routine microscopy for biological
Faecal Microscopy		✓	✓	✓	✓	✓	

Test	Comm- unity	MCHP	CHP	CHC	Hospital	Ref Centre	Changes in BPEHS 2015 compared to BPEHS 2010
HVS		√	√	√	√	√	specimens'
Gram staining (ie. Culture/identification + antibiogram)		√	√	√	√	√	Gram staining kit required at MCHP, CHP, CHC and hospital
Sputum microscopy		√	√	√	√	√	no change
Blood microscopy (Tryp, Filaria)			√	√	√	√	Now required at CHP and CHC facilities
Other specific parasite detection (Oncho - skin snip)			√	√	√	√	Now required at CHP and CHC facilities
Virology							no change
Syphilis test (TPHA, RPR)					√	√	no change
HIV rapid test					√	√	no change
Hepatitis B rapid test					√	√	no change
Hepatitis C rapid test					√	√	no change
Surveillance							
Widal (for enteric bacteria)					√	√	no change

Annex 2: List of Participating Facilities

A digital map of all participating facilities was produced, which can be found online:

<https://www.google.com/maps/d/edit?mid=zaSqVUe8fJfE.kg0pZZYWobN8>

Region	District	Name of Facility	Facility Location
Southern	Bo	M.M. Maternity MCHP	Sheriff Town
Southern	Bo	Sahn CHP	Sahn Village (Bumpe)
Southern	Bo	Bumpeh NGO CHC	Bumpe Town
Southern	Bo	Sowa Clinic	3 Brima Lane
Southern	Bo	Yemeh Town CHC	Yemeh Town
Southern	Bo	Jimmy Bagbo CHC	Jimmy Town
Southern	Bo	Gondoma CHC	Gondoma Town
Southern	Bo	Mamboma CHP	Mamboma Town
Southern	Bo	Dambala CHC	Dambala Town
Southern	Bo	Nafaya MCHP	27 Bo Kenema Highway
Southern	Bo	Bo Government Hospital	Bo City
Southern	Bo	Mercy Hospital	Kulanda Town Bo
Southern	Bo	New Police Barracks	New Police Barracks
Southern	Bo	Serabu Town	Serabu CHC
Southern	Bo	Koribondo CHC	Koribondo Town
Southern	Bo	Jembe CHC	Jembe Town
Southern	Bo	Sumbaya CHC	Sumbaya Town
Southern	Bo	Mongere CHC	Mongere Town
Southern	Bo	Ngalu CHC	Ngalu Town
Southern	Bo	Gerehun CHC	Gerehun Town
Southern	Bo	Tinkoko CHC	Tinkoko Town
Southern	Bo	Paramedical Kowama	Paramedical Compound Bo
Southern	Bonthe	Mobefa MCHP	Mobefa
Southern	Bonthe	YONI CHC	Yoni
Southern	Bonthe	Tissana CHC	Tissana
Southern	Bonthe	Torma Bum CHP	Torma Bum
Southern	Bonthe	Talia CHC	Talia
Southern	Bonthe	GBAP CHC	Gbap
Southern	Bonthe	Yagoi CHC	Yargoi
Southern	Bonthe	Lawana MCHP	Lawana
Southern	Bonthe	Mogbwoumo CHC	Mogbwoumo

Region	District	Name of Facility	Facility Location
Southern	Bonthe	Gbangbama CHC	Gbangbame
Southern	Bonthe	Mattru CHC	Mahru CHC
Southern	Bonthe	Madina Bun	Madina
Southern	Bonthe	Bendu CHC	Bendu - CHA
Southern	Bonthe	Motuo CHP	Motuo
Southern	Bonthe	Kabati CHP	Kaboti
Southern	Bonthe	Bonthe Government Hospital	Bonthe Island
Southern	Bonthe	Sierra Rutile Hospital	Siera Rutile
Southern	Bonthe	UBC Hospital	Mathru Jong
Southern	Bonthe	SLRC Mattru CHP	Mattru
Southern	Bonthe	Moriba Town CHC	Moriba Town
Southern	Bonthe	Tihun CHC	Thihun
Southern	Bonthe	Gambia CHC	Gambia CHC
Southern	Moyamba	Bradford CHC	Bradford
Southern	Moyamba	Mokondor CHP	Mokandor
Southern	Moyamba	Levuma Ngormeh CHP	Levuma Ngormeh
Southern	Moyamba	Gandorhun CHC	Grandorhun
Southern	Moyamba	Senehun CHC	Senehun
Southern	Moyamba	Mokorewa MCHP	Mokorewa
Southern	Moyamba	Mosenesie Junction CHP	Mosenesie Junction
Southern	Moyamba	Kabaima MCHP	Kabaima
Southern	Moyamba	Njama CHC	Njama
Southern	Moyamba	Moyamba Junction CHC	Moyamba Junction
Southern	Moyamba	Moyamba Government Hospital	Moyamba
Southern	Moyamba	Kongahun CHC	Kongahun
Southern	Moyamba	Sembehun CHC	Sembehun
Southern	Moyamba	Rotifunk CHC	Rotifunk CHC
Southern	Moyamba	Njala Hospital	Njala Mokonde
Southern	Moyamba	UMC clinic	Taiama
Southern	Moyamba	Bauya CHC	Bauya
Southern	Moyamba	Taiama CHC	Taiama
Southern	Moyamba	Bomotoke CHC	Bomotoke
Southern	Moyamba	Shenge CHC	Shenge
Southern	Moyamba	Gbangbatoke	Gbangbatoke

Region	District	Name of Facility	Facility Location
Southern	Moyamba	Mano CHC	Mano
Southern	Pujehun	Geoma Jorjoh CHP	Town
Southern	Pujehun	Blama CHC	Blama Town
Southern	Pujehun	Fairo CHC	Fairo CHC
Southern	Pujehun	Taninahun Malen CHC	Taninahun Town
Southern	Pujehun	Bandasuma CHC	Bandasuma Town
Southern	Pujehun	Gofor CHP	Gofor CHP
Southern	Pujehun	Dandabu CHP	Town
Southern	Pujehun	Bayama MCHP	Bayans Town
Southern	Pujehun	Makorma CHP	Mokorma Town
Southern	Pujehun	Sengema Malen CHP	Town
Southern	Pujehun	Karlu CHC	Karlu Town
Southern	Pujehun	Massam MCHP	Town
Southern	Pujehun	Pujehun Government Hospital	Pujehun Town
Southern	Pujehun	Maternity Government Hospital	Pujehun Town
Southern	Pujehun	Jendema CHC	Jendema Town
Southern	Pujehun	Bumpeh Peri CHC	Bumpeh Town
Southern	Pujehun	Sahn Malen CHC	Town
Southern	Pujehun	Gbondapi CHC	Town
Southern	Pujehun	Zimmi CHC	Zimmi
Southern	Pujehun	Bandajuma Sowo CHC	Bandajuma Town
Southern	Pujehun	Futa CHC	Futa
Southern	Pujehun	Potoru CHC	Potoru Town
Eastern	Kailahun	Dia CHC	Dia
Eastern	Kailahun	Mende-Buima MCHP	Mende-Buima
Eastern	Kailahun	Levuma CHP	Levuma Town
Eastern	Kailahun	Segbewema CHC	Segbewema Town
Eastern	Kailahun	Pejewa CHP	Pejewa Town
Eastern	Kailahun	Woroma CHP	Woroma
Eastern	Kailahun	Bendu Yawei CHP	Bendu Yawei
Eastern	Kailahun	Bandajuma Sinneh MCHP	Bandajuma Sinneh
Eastern	Kailahun	Dambu MCHP	Dambu
Eastern	Kailahun	Kangama CHP	Kangama Town
Eastern	Kailahun	Kailahun Government Hospital	Kailahun Town

Region	District	Name of Facility	Facility Location
Eastern	Kailahun	Nixon Memorial Hospital	Segbewma Town
Eastern	Kailahun	Hand Maids Catholic Clinic	Pendembu
Eastern	Kailahun	Buedu CHC	BUEDU TOWN
Eastern	Kailahun	Bandajuma CHC	Bandajuma Town
Eastern	Kailahun	Sandaru CHC	Sandaru Town
Eastern	Kailahun	Jojoima CHC	Jojoima Town
Eastern	Kailahun	Mobai CHC	Mobai Town
Eastern	Kailahun	Baiwalla CHC	Baiwalla Town
Eastern	Kailahun	Daru CHC	Daru Town
Eastern	Kailahun	Pendembu CHC	Pendembu Town
Eastern	Kailahun	Manowa CHC	Manowa
Eastern	Kailahun	Bunumbu CHC	Bunumbu Town
Eastern	Kailahun	Koindu CHC Lab	Koindu town
Eastern	Kenema	Negelehun MCHP	Ngelehun MCHP
Eastern	Kenema	Potehun MCHP	Potehun
Eastern	Kenema	Sarabu CHP	Sarabu
Eastern	Kenema	Loppa Dama CHP	Loppa
Eastern	Kenema	KATHOMBO MCHP	Kochombo MCHP
Eastern	Kenema	Dodo CHC	Dodo
Eastern	Kenema	Sendumei CHC	Sendumei
Eastern	Kenema	Blama CHC	Blama
Eastern	Kenema	Largo CHC	Largo
Eastern	Kenema	Gorahun CHC	Gorahun
Eastern	Kenema	Baoma Koya CHC	Baoma Koya
Eastern	Kenema	Tongo CHC	Tongo
Eastern	Kenema	Talia CHC	Talia
Eastern	Kenema	Goverment Hospital Kenema	Kenema City
Eastern	Kenema	Ahmaddiya Muslim Hospital	Hangha Rd. Kenema
Eastern	Kenema	Panguma Mission Hospital	Panguma
Eastern	Kenema	Nekabo CHC	Nehabo
Eastern	Kenema	Lowoma CHC	Lowoma
Eastern	Kenema	Boajibu CHC	Boajibu
Eastern	Kenema	Joru CHC	Joru

Region	District	Name of Facility	Facility Location
Eastern	Kenema	Levuma CHC	Levuma
Eastern	Kenema	Geima Dama CHP	Geima
Eastern	Kono	Tefeya CHC	Tefeya
Eastern	Kono	Kania CHP	Kania
Eastern	Kono	Njagbwema CHC	Njagbwema
Eastern	Kono	Kangama CHC	Kangama
Eastern	Kono	KAMADU CHP	Kamadu
Eastern	Kono	Koeyor MCHP	Koeyor
Eastern	Kono	Kimberdu CHC	Kimberdu
Eastern	Kono	Koidu CHP	Koidu
Eastern	Kono	Motema PHU	Motema
Eastern	Kono	Koraguima CHC	Koaquima
Eastern	Kono	UMC Mission CHC Jaiama	Jaiama
Eastern	Kono	Koidu Government Hospital	Koidu
Eastern	Kono	Wellbody Clinic	Koidu City
Eastern	Kono	Yormandu CHC	Yormandu
Eastern	Kono	Jaiama Sewafe CHC	Jaiama Sewafe
Eastern	Kono	Yengema CHC	Yengema
Eastern	Kono	Kayima CHC	Kayima
Eastern	Kono	Gandorhun	Gandorhun
Eastern	Kono	Kainkordu CHC	Kainkordu
Eastern	Kono	Tombodu CHC	Tombodu
Eastern	Kono	Kombayendeh CHC	Kombayendeh
Eastern	Kono	Boroma MCHP	Boroma

Region	District	Name of Facility	Facility Location
Northern	Bombali	Maforay MCHP	Maforay
Northern	Bombali	Makump CHP	Makump
Northern	Bombali	Masongbo CHC	Masongbo
Northern	Bombali	Masuba CHC	Makeni
Northern	Bombali	Masongbo Limba CHP	Masongbo Limba
Northern	Bombali	Mangay Loko MCHP	Mangay Loko
Northern	Bombali	Magbaikolie CHP	Magbaikolie
Northern	Bombali	Makeni Regional Hospital	Makeni
Northern	Bombali	Kamakwie Wesleyan Hospital	Kamawie
Northern	Bombali	Holy Spirit Hospital	Makeni Town
Northern	Bombali	Binkolo CHC	Binkolo
Northern	Bombali	Kalangba CHC	Kalangba
Northern	Bombali	Rokulan CHC	Rokulan
Northern	Bombali	Kamaranka CHC	Kamaranka
Northern	Bombali	Gbanti CHP	Gbanti
Northern	Bombali	Kamabia CHC	Kamabia
Northern	Bombali	Mapaki CHC	Maki
Northern	Bombali	Batkanu CHC	Batkanu
Northern	Bombali	Fintonia CHC	Fintona
Northern	Bombali	Kamalo CHC	Kamalo
Northern	Bombali	Kagbere CHC	Kagbero
Northern	Bombali	Gbendembu CHC	Gbendembu
Northern	Bombali	Stocco TB Clinic	Makeni
Northern	Kambia	Mafaray CHC	Mafany
Northern	Kambia	Masselleh CHP	Masselleh
Northern	Kambia	Barmoi Luma CHP	Barmoi Luma
Northern	Kambia	Meni Curve MCHP	Merri Curve
Northern	Kambia	Kawula CHP	Kawula
Northern	Kambia	Kania CHC	Kania CHC
Northern	Kambia	Dibia CHP	Dibia
Northern	Kambia	Numea CHP	Numea
Northern	Kambia	Modia MCHP	Modia MCHP

Region	District	Name of Facility	Facility Location
Northern	Kambia	Mafufuneh CHC	Mafufuneh
Northern	Kambia	Kambia Government Hospital	Kambia
Northern	Kambia	Ahmadiya Mission	Rokupr
Northern	Kambia	Gbolamuya CHC	Gbolamuya
Northern	Kambia	Rokupr CHC	Rokupr
Northern	Kambia	Mambolo CHC	Mambolo
Northern	Kambia	Barmoi Munu CHC	Barmoi Munu
Northern	Kambia	Bukuna CHC	Kukuna
Northern	Kambia	Madina CHC	Madina
Northern	Kambia	Kamasasa CHC	Kamasasa
Northern	Kambia	Kasirie CHC	Kosine
Northern	Kambia	Kychom CHC	Kychom
Northern	Kambia	Mapatolon CHC	Mepotolon
Northern	Koinadugu	Badala MCHP	Village
Northern	Koinadugu	Kamaro CHP	Town
Northern	Koinadugu	Community Faith Clinic	Town
Northern	Koinadugu	Falaba CHC	Town
Northern	Koinadugu	Seria MCHP	Town
Northern	Koinadugu	Yattaya CHP	Town
Northern	Koinadugu	Sawuria CHP	Town
Northern	Koinadugu	Yiffin CHC	Town
Northern	Koinadugu	Foria CHP	Village
Northern	Koinadugu	Yiraia CHP	Village
Northern	Koinadugu	Mongo CHC	Mongo Town
Northern	Koinadugu	Kurubola CHC	Town
Northern	Koinadugu	Fadugu CHC	Town
Northern	Koinadugu	Government Hospital Kabala	Kabala
Northern	Koinadugu	Narsarah Laboratory Kabala	Town
Northern	Koinadugu	Kondembaia CHC	Town
Northern	Koinadugu	Kamadugu Sokurela	Village
Northern	Koinadugu	Musaia CHC	Town
Northern	Koinadugu	Gbentu CHP	Town
Northern	Koinadugu	Sinkunia CHC	Town

Region	District	Name of Facility	Facility Location
Northern	Koinadugu	Bafodia CHC	Town
Northern	Koinadugu	Alikalia CHP	Alikalia Town
Northern	Port Loko	Pepel CHC	Pepel
Northern	Port Loko	Conakry dee CHC	Conakry Dee
Northern	Port Loko	Lunsar CHC	Lunsar town
Northern	Port Loko	Malal MCHP	Malal
Northern	Port Loko	Targrin CHC	Targrin
Northern	Port Loko	Sumbuya MCHP	Sumbuya
Northern	Port Loko	Konta Line CHP	Tonta Line
Northern	Port Loko	Lungi Government Hospital	Suctar
Northern	Port Loko	Government Hospital Port-Loko	Port Loko
Northern	Port Loko	Bai Bureh Memorial Private Hospital	Mahera
Northern	Port Loko	Saint John of God Hospital Mabesseneh	Lunsar
Northern	Port Loko	Petifu CHC	Petifu
Northern	Port Loko	Bailor CHP	Bailor
Northern	Port Loko	Babara CHC	Babara
Northern	Port Loko	Rogberie CHC	Rogbere Junction
Northern	Port Loko	Gbinty CHC	Gbinti
Northern	Port Loko	Sendugu CHC	Sendugu
Northern	Port Loko	Kambia Makama CHP	Kambia Makama
Northern	Port Loko	Kamasondo CHC	Kamasondo
Northern	Port Loko	Kagbanthama CHP	Kagbanthama
Northern	Port Loko	Mange CHC	Mange
Northern	Port Loko	Masiaka CHC	Masiaka
Northern	Tonkolili	Makokorie CHP	Makokori
Northern	Tonkolili	Magbass MCHP	Magbass
Northern	Tonkolili	Malone CHP	Malone
Northern	Tonkolili	Mabang CHC	Mabang
Northern	Tonkolili	Mamansosanka CHP	Mamansosanka
Northern	Tonkolili	Mamansokafla MCHP	Mamansokafla
Northern	Tonkolili	Goderich CHC	Goderich (Western Rural)
Northern	Tonkolili	Magburaka Government Hosital	Magburaka

Region	District	Name of Facility	Facility Location
Northern	Tonkolili	Lion Heart Hospital	Yele
Northern	Tonkolili	Weima CHC	Weima
Northern	Tonkolili	Matotoka CHC	Matotoka
Northern	Tonkolili	Yele CHC	Yele
Northern	Tonkolili	Mayeppoh CHP	Mayeppoh
Northern	Tonkolili	Bumbuna CHC	Bumbubuna
Northern	Tonkolili	Hinistas CHC	Mile 91
Northern	Tonkolili	Magbontor CHC	Magbontor
Northern	Tonkolili	Masingbi CHC	Masingbi
Northern	Tonkolili	Mara CHC	Mara
Northern	Tonkolili	Makali CHC	Makali
Northern	Tonkolili	Mathoir CHC	Mathoir
Northern	Tonkolili	Roruks CHP	Roruks
Northern	Tonkolili	Benduju CHC	Benduju
Western	Tonkolili	Masanga Hospital	Masanga
Western	Western Rural	Charlotte CHP	Charlotte
Western	Western Rural	Lakka Ogo Farm CHC	Lakka Ogo Farm
Western	Western Rural	Hasting CHC	Hastings
Western	Western Rural	Jui Police Clinic CHC	Jui
Western	Western Rural	Grafton CHC	Grafton
Western	Western Rural	Goderich Bks Mi Room CHC	Goderich
Western	Western Rural	Borah Maternity CHP	Devil Hole
Western	Western Rural	Leicester CHP	Leicester
Western	Western Rural	Benguima Mi Room CHC	Benguiman
Western	Western Rural	Tokeh MCHP	Tokeh
Western	Western Rural	York CHC	York Village
Western	Western Rural	Fourah Bay College CHC	Mount Aureol
Western	Western Rural	Heart and Hands	Grafton
Western	Western Rural	Shepherd Hospice	Allen Town
Western	Western Rural	S.L. China Friendship	Jui
Western	Western Rural	Songo CHC	Songo
Western	Western Rural	Waterloo CHC	Waterloo Town
Western	Western Rural	Newton MCHP/CHC	Newton

Region	District	Name of Facility	Facility Location
Western	Western Rural	Tombo CHC	Tombo Town
Western	Western Rural	Kissy Town CHP	Kissy Town Waterloo
Western	Western Rural	Fogbo CHP	Fogbo
Western	Western Rural	Regent CHC	Regent
Western	Western Urban	Tasly CHC	Grass Field
Western	Western Urban	Mayemi MCHP	
Western	Western Urban	Juba Mi Room CHP	Juba
Western	Western Urban	Thomson Bay MCHP	Thomson Bay
Western	Western Urban	Wilberforce CHC	Wilberforce
Western	Western Urban	Kroobay CHC	Kroobay
Western	Western Urban	FHM CHP	FHM
Western	Western Urban	Mabela MCHP	Mabella
Western	Western Urban	Susan's Bay CHC	Freetown
Western	Western Urban	34 Military Hospital	Wilberforce
Western	Western Urban	Connaught Hospital	Freetown
Western	Western Urban	Kingharman Road	Kingharman Road
Western	Western Urban	Rokupa Hospital	Eastern Part
Western	Western Urban	Macauley Government Hospital	Freetown
Western	Western Urban	PCMH/OLA During	Freetown
Western	Western Urban	Aberdeen Women Centre	Aberdeen
Western	Western Urban	UMC General Hospital	Kissy Freetown
Western	Western Urban	Murray Town CHC	Murray Town
Western	Western Urban	Wellington CHC	Wellington
Western	Western Urban	Kanikay CHC	Kanikay
Western	Western Urban	Kissi CHC	Kissi
Western	Western Urban	Dworzark CHC	Dworzark
Western	Western Urban	Calaba Town CHC	Calaba Town
Western	Western Urban	Grey Bush CHC	Grey Bush
Western	Western Urban	Lumley Government Hospital	Lumley

Annex 3: Hospital Laboratory Data Dashboard

	District	North						South				
		Bombali	Kambia	Koinadugu	Port Loko	Port Loko	Tonkolili	Bo	Bonthe	Moyambo	Pujehun	Pujehun
Hospitals		Makeni	Kambia	Kabala	Lungi	Port Loko	Magburaka	Bo	Bonthe	Moyambo	Pujehun	Maternity
		Regional Hospital	Government Hospital	Government Hospital	Government Hospital	Government Hospital	Government Hospital	Government Hospital	Government Hospital	Government Hospital	Government Hospital	Government Hospital
Waste Disposal Equipment												
	Laboratory boots	●	●	●	●	●	●	●	●	●	●	●
	Laboratory coats	●	●	●	●	●	●	●	●	●	●	●
	Laboratory head gear	●	●	●	●	●	●	●	●	●	●	●
	Laboratory nose mask	●	●	●	●	●	●	●	●	●	●	●
	Laboratory shower	●	●	●	●	●	●	●	●	●	●	●
	Protective eye goggles	●	●	●	●	●	●	●	●	●	●	●
	First aid kit	●	●	●	●	●	●	●	●	●	●	●
	Gloves	●	●	●	●	●	●	●	●	●	●	●
	Hand sanitizer	●	●	●	●	●	●	●	●	●	●	●
	Laboratory tissues (absorbent)	●	●	●	●	●	●	●	●	●	●	●
	Soap and disinfectant (including chlorine)	●	●	●	●	●	●	●	●	●	●	●
	Water bath	●	●	●	●	●	●	●	●	●	●	●
	Water distillation unit	●	●	●	●	●	●	●	●	●	●	●
	Water purification chemicals or filter	●	●	●	●	●	●	●	●	●	●	●
	3 bucket system for decontamination	●	●	●	●	?	●	●	●	●	●	●

District	East			West					
	Kailahun	Kenema	Kono	Western Urban	Western Urban	Western Urban	Western Urban	Western Urban	Western Urban
Hospitals	Kailahun Government Hospital	Kenema Government Hospital	Koidu Government Hospital	34 Military Hospital	Connaught Hospital	Kingharma Road Hospital	Macauley Government Hospital	PCMH/Ola During	Rokupa Hospital
Waste Disposal Equipment									
Laboratory boots	●	●	●	●	●	●	●	●	●
Laboratory coats	●	●	●	●	●	●	●	●	●
Laboratory head gear	●	●	●	●	●	●	●	●	●
Laboratory nose mask	●	●	●	●	●	●	●	●	●
Laboratory shower	●	●	●	●	●	●	●	●	●
Protective eye goggles	●	●	●	●	●	●	●	●	●
First aid kit	●	●	●	●	●	●	●	●	●
Gloves	●	●	●	●	●	●	●	●	●
Hand sanitizer	●	●	●	●	●	●	●	●	●
Laboratory tissues (absorbent)	●	●	●	●	●	●	●	●	●
Soap and disinfectant (including chlorine)	●	●	●	●	●	●	●	●	●
Water bath	●	●	●	●	●	●	●	●	●
Water distillation unit	●	●	●	●	●	●	●	●	●
Water purification chemicals or filter	●	●	●	●	●	●	●	●	●
3 bucket system for decontamination	●	●	●	●	●	●	●	●	●

District	North						South				
	Bombali	Kambia	Koinadugu	Port Loko	Port Loko	Tonkolili	Bo	Bonthe	Moyambo	Pujehun	Pujehun
Hospitals	Makeni Regional Hospital	Kambia Government Hospital	Kabala Government Hospital	Lungi Government Hospital	Port Loko Government Hospital	Magburaka Government Hospital	Bo Government Hospital	Bonthe Government Hospital	Moyambo Government Hospital	Pujehun Government Hospital	Maternity Government Hospital
Availability of Test/SOP/IQC/EQA											
Haemoglobin	●	●	●	●	●	●	●	●	●	●	●
SOP	●	●	●	●	●	●	?	●	●	●	?
IQC	●	●	●	●	●	●	?	●	●	●	?
EQA	●	●	●	●	●	●	?	●	●	●	?
Haematocrit	●	●	●	●	●	●	●	●	●	?	●
SOP			●	●							
IQC			●	●							
EQA			●	●							
Full blood count	●	●	●	●	●	●	●	●	●	●	●
SOP	●	●	●	●	●	●	?		●		
IQC	?	●	●	●	●	●	?		●		
EQA	?	?	●	●	●	●	?		●		
Blood Grouping	●	●	●	●	●	●	●	●	●	●	●
SOP	●	?	●	●	●	●	?	●	●	●	?
IQC	?	●	●	●	●	●	?	?	●	●	?
EQA	?	●	●	●	●	●	?	?	●	●	?
Platelet	●	●	●	●	●	●	●	●	●	●	●
SOP	●										
IQC	?										
EQA	?										
Peripheral Blood Film	●	●	●	●	●	●	●	●	●	●	●
SOP	●				●		?		●		
IQC	●				●		?		●		
EQA	●				●		?		●		

District Hospitals Availability of Test/SOP/IQC/EQA	North						South				
	Bombali	Kambia	Koinadugu	Port Loko	Port Loko	Tonkolili	Bo	Bonthe	Moyambo	Pujehun	Pujehun
	Makeni Regional Hospital	Kambia Government Hospital	Kabala Government Hospital	Lungi Government Hospital	Port Loko Government Hospital	Magburaka Government Hospital	Bo Government Hospital	Bonthe Government Hospital	Moyambo Government Hospital	Pujehun Government Hospital	Pujehun Maternity Government Hospital
Bleeding Time	●	●	●	●	●	●	●	●	●	●	●
SOP	?	●			●		?				?
IQC	?	●			●		?				?
EQA	?	●			●		?				?
Clotting Time	●	●	●	●	●	●	●	●	●	●	●
SOP	?	●			●		?				?
IQC	?	●			●		?				?
EQA	?	●			●		?				?
PTT	●	●	●	●	●	●	●	●	●	?	●
SOP			●								
IQC			●								
EQA			●								
Sickling	●	●	●	●	●	●	●	●	●	●	●
SOP	?	?	●	●	●	●	?	●	●	●	
IQC	?	●	●	●	●	●	?	●	●	●	
EQA	?	●	●	●	●	●	?	●	●	●	
Malaria parasites	●	●	●	●	●	●	●	●	●	●	●
SOP	?	●	●	●	●	●	?	●	●	●	
IQC	?	●	●	●	●	●	?	●	●	●	
EQA	?	●	●	●	●	●	?	●	●	●	
Urine microscopy	●	●	●	●	●	●	●	●	●	●	●
SOP	?	●	●	●	●	●	?	●	●	●	
IQC	?	●	●	●	●	●	?	●	●	?	
EQA	?	●	●	●	●	●	?	●	●	●	

District Hospitals Availability of Test/SOP/IQC/EQA	North						South				
	Bombali	Kambia	Koinadugu	Port Loko	Port Loko	Tonkolili	Bo	Bonthe	Moyambo	Pujehun	Pujehun
	Makeni Regional Hospital	Kambia Government Hospital	Kabala Government Hospital	Lungi Government Hospital	Port Loko Government Hospital	Magburaka Government Hospital	Bo Government Hospital	Bonthe Government Hospital	Moyambo Government Hospital	Pujehun Government Hospital	Pujehun Maternity Government Hospital
Gram staining	●	●	●	●	●	●	●	●	●	●	●
SOP		●						●			
IQC		●						●			
EQA		●						●			
Sputum for AFB (Ziehl Nielsen stain)	●	●	●	●	●	●	●	●	●	●	●
SOP	●	●	●	●	●	●	?	●	●	●	
IQC	?	●	●	●	●	●	?	●	●	●	
EQA	?	●	●	●	●	●	?	●	●	●	
Blood microscopy (Tryp, Filaria)	●	●	●	●	●	●	●	●	●	●	●
SOP	?	●					?	●			
IQC	●	●					?	●			
EQA	●	●					?	●			
Faecal microscopy	●	●	●	●	●	●	●	●	●	●	●
SOP	?	●	●	●	●	●	?	●			
IQC	?	●	●	●	●	●	?	●			
EQA	?	●	●	●	●	●	?	●			
HVS	?	●	●	●	●	●	●	●	●	?	●
SOP		●			●		?				
IQC		●			●		?				
EQA		●			●		?				
RDT for malaria	●	●	●	●	●	●	●	●	●	●	●
SOP		●		●	●						?
IQC		●		●	●						?
EQA		●		●	●						?

District Hospitals Availability of Test/SOP/IQC/EQA	North						South				
	Bombali	Kambia	Koinadugu	Port Loko	Port Loko	Tonkolili	Bo	Bonthe	Moyambo	Pujehun	Pujehun
	Makeni Regional Hospital	Kambia Government Hospital	Kabala Government Hospital	Lungi Government Hospital	Port Loko Government Hospital	Magburaka Government Hospital	Bo Government Hospital	Bonthe Government Hospital	Moyambo Government Hospital	Pujehun Government Hospital	Maternity Government Hospital
Skin snip (Oncho)	●	●	●	●	●	●	●	●	●	●	●
SOP		●		●	●	●	?	●	●	?	
IQC		●		●	●	●	?	●	●	●	
EQA		●		●	●	●	?	●	●	●	
Widal	●	●	●	●	●	●	●	●	●	●	●
SOP	?	●	●	●	●	●	?	●	●	●	
IQC	?	●	●	●	●	●	?	●	●	●	
EQA	?	●	●	●	●	●	?	●	●	●	
Blood glucose	●	●	●	●	●	●	●	●	●	●	●
SOP	?	●	●	●	●	●	?	●		●	
IQC	?	●	●	●	●	●	?	●		●	
EQA	?	●	●	●	●	●	?	●		●	
Protein	●	●	●	●	●	●	●	●	●	●	●
SOP	?	●				●	?			●	
IQC	?	●				●	?			●	
EQA	?	●				●	?			●	
Rapid pregnancy test	●	●	●	●	●	●	●	●	●	●	●
SOP	?	●		●	●	●	?	●	●	●	
IQC	?	●		●	●	●	?	●	●	●	
EQA	?	●		●	●	●	?	●	●	●	
Bilirubin	●	●	●	●	●	●	●	●	●	●	●
SOP	?						?			●	
IQC	?						?			●	
EQA	?						?			●	
AST	●	●	●	●	●	●	●	●	●	?	●
SOP	?										
IQC	?										
EQA	?										

District	North						South				
	Bombali	Kambia	Koinadugu	Port Loko	Port Loko	Tonkolili	Bo	Bonthe	Moyambo	Pujehun	Pujehun
	Makeni	Kambia	Kabala	Lungi	Port Loko	Magburaka	Bo	Bonthe	Moyambo	Pujehun	Maternity
	Regional Hospital	Government Hospital	Government Hospital	Government Hospital	Government Hospital	Government Hospital	Government Hospital	Government Hospital	Government Hospital	Government Hospital	Government Hospital
Availability of Test/SOP/IQC/EQA											
ALT	●	●	●	●	?	●	●	●	●	?	●
SOP	?										
IQC	?										
EQA	?										
Urea	●	●	●	●	?	●	●	●	●	?	●
SOP	?						?				
IQC	?						?				
EQA	?						?				
Creatinine	●	●	●	●	?	●	●	●	●	?	●
SOP	?						?				
IQC	?						?				
EQA	?						?				
Uric Acid	●	●	●	●	?	●	●	●	●	?	●
SOP	?						?				
IQC	?						?				
EQA	?						?				
Electrolytes	●	●	●	●	?	●	●	●	●	●	●
SOP	?										
IQC	?										
EQA	?										
Urinalysis	●	●	●	●	●	●	●	●	●	●	●
SOP	?	●	●		●	●	?	●	●	●	
IQC	?	●	●		●	●	?	●	●	●	
EQA	?	●	●		●	●	?	●	●	●	

District Hospitals Availability of Test/SOP/IQC/EQA	North						South				
	Bombali	Kambia	Koinadugu	Port Loko	Port Loko	Tonkolili	Bo	Bonthe	Moyambo	Pujehun	Pujehun
	Makeni Regional Hospital	Kambia Government Hospital	Kabala Government Hospital	Lungi Government Hospital	Port Loko Government Hospital	Magburaka Government Hospital	Bo Government Hospital	Bonthe Government Hospital	Moyambo Government Hospital	Pujehun Government Hospital	Maternity Government Hospital
HIV Rapid Test	●	●	●	●	●	●	?	●	●	●	●
SOP	●	●	●	●	●	●	?	●	●	●	?
IQC	●	●	●	●	●	●	?	●	●	●	?
EQA	●	●	●	●	●	●	?	●	●	●	?
RPR test for syphilis	●	●	●	●	●	●	●	●	●	●	●
SOP	?	●	●	●	●	●	?	●	●	●	?
IQC	?	●	●	●	●	●	?	●	●	●	?
EQA	?	●	●	●	●	●	?	●	●	●	?
HBsAg	●	●	●	●	●	●	●	●	●	●	●
SOP	?	●	●	●	●	●	?	●	●	●	?
IQC	?	●	●	●	●	●	?	●	●	●	?
EQA	?	●	●	●	●	●	?	●	●	●	?
HCV	●	●	●	●	●	●	●	●	●	●	●
SOP	?	●	●	●	●	●	?	●	●	●	?
IQC	?	●	●	●	●	●	?	●	●	●	?
EQA	?	●	●	●	●	●	?	●	●	●	?

District	East			West					
	Kailahun	Kenema	Kono	Western Urban	Western Urban	Western Urban	Western Urban	Western Urban	Western Urban
	Kailahun	Kenema	Koidu	34 Military	Connaught	Kingharma	Macauley	PCMH/Ola	Rokupa
	Government Hospital	Government Hospital	Government Hospital	Hospital	Hospital	Road Hospital	Government Hospital	During	Hospital
Hospitals									
Availability of Test/SOP/IQC/EQA									
Haemoglobin	●	●	●	●	●	●	●	●	●
SOP	●	?	●	●	●	●	●	●	●
IQC	?	?	●	●	●	●	●	●	●
EQA	?	?	●	●	●	●	●	●	●
Haematocrit	●	●	●	●	●	●	●	●	●
SOP	●	?		●	●		●	●	●
IQC	?	?		●	●		●	●	●
EQA	?	?		●	●		●	●	●
Full blood count	●	●	●	●	●	●	●	●	●
SOP	●	?	●	●	●	●	●	●	●
IQC	?	?	●	●	●	●	●	●	●
EQA	?	?	●	●	●	●	●	●	●
Blood Grouping	●	●	●	●	●	●	●	●	●
SOP	?	?	●	●	●	●	●	●	●
IQC	?	?	●	●	●	●	●	●	●
EQA	?	?	●	●	●	●	●	●	●
Platelet	●	●	●	●	●	●	●	●	●
SOP		?		●	●			●	
IQC		?		●	●			●	
EQA		?		●	●			●	
Peripheral Blood Film	●	●	●	●	●	●	●	●	●
SOP		?	●	●	●	●		●	
IQC		?	●	●	●	●		●	
EQA		?	●	●	●	●		●	

District	East			West					
	Kailahun	Kenema	Kono	Western Urban	Western Urban	Western Urban	Western Urban	Western Urban	Western Urban
	Kailahun	Kenema	Koidu			Kingharma	Macauley		
	Government Hospital	Government Hospital	Government Hospital	34 Military Hospital	Connaught Hospital	Road Hospital	Government Hospital	PCMH/Ola During	Rokupa Hospital
Hospitals									
Availability of Test/SOP/IQC/EQA									
Bleeding Time									
SOP		?							
IQC		?							
EQA		?							
Clotting Time									
SOP		?							
IQC		?							
EQA		?							
PTT									
SOP				?				?	
IQC								?	
EQA								?	
Sickling									
SOP		?							
IQC	?	?							
EQA	?	?							
Malaria parasites									
SOP		?							
IQC	?	?							
EQA	?	?							

District	East			West					
	Kailahun	Kenema	Kono	Western Urban	Western Urban	Western Urban	Western Urban	Western Urban	Western Urban
Hospitals	Kailahun Government Hospital	Kenema Government Hospital	Koidu Government Hospital	34 Military Hospital	Connaught Hospital	Kingharma Road Hospital	Macauley Government Hospital	PCMH/Ola During	Rokupa Hospital
Availability of Test/SOP/IQC/EQA									
Urine microscopy	●	●	●	●	●	●	●	●	●
SOP	●	?	?	●	●	●	●	●	●
IQC	?	?	●	●	●	●	●	●	●
EQA	?	?	●	●	●	●	●	●	●
Gram staining	●	●	●	●	●	●	●	●	●
SOP		?	?	●	●			●	
IQC		?	?	●	●			●	
EQA		?	?	●	●			●	
Sputum for AFB (Ziehl Nielsen stain)	●	●	●	●	●	●	●	●	●
SOP	●	?	?	●	●				●
IQC	?	?	?	●	●				●
EQA	?	?	?	●	●				●
Blood microsocopy (Tryp, Filaria)	●	●	●	●	●	●	●	●	●
SOP	?	?	●	●	●	●	●	●	
IQC	?	?	●	●	●	●	●	●	
EQA	?	?	●	●	●	●	●	●	
Faecal microscopy	●	●	●	●	●	●	●	●	●
SOP	●	?	●	●	●	●	●	●	●
IQC	?	?	●	●	●	●	●	●	●
EQA	?	?	●	●	●	●	●	●	●

District	East			West					
	Kailahun	Kenema	Kono	Western Urban	Western Urban	Western Urban	Western Urban	Western Urban	Western Urban
	Kailahun Government Hospital	Kenema Government Hospital	Koidu Government Hospital	34 Military Hospital	Connaught Hospital	Kingharma Road Hospital	Macauley Government Hospital	PCMH/Ola During	Rokupa Hospital
	Availability of Test/SOP/IQC/EQA								
HVS	●	●	●	●	●	●	●	●	●
SOP	●	?	●	●	●	●	●	●	●
IQC	?	?	●	●	●	●	●	●	●
EQA	?	?	●	●	●	●	●	●	●
RDT for malaria	●	●	●	●	●	●	●	●	●
SOP	?		●	●	●	●	●	●	●
IQC	?		●	●	●	●	●	●	●
EQA	?		●	●	●	●	●	●	●
Skin snip (Oncho)	●	●	●	●	●	●	●	●	●
SOP	●	?	●	●	●	●	●	●	●
IQC	?	?	●	●	●	●	●	●	●
EQA	?	?	●	●	●	●	●	●	●
Widal	●	●	●	●	●	●	●	●	●
SOP	●	?	●	●	●	●	●	●	●
IQC	?	?	●	●	●	●	●	●	●
EQA	?	?	●	●	●	●	●	●	●
Blood glucose	●	●	●	●	●	●	●	●	●
SOP	●	?	●	●	●	●	●	●	●
IQC	?	?	●	●	●	●	●	●	●
EQA	?	?	●	●	●	●	●	●	●
Protein	●	●	●	●	●	●	●	●	●
SOP	●	?	●		●			●	●
IQC	?	?	●		●			●	●
EQA	?	?	●		●			●	●

<i>District</i>	East			West					
	Kailahun	Kenema	Kono	Western Urban	Western Urban	Western Urban	Western Urban	Western Urban	Western Urban
	Kailahun	Kenema	Koidu	34 Military	Connaught	Kingharma	Macauley	PCMH/Ola	Rokupa
	Government Hospital	Government Hospital	Government Hospital	Hospital	Hospital	Road Hospital	Government Hospital	During	Hospital
<i>Availability of Test/SOP/IQC/EQA</i>									
Rapid pregnancy test	●	●	●	●	●	●	●	●	●
SOP	●	?	●	●	●	●	●	●	●
IQC	?	?	●	●	●	●	●	●	●
EQA	?	?	●	●	●	●	●	●	●
Bilirubin	●	●	●	●	●	●	●	●	●
SOP		?	●		●				
IQC		?	●		●				
EQA		?	●		●				
AST	●	●	●	●	●	●	●	●	●
SOP		?		?	●				
IQC		?		?	●				
EQA		?		?	●				
ALT	●	●	●	●	●	●	●	●	●
SOP		?			●				
IQC		?			●				
EQA		?			●				
Urea	●	●	●	●	●	●	●	●	●
SOP		?		●	●				
IQC		?		●	●				
EQA		?		●	●				
Creatinine	●	●	●	●	●	●	●	●	●
SOP		?			●				
IQC		?			●				
EQA		?			●				

District	East			West					
	Kailahun	Kenema	Kono	Western Urban	Western Urban	Western Urban	Western Urban	Western Urban	Western Urban
	Kailahun Government Hospital	Kenema Government Hospital	Koidu Government Hospital	34 Military Hospital	Connaught Hospital	Kingharma Road Hospital	Macauley Government Hospital	PCMH/Ola During	Rokupa Hospital
	Hospitals			Availability of Test/SOP/IQC/EQA					
Uric Acid									
SOP		?							
IQC		?							
EQA		?							
Electrolytes									
SOP		?							
IQC		?							
EQA		?							
Urinalysis									
SOP		?							
IQC	?	?							
EQA	?	?							
HIV Rapid Test									
SOP		?							
IQC	?	?							
EQA	?	?						?	
RPR test for syphilis									
SOP		?							
IQC	?	?							
EQA	?	?						?	

District	East			West					
	Kailahun	Kenema	Kono	Western Urban	Western Urban	Western Urban	Western Urban	Western Urban	Western Urban
Hospitals	Kailahun Government Hospital	Kenema Government Hospital	Koidu Government Hospital	34 Military Hospital	Connaught Hospital	Kingharma Road Hospital	Macauley Government Hospital	PCMH/Ola During	Rokupa Hospital
Availability of Test/SOP/IQC/EQA									
HBsAg	●	●	●	●	●	●	●	●	●
SOP	●	?	●	●		●	●	●	
IQC	?	?	●	●		●	●	●	
EQA	?	?	●	●		●	●	?	
HCV	●	●	●	●	●	●	●	●	●
SOP	●	?	●	●		●	●	●	●
IQC	?	?	●	●		●	●	●	●
EQA	?	?	●	●		●	●	?	●

<i>Education level</i>	Secondary Level Education and	Certificate	Diploma	Graduate	Post-Graduate	Total
Makeni Regional Hospital						
Laboratory Superintendent						1*
Laboratory Technician		2	19			21
Laboratory Assistant	1		2			3
Total	1	2	21			25
Kambia Government Hospital						
Laboratory Technician			4			4
Laboratory Assistant	5					5
Volunteer	1					1
Total	6		4			10
Kabala Government Hospital						
Laboratory Scientist			1			1
Laboratory Technician		1	1			2
Laboratory Assistant		1				1
Total		2	2			4
Lungi Government Hospital						
Laboratory Technician		1	3			4
Laboratory Assistant	3		1			4
Volunteer	1					1
Total	4	1	4			9
Port Loko Government Hospital						
Laboratory Technician			6			6
Laboratory Assistant	1	2				3
Clerical		1				1
Total	1	3	6			10

<i>Education level</i>	Secondary Level Education and	Certificate	Diploma	Graduate	Post-Graduate	Total
Magburaka Government Hospital						
Laboratory Superintendent			1			1
Laboratory Technician			1			1
Laboratory Assistant						3*
Total			2			5
Bo Government Hospital						
Laboratory Superintendent			1			1
Laboratory Technician			19			19
Laboratory Assistant		1				1
Total		1	20			21
Bonthe Government Hospital						
Laboratory Technician	1					1
Laboratory Assistant	2					2
Total	3					3
Moyambo Government Hospital						
Laboratory Superintendent			1			1
Laboratory Technician			7			7
Laboratory Assistant		1				1
Total		2*	8			10
Pujehun Government Hospital						
Laboratory Technician			7			7
Total			7			7
Maternity Government Hospital						
Laboratory Technician			2			2
Total			2			2

<i>Education level</i>	Secondary Level Education and	Certificate	Diploma	Graduate	Post-Graduate	Total
Kailahun Government Hospital						
Laboratory Superintendent		1				1
Laboratory Technician			9			9
Total		1	9			10
Kenema Government Hospital						
Laboratory Superintendent				1		1
Laboratory Technician			22			22
Laboratory Assistant						2*
Total			22	1		25
Koidu Government Hospital						
Laboratory Superintendent			1			1
Laboratory Scientist			1			1
Laboratory Technician	2		4			6
Laboratory Assistant	11		1			12
Total	13		7			20
34 Military Hospital						
Laboratory Superintendent			1		1	2
Laboratory Technician			6			6
Laboratory Assistant			1			1
Volunteer			4			4
Total			12		1	13

<i>Education level</i>	Secondary Level Education and	Certificate	Diploma	Graduate	Post-Graduate	Total
Connaught Hospital						
Laboratory Superintendent				1	1	2
Laboratory Technician	1	2	19			22
Total				2*		25
Kingharma Road Hospital						
Laboratory Technician	1		6			7
Total	1		6			7
Macauley Government Hospital						
Laboratory Superintendent						1
Laboratory Technician	1		2			3
Laboratory Assistant	1					1
Total	2		2			5
PCMH/Ola During						
Laboratory Technician	6		12			18
Laboratory Assistant	6		1			7
Total	12		13			25
Rokupa Hospital						
Laboratory Technician	4		3			7
Laboratory Assistant	1					1
Total	5		3			8

	North												South									
	Bombali		Kambia		Koinadugu		Port Loko		Port Loko		Tonkolili		Bo		Bonthe		Moyambo		Pujehun		Pujehun	
	Makeni Regional Hospital		Kambia Government Hospital		Kabala Government Hospital		Lungi Government Hospital		Port Loko Government Hospital		Magburaka Government Hospital		Bo Government Hospital		Bonthe Government Hospital		Moyambo Government Hospital		Pujehun Government Hospital		Maternity Government Hospital	
	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?
Equipment																						
Graduated Bottles with screw cap	●		●		●	●	●		●		●		●		●		●		●		●	
10ml Container with screw cap	●		●	●	●	●	●		●		●		●		●		●		●		●	?
Balance	●	●	●		●	●	●	?	●		●		●	●	●		●		●	●	●	●
Bunsen Burner	●		●		●	●	●		●		●		●	●	●		●		●		●	●
Hand centrifuge / centrifuge	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●		●	●
Waste bin	●	●	●		●	●	●	●	●	●	●		●		?	●	●	●	●		●	●
Haemocue machines	●	●	●	?	●	●	●		●	●	●		●	●	●	●	●		●		●	●
Haemoglobin Meters	●	●	?		●	●	●	●	●		●	●	●		●		●		●	●	●	●
Hand-washing sinks and taps or veronica buckets in all areas	●	?	●	●	●	●	●	●	●		●		●	●	●	●	●		●	●	●	●
Incinerators	●	●	●	●	●	●	●	●	●		●	●	●		●	●	●		●	●	●	●
Laboratory scale and weights	●	●	●		●	●	●	●	●		●	●	●		●		●	●	●		●	●
Manual pipette pump	●		●		●	●	●		●		●		●		●		●		●		●	
pH Meter, pH tester	●	●	●		●		●		●		●		●		●		●		●	●	●	●
Pipette stands	●		●		●	●	●	●	●		●		●	●	●		●	●	●		●	●
Serological pipette sets	●		●		●		●	●	●		●		●		●		●		●		●	
Sharps container	●	●	●	●	●	●	●	●	●	●	●		●	●	●		●	●	●		●	●
Slide racks	●	●	●		●		●	●	●	●	●		●		●		●	●	●		●	●
solar lights and backup generator	●		●		●	●	●		●		●		●		●	●	●		●		●	●
Spirit lamp	●		●		●	●	●		●		●		●		●	●	●		●	●	●	
Staining jars	●	●	●		●	●	●		●	?	●		●	●	●		●	●	●		●	
Stopwatch	●		●	●	●	●	●	●	●		●		●		●		●		●	●	●	
Storage tank	●		●		●		●		●		●		●		●		●		●		●	

	Bombali		Kambia		Koinadugu		Port Loko		Port Loko		Tonkolili		Bo		Bonthe		Moyambo		Pujehun		Pujehun	
	Makeni Regional Hospital		Kambia Government Hospital		Kabala Government Hospital		Lungi Government Hospital		Port Loko Government Hospital		Magburaka Government Hospital		Bo Government Hospital		Bonthe Government Hospital		Moyambo Government Hospital		Pujehun Government Hospital		Maternity Government Hospital	
	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?
Equipment																						
Thermometer	●		●		●		●		●		●	●	●		●		●		●	●	●	
Timer	●		●	●	●	●	●	●	●		●	●	●		●		●	●	●	●	●	
Water distillation unit	●	●	●	●	●		●	●	●	●	●	●	●	●	●		●		●		●	
Water purification chemicals or filter	●		●		●		●		●		●		●		●		●		●		●	
WHO Haemoglobin colour match	●	●	●		●		●		●		●		●	●	●		●		●		●	
Beakers (e.g. 50ml, 250ml, 1,000ml)	●	●	●		●	●	●	●	●	●	●	●	●		●		●		●	●	●	
Conical Flask (e.g. 250ml, 500ml, 1000ml)	●	●	●		●		●		●	●	●	●	●		●		●	●	●		●	
Glass cuvettes	●		●		●	●	●		●		●		●		●		●		●	●	●	
Glass dryer	●		●		●		●		●		●		●		●		●		●	●	●	
Glass slides	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
Measuring Cylinders (e.g. 10ml, 50ml, 500ml)	●	●	●	●	●	●	●	●	●	●	?	?	●		●		●	●	●	●	●	
Measuring jars, beakers, test tubes	●	●	●		●	●	●		●	●	?	?	●		●		●	●	●	●	●	
Volumetric Flask (e.g. 250ml, 1,000ml)	●	?	●		●		●		●		●		●		●		●		●	●	●	
First aid kit	●		●		●		●		●		●		●		●		●		●		●	
Tourniquet	●	?	●		●	●	●		●		?		●		●		●	●	●		●	

	North												South									
	Bombali		Kambia		Koinadugu		Port Loko		Port Loko		Tonkolili		Bo		Bonthe		Moyambo		Pujehun		Pujehun	
	Makeni Regional Hospital		Kambia Government Hospital		Kabala Government Hospital		Lungi Government Hospital		Port Loko Government Hospital		Magburaka Government Hospital		Bo Government Hospital		Bonthe Government Hospital		Moyambo Government Hospital		Pujehun Government Hospital		Maternity Government Hospital	
	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?
Lab Accessories																						
laboratory stools	●		●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
laboratory chairs	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Laboratory tables	●		●	●	●	●	●		●		●	●	●	●	●	●	●	●	●	●	●	●
Lockable reagent cupboards in laboratory areas	●	?	●	●	●	●	●		●		●	●	●		●	●	●	●	●	●	●	●
Office furniture	●		●		●	●	●		●		●	●	●	●	●	●	●	●	●	●	●	●
Shelves	●	?	●		●		●		●		●	●	●	●	●	●	●	●	●	●	●	●
Brooms/brush/mop	●	?	●		●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●

	North												South									
	Bombali		Kambia		Koinadugu		Port Loko		Port Loko		Tonkolili		Bo		Bonthe		Moyambo		Pujehun		Pujehun	
	Makeni Regional Hospital		Kambia Government Hospital		Kabala Government Hospital		Lungi Government Hospital		Port Loko Government Hospital		Magburaka Government Hospital		Bo Government Hospital		Bonthe Government Hospital		Moyambo Government Hospital		Pujehun Government Hospital		Maternity Government Hospital	
Consumables	In stock?	7 days' supply?	In stock?	7 days' supply?	In stock?	7 days' supply?	In stock?	7 days' supply?	In stock?	7 days' supply?	In stock?	7 days' supply?	In stock?	7 days' supply?	In stock?	7 days' supply?	In stock?	7 days' supply?	In stock?	7 days' supply?	In stock?	7 days' supply?
Alcohol swabs	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Aprons	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Biohazard bags	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Blood collection tubes	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Blood Lancet	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Biohazard bin	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Capillary tubes	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Cotton wool	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
coverslips	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Cryovial tubes	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Face shields	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Gloves	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Haemocue cuvettes	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Hand Sanitizer	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
laboratory tissues (absorbent)	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Microplate	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Microscope slides & cover slips	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Needles	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Syringes	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Pasteur pipette	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Powdered-disposable gloves	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Rexoguard Antiseptic Disinfectant	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Soap	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Disinfectant (including chlorine)	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Specimen collection cups	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Specimen collection tubes	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Specimen collection capillary tubes	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Test Tubes	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Vacuum Test Tube Plain / EDTA	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●

	North												South									
	Bombali		Kambia		Koinadugu		Port Loko		Port Loko		Tonkolili		Bo		Bonthe		Moyambo		Pujehun		Pujehun	
	Makeni Regional Hospital		Kambia Government Hospital		Kabala Government Hospital		Lungi Government Hospital		Port Loko Government Hospital		Magburaka Government Hospital		Bo Government Hospital		Bonthe Government Hospital		Moyambo Government Hospital		Pujehun Government Hospital		Maternity Government Hospital	
Consumables	In stock?	7 days' supply?	In stock?	7 days' supply?	In stock?	7 days' supply?	In stock?	7 days' supply?	In stock?	7 days' supply?	In stock?	7 days' supply?	In stock?	7 days' supply?	In stock?	7 days' supply?	In stock?	7 days' supply?	In stock?	7 days' supply?	In stock?	7 days' supply?
Personal Protective Equipment																						
laboratory boots												?				?						
Laboratory coats												?				?						
laboratory head gear												?				?						
laboratory nose mask												?										
laboratory shower								?														
Protective eye goggles												?										
Reagents												?										?
Ammonia Solution 35%		?																				
Determine,SD Bioline,&Unigold												?										
EDTA Anticoagulant												?										
Ethanol																?						
Field stain A&B,																						
Giemsa Stain Solution				?								?										
HBsAg Dipstrip												?										
HCV Dipstrip												?										
Immersion oil									?			?										
leishman stain																						
Malaria RDT kit												?										
Mutistix for urinalysis												?										
Normal saline												?										
Rapid Plasmareagin (RPR) test for syphilis												?										
Ziehl Nielsen stain												?										
Xylene												?										

	East						West									
	Kailahun		Kenema		Kono		Western Urban		Western Urban		Western Urban		Western Urban		Western Urban	
	Kailahun Government Hospital		Kenema Government Hospital		Koidu Government Hospital		34 Military Hospital		Connaught Hospital		Kingharma Road Hospital		Macauley Government Hospital		PCMH/Ola During	
	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?
Equipment																
Graduated Bottles with screw cap	●		●	?	●		●	●	●		●		●		●	
10ml Container with screw cap	●		●	?	●		●	●	●	●	●		●		●	
Balance	●	●	●	?	●		●	●	●	●	●		●		●	●
Bunsen Burner	●	●	●	?	●		●	●	●	●	●	●	●	●	●	
Hand centrifuge / centrifuge	●		●	?	●	●	●	●	●	●	●	●	●	●	●	●
Waste bin	●	●	●	?	●	●	●	●	●	●	●	●	●	●	●	
Haemocue machines	●	●	●	?	●		●		●	●	●	●	●		●	
Haemoglobin Meters	●	●	●	?	●		●	●	●	●	●		●		●	
Hand-washing sinks and taps or veronica buckets in all areas	●	●	●	?	●	●	●	●	●	●	?	●	●	●	●	●
Incinerators	●		●	?	●		●	●	●	●	●	●	●	●	●	
Laboratory scale and weights	●		●	?	●		●	●	●	●	●		●		●	●
Manual pipette pump	●		●	?	●	●	●		●	●	●		●		●	
pH Meter, pH tester	●		●	?	●		●		●	●	●		●	●	●	
Pipette stands	●		●	?	●		●	●	●		●		●	●	●	
Serological pipette sets	●		●	?	●		●	●	●	●	●		●		●	
Sharps container	●	●	●	?	●	●	●	●	●	●	●	●	●	●	●	●
Slide racks	●	●	●	?	●	●	●	●	●	●	●		●	●	●	●
solar lights and backup generator	●		●	?	●		●	●	●	●	●		●	●	●	
Spirit lamp	●		●	?	●	●	●		●	●	●		●		●	
Staining jars	●		●	?	●		●		●	●	●	●	●	●	●	●
Stopwatch	●	●	●	?	●		●	●	●		●	●	●	●	●	
Storage tank	●		●	?	●		●	●	●		●		●		●	

	East						West									
	Kailahun		Kenema		Kono		Western Urban		Western Urban		Western Urban		Western Urban		Western Urban	
	Kailahun Government Hospital		Kenema Government Hospital		Koidu Government Hospital		34 Military Hospital		Connaught Hospital		Kinghama Road Hospital		Macauley Government Hospital		PCMH/Ola During	
	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?
Equipment																
Thermometer	●		●	?	●		●	●	●	●	●		●		●	●
Timer	●	●	●	?	●	●	●	●	●	●	●		●		●	●
Water distillation unit	●		●	?	●		●	●	●	●	●	●	●		●	●
Water purification chemicals or filter	●		●		●		●		●		●		●		●	
WHO Haemoglobin colour match	●	●	●		●	●	●		●		●		●	●	●	●
Beakers (e.g. 50ml, 250ml, 1,000ml)	●	●	●	?	●		●	●	●	●	●	●	●	●	●	●
Conical Flask (e.g. 250ml, 500ml, 1000ml)	●	●	●	?	●		●	●	●	●	●		●	●	●	●
Glass cuvettes	●		●	?	●		●	●	●	●	●		●		●	●
Glass dryer	●		●	?	●		●	●	●	●	●		●		●	●
Glass slides	●	●	●	?	●		●	●	●	●	●	●	●	●	●	●
Measuring Cylinders (e.g. 10ml, 50ml, 500ml)	●		●	?	●	●	●	●	●	●	●	●	●	●	●	●
Measuring jars, beakers, test tubes	●		●	?	●		●	●	●	●	●	●	●		●	●
Volumetric Flask (e.g. 250ml, 1,000ml)	●	●	●	?	●		●	●	●	●	●		●		●	●
First aid kit	●		●		●		●	●	●		●		●		●	●
Tourniquet	●	●	●	?	●	●	●	●	●	●	●		●		●	

	East						West									
	Kailahun		Kenema		Kono		Western Urban		Western Urban		Western Urban		Western Urban		Western Urban	
	Kailahun Government Hospital		Kenema Government Hospital		Koidu Government Hospital		34 Military Hospital		Connaught Hospital		Kingharma Road Hospital		Macauley Government Hospital		PCMH/Ola During	
	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?
Lab Accessories																
laboratory stools	●	●	●	?	●	●	●		●	●	●	●	●	●	●	●
laboratory chairs	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●
Laboratory tables	●	●	●	?	●	●	●		●	●	●	●	●	●	●	●
Lockable reagent cupboards in laboratory areas	●	●	●		●		●	●	●	●	●	●	●	●	●	●
Office furniture	●		●		●		●	●	●	●	●	●	●	●	●	●
Shelves	●		●		●		●		●		●	●	●	●	●	●
Brooms/brush/mop	●		●	?	●	●	●	●	●		●		●	●	●	●

	East						West									
	Kailahun		Kenema		Kono		Western Urban		Western Urban		Western Urban		Western Urban		Western Urban	
	Kailahun Government Hospital		Kenema Government Hospital		Koidu Government Hospital		34 Military Hospital		Connaught Hospital		Kinghama Road Hospital		Macauley Government Hospital		PCMH/Ola During	
	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?
Consumables																
Alcohol swabs	●	●	?		●		●	●	●		●		●	●	●	●
Aprons	●	●	?		●	●	●	●	●	●	●	●	●	●	●	●
Biohazard bags	●	●	?		●	●	●	●	●	●	●	●	●	●	●	●
Blood collection tubes	●	●	?		●	●	●	●	●	●	●	●	●	●	●	●
Blood Lancet	●	●	?		●	●	●	●	●	●	●	●	●	●	●	●
Biohazard bin	●	●	?		●	●	●	●	●	●	●	●	●	●	●	●
Capillary tubes	●	●	?		●	●	●	●	●	●	●	●	●	●	●	●
Cotton wool	●	●	?		●	●	●	●	●	●	●	●	●	●	●	●
coverslips	●	●	?		●	●	●	●	●	●	●	●	●	●	●	●
Cryovial tubes	●		?		●		●	●	●	●	●		●	●	●	
Face shields	●	●	?		●	●	●	●	●	●	●		●	●	●	●
Gloves	●	●	?		●	●	●	●	●	●	●	●	●	●	●	●
Haemocue cuvettes	●	●	?		●	●	●	●	●	●	●	●	●	●	●	●
Hand Sanitizer	●		?		●	●	●	●	●	●	●	●	●	●	●	●
laboratory tissues (absorbent)	●		?		●	●	●	●	●	●	●	●	●	●	●	●
Microplate	●		?		●	●	●	●	●	●	●	●	●	●	●	●
Microscope slides & cover slips	●	●	?		●	●	●	●	●	●	●	●	●	●	●	●

	East						West									
	Kailahun		Kenema		Kono		Western Urban		Western Urban		Western Urban		Western Urban		Western Urban	
	Kailahun Government Hospital		Kenema Government Hospital		Koidu Government Hospital		34 Military Hospital		Connaught Hospital		Kinghama Road Hospital		Macauley Government Hospital		PCMH/Ola During	
	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?
Consumables																
Needles	●	●	?		●		●	●	●		●	●	●		●	●
Syringes	●	●	?		●		●	●	●		●	●	●		●	●
Pasteur pipette	●	●	?		●	●	●	●	●		●	●	●	●	●	●
Powdered-disposable gloves	●	●	?		●		●	●	●		●	●	●	●	●	●
Rexoguard Antiseptic Disinfectant	●		?		●		●	●	●		●	●	●	●	●	●
Soap	●		?		●	●	●	●	●	●		●	●	●	●	●
Disinfectant (including chlorine)	●	●	?		●	●	●	●	●	●		●	●	●	●	●
Specimen collection cups	●	●	?		●	●	●	●	●	●		●	●	●	●	●
Specimen collection tubes	●	●	?		●	●	●	●	?	●		●	●	●	●	●
Specimen collection capillary tubes	●	●	?		●	●	●	●	?	●		●	●	●	●	●
Test Tubes	●	●	?		●	●	●	●	?	●		●	●	●	●	●
Vacuum Test Tube Plain / EDTA	●		?		?		●	●	●	●		●	●	●	●	●
Personal Protective Equipment																
laboratory boots	●	●	?		●	●	●		●	●		●		●	●	●
Laboratory coats	●	●	?		●	●	●	●	●	●		●	●	●	●	●
laboratory head gear	●		?		●	●	●	●	●	●	●	●		●	●	●
laboratory nose mask	●	●	?		●	●	●	●	●	●	●	●		●	●	●
laboratory shower	●		?		●		?		●		●		●		●	
Protective eye goggles	●		?		●	●	●	●	●		●		●		●	

	East						West									
	Kailahun		Kenema		Kono		Western Urban		Western Urban		Western Urban		Western Urban		Western Urban	
	Kailahun Government Hospital		Kenema Government Hospital		Koidu Government Hospital		34 Military Hospital		Connaught Hospital		Kinghama Road Hospital		Macauley Government Hospital		PCMH/Ola During	
	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?	In stock?	Functional?
Reagents	?		?		●	●	●	●	●	●	●	●	●	●	●	●
Ammonia Solution 35%	●		?		●	●	●	●	●	●	●	●	●	●	●	●
Determine,SD Bioline,&Unigold	●	●	?		●	●	●	●	●	●	●	●	●	●	●	●
EDTA Anticoagulant	●	●	?		●	●	●	●	●	●	●	●	●	●	●	●
Ethanol	●		?		●	●	●	●	●	●	●	●	●	●	●	●
Field stain A&B,	●		?		●	●	●	●	●	●	●	●	●	●	●	●
Giemsa Stain Solution	●	●	?		●	●	●	●	●	●	●	●	●	●	●	●
HBsAg Dipstrip	●	●	?		●	●	●	●	●	●	●	●	●	●	●	●
HCV Dipstrip	●	●	?		●	●	●	●	●	●	●	●	●	●	●	●
Immersion oil	●		?		●	●	●	●	●	●	●	●	●	●	●	●
leishman stain	●		?		●	●	●	●	●	●	●	●	●	●	●	●
Malaria RDT kit	●	●	?		●	●	●	●	●	●	●	●	●	●	●	●
Mutistix for urinalysis	●	●	?		●	●	●	●	●	●	●	●	●	●	●	●
Normal saline	●		?		●	●	●	●	●	●	●	●	●	●	●	●
Rapid Plasmareagin (RPR) test for syphilis	●		?		●	●	●	●	●	●	●	●	●	●	●	●
Ziehl Nielsen stain	●	●	?		●	●	●	●	●	●	●	●	●	●	●	●
Xylene	●		?		●	●	●	●	●	●	●	●	●	●	●	●