Report

Fleming Fund: supporting surveillance capacity for antimicrobial resistance

Overview of the antimicrobial resistance surveillance systems for Ghana, Malawi, Nepal and Nigeria

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Executive summary

This study addresses part of the Terms of Reference for a scoping report '*An analysis of approaches to laboratory capacity strengthening for drug resistant infections in low and middle income countries*'. It has been produced as a separate report because it is also very relevant for a second study '*Supporting Surveillance Capacity for Antimicrobial Resistance: Regional Networks and Educational Resources'*. This study compares antimicrobial surveillance systems in three low and middle income countries in order to describe the components of these systems and to understand which surveillance models are best suited to particular contexts. Ghana, Nigeria and Nepal were selected as study countries because they cover different continents and include one 'fragile' context (Nigeria). Brief information from Malawi is also included.

Standardised data collection tools and approaches for assessing anti-microbial resistance (AMR) surveillance capacity at national level and in four laboratories in each country were provided to each in-country team. The data collection tools were based on published guidelines including the World Health Organisation's (WHO) Global Antimicrobial Resistance Surveillance System (GLASS) manual for early implementation of AMR surveillance systems, the OASIS tool for assessing epidemiological surveillance systems and a checklist for assessing regional laboratories' capacity for supporting neglected tropical diseases programmes. Data was obtained from interviews, observations of facilities and by reviewing relevant documents.

Ghana has no national AMR surveillance system but there is a draft AMR policy currently awaiting parliamentary approval. Three public health laboratories do carry some AMR activities and individual hospitals are beginning to collaborate on AMR for a limited range of diseases such as tuberculosis and cholera. Malawi has recently started an externally-supported surveillance programme. Nepal has a nation-wide, functional AMR surveillance system which is based only on laboratory data. Nigeria has a well-developed structure for collecting information on resistance to anti-tuberculosis drugs. Nigeria also has a system for checking the quality of antimicrobials but does not have federal polices relating to AMR surveillance.

Introduction

This study addresses part of the Terms of Reference for a scoping report '*An analysis of approaches to laboratory capacity strengthening for drug resistant infections in low and middle income countries*'. It has been produced as a separate report because although it was within these ToRs it is also very relevant for a second study '*Supporting Surveillance Capacity for Antimicrobial Resistance: Regional Networks and Educational Resources'*.

This study compares antimicrobial surveillance systems in three low and middle income countries (LMICs) to describe the components of these systems and to understand which surveillance models are best suited to particular contexts. Specifically the study aimed to:

- Identify different approaches for monitoring emergence and spread of resistance in different country settings, including the range of baseline data gathered.
- Assess the different approaches to monitoring resistance in each country and determine the best models and mechanisms for surveillance, capacity strengthening and training in the different country/regional settings.
- Produce a report documenting the different approaches for monitoring emergence and spread of resistance in each country and present the best models and mechanisms for surveillance, capacity strengthening and training in each.

Ghana, Nigeria and Nepal were selected as study countries because they represent at least two different continents and include one fragile state. They were also countries where we already had collaborations with reliable in-country teams that had the skills and availability to conduct such a study within a short time frame.

Information from Malawi was included in the report as one of the review team was visiting Malawi on another project and used the opportunity to meet with the head of the AMR reference laboratory. The information in this report concerning Malawi is therefore in less in-depth than that for Ghana, Nepal and Nigeria as it is based on one key informant interview and a brief visit to the AMR reference laboratory.

Standardised data collection tools and approaches were provided to each in-country team for assessing AMR surveillance capacity in Ghana, Nepal and Nigeria. However it is possible that the use of different in-country teams may have introduced a degree of variability in the way the assessments were carried out so information concerning inter-country comparisons should be interpreted with caution.

1. Overview of methodology used

1.1. Surveillance system assessment

A data collection tool was developed for assessing each country's anti-microbial resistance (AMR) surveillance network. This tool was developed from existing benchmark documents and was strongly influenced by the World Health Organisation (WHO) Global Antimicrobial Resistance Surveillance System (GLASS)(1) manual for early implementation of AMR surveillance systems and the OASIS tool for assessing epidemiological surveillance systems(2).

Data on national AMR surveillance systems was gathered primarily through key informant interviews in each of the countries (Ghana, Malawi, Nepal, Nigeria) by teams led by senior

microbiologists. Following piloting of the data collection process in Nepal, an additional tool was developed to collect AMR surveillance data from individual hospitals which were visited as part of the laboratory capacity assessment. Further details are provided in the relevant country sections.

1.2 Laboratory capacity assessment

Four laboratories were purposively selected in each country (apart from Malawi) for capacity assessment site visits. Laboratories were selected for diversity to represent the private and public sector and tertiary and secondary facilities. Laboratories were assessed using a modified version of the tool developed by Njelesani et al(3) for assessing regional laboratories' capacity for supporting neglected tropical diseases programmes. This tool was primarily derived from the international standard for medical laboratories ISO15189 and expanded to incorporate information from the EFQM excellence model(4), the SIDA evaluation model of HEPNet (5) and the UNDP Measuring Capacity document(6) to cover capacity strengthening areas related to networking and planning that are key requirements for sustainability. The content was modified to specifically focus on AMR and data were gathered from on-site interviews and observations. Further details are presented in the relevant country sections, as there were minor adaptations to the methods for the different contexts. Scores for the ISO15189 assessment were grouped according to quality system element(7).

2. Overview of the antimicrobial resistance (AMR) surveillance systems for Ghana, Malawi, Nepal and Nigeria

The data collected from each country show that their AMR surveillance systems are at very different stages of maturity. Only two of the countries had a national plan for AMR surveillance and these were both not yet finalised, and only one country (Nepal) had a national coordinating centre for AMR surveillance (table 2.1). AMR surveillance was limited to TB or selected conditions in three of the four countries and none had a national electronic AMR information system. Two countries relied on external funding to fully or partially sustain the AMR surveillance activities.

Two countries, Nepal and Malawi, had national reference laboratories for AMR but neither of these were internationally accredited (table 2.2). Nepal and Malawi have sentinel sites for AMR surveillance monitoring (only TB in Malawi) but only Nepal collects data from these sites regularly (table 2.3). None of the key informants were aware of any AMR programmes for animal or environmental monitoring in any of the countries investigated.

Ghana has no national AMR surveillance system but does have a draft policy currently awaiting parliamentary approval. There are individual projects on AMR and three public health laboratories that do some AMR work but this is mainly focused on tuberculosis and cholera. **Malawi** has recently started a surveillance programme with support from Norway (through NORAD). **Nepal** does have a functional AMR surveillance system with a national scope. However only laboratory data is available so its usefulness is limited because of the lack of clinical information. Laboratory guidelines exist for a priority specimen based approach but it was not clear if this approach or the laboratory-based approach was currently being implemented. **Nigeria,** Africa's most populated country, currently has a well-developed structure for collecting information only on resistance to anti-tuberculosis drugs. Nigeria does have a system for checking the quality of antimicrobials but there were no polices relating to AMR surveillance at federal level.

Table 2.1: Overview of surveillance systems for AMR by country

	Nepal	Ghana	Nigeria	Malawi
Is there a plan for AMR?	Draft	Draft	No	No
Is there a National Coordinating Centre	Yes	No	No	No
National Coordinating Centre location	National Public Health Laboratory, Teku, Kathmandu, Nepal	-	-	-
Surveillance Approach	Laboratory-based surveillance	TB only	TB only	Priority specimen[1]
Data collection	Paper based	-	-	Paper based
Sentinel Sites	18	-	-	5
Point Prevalence surveys in last 10 years	None			-
Funding source	Govt. Nepal	Danish govt. & ReAct for AMR	-	NORAD
Steering committee (meeting frequency)	Yes twice a year	-	-	-

[1]Specimen criteria not clearly defined

Table 2.2: AMR National reference laboratory profiles

	Nepal	Malawi
Name of reference laboratory for AMR	NPHL	CHSU
Location	Teku, Kathmandu, Nepal	Area 3, Lilongwe, Malawi
AST methodology	CLSI – Disc diffusion	EUCAST – Disc diffusion
ISO 15189 Accreditation	No	No
Technical Support	WHO country office	Universities of Tromso and Kwazulu Natal
AMR EQA scheme (frequency)	Yes (2-4/year)	
Funding	Govt. Nepal, WHO	Govt of Malawi, NORAD
Data management	WHO Net (electronic)	No Data

AST= Antimicrobial susceptibility testing
CHSU = Community Health Sciences Unit
CLSI = Clinical Laboratory Standards Institute
EUCAST = European Committee of Antimicrobial Susceptibility Testing
NPHL = National Public Health Laboratory, Kathmandu

Table 2.3: Sentinel sites

	Nepal	Malawi
Tertiary/urban	7	3
Tertiary/Urban and rural	9	0
Secondary/Urban	0	1
Secondary/Rural	2	1
AMR surveillance staff	1 per site	No information
Data reporting method	phone/fax/email	No information
Data collection frequency	Monthly or quarterly	No information
AST SOPs	Yes	Yes

Detailed descriptions of AMR surveillance and laboratory capacity in each of the countries is provided in the following sections.

3. Findings by country

3.1 Nepal

Description of methodology used for data collection in Nepal

A plan was made to visit four diverse laboratories including a central government laboratory, a tertiary level laboratory in a medical school and a district hospital laboratory. The laboratories were chosen to represent the different levels of AMR activities across Nepal. Permission to conduct the visit and to interview staff was obtained from the head of each facility prior to staring data collection. During interviews each question was explained and clarified to the interviewees and their answers to each item on the data collection tools were recorded. The laboratory facilities were visited and observed between the interviews and where possible, photographs were taken. Available documents and reports were collected. The findings in each laboratory are summarised below.

National Public Health Laboratory (NPHL) is the government national reference laboratory. Interviews with staff included a senior medical technologist and a microbiologist who were both working on AMR surveillance. Interviews were held in the afternoon after they had finished their peak workload of the day. The visit took four days and each interview lasted 2-3 hours.

Patan Hospital is a teaching hospital for the Patan Academy of Health Sciences. Interviews were held with two senior microbiologists working in the hospital laboratory and a microbiologist in the Oxford University Clinical Research (OUCRU)-Nepal unit. Interviews were carried out over 2-3 hours each day for three days.

Bhaktapur District Hospital is a government district hospital where an interview was carried out with one of the laboratory technologists.

Siddhi Memorial Hospital is a charity-run hospital for women and children where an interview was carried out with the laboratory in-charge.

Findings from Nepal

Scope of AMR surveillance

Nepal is currently finalising a national plan for AMR surveillance which s are:
- to improve awareness and understanding of antimicrobial resistance;
- to strengthen knowledge through surveillance and research;

- to reduce the incidence of infection;
- to optimize the use of antimicrobial agents; and
- develop the economic case for sustainable investment that takes account of the needs of all countries, and increase investment in new medicines, diagnostic tools, vaccines and other interventions.

Laboratory data on AMR are gathered from eighteen sentinel sites, eight within the Kathmandu valley and twelve outside the valley. Data on organisms and anti-bacterial agents are collected monthly from sites within the valley and quarterly from sites outside the valley (see Table 2.1).

Table 3.1: Pathogen-antimicrobial combinations on which the Nepal surveillance programme gathers data*

Organism	Antibacterial Class	Antibacterial agent	Monitored under GLASS	Notes
Salmonella spp (inlcd. Typhi, para typhi)	Quinolones	Nalidixic acid,	No	
		Ciprofloxacin	Yes	EUCAST requirement - perfloxacin
	Third generation cephalosporin	Ceftriaxone,	Yes	
	Sulphonamides and trimethoprim	Co-trimoxazole	No	
	Miscellaneous	Chloramphenicol	No	
Shigella spp	Quinolones	Nalidixic acid	No	
		Ciprofloxacin	Yes	
	Third generation cephalosporin	Ceftriaxone	Yes	
	Sulphonamides and trimethoprim	Co-trimoxazole	No	
	Miscellaneous	Chloramphenicol	No	
V.cholerae	Quinolones	Naldixic acid	No – data on *V.cholerae* not collected	
		Ciprofloxacin		
	Third generation cephalosporin	Ceftriaxone		
	Sulphonamides and trimethoprim	Co-trimoxazole		
	Miscellaneous	Chloramphenicol		
S.pneumoniae	Penicillin	Penicillin G	Yes	Oxacillin recommended for disc method
	Macrolide	Erythromycin	No	GLASS requirement – Azithromycin

Organism	Antibacterial Class	Antibacterial agent	Monitored under GLASS	Notes
	Quinolones	Ciprofloxacin	No	
	Third generation cephalosporin	Ceftriaxone	Yes	
	Miscellaneous	Chloramphenicol		
H.influenzae	Sulphonamides and trimethoprim	Co-trimoxazole	No - data on *H.influenzae* not collected	
	Penicillin	Ampicillin		
	Macrolide	Erythromycin		
	Quinolones	Ciprofloxacin		
	Third generation cephalosporin	Ceftriaxone		
E.coli	Carbapenems	Imipenem,	Yes	
	Carbapenems	Meropenem,	Yes	
	Aminoglycoside	Amikacin	No	
	Miscellaneous	Nitrofurantoin	No	
	Miscellaneous	Chloramphenicol	No	
	Third generation cephalosporin/beta lactamase inhibitor	Cefoperazone /sulbactam	No	GLASS recommends ceftriaxone, cefotaxime or ceftazidine
	Penicillin	Piperacilln-tazobactam		
S.aureus	Penicillin stable beta-lactam antibiotics	Cefoxitin	Yes	
	Quinolones	Ciprofloxacin	No	
	Macrolides	Erythromycin	No	
	Aminoglycoside	Gentamicin	No	
	Miscellaneous	Chloramphenicol	No	
	Oxazolidone	Linezolid	No	
Neisseria gonorrhoeae	No Data	No Data	No Data	No Data

Table 3.2 details pathogen-antimicrobial combinations that WHO recommends should be covered by an AMR surveillance system (i.e. GLASS guidance)(1) but which are not included in the Nepal system.

Table 3.2: GLASS Pathogen-antimicrobial combinations on which the Nepal surveillance programme does not gather data

Organism	Antibacterial Class	Antibacterial Agent
E.coli	Sulphonamides and trimethoprim	Co- trimoxazole
	Quinolones	Ciprofloxacin/levofloxacin
	Third generation cephalosporin	Ceftriaxone/cefotaxime/ceftazidime
	Fourth generation Cephalosporin	Cefepime
	Polymyxins	Colistin
	Penicillin	Ampicillin
K.pneumoniae	Sulphonamides and trimethoprim	Co- trimoxazole
	Quinolones	Ciprofloxacin/levofloxacin
	Third generation cephalosporin	Ceftriaxone/cefotaxime/ceftazidime
	Fourth generation cephalosporin	Cefepime
	Carbapenems	Imipenem,/meropenim/ertapenem/doripenem
	Polymyxins	Colistin
S.pneumoniae	Sulphonamides and trimethoprim	Co- trimoxazole
Salmonella spp	Carbapenems	Imipenem,/meropenim/ertapenem/doripenem
Shigella spp	Macrolide	Azithromycin
Acinetobacter baumannii	Tetracyclines	Tigecycline/minocycline
	Aminoglycosides	Gentamycin/Amikacin
	Carbapenems	Imipenem,/meropenim/ertapenem/doripenem
	Polymyxins	Colistin
Neisseria gonorrhoeae	Third generation cephalosporin	Cefixime/Cefriaxone
	Macrolide	Azithromycin
	Aminocyclitols	Spectinomycin
	Quinolones	Ciprofloxacin
	Aminoglycosides	Gentamycin

A. baumannii was not covered by the surveillance system possibly because it was not seen as a public health priority. *K.pneumoniae* was a surprising omission considering its role in the production of carbapenemases and their prevalence in the Indian sub-continent. *N. gonorrhoeae* is covered by the surveillance system but no isolates had been received.

Chloramphenicol, though not on the GLASS list of priority antibiotics, features regularly in the Nepalese surveillance, possibly indicating widespread use of this relatively cheap and effective (though toxic) drug. *V cholera* is also monitored, unsurprising in the Indian subcontinent.

Most of the antibiotics that WHO GLASS recommends should be included in an AMR surveillance system are being used by the Nepalese NPRL following an approved standard (CLSI) indicating that major changes in testing procedures in the laboratory would not be required. Guidance documents developed in partnership with WHO were present at the NPHL though it was not clear from key informant interviews if they were being used. A major change in the collection of data at the sentinel sites would be needed to meet the minimum GLASS criteria for the type of data collected.

National Level

National Coordinating Centre (NCC)
The NPHL act as the National Coordinating Centre (NCC) for AMR surveillance and is currently developing its Terms of Reference so it is at an early stage of strategic development. The NCC provides monitoring and logistical support and outbreak investigation, and organises training twice a year in bacteriology and AMR.

National Reference Laboratory
The NPHL is the only national reference laboratory for Nepal. The laboratory follows the CLSI standard for antimicrobial susceptibility testing and uses this standard for the sentinel sites. An SOP is in place for data collection. Internal quality control of laboratory materials and reagents is maintained by monitoring expiry dates and using control strains.

The NPHL is enrolled in an EQA programme with the National Institute of Health in Thailand who send out three isolates for identification and ANTIMICROBIAL SUSCEPTIBILITY TESTING . The NPHL runs an EQA scheme for sentinel sites consisting of two isolates sent out every three months to each centre for identification and ANTIMICROBIAL SUSCEPTIBILITY TESTING . Two microbiology technicians are assigned to work on AMR at the NPHL.

Field Organisation

The sentinel sites in the AMR surveillance network are detailed in Table 3.3. The vast majority are at tertiary level in zonal or regional hospitals. Each site has one person responsible for collating and reporting AMR data. This is requested and sent by phone, fax or email. Standard operational procedures for testing are standardised

across the sites. Refresher training of the laboratory staff at sentinel sites occurs every 2 years and annually at the NPHL. Sentinel sites should receive supervision visits four times per year but verification of the training and supervision visits at field sites indicated that the visits might be erratic due to a shortage of funds.

Table 3.3: AMR surveillance sites in Nepal

Name of the site	Address	Type (Primary/secondary/tertiary)	Location (rural/urban)	Data collection (inpatient/outpatient/community)	Type of data collected	Patient identification	Electronic/paper	Susceptibility testing (yes/no)
Kanti Children's Hospital	Kathmandu	Tertiary	Urban	no	Microbiological	no	Electronic/paper	Yes
Tribhuwan University Teaching Hospital (TUTH)	Kathmandu	Tertiary	Urban	no	Microbiological	no	Electronic/paper	Yes
Patan Hospital	Lalitpur	Tertiary	Urban	no	Microbiological	no	Electronic/paper	Yes
Kist Medical college	Kathmandu	Tertiary	Urban	no	Microbiological	no	Electronic/paper	Yes
Kathmandu Model Hospital	Kathmandu	Tertiary	Urban	no	Microbiological	no	Electronic/paper	Yes
Dhulikhel Hospital	Kabhre	Tertiary	Urban and rural	no	Microbiological	no	Electronic/paper	Yes
Western Regional Hospital	Pokhara	Tertiary	Urban	no	Microbiological	no	Electronic/paper	Yes

Name of the site	Address	Type (Primary/secondary/tertiary)	Location (rural/urban)	Data collection (inpatient/outpatient/community)	Type of data collected	Patient identification	Electronic/paper	Susceptibility testing (yes/no)
Manipal Teaching Hospital	Pokhara	Tertiary	Urban	no	Microbiological	no	Electronic/paper	Yes
BPKIHS	Dharan	Tertiary	Urban and rural	no	Microbiological	no	Electronic/paper	Yes
Mission Hospital Tansen	Palpa	Secondary	rural	no	Microbiological	no	Electronic/paper	Yes
Lumbini Zonal Hospital	Butwal	Tertiary	Urban and rural	no	Microbiological	no	Electronic/paper	Yes
Mechi Zonal Hospital	Jhapa	Tertiary	Urban and rural	no	Microbiological	no	Electronic/paper	Yes
Bheri Zonal hospital	Nepalgunj	Tertiary	Urban and rural	no	Microbiological	no	Electronic/paper	Yes
Seti zonal Hospital	Dhangadi	Tertiary	Urban and rural	no	Microbiological	no	Electronic/paper	Yes
Mid-Western Zonal Hospital	Surkhet	Tertiary	Urban and rural	no	Microbiological	no	Electronic/paper	Yes
Mahakali zonal hospital	Kanchanpur	Tertiary	Urban and rural	no	Microbiological	no	Electronic/paper	Yes

Name of the site	Address	Type (Primary/secondary/tertiary)	Location (rural/urban)	Data collection (inpatient/outpatient/community)	Type of data collected	Patient identification	Electronic/paper	Susceptibility testing (yes/no)
Koshi Zonal Hospital	Biratnagar	tertiary	Urban and rural	no	microbiological	no	Electronic/paper	Yes
Bayalpata Hospital	Accham	secondary	rural	no	microbiological	no	Electronic/paper	Yes

Data management

Data collected from sentinel sites is managed using WHO Net software. One person at the NPHL is responsible for data management. Data is reported as line data. The extent of data cleaning was not evaluated. Data has been used to determine AMR policy; a recent example was to change ciprofloxacin use in typhoid.

Strengths and weaknesses of the national surveillance system in Nepal

Strengths

- The surveillance network has the essential structural components; a national coordinating centre, a national reference laboratory and AMR surveillance sites.
- Laboratory capacity is acceptable. The network has functional surveillance sites, which are quality assured by the NPHL through regular EQA panels. The NPHL is also enrolled in a regional EQA programme. The AMR surveillance network is using a WHO GLASS approved ANTIMICROBIAL SUSCEPTIBILITY TESTING standard (CLSI).

Weaknesses

- The draft national policy for AMR needs to be approved.
- The data collection system from sentinel sites needs to be strengthened to ensure it is able to report the level of data required by WHO GLASS (e.g. length of admission > or < 2 days for in-patients).
- A priority specimen approach needs to be implemented across the network. Documentation exists for this but it was not clear from key informants if it had been implemented.
- Not all the GLASS organism and drug combinations were covered but this could quite easily be changed as a GLASS approved ANTIMICROBIAL SUSCEPTIBILITY TESTING methodology is already in place across the network.
- Supervision and training of sentinel sites needs to be well supported to ensure it can be conducted regularly.
- There was no diagnostic stewardship programme in Nepal.
- THE NPHL was not ISO15189 (or equivalent) accredited.

Laboratories visited in Nepal to determine capacity

Indicators of capacity development were based on those used by Njelesani et al(3). Overall the non-governmental laboratories (Siddi and Patan) seemed to be more developed than government laboratories in relation to the international quality standard for medical laboratories (ISO15189) and in quality monitoring. Unsurprisingly the NPHL was generally stronger in most areas than the lower level district hospital, Bhaktapur (tables 3.4 and 3.5). Tertiary level hospitals had more external interaction; Patan and NPHL had better AMR surveillance networking due to their higher-level involvement in surveillance. The non-governmental laboratories had markedly more opportunities for learning than both government laboratories.

Table 3.4 Characteristics of laboratories visited

Characteristics	Siddhi Memorial Hospital	Patan Hospital	NPHL	Bhaktapur hospital
Rural/Urban	Urban	Urban	Urban	Urban
Tier	Tertiary	Tertiary	Tertiary	Secondary
Private/public	NGO	NGO	Government	Government
Sentinel site	No	Yes	-	No
Who receives AMR data	Hospital doctors	Hospital doctors	WHO	Hospital doctors
Focal point for stewardship	No	Antibiotic Committee/Infection Control Committee, Drug and Therapeutic Committee	N/A	None
AST SOPs	No	Yes	Yes	Yes
AMR Notification	No	Monthly	-	No
Data collection	Electronic	Electronic & manual	Electronic & manual	Electronic & manual
Local usage	Yes	Antibiotic Committee	Yes	Yes
Last NPHL AMR training	None	2 years	-	Yes – No date
QMS supervision	None	WHO (1-2 months)	-	None
Stewardship policy/guidance	No	Yes	No	No

Table 3.5 Nepal laboratory capacity assessment scores

Capacity component (maximum points)	Nepal			
	NPHL	Patan	Bhaktapur	Siddhi
Laboratory strategies and communication (28)	5	8	1	3
Opportunities for organisational learning (26)	7	15	8	16
External interactions (22)	10	17	5	16
Financial resource management (22)	10	18	13	16
People and Equity (40)	18	13	15	22
AMR surveillance networking (40)	27	23	3	6
ISO15189 Quality System Element				
Safety (45)	26	23	16	30
Equipment (43)	14	20	19	38
Infrastructure (18)	7	15	7	12
Supply chain (28)	17	21	18	26
Specimen management (102)	56	45	27	44
Quality monitoring (117)	28	45	16	56
Personnel management (51)	18	21	16	33
Requesting and reporting (70)	34	18	38	46

Data and document management (27)	12	8	6	12
Client communication (22)	9	6	4	9
Organisation and finance (12)	9	8	6	6

3.2 Ghana

Description of methodology used for data collection in Ghana

Four institutions were selected for on-site visits: Korle-bu Teaching Hospital (KBTH), Cape Coast Teaching Hospital (CCTH), Koforidua Regional Hospital (KRH) and Kumasi Collaborative Research Centre (KCCR). They were chosen because they provided regional balance (i.e. geographical spread across the country) and the level of their capability and service (i.e. teaching hospital, regional hospital and a research centre). Due to difficulties in organising interviews at KBTH, which is the biggest hospital in Ghana, this site was replaced by Komfo Anokye Teaching Hospital (KATH), which is the 2nd largest teaching hospital in Ghana.

Structured and non-structured interviews, discussions and observations were used to obtain all required data in these institutions. A uniform style was used across all four centres so that data were comparable. An initial visit was made to each institution to meet the Institutional heads and the laboratory management teams to explain the purpose of study and to seek their approval to be involved in the assessment. Once the institutions agreed to be part of the study, official letters were sent to them by the Ghana team leader which contained more details of the study rationale and the assessment visits that were to be done. Subsequently, visit dates were agreed and assessments visits performed.

Each visit had 3 components:

- An introductory meeting with the laboratory manager or Head of institution. At this meeting, the team leader presented the background to the study, purpose and evaluable criteria/measures to be assessed. The institution provided details of the hospital and the laboratory and an outline of how the laboratories were run. This information included the management and functional structure, the mission and vision, operations including collaborations, research activities and human resource and financial management.
- A tour of the facility was undertaken after the initial meeting to collect information on the issues of interest in the checklist/surveillance tool. The tour gave the opportunity to interact, probe and ask further questions on anything mentioned at the entry meeting and to ask laboratory staff more detailed questions. During the tour SOPs, guidelines, manuals, minutes of meetings, research proposals and work protocols were sought for and inspected. Equipment, and related procedures and work flow were also observed. After this second component the team leader reviewed to interview guide and data tools to identify any gaps/information that had not been captured.
- The third component was a face-to-face meeting/interview with the laboratory heads or representatives to clarify specific issues that may have missed or not covered. More details were sought about past and present involvement in AMR surveillance and the

related issues. During this meeting, laboratory personnel or clinicians/users of the laboratory were also available for questioning.

To obtain the prevailing situation in the country, key personnel involved in AMR at the hospitals, universities and Ministry of Health were contacted and interviewed.

Findings from Ghana

Ghana does not currently have a national surveillance system for AMR though there are isolated projects going on around the country (tables 3.6 and 3.7)(e.g. pneumococcal and salmonella surveillance with WHO). There is a National Policy Platform group for AMR but they have not met regularly. Members are multi-disciplinary including medical doctors, pharmacists, veterinary doctors, microbiologists and policy makers. The objective of the group was to develop and implement a policy for containment of antibiotic resistance. Some of the specific objectives include establishing surveillance on antibiotic use and resistance, increasing capacity of health professionals and laboratories to deal with antibiotic resistance issues in the health system, review and enforce the regulations on antibiotics in Ghana, and generate data and information to behavioural change programmes and communications for rational use of antibiotics. After a situational analysis and some KAPB surveys, a draft national policy has been written and is awaiting approval by parliament and government of Ghana. The next action of the group is to write an implementation plan with a budget and a framework for monitoring and evaluation. This process is still on-going. The group does not collate ongoing information about AMR but has used one-off surveillance data. In fact the role of the group is not to collate information but rather put in place structures to ensure this is done.

Although there is little going on at the national level, there are isolated and independent activities to promote AMR surveillance within some hospitals. For example in some teaching hospitals, Infection Control committees are active and operational and make use of AMR information. There are also cross-collaborations across some hospitals to collate data on AMR. For example, the two major teaching hospitals (Korle-Bu and Komfo Anokye) are involved in prevalence and AMR surveillance for pneumococcal and haemophilus infections.

There is no specific body responsible for gathering data of distribution and use of antibiotics. The Ghana Food and Drugs Authority (FDA) is responsible for ensuring that only registered drugs are brought into the country and for ensuring that no expired or illegal drugs are kept on shelves or distributed. The Ministry of Health receives information about the amount of drugs used by each facility and by each region, but this is not done in a regular or systematic fashion. There is a pharmacovigilance unit at the FDA which is responsible for monitoring adverse events from drugs. The reporting system is voluntary and doctors have to obtain forms to document any drug reaction or adverse event they observe.

Sample of laboratories visited to determine capacity

Table 3.6 Characteristics of laboratories visited

Characteristic	KATH	CCTH	KRH	KCCR
Rural/Urban	Urban	Urban	Urban	Urban
Laboratory Tier	Tertiary	Tertiary	Secondary	Tertiary
Private/public	Government	Government	Government	NGO -Research
Who receives AMR data	Hospital management[1]	Hospital management[1]	No-one	N/A[4]
Focal point for stewardship	Partial implementation of antimicrobial stewardship	No stewardship	No stewardship	N/A
AST SOPs	Yes	Yes	Yes	Yes
Local antibiotic usage monitoring	Drug and Therapeutic committee & Infection Control Commitees[2]	Hospital directors[2]	Pharmacist	N/A
Stewardship policy/guidance	Protocols and guidelines available	No	Departmental level[3]	N/A

1. For workload monitoring only.
2. There have been broad discussions held to regulate antibiotic use but nothing concrete has been implemented. Antibiotic use is indirectly supervised by specialists who lead the clinical teams. There is no auditing or systematic feedback to prescribers
3. Recommended drugs are often not available or affordable for patients therefore implementation is difficult.
4. Laboratory not attached to hospital

All laboratories visited scored similarly for each Quality Systems Element of ISO15189. KRHs quality monitoring was lower than the other three laboratories.

Table 3.7 Ghana laboratory capacity assessment scores

Capacity component (maximum points)	Ghana			
	KATH	CCTH	KRH	KCCR
Laboratory strategies and communication (28)	27	16	17	12
Opportunities for organisational learning (26)	24	13	20	14
External interactions (22)	19	10	8	17
Financial resource management (22)	18	11	7	10
People and Equity (40)	35	25	30	29
AMR surveillance networking (40)	36	2	22	33
ISO15189 Quality System Elements				
Safety (45)	31	32	36	36
Equipment (43)	27	25	28	28

Infrastructure (18)	*17*	*17*	*16*	*16*
Supply chain (28)	*27*	*28*	*25*	*25*
Specimen management (102)	*44*	*47*	*43*	*56*
Quality monitoring (117)	*73*	*74*	*44*	*75*
Personnel management (51)	*38*	*38*	*39*	*38*
Requesting and reporting (70)	*48*	*38*	*36*	*40*
Data and document management (27)	*25*	*23*	*25*	*26*
Client communication (22)	*17*	*17*	*11*	*14*
Organisation and finance (12)	*11*	*11*	*11*	*11*

3.3. Nigeria

Description of methodology used for data collection in Nigeria

Selection of Sites for the Study

Nigeria does not have a national system for AMR Surveillance but the TB Control Programme has a functional resistance surveillance mechanism for TB drugs. There are also localised mechanisms for antimicrobial resistance monitoring in some tertiary facilities in the country. Selection criteria for facilities to visit were therefore that they should:

- Have a functional laboratory with culture and antimicrobial susceptibility testing facilities and resistance monitoring accordingly.
- Participate in TB control activities and belong to the network of laboratories involved in drug resistance-TB surveillance

Ten facilities comprising tertiary and secondary (public and private) were visited and four were selected based of the criteria. These were:

- Aminu Kano Teaching Hospital (AKTH): A tertiary public facility
- Infectious Diseases Hospital (IDH): A secondary Referral public facility
- Sir Muhammadu Sunusi Specialist Hospital (SMSSH): A secondary public facility
- Al-Noury Specialist Hospital (ASH): A secondary private facility

Selection of Key Informants

The key informants comprised heads of the selected facilities, other stakeholders at the facilities with knowledge or experience of antimicrobial drug administration, and representatives of state and federal ministries of health, the Pharmaceutical Society of Nigeria (PSN) and the Pharmaceutical Association of Nigeria (PAN).

Data Collection Strategies

Ethical approval was sought from the Kano State Ministry of Health, Aminu Kano Teaching Hospital and the Management of Annoury Hospital. Letters of support

were also written to the respective Heads of the selected facilities and the identified key informants by the LSTM CRU team.

Laboratory Assessments / key informant interviews

Visits to each facility lasted two days and comprised a general observation of laboratory infrastructure and activities, interviews with the laboratory manager and / or staff conducting antimicrobial susceptibility testing, observation of facilities, document verification and an interview with the head of the facility.

Key Informant Interviews

Interviews were held with four additional key informants to capture more information required by the AMR surveillance tool. Particular attention was paid to the drug resistance-TB Surveillance system across Nigeria, as an AMR surveillance system is not in place. Notes were taken from the interviews and information entered against the items in the AMR surveillance tool.

Findings from Nigeria

Nigeria does not currently have a national surveillance system for AMR and key informants were not aware of any plans to develop such a system. Some tertiary facilities have independent mechanisms for monitoring AMR but are not linked to any state, federal or international structures.

Nigeria does have a national surveillance system for monitoring drug resistance in TB and carried out a national TB drug resistance survey in 2012. The National TB and Leprosy control programme (NTBLCP) in the Federal Ministry of Health is responsible for multi-drug resistance (MDR) TB surveillance. It has a network of national and zonal laboratories comprising 210 sites across the country that support the detection of MDR TB with an MDR TB steering committee that meets every 6 months.

There are policies and guidelines in place to support the optimal use of antibiotics but only for TB, malaria and HIV. Recently the Nigerian Infectious Disease Society (NIDS) developed a 'Guide to Empiric Antibiotic Therapy for Common Severe Bacteria Infections in Adults'[1]. The guidelines recommend a biannual review of susceptibility and resistance patterns of the bacterial pathogens.

The National Agency for Food and Drug Administration and Control (NAFDAC), the Pharmacists Council of Nigeria and State Drugs Task Forces are responsible for the quality of antimicrobials in Nigeria. At laboratory levels, there are also some innovative approaches in reporting antimicrobial resistance using a scoring system that appears to differ from the CLSI system.

Engagement with Nigerian key federal and state policymakers on the importance of AMR surveillance is key to start progressing towards a surveillance system. A

[1] http://www.nigerianidsociety.com/Files/GuidetoempiricAntibiotics.pdf

participatory, systematic needs assessment and joint planning will be required to fully understand how a surveillance system for AMR could be established in Nigeria.

Sample of laboratories visited to determine capacity

A summary of the comparative characteristics and capacity of the four laboratories visited is provided in tables 3.8 and 3.9. Interestingly the tertiary government laboratory in AKTH scored lower in terms of meeting ISO15189 requirements compared to two of the secondary government laboratory in IDH and the private laboratory in ASH. However, the IHVN supported Virology Centre in AKTH (not included in the assessment) could score higher in terms of meeting ISO15189 requirements. Both IDH and ASH scores showed they were operating a QMS close to international standards due to intervention supports and supervision from non-governmental organizations including GFATM, FHI, IHVN, USAID, DFID and WHO through NACA and NTBLCP.

Resistance to antimicrobials in the four laboratories are reported as zones of inhibition ranging from 6.6 mm to 15 mm depending on the type of antimicrobial. AKTH and ASH showed to conform to the CLSI system (Resistant, Intermediate or Susceptible) with scoring of the Susceptibility result as 1+ (13mm – 18mm), 2+ (14mm – 22mm) or 3+ (15mm - 27mm) depending on the types of antimicrobials used. IDH, SMSSH and two other laboratories use an innovative scoring system using ranges of zones of inhibition in reporting resistance and grading sensitivities as 1+ (7mm – 13mm), 2+ (11mm – 18mm) or 3+ (>19mm) accordingly.

Table 3.8 Characteristics of laboratories visited

Characteristics	AKTH	IDH	SMSSH	ASH
Rural/Urban	Urban	Urban	Sub-Urban	Urban
Tier	Tertiary	Secondary	Secondary	Secondary
Private/public	Government	Government	Government	Private
Who receives AMR data	Hospital doctors	Hospital doctors	Hospital doctors	Hospital doctors
Focal point for stewardship	No stewardship	No stewardship	No stewardship	N/A
AST SOPs	Yes	Yes	Yes	Yes
Local antibiotic usage monitoring	Hospital directors[2]	Hospital directors[2]	Pharmacist	N/A
Stewardship policy/guidance	No	No	Departmental level[3]	N/A

Table 3.9 Nigeria laboratory capacity assessment scores

Capacity component (maximum points)	Nigeria			
	AKTH	ASH	IDH	SMSSH
Laboratory strategies and communication (28)	7	6	10	2
Opportunities for organisational learning (26)	13	15	20	12
External interactions (22)	13	9	14	11
Financial resource management (22)	11	11	10	6
People and Equity (40)	20	20	33	27
AMR surveillance networking (40)	6	12	2	0
ISO15189 Quality System Element				
Safety (45)	32	44	45	31
Equipment (43)	18	31	41	25
Infrastructure (18)	17	18	18	13
Supply chain (28)	24	27	27	17
Specimen management (102)	31	82	102	27
Quality monitoring (117)	30	113	113	27
Personnel management (51)	29	51	51	35
Requesting and reporting (70)	38	69	67	26
Data and document management (27)	16	25	25	21
Client communication (22)	11	21	21	1
Organisation and finance (12)	9	12	10	9

3.4 Malawi

Description of methodology used for data collection in Malawi

Malawi was not included in the original list of countries but an opportunity arose to briefly assess the national reference laboratory during a visit to Malawi for another project. Using the AMR surveillance tool one interview was held with the head of the AMR NRL and the NRL was visited.

Findings from Malawi

National Level

Malawi had recently instigated AMR surveillance coordinated thorough the Community Health Sciences Unit (CHSU) in Lilongwe. Laboratory space has been refurbished in CHSU and equipment purchased to strengthen National Microbiology Reference Laboratory. Technical assistance to establish an AMR surveillance system has been provided by Universities of Tromso and Kwazulu Natal. The refurbishment, equipment and technical assistance are part of the Antimicrobial Stewardship and Conservancy in Africa project funded by NORAD. There is no NCC or policy on AMR according to key informants. The National Microbiology Reference Laboratory uses

European Committee on Antimicrobial Susceptibility Testing standards for anti-microbial sensitivity testing.

Field Sites

Currently five sentential sites have been established for AMR (table 3.10).
The NRL currently performs ANTIMICROBIAL SUSCEPTIBILITY TESTING on isolates sent from surveillance sites. The criteria for referral to the NMRL is resistance to three or more antibiotics. There is an balanced mix of tertiary and secondary sites though they are predominately urban. Shortages of critical supplies have restricted the NMRL to providing EQA for the sites annually. They NMRL also provides annual training in AMR for sentinel sites.

Strengths and weaknesses of Malawi's AMR surveillance system

Strengths

- The NMRL uses WHO approved EUCAST standards for ANTIMICROBIAL SUSCEPTIBILITY TESTING .
- The NMRL staff are committed to improvement
- A network of sentinel sites has been established

Weaknesses

- A non-standard surveillance approach has been adopted. The NMRL should focus on gradually developing a priority specimen approach as defined in the GLASS guidelines(1).
- There is no policy on AMR
- There is a shortage of funding for NMRL to allow it to effectively carry out its EQA and testing functions.
- Specialist data management support is required

Table 3.10 Sentinel sites for AMR in Malawi

Name of the site	Address	Type (Primary/secondary/tertiary)	Location (rural/urban)	Data collection (inpatient/outpatient/community)	Type of data collected (microbiological/clinical/epidemiological)	Patient identification (yes/no)	Electronic /paper	Susceptibility testing (yes/no)
Kamuzu Central Hospital	Lilongwe	Tertiary	Urban	Inpatients and outpatient	microbiological	No data	No data	Yes
Karonga District Hospital	Karonga	Secondary	Urban	Inpatients and outpatient	microbiological	No data	No data	Yes
Matchinga District Hospital	Matchinga	Secondary	Rural	Inpatients and outpatient	microbiological	No data	No data	Yes
Mzuzu Central Hospital	Mzuzu	Tertiary	Urban	inpatients and outpatient	microbiological	No data	No data	Yes
Queen Elizabeths Central Hospital	Blantyre	Tertiary	Urban	Inpatients and outpatient	Not currently active	No data	No data	Yes

References

1. World Health Organisation. Global Antimicrobial Resistance Surveillance System. Manual for Early Implimentation. 2015.
2. Hendrikx P, Gay E, Chazel M, Moutou F, Danan C, Richomme C, et al. OASIS: an assessment tool of epidemiological surveillance systems in animal health and food safety. Epidemiol Infect. 2011;139(10):1486-96.
3. Njelesani J, Dacombe R, Palmer T, Smith H, Koudou B, Bockarie M, et al. A systematic approach to capacity strengthening of laboratory systems for control of neglected tropical diseases in Ghana, Kenya, Malawi and Sri Lanka. PLoS Negl Trop Dis. 2014;8(3):e2736.
4. EFQM. The EFQM Excellence Model [Available from: http://www.efqm.org/the-efqm-excellence-model.
5. Erlandsson BG, V. Evaluation of HEPNet in SSA. 2005.
6. United Nations Development Programme. Measuring Capacity 2010 [Available from: http://www.undp.org/content/undp/en/home/librarypage/capacity-building/undp-paper-on-measuring-capacity.html.
7. Datema TA, Oskam L, Engelberts MF, van Beers SM, Shinnick TM, Baker M, et al. Global laboratory initiative tool for a stepwise process towards tuberculosis laboratory accreditation. Int J Tuberc Lung Dis. 2012;16(5):704-5.