Ethiopia Antimicrobial Resistance Surveillance

Annual Report (2nd Year)

September 2018 – October 2019

Ethiopian Public Health Institute

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Foreword

Antimicrobial resistance (AMR) is a global public health concern and is a priority for Ethiopia. In recognition of this problem, combating the burden of AMR has given high priority by the Federal Ministry of Health (FMOH). To this end, strengthening AMR surveillance system was one of EPHI's flagship initiatives since 2019.

This annual report presents progress made in the second year of the implementation of Ethiopia's Laboratory-Based AMR surveillance system from September 2018 to October 2019. Although, the surveillance system is extremely young to generate quality data for designing intervention strategies and actions, it provides information on antimicrobial resistance patterns of selected antibiotic tested from surveillance hospitals and it provides information for infection control in those hospitals. More importantly, the report provides information on the surveillance system coordination and organization, major laboratory capacity building initiatives, how the system was monitored and evaluated, data management and analysis, quality assurance, collaboration, increasing awareness, challenges faced during the implementation, and upcoming activities.

It is my hope that the capacity building initiatives started during the reporting period, the findings, and the conclusions, identified challenges and upcoming priority actions will be taken into consideration by key stakeholders to improve implementation strategies of the surveillance plan in particular and on how to reduce the burden of antimicrobial resistance in Ethiopia in general.

Finally, EPHI would like to acknowledge the support and contribution of the United States Centers for Disease Control and Prevention (CDC), the American Society for Microbiology (ASM), The OHIO State University (OSU), and the World Health Organization (WHO), for supporting the ongoing Antimicrobial Resistance Surveillance system in Ethiopia.

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ABOUT THIS REPORT

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EXECUTIVE SUMMARY

The Ethiopian Antimicrobial Resistance Surveillance System represents one of the first national efforts to strengthen the knowledge and evidence around resistance. Launched by the Ethiopian Public Health Institute (EPHI) in July 2017, this laboratory-based surveillance system captures isolate data from routine clinical laboratory practice. A phased implementation is underway with ongoing participation by four Phase I sites and preparations underway for five additional sites (Phase II) to start Antimicrobial Resistance (AMR) reporting.

This report describes progress made in the implementation and expansion of Ethiopia's laboratory - based AMR Surveillance System from September 2018 through October 2019, presents findings from data reported by Phase I sites between September 2018 and August 2019, and reviews the successes and challenges encountered during the second year of AMR surveillance implementation to facilitate planning for system improvement and continued expansion.

This report presents data findings and describes progress made in the second year of implementation of Ethiopia's AMR Surveillance System through October 2019

Summary of Achievements

- Expanded AMR Surveillance Network.
- Built laboratory capacity through hands-on mentorship and virtual case-based learning.
- Cascaded Clinical Specimen Collection trainings at national and sentinel site levels.
- Collected, collated, and analyzed AMR surveillance data from Phase 1 surveillance sites.
- Increased awareness of AMR Surveillance System among key stakeholders and partners.

Priorities for Coming Year

- Establish an NRL-led laboratory mentorship program and Project ECHO.
- Monitor and evaluate the cascade of the Clinical Specimen Collection Training Curriculum to front-line healthcare workers at the health facility level.
- Improve the quality of data used for patient care and reported to AMR surveillance.
- Select additional surveillance sites for continued network expansion.
- Strengthen collaboration and networking with partners and relevant stakeholders in the context of One Health to combat the burden of AMR.
- Revise the National AMR Surveillance Plan to account for lessons learned, improved methodologies, and updated timelines.

INTRODUCTION

In July 2017, the Ethiopia AMR Surveillance System was launched by the Ethiopian Public Health Institute (EPHI) under the direction of the Federal Ministry of Health (FMOH), and with support from the Ethiopian Food Medicine and Health Care Administration and Control Authority (EFMHACA) and international partners including the WHO, the U.S. Centers for Disease Control and Prevention (CDC), the American Society for Microbiology (ASM), and The Ohio State University (OSU) Global One Health Initiative. Antimicrobial resistance (AMR) is a global health threat and can complicate the treatment of infections leading to increased mortality, morbidity, and healthcare costs.

Surveillance implementation began at four laboratory sites (Phase 1) in July 2017 and was accompanied by several initiatives to ensure the quality of data reported to the system. Now in its second year of implementation, the AMR Surveillance Network has been expanded to include five additional laboratory sites (Phase II). Through support provided by the national reference laboratory (NRL) at EPHI, Phase II sites are currently undergoing preparations to begin AMR reporting.

OVERVIEW OF ETHIOPIAN LABORATORY-BASED AMR SURVEILLANCE SYSTEM

Ethiopia's AMR surveillance system is designed to connect sentinel surveillance sites to the National AMR Surveillance Coordinating Center. The National Reference Laboratory (NRL) at EPHI is the nation's only microbiology laboratory accredited by the International Standards Organization (ISO), and serves in the role of the National AMR Surveillance Coordinating Center. System roles and responsibilities include:

Sentinel Surveillance Sites	National Surveillance Coordinating Center
• Perform quality assured bacterial culture, and antibiotic susceptibility testing • Report AMR data as outlined in the AMR surveillance plan • Package and submit isolates as requested	• Coordinate surveillance and capacity building activities • Ensure data quality • Data management and analysis • Disseminate results and findings

To ensure data quality is maintained, roll-out of the AMR surveillance network is occurring in phases. Currently, Phases I and II of the Ethiopia AMR Surveillance Plan (2017) have been rolled out, thus including a total of 9 sentinel laboratory sites, which serve multiple clinical sites. Sentinel laboratory sites include:

Phase I Sentinel Sites

EPHI: Clinical Bacteriology and Mycology, National Reference Laboratory (NRL) providing clinical testing services to multiple healthcare facilities including Ras Desta Hospital and AaBET Hospital.

Tikur Anbessa Specialized Hospital: Federal specialized referral hospital serving patients from Addis Ababa and other regions of the country.

Amhara Public Health Institute Laboratory, Dessie branch: Regional reference laboratory based in Dessie serving healthcare facilities in the Amhara Region including Dessie Referral Hospital.

Ayder Comprehensive Specialized Hospital: Federal comprehensive specialize hospital-serving patients in Mekelle. In-house microbiology also conducts testing for Seame Clinic.

Phase II Sentinel Sites

St. Paul Millennium Medical College Hospital: Federal specialized referral and teaching hospital serving patients from Addis Ababa and other regions.

Hawassa University Referral Hospital: Referral hospital serving patients from Hawassa and other areas in the region.

Jimma University Referral Hospital: Referral hospital serving patients from Jimma town and other areas in western part of the country.

Felegehiwot Regional Referral Hospital: Regional referral hospital serving patients from Bahir Dar City and other surroundings areas.

Gonder University Referral Hospital: University referral hospital serving patients from Gonder town and other surrounding areas.

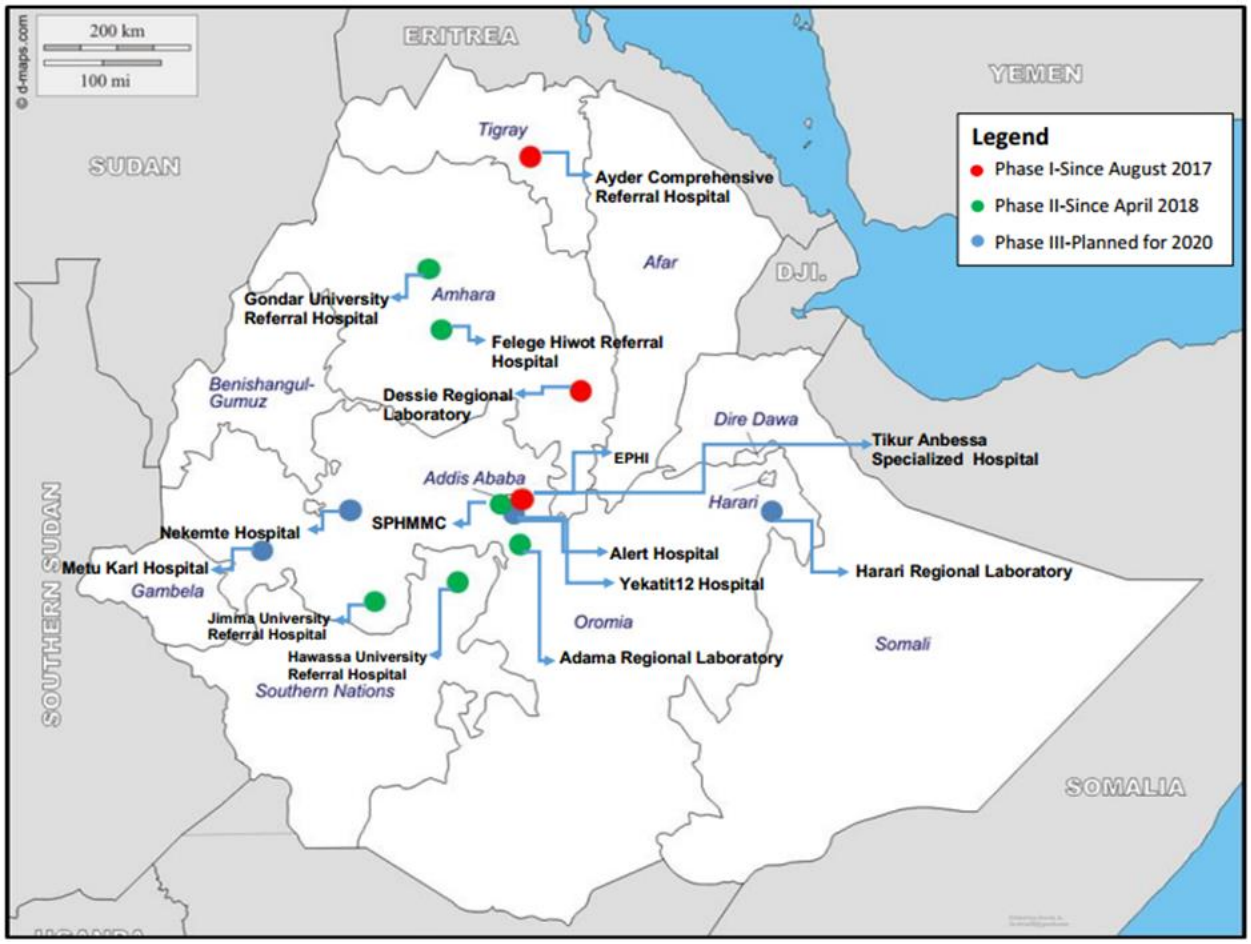


Figure 1. *Locations of Phase I, II & III surveillance sites. Ethiopian AMR Surveillance Network.*

SURVEILLANCE GOALS

The stated goals of Ethiopia's AMR surveillance system are:

1. To asses and support building the laboratory capacity to provide actionable, quality assured, laboratory-based AMR surveillance data.
2. Establish a nationwide surveillance network.
3. Estimate the extent and burden of priority AMR pathogens.
4. Analyze and report national data on a regular basis.
5. Detect emerging resistance and characterize national spread.
6. Generate evidence to inform the implementation of targeted prevention and control programs.
7. Eventually transfer the AMR surveillance data to the national One Health system.

METHODS

Surveillance efforts are laboratory-based with the system designed to capture isolate data from routine laboratory clinical practice. Patient-level data (example: age, gender, in-patient location) are limited to data availability within laboratory information systems. Manual microbiology methods (example: plate culture and disc diffusion for antimicrobial susceptibility testing) are used at all sites.

Laboratory data management at sentinel sites is primarily paper-based with AMR surveillance data entered into an electronic database adapted for this purpose. To limit the burden of data collection and focus laboratory capacity building, a limited set of AMR priority pathogens are targeted for surveillance reporting (Table 1).

Table 1. Priority surveillance pathogens by specimen for reporting to Ethiopia AMR Surveillance

Specimen	Priority Surveillance Pathogens
Urine	• *Escherichia coli* • *Klebsiella pneumoniae*
Wound (Purulent Drainage)	• *Staphylococcus aureus*
All specimens	Carbapenem resistant: • *Acinetobacter* spp. • *Pseudomonas aeruginosa* • Enterobacteriaceae

An overview of the data and isolate flow throughout the AMR surveillance system is provided in Figure 2. In addition to standard laboratory quality control activities and External Quality Assurance (EQA) testing, a proportion of recovered isolates are being sent on monthly basis to EPHI for confirmation testing. Results from confirmation testing inform capacity building activities and further ensure data quality. During the bi-annual review meeting held in June 2019, a report containing analyses of the AMR data from August 2018 to April 2019 was generated and provided to sentinel sites to inform infection prevention and control activities at hospitals and further guide antibiotic stewardship policies and practices.

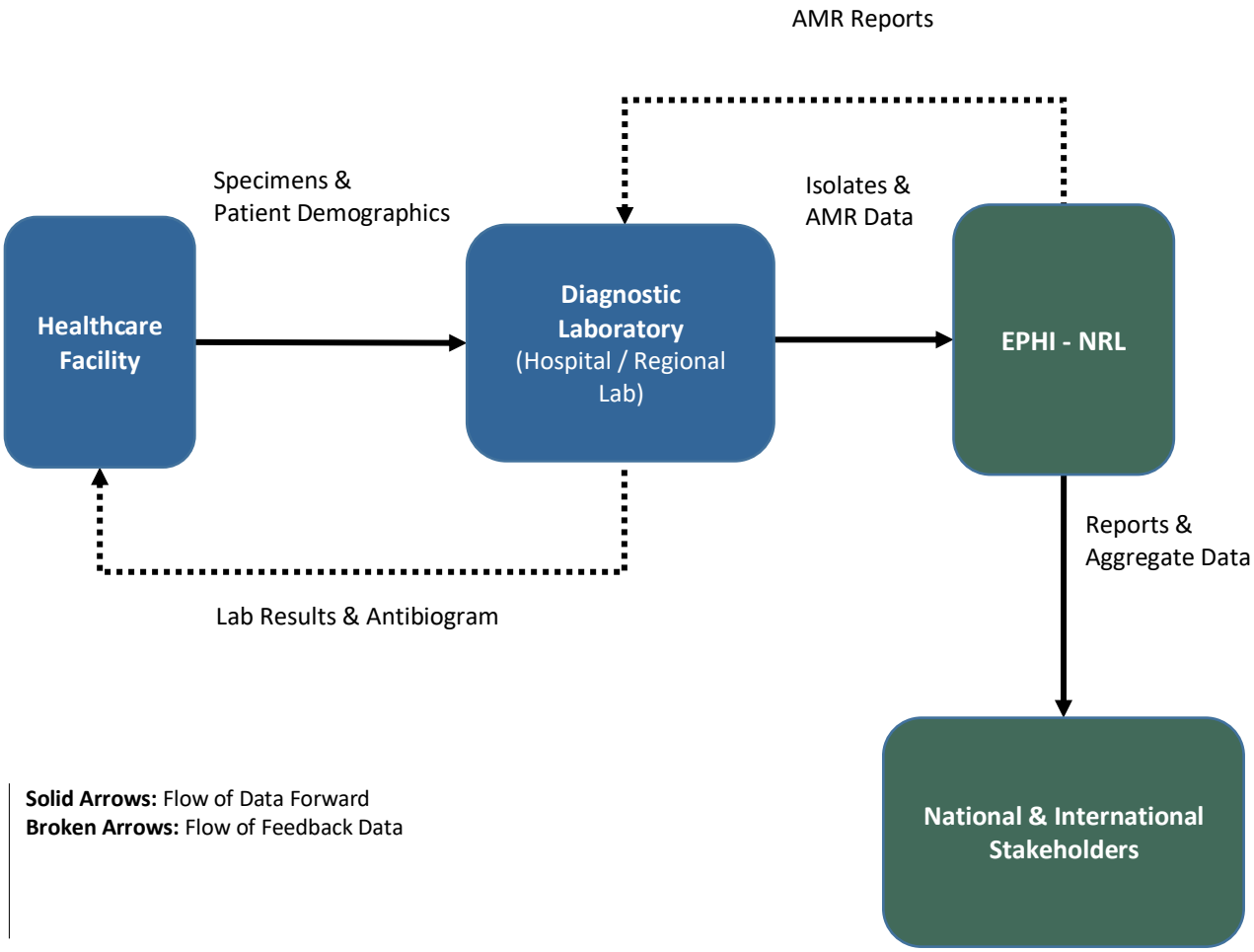


***Figure 2**: Ethiopian AMR Surveillance System Overview.*

ACHIEVEMENTS

Since September 2018, substantial progress has been made in building workforce capacity, integrating and coordinating laboratory networks and communication, laboratory data management, provision of laboratory commodities, promoting EPHI's Laboratory-Based AMR Surveillance Plan to relevant actors and international collaborators, producing training manuals and standard operating procedures (SOPs), expanding surveillance activities to Phase II sites, and ensuring important gaps are identified and addressed through regular monitoring, site visits, and bi-annual & annual review meetings. Specific achievements are outlined below.

Preparatory Activities for AMR Surveillance Network Expansion

- Five Phase II AMR surveillance sites were selected based on the results of standard baseline assessments conducted in mid-2018 on seven potential sites. Results were also used to identify capacity building needs and plan for ongoing surveillance activities.
- Sensitization workshops for Phase II sites were held April-May 2019, prior to the start of AMR surveillance implementation in their laboratories. Workshops were conducted at each selected site for relevant stakeholders including health facility management and administration. The goal was to establish common ground on surveillance implementation, to clarify roles, responsibilities and methods, and to develop work plans for implementation.
- EPHI began discussions with USAID's Infectious Disease Detection and Surveillance (IDDS) Program. IDDS proposes to support Phase II sites with laboratory capacity building and AMR surveillance activities. Various discussion and negotiations have included drafting an MOU between EPHI leadership and the technical heads of IDDS to start the implementation in Phase II sites.
- EPHI began preparations for Phase III sites by conducting renewed assessments between September-October 2019. Phase III sites were previously assessed between October 2016 and February 2017. Re-assessments determined readiness for expansion.

Network Coordination & Communication

- Participated in Technical Working Groups (TWG) including the Federal Ministry of Health (FMOH) AMR TWG, EPHI internal AMR TWG, and the TWG formed between EPHI and Ethiopian Pharmaceutical Supply Agency (EPSA) to address issues around supply

procurement and inventory. EPHI's AMR team played a pivotal role in establishing thee TWGs at all levels.

- Hired a new Data Manager dedicated to the AMR surveillance program.
- Conducted monthly calls with international AMR surveillance partners (CDC, ASM, OSU, and more recently IDDS) focused on progress updates and providing technical assistance on specific programmatic issues.
- Conducted weekly and monthly formal and informal lines of communication with surveillance sites through assignment of dedicated focal persons and weekly calls with sites; supported monthly supervision site visits.

Clinical Specimen Collection Training Package and Rollout

- With support from The Ohio State University's Global One Health initiative (OSU GOHi) a robust training package was developed to improve the quality of clinical specimens collected for bacteriology and thus improve the laboratory data produced for patient treatment and AMR surveillance reporting. The training package included a Clinical Specimen Collection Trainers Manual, training modules, and a Reference Manual in English and Amharic languages. With a technical and financial support of CDC and OSU, 500 copies of the manuals were printed and distributed to all AMR surveillance sites to be used as general guidance and for education of clinicians, laboratory personnel, and others involved in the collection of clinical specimens.

Fig 3: Shows Clinical Specimen Collection Manual for Trainers & Reference Manual distributed to all sentinel sites.

- A cadre of 19 clinical specimen collection master trainers was developed in July 2018 through a 3-day training of trainers (TOT) held in collaboration with OSU GOHi.
- Seven of the Clinical Specimen Collection Master Trainers held two rounds of 3-day TOTs on clinical specimen collection in February and August 2019 to produce a cadre of 49 facility-based trainers. The 49 facility-based trainers were health professionals, including nurses, physicians, and lab technologists from healthcare facilities interested in conducting facility level trainings to improve clinical specimen collection practices in their facilities. Experts from OSU were present to provide clinical expertise and evaluation support.

- Site visits were conducted at a few selected Phase I and II surveillance sites by a team from EPHI and OSU to identify barriers to cascade the training at facility level.
- Developed Logic Model for Clinical Specimen Collection Training Program for use with monitoring and evaluating implementation at healthcare facilities.
- Developed Clinical Specimen Collection Evaluation Questionnaires and collected data collected from 11 AMR surveillance sites

.**Laboratory Capacity Building: Mentorship**

- On a monthly basis, NRL site focal persons provided Phase I and II sites with hands-on training and mentorship in basic microbiology and antibiotic susceptibility testing (AST) methods.
- Provided Phase II sentinel sites with standard and up-to-date microbiology SOPs.
- Provided Phase I and II sites with limited relevant Quality Control (QC) strains, licensed Clinical and Laboratory Standards Institute (CLSI) guidelines for results interpretation and reporting, and clinical microbiology reference books.
- ASM consultants in collaboration with NRL site focal persons conducted two rounds of 2-3 week long mentorship visits at Ayder Comprehensive Specialized Hospital, Amhara Public Health Institute (Dessie branch), and Tikur Anbessa Specialized Hospital. Mentorship reports shared with sites for further improvement and corrective action.

Laboratory Capacity Building: Virtual Case-Based Learning via Project ECHO

- Laboratory Project ECHO (Extension Community Health care Outcomes), a virtual case-based learning platform, with a curriculum developed by ASM and CDC, was conducted for two sites, the EPHI NRL and Tikur Anbessa Specialized Hospital (TASH) starting in October 2018 to supplement ongoing laboratory capacity building activities. The program was coordinated by ASM expert with a technical input from CDC in collaboration with EPHI facilitators.
- NRL and TASH staff participated in multi-point video conferences for “Lab ECHO” on a bi-weekly basis. Attempts were made to include the two remaining Phase I sites, Ayder Comprehensive Specialized Hospital and the Amhara Public Health Institute Laboratory, Dessie branch. These two sites were able to join on occasion.

- In one year, 23 case presentations were completed; these were presented by staff from NRL and TASH, rotating on bi-weekly basis. Topics focused on isolation, identification (ID) and antibiotic susceptibility testing (AST) of AMR priority organisms.

Data Management and Analysis

- A new data manager was recruited to assist Phase I and Phase II sites in WHONET data management, manipulation, and analysis-using WHONET (5.6) customized to the needs of both the surveillance system and the surveillance sites.
- Phase I sites sent surveillance data on AMR priority pathogens and specimens on monthly basis. Data was cleaned and analyzed at the EPHI NRL.
- To ensure standardization of AMR data management in all sites, onsite trainings on WHONET data entry were held for Phase II surveillance sites and sites were provided with the Data Management SOP containing instructions on data entry, manipulation, and analysis.

Microbiology Supplies and Equipment

- Established a TWG with EPSA to improve communication and collaboration around microbiology supply chain management in a sustainable way.
- Locally procured and distributed bacteriology reagents and supplies from EPSA to sentinel sites to fill critical gaps in stock.
- With support of ASM, procured and distributed AST discs to Phase I, II and III sentinel sites.
- Conducted a situational analysis of supply chain management system.
- In April 2019, a consultative meeting was held in participation with ASM consultants to finalize the draft inventory management situational analysis and identify areas to prioritize for strategies.
- EPHI-EPSA TWG revised the list of minimum required microbiology supplies to standardize the inventory needs of the country for bacteriology.
- Quantified consumption list of laboratory commodities collected from 22 laboratories (including AMR surveillance).

Isolate Repository

- All AMR Priority isolates transported from sentinel sites reposted at the national reference laboratory. Discussions are under way to determine future isolates needed for repository.

Quality Assurance Testing

- Enrolled sites in external quality assurance (EQA) program. EQA results are monitored to better understand how to improve the capacities of laboratories over time.
- Prior to June 2019, confirmatory testing was being performed monthly at the NRL on 10% of the isolates received from the surveillance sites with reports of findings shared with sites for root cause analysis and take corrective action.
- To improve confirmatory testing and increase the information available about the quality of the data in the system, a TWG was formed in April 2019 with participation by CDC, the EPHI NRL, and Phase I sites. The TWG created a detailed plan for improvement of this "Alternative Assessment Procedure" and steps taken included confirmatory testing process mapping, and development of guidelines for the NRL to perform monitoring and evaluation activities including SOPs for the NRL and surveillance sites. Currently the protocol is in use at both the surveillance sites and at the NRL.

International Collaborations

- In 2018, Ethiopia enrolled in the World Health Organization's Global Antimicrobial Resistance Surveillance System (WHO|GLASS) and has been reporting progress on surveillance implementation.
- Submitted data collected from March–December 2018 to GLASS.
- EPHI collaborated closely with international partners including CDC, ASM, OSU, and the WHO to further AMR surveillance initiatives in Ethiopia. Monthly Zoom Conference calls were conducted among the EPHI AMR team, CDC, ASM, OSU, and more recently IDDS, to update progress and challenges as well as initiate new ideas and strategies to strengthen the current surveillance system in Ethiopia.
- In 2019, EPHI began exploring potential collaborations with Infectious Disease Detection and Surveillance Program (IDDS), a USAID–funded project interested on strengthening the five –Phase II AMR surveillance sites and developing a central level mechanism for efficient procurement of AMR supplies.

Advocacy and Increasing AMR Awareness

- Information on AMR surveillance activities was disseminated to various key stakeholders using different platforms. Copies of the 2018 AMR Surveillance Annual Report were printed and distributed to key actors during EPHI's AMR Bi-annual Review Meeting (November 2018), Ethiopia's Worldwide Antibiotic Awareness Week (WAAW) celebration (November 2018), and the Ministry of Health Annual Review meeting (October 2018 and October 2019). The Annual Report was also shared with partners and interested visitors of the EPHI NRL (Bacteriology and Mycology Laboratory) and was uploaded on to the EPHI to reach the wider audience at the national and international level. www.ephi.gov.et
- EPHI leadership and the AMR technical team presented progress on AMR Surveillance implementation activities to higher officials of Ministry of Health in April 2019.
- Two manuscripts were written and published in international peer-reviewed journals to share the experiences of the Ethiopia's AMR Surveillance System with the wider scientific community.
    - Antimicrobial resistance surveillance in Ethiopia: Implementation experiences and lessons learned (Ibrahim, 2018). Afr J Lab Med. 2018;7(2), a770. https://doi.org/10.4102/ajlm.v7i2.770.
    - Establishment of a Sentinel Laboratory-Based Antimicrobial Resistance Surveillance Network in Ethiopia (Hazim, 2018). **www.liebertpub.com**
- Abstracts on Clinical Specimen Collection Training, Virtual-Case-Based Learning, and Confirmation Testing Improvements were submitted to the SHEA Decennial 2020: 6th International Conference on Healthcare-Associated Infections, which takes place in Atlanta, Georgia, USA in April 2020

MONITORING & EVALUATION

Monitoring Activities

- Monitored the progress of each site through weekly calls with sites and collected dashboard indicators to track progress on AMR surveillance implementation.
- Monthly site visits were conducted by EPHI NRL staff members to identify gaps, provide technical and administrative assistance, and to monitor progress on laboratory capacity building activities and work plans.
- Progress update meetings were conducted with all NRL staff involved in AMR surveillance implementation. Findings from monitoring visits and ASM mentorship visits were discussed and corrective actions taken.
- In June 2019, EPHI held a progress review meeting with Phase I and Phase II sites and partners to review progress, share learning experiences, and plan for next steps.
- Began development of specific programmatic monitoring indicators to monitor progress and evaluate the impact of each program.

External Surveillance Evaluation

In March 2019, a descriptive cross study using interviews and document review was conducted to evaluate the Ethiopia AMR Surveillance System at EPHI and TASH by a 2nd year Ethiopian Field Epidemiology Training Program resident from St. Paul Hospital Millennium Medical College.

Activities included:

- Interviews with the AMR coordinator, data manager, and laboratory staff at the NRL and TASH.
- Review of documents and analysis of available surveillance data.
- Observation of surveillance activities at site level with activity and data flow mapping.
- Data analysis and presentation.
- Ethical clearance.

The final evaluation report was submitted to EPHI and relevant stakeholders and was presented during the AMR Bi-annual Review Meeting conducted in June 2019. Findings and recommendations were provided to improve AMR surveillance implementation.

A brief summary of external evaluation findings (system strengths and implementation challenges):

Strengths	Gaps
NRL & TASH • AST for the six priority pathogens • For AST, utilizing majority of antimicrobials • Providing individual patient AMR result to clinicians • Utilize WHONET for AMR data management • Inventory management of reagents and supplies done • Can identify priority organisms & perform AST NRL-Specific • Published & distributed official AMR summary report • Training given for all sentinel sites • Onsite AMR data management training for phase I sites • WHONET database created for all sites • Monthly assessment of sentinel sites • Lab requisition forms, Specimen Collection Manuals, SOPs & forms supplied • Majority of sites reported on time TASH-Specific • Sending AMR report and prioritized isolates to NRL monthly • Every report reported on time	NRL & TASH • Not sharing AMR summaries with relevant clinical departments and Hospital relevant committees. • No denominator for AMR data analysis • No outbreak threshold for each pathogen NRL-Specific • No quarterly analysis of aggregated AMR report • No system evaluation was done so far • Data quality (for blank spaces) is 85.6% • Inadequate supplies to sites, delay in delivery of supplies to sentinel sites & low quality supplies TASH –Specific • No AMR data back-up • Few staff have WHONET Training • Lack of adequate specimen collection containers • Staff turnover & inadequate staff and inadequate supplies

FINDINGS

Data is currently being collected from all four Phase 1 AMR surveillance clinical sites on a monthly basis. Data management and analyses are done using WHONET software. Data reported here were captured between September 2018-August 2019 and have been cleaned and analyzed in detail from Phase I surveillance site hospitals. Data presented below comes from AaBET Hospital & Ras Desta Hospital (data submitted from the EPHI National Reference Laboratory), Tikur Anbessa Specialized Hospital (TASH, Dessie Referral Hospital (data submitted from the Amhara Public Health Institute Laboratory, Dessie branch), and Ayder Comprehensive Specialized Hospital. Hospital-level analyses include frequency of clinical specimens sent for culture, number of priority surveillance pathogens identified, and patterns of resistance when sufficient data were available. Limited data analysis and findings are also presented on Carbapeneum-resistant pathogens in the following tables and graphs.

Table 2: Number of Specimens by Type Processed by Phase I Hospital Sites. Ethiopian AMR Surevillance, September 2018 - August 2019

Specimen Type	Phase I Sites					Total
	AaBET	Ras Desta	Dessie	TASH	Ayder	
Urine	204	88	100	1246	487	2125
Pus*	200	7	62	171	95	535

*Pus includes abscess and wound specimen.

As the above table shows the highest number of urine specimens was processed at TASH due to high patient flow in the hospital followed by Ayder Comprehensive Specialized Hospital. On the other hand, the highest number of pus specimens was processed at AaBET Hospital. This is probably due to their high levels of traumatic injury and burn patients.

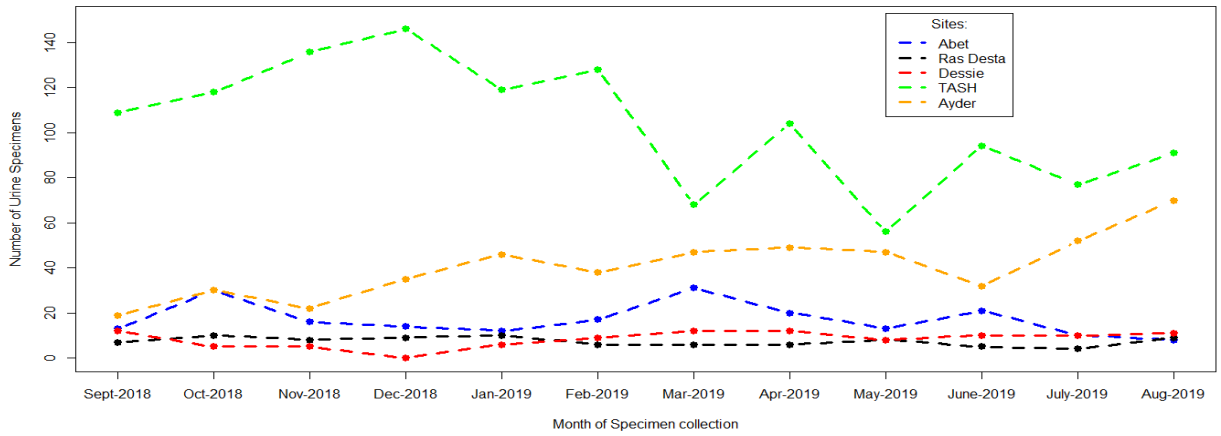


Figure 4: *Number of Urine Specimens Processed by Month, Phase I Hospital Sites. Ethiopia AMR Surveillance, September 2018 - August 2019.*

TASH and Ayder, which both contain in-house microbiology laboratories consistently processed more urine specimens than the other sites, which send cultures out to reference laboratories for testing. As depicted in Figure 3, the number of urine specimen processed at TASH increased from September to December 2018 and decreased from December 2018 to August 2019. Potential reasons for this may be limited availability collection supplies or incomplete data entry. The Dessie Referral Hospital sent the least number of urine specimens to be processed.

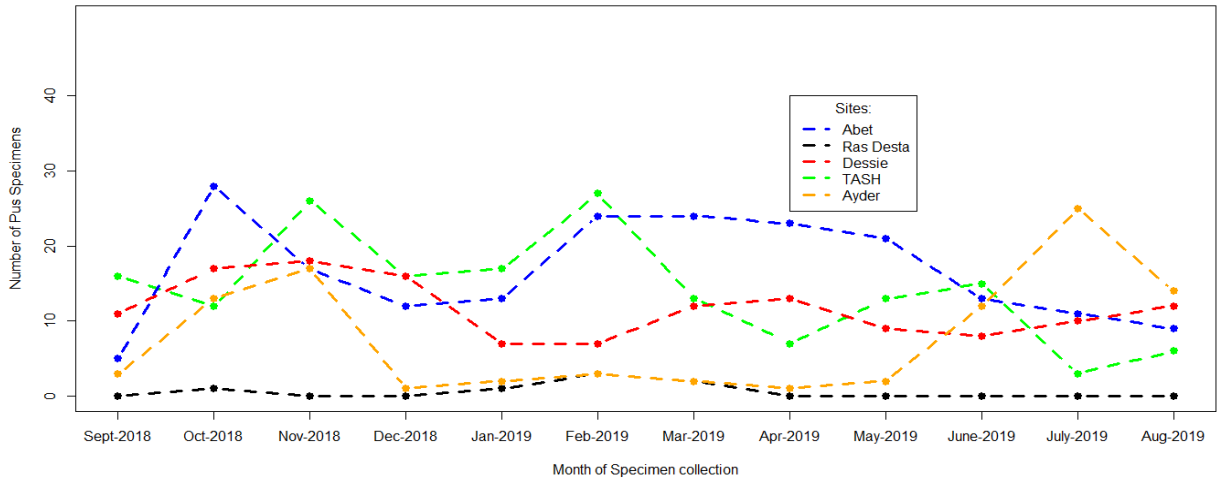


Figure 5: *Number of Pus Specimens Processed by Month, Phase I Hospital Sites. Ethiopia AMR Surveillance, September 2018 - August 2019.*

As shown in Figure 4, AaBET has a consistently high number of pus specimens sent for processing compared to other sites. As AaBET is a burns and trauma hospital this higher number of pus specimens is to be expected with a patient population seeking care for wounds.

Table 3: Number of Priority Surveillance Pathogens Processed by Specimen Type for each Phase I Hospital Site. Ethiopia AMR Surveillance, September 2018 - August 2019

Site	Urine Specimens		Pus Specimens*		
	E. coli	*K. pneumonia*	*E. coli*	*K. pneumonia*	*S. aureus*
AaBET	22	11	18	9	53
Ras Desta	12	1	1	1	1
Dessie	8	3	1	4	14
TASH	152	85	16	12	58
Ayder	67	21	9	5	21
Total	261	121	45	31	147

Note: Includes all isolates from all patients sampled

*Pus includes abscess and wound specimen.

As can be seen in Table 3, *Escherichia coli* was the most common pathogen isolated from urine specimen in all hospitals. *Staphylococcus aureus* was the most common pathogen isolated from pus specimen followed by *E.coli* in all hospitals.

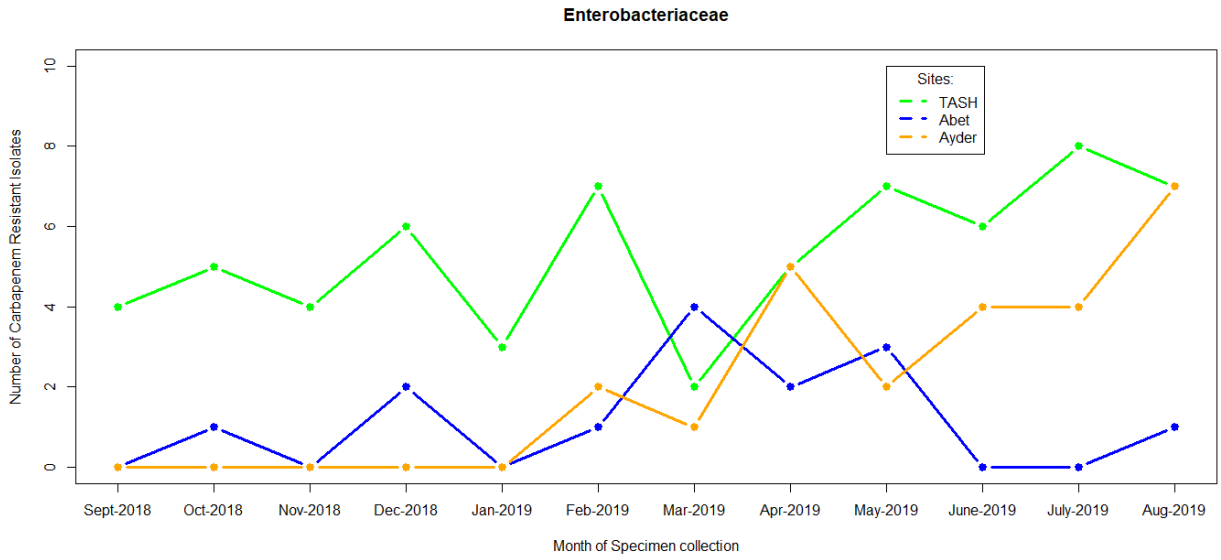


***Figure 6**: Number of Carbapenem Resistant Enterobacteriaceae Received by Month at Phase 1 Hospital Sites - Ethiopia AMR Surveillance, September 2018 - August 2019.*

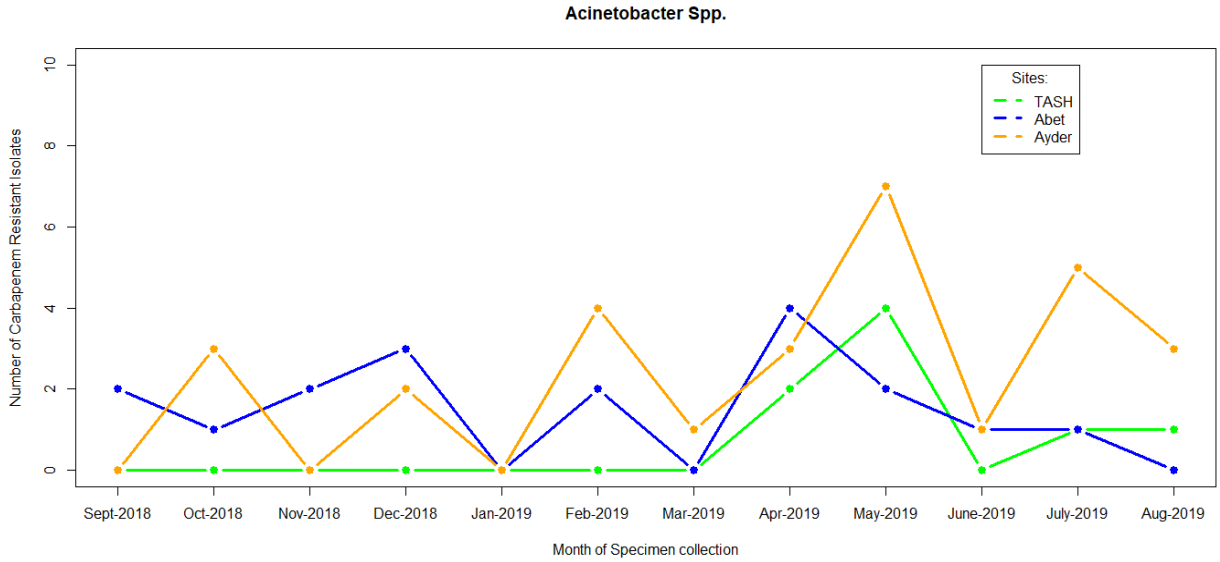


***Figure 7**: Number of Carbapenem Resistant Acinetobacter Received by Month at Phase 1 Hospital Sites - Ethiopia AMR Surveillance, September 2018 – August 2019.*

Ayder Comprehensive Specialized Hospital

Table 4: Number of Priority Surveillance Pathogens from All Urine and Pus Specimens tabulated by selected departments. Ayder Comprehensive Specialized Hospital, Ethiopian AMR Surveillance, and September 2018 - August 2019.

Department	*E. coli* (N=76)	*K. pneumonia* (N=26)	*S. aureus* (N=22)
Emergency	1	0	3
Gynecology	3	1	0
ICU	8	8	0
Medical	42	9	8
Neonatology	2	1	1
Pediatrics	10	5	9
Surgery	10	2	1

Note: Includes all isolates from all patients sampled

Table 5: Proportion of *Escherichia coli* Isolates (N=71) from All Urine and Pus Specimens showing Resistance by Antibiotic Tested. Ayder Comprehensive Specialized Hospital, Ethiopian AMR Surveillance, September 2018 - August 2019.

Antibiotic	Number Tested	% Tested	% Resistant
Ampicillin	67	94.37	85.1
Amoxicillin/Clavulanic acid	71	100	62
Cefepime	30	42.25	66.7
Meropenem	66	92.96	4.5
Gentamicin	32	45.07	21.9
Tobramycin	69	97.18	43.5
Ciprofloxacin	68	95.77	64.7
Trimethoprim/Sulfamethoxazole	67	94.37	76.1
Nitrofurantoin (Urine Only)	60	84.51	0
Tetracycline	47	66.2	70.2

Note: Includes only first isolate from each patient[1]

AaBET Hospital

Limited data is available on pathogens by departments in AaBET Hospital

Table 6: Proportion of *Escherichia coli* Isolates (N=39) from All Urine and Pus Specimens, showing Resistance by Antibiotic Tested. AaBET Hospital, Ethiopian AMR Surveillance, and September 2018 - August 2019.

Antibiotic	Number Tested	% Tested	% Resistant
Meropenem	36	92.31	5.6
Tobramycin	31	79.49	41.9
Ciprofloxacin	36	92.31	69.4
Trimethoprim/Sulfamethoxazole	36	92.31	80.6

Note: Includes only first isolate from each patient

Table 7: Proportion of *S. aureus* Isolates (N=50) from All Urine and Pus Specimens showing Resistance by Antibiotic Tested. AaBET Hospital, Ethiopian AMR Surveillance, September 2018 - August 2019.

Antibiotic	Number Tested	% Tested	% Resistant
Penicillin G	34	68	76.5
Oxacillin	40	80	22.5
Ciprofloxacin	39	78	20.5
Trimethoprim/Sulfamethoxazole	42	84	23.8
Clindamycin	44	88	11.4
Erythromycin	37	74	27

Note: Includes only first isolate from each patient

[1] Due to limitations of the data, it is not recommended that this data be used for guiding empiric therapy at this time.

Tikur Anbessa Specialized Hospital

Table 8: Number of Priority Surveillance Pathogens from All Urine and Pus Specimens tabulated by selected departments. Tikur Anbessa Specialized Hospital, Ethiopian AMR Surveillance, and September 2018 - August 2019.

Department	*E. coli* (N=168)	*K. pneumonia* (N=97)	*S. aureus* (N=62)
Emergency	34	5	8
Gynecology	2	0	0
ICU	3	4	0
Medicine	41	12	6
Neonatology	1	2	2
Orthopedics	2	2	9
Pediatrics	64	58	27
Surgery	15	13	8
Unknown/Other	6	1	2

Note: Includes all isolates from all patients sampled

Table 9: Proportion of *Escherichia coli* Isolates (N=152) from All Urine and Pus Specimens showing Resistance by Antibiotic Tested. Tikur Anbessa Specialized Hospital, Ethiopian AMR Surveillance, September 2018 - August 2019

Antibiotic	Number Tested	% Tested	% Resistant
Ampicillin	125	82.24	93.6
Amoxicillin/Clavulanic acid	75	49.34	69.3
Piperacillin/Tazobactam	130	85.53	20.8
Ceftazidime	140	92.11	54.3
Ceftriaxone	125	82.24	70.4
Cefepime	127	83.55	50.4
Meropenem	145	95.39	2.1
Amikacin	133	87.5	1.5
Gentamicin	133	87.5	21.1
Tobramycin	82	53.95	15.9
Ciprofloxacin	141	92.76	67.4
Trimethoprim/Sulfamethoxazole	129	84.87	85.3
Nitrofurantoin (Urine Only)	49	32.24	24.5

Note: Includes only first isolate from each patient

Table 10: Proportion of *S. aureus* Isolates (N=59) from All Urine and Pus Specimens showing Resistance by Antibiotic Tested. Tikur Anbessa Specialized Hospital, Ethiopian AMR Surveillance, September 2018 - August 2019.

Antibiotic	Number Tested	% Tested	% Resistant
Penicillin	47	79.66	100
Oxacillin	50	84.75	8
Trimethoprim/Sulfamethoxazole	49	83.05	51
Clindamycin	58	98.31	12.1
Erythromycin	59	100	20.3

Note: Includes only first isolate from each patient

Table 11: Proportion of *K. pneumonia* Isolates (N=85) from All Urine and Pus Specimens showing Resistance by Antibiotic Tested. Tikur Anbessa Specialized Hospital, Ethiopian AMR Surveillance, September 2018 - August 2019.

Antibiotic	Number Tested	% Tested	% Resistant
Piperacillin/Tazobactam	76	89.41	44.7
Ceftazidime	75	88.24	86.7
Ceftriaxone	72	84.71	95.8
Cefepime	66	77.65	83.3
Meropenem	85	100	30.6
Amikacin	69	81.18	7.2
Gentamicin	75	88.24	62.7
Tobramycin	48	56.47	31.2
Ciprofloxacin	79	92.94	48.1
Trimethoprim/Sulfamethoxazole	68	80	95.6

Note: Includes only first isolate from each patient

SURVEILLANCE LIMITATIONS

The Ethiopian Laboratory–Based AMR Surveillance System has its own limitations as any other surveillance system. Limitations should be recognized for their impact on the information the system is able to produce, and how the data can be interpreted and used.

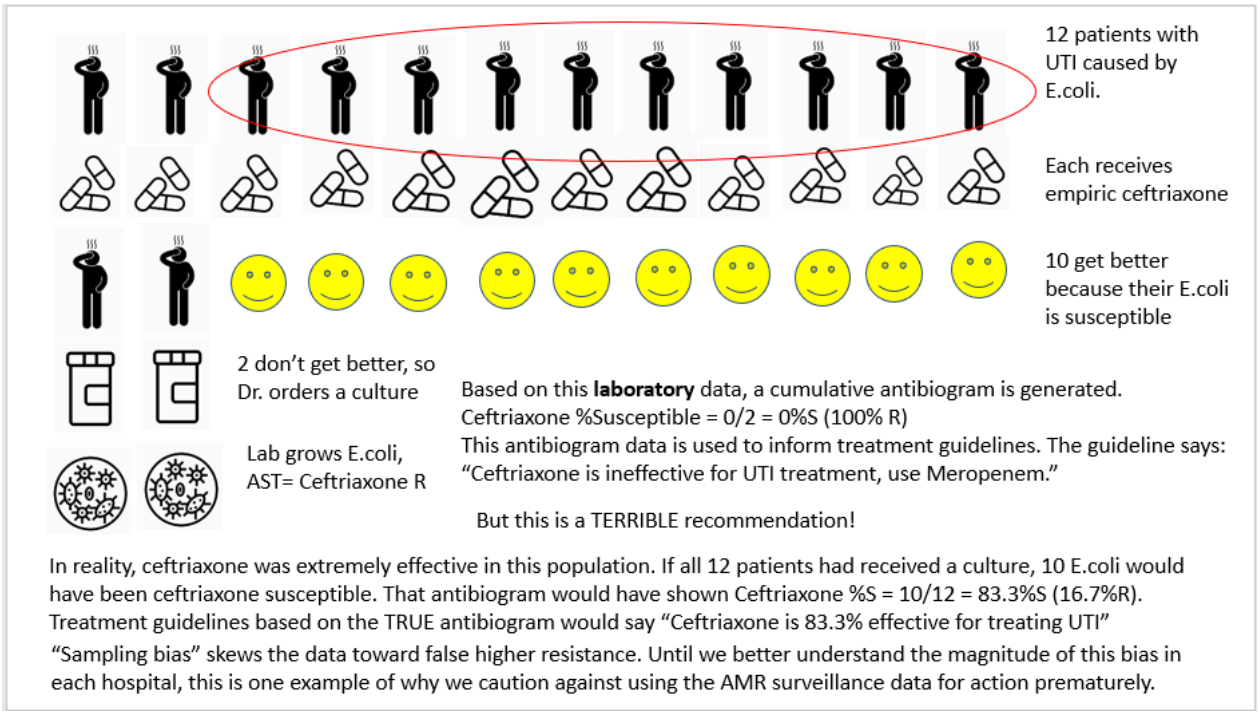
Due to ongoing challenges and limitations, it is advisable that this data only be used for infection prevention and control interventions at this time.

The data findings presented above should be considered in light of the following limitations:

Limitation 1: Reliance on existing clinical specimen collection practices

The existing surveillance system captures data from clinical specimens sent, at the discretion of physicians, for routine laboratory diagnostics. To the extent that microbiology services are underutilized and/or empiric antibiotic therapy is provided prior to collection of specimens,

patients that have failed first-line antibiotic therapy will be over represented. This situation will tend to overestimate resistant infections.



To improve quality specimen collection process, EPHI in collaboration with partners, developed and start implementation of a training of trainer's educational program designed to improve clinical culture specimen collection among healthcare workers at healthcare facilities in Ethiopia. A Clinical Specimen Collection training package was created consisting of a Trainer's Manual Reference Manual, Assessment Tools, step-by-step instructional guides, and Core Module Power Point Slides also developed to facilitate the evaluation support.

Limitation 2: Reliance on patients presenting to sentinel sites

As reported in 2018, still the system currently captures data on patients presenting to the existing sentinel laboratory sites, the majority of which serve larger public tertiary referral hospitals. Patients attending private facilities or smaller healthcare facilities will not be represented in the data. When interpreting findings, this limited patient population should be considered.

When possible, alternative approaches to including healthcare facility and/or private clinical networks (e.g., accessing private laboratory network data and/or isolate-based surveillance where isolates are centrally processed at the NRL) should be considered.

Limitation 3: Data management related operational challenges

The following major weakness exist which limit completeness and quality of the data:

- Quality control of laboratory processes
- Challenges with data collection systems
- Poor specimen collection practices
- Lack of critical microbiology supplies
- Total number of patients submitting specimens is not known due to duplication of patient ID and duplication of specimen ID which affects data cleaning processes
- Zone diameter is not always recorded which prevents verification of result interpretation
- Patient location is not always recorded both in hard and soft copy
- Relying on pus and urine specimens rather than blood specimens.

It is important to note that the AMR surveillance system is extremely young and due to ongoing challenges and limitations, it is not advisable to use the existing data for interventions beyond infection prevention and control.

CONCLUSIONS & NEXT STEPS

This report covers the achievements and encountered challenges of Ethiopia's Laboratory–Based AMR Surveillance Program between September 2018 and October 2019 in Phase I and Phase II surveillance sites. In the past year, significant improvements have been achieved in terms of coordination, standardized surveillance implementation, surveillance network expansion, and laboratory capacity building including supply provision, data management, communication and advocacy with surveillance site healthcare providers, key stakeholders and partners. The surveillance system is valuable for its ability to strengthen the knowledge and evidence around antimicrobial resistance in the country and the international community. Key elements that ensured the success of this program included key stakeholder and site engagement, good partnership and teamwork & communication as well as leadership support and staff dedication at EPHI, sites, and among partners.

Even though significant improvements were achieved, the implementation of the program was challenged by the following factors:

- The availability of quality microbiology testing capacity to support patient care and provide data for surveillance.
- Interrupted supply and shortage of microbiology laboratory supplies and commodities.
- Lack of national AMR strategic plan, which contributes to the weak ownership of the program by key stakeholders at all levels.
- Staff turnover, shortage, and lack of motivation at all levels. This compromises regular mentorship and over all data management activities at national and site levels.
- Poor infrastructure of microbiology laboratories in many healthcare facilities across the country influences the ability to expand the AMR surveillance network.

Government support for the establishment and enhancement of quality microbiology laboratories throughout the country will serve to expand surveillance sites to generate representative data for policy and decision-making and further improvement of patient outcomes and microbiology-dependent surveillance programs.

Ethiopia's AMR surveillance system is developing to provide evidence-based information that may contributed to an integrated One-Health AMR approach. Ultimately, the benefits of implementing AMR surveillance may extend beyond surveillance activities improving Ethiopia's ability to detect and respond to future public health threats.

Upcoming Activities & Next Steps

A number of activities are planned for the coming year:

- EPHI will formally establish an NRL-led mentorship program that would offer mentorship and supportive supervision services in order to build microbiology capacity of laboratories across Ethiopia, in particular sites currently participating in the AMR Surveillance Program.
- In collaboration with EPHI and CDC, ASM is developing a Mentorship TOT curriculum to capacitate EPHI NRL Focal Points to be better mentors and sustain laboratory capacity building through an NRL-led mentorship program. Preparation for this training and the creation of an NRL-led microbiology mentorship program began with the development of a Terms of Reference (TOR) with roles and responsibilities of the NRL Focal Point Mentors. The TOR was further refined during a meeting with ASM in April 2019. During this meeting the curriculum for the TOT was also outlined. The ASM-led training is expected to occur in November and December 2019.

- The Ethiopian AMR Laboratory ECHO Transition Plan is in process to hand over leadership of Lab ECHO to EPHI. The transition will include sending key staff to ECHO immersion training, and defining the roles and responsibilities of EPHI facilitators, and rolling out Lab ECHO to new sites with ASM available for technical support as needed.
- EPHI will continue to play a key role at an intergovernmental/multi-sectorial AMR technical working group which has been established at higher ministerial (FMOH and EPHI) levels.
- Close monitoring and laboratory capacity building of Phase I & II sentinel sites will continue.
- Continue to monitor and support the cascading of the Clinical Specimen Collection Training curriculum to front-line healthcare workers at the health level. Advocate for the curriculum to be incorporated in to the pre-service training curricula of universities and training institutions.
- The National AMR Surveillance Plan will be revised to account for lessons learned, improved methodologies, and updated timelines.
- Re-assessment of remaining Phase III surveillance sites will be completed so as to determine which sites will be included as participating sites. This will be based on site readiness, existing capacity, and the availability of financial, human and material resources to support expansion.
- Strengthen collaboration and networking with partners and relevant stakeholders in the context of one health to combat the burden of AMR.
- Ensure the implementation of recently developed manuals and guidelines (i.e. Clinical Specimen Collection, Confirmatory Testing, etc.) to strengthen the surveillance system.
- Develop comprehensive AMR surveillance system monitoring and evaluation indicators.
- Develop profile of participating sentinel site health facilities including information on hospital population served, etc.
- To ensure standardization of AMR data management in all sites, onsite trainings on WHONET data management SOP containing instructions on data entry, manipulation, and analysis will be provided for Phase II surveillance sites.