World Health Organization

South-East Asia Region Western Pacific Region

Laboratory-based surveillance of antimicrobial resistance

Report of a bi-regional workshop
Chennai, India, 21-25 March 2011

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Annexes

1. Background

During the past six decades antimicrobial agents have played a critical role in reducing the burden of communicable diseases all over the world. The emergence of resistance and its rapid spread is negating the impact of these drugs, obstructing progress towards achievement of the Millennium Development Goals (MDGs) and hindering effective application of modern technologies in mitigating human misery. While appearance of resistance is a continuous phenomenon in microorganism, its amplification and spread is through an array of practices conducted by human beings. Improper utilization of antimicrobial agents especially in high disease-burden settings and for non-therapeutic use as in the veterinary sector result in strong selection pressure that allows the resistant strain to grow and rapidly replace the susceptible isolates. Detection of resistance and monitoring for its spread requires laboratory-based surveillance.

Recognizing that diseases due to resistant organisms take longer to heal, require expensive and at times toxic drugs for longer periods, often making the disease untreatable and that resistant organisms can also move across countries through travel and trade, there is growing global concern about this problem. Combating the problem of antimicrobial resistance (AMR) warrants concerted efforts at national and international levels to preserve the available antimicrobial agents.

An effective response to antimicrobial resistance is possible through treatment policies such as combination therapy, rational prescription, patient adherence, strong regulatory mechanism and educational activities, along with an efficient surveillance system.

To facilitate these activities at the country level, the WHO Regional Office for South-East Asia has developed a strategy that is simple, practical and easy to scaleup. The regional strategy aims to give particular attention to interventions involving the introduction of legislation and policies governing the use of antimicrobial agents, establishing laboratory-based networks for surveillance of resistance and ensuring the rational use of these drugs at all levels of health-care settings. In addition, an Asia-Pacific Strategy for Strengthening Health Laboratory Services (APSLab) was developed jointly by the Regional Office for South-East Asia (SEA) and the

Western Pacific (WP) regions in 2009. Building laboratory capacity and addressing antimicrobial resistance are two of the key elements of this strategy.

At the recently held Sixty-third Session of the WHO Regional Committee for South-East Asia, a resolution on prevention and containment of antimicrobial resistance was endorsed. This resolution requests the Regional Director to assist national authorities in building their laboratory capacity for efficient surveillance of emergence and spread of antimicrobial resistance. A workshop was planned in accordance with the request made by Member States.

The aim of the workshop was to provide an opportunity for information-sharing on antimicrobial resistance between all Member States forging a network of laboratories on AMR.

The workshop was attended by 19 participants from 17 Member States, from SEA and WP regions. All Member States from the SEA Region except DPR Korea and Timor-Leste were represented at the workshop. The workshop was facilitated by experts from the WHO Collaborating Centre for AMR, Ministry of Public Health, Thailand, Office of the WHO Representative to India and WHO staff (Annex 2). The programme of work is at Annex 1.

2. Objectives

The following were the objectives of the workshop:

(1) To review the status of laboratory-based surveillance of antimicrobial resistance in Asia-Pacific;

(2) To orient and train participants on the WHO-recommended laboratory techniques for determination of antimicrobial resistance;

(3) To impart training on WHONet5, the WHO software for antimicrobial resistance data analyses; and

(4) To develop follow-up actions at country level for the establishment of a national laboratory-based surveillance system for monitoring drug resistance.

3. Inaugural session

The inaugural session of the workshop was held in the auditorium at Sankara Nethralaya, Chennai, India and the welcome address was delivered by Dr H.N. Madhavan (President, Vision Research Foundation, Sankara Nethralaya). This was followed by an address by Dr Badrinath (Chairman Emeritus, Sankara Nethralaya) who also spoke about the achievements of Sankara Nethralaya. Dr Rajesh Bhatia, Regional Adviser – Blood Safety and Laboratory Technology, WHO-SEARO, in his inaugural address spoke about the WHO initiatives to contain AMR and hoped that all 19 participants from 17 countries of the SEA and WP regions shall benefit from the proceedings. Dr Lily Therese (Head of Microbiology, Sankara Nethralaya) proposed the vote of thanks.

4. Proceedings of the workshop

The workshop included presentations of country reports to review the current status of antimicrobial resistance in countries; presentations and discussions to disseminate recommended techniques for antimicrobial susceptibility testing and antimicrobial susceptibility data compilation; and hands-on training for antimicrobial susceptibility testing and WHONET.

4.1 Plenary sessions

The plenary sessions pertained to a review of the national laboratory-based surveillance of AMR in the Region. While Thailand has a well functioning National Antimicrobial Resistance Surveillance Programme for the last 10 years, remaining Member States are still in early stages of planning or implementation. It was felt this workshop would act as a good catalyst in these country initiatives.

The status of AMR in the SEA Region also showed it to be a major problem especially in hospital-associated infections and two of the three diseases included in MDGs, viz. TB and malaria. The participants agreed that the regional strategy developed by the Regional Office was a practical document and a useful tool.

Various mechanisms that confer resistance to organisms were discussed. Special focus was on methicillin-resistant *Staphylococcus aureus*

(MRSA), vancomycin-resistant enterococci (VRE), extended-spectrum beta lactamases (ESBL) and metallo-beta lactamases (MBL) producing Gram-negative bacteria.

The WHO-approved method of determination of antimicrobial susceptibility – the modified Kirby Bauer technique with breakpoints developed by Clinical and Laboratory Standards Institute (CLSI) of the United States of America - was explained. Possible variables that influence results of testing using this method were also discussed and key variables were explained.

To rapidly and accurately analyse the data on AMR, WHO has a freely-downloadable software - WHONET. A copy of the software along with other WHO resources was shared with participants.

4.2 Current status

Status of AMR in SEA Region

Dr Rajesh Bhatia provided an overview of the status of AMR in the SEA Region. He spoke about the need to act now to ensure the availability of effective antibiotics for future generations. The movement to contain antimicrobial resistance needs collaboration between governments with all stakeholders to address this public health problem.

Country reports

Bangladesh

The most important need in the country is quality assurance of the laboratory system, and this can be handled by the government institute - The Institute of Epidemiology, Disease Control and Research (IEDCR) that could be the focal point. The IEDCR in collaboration with the Management Information System (MIS) of the Directorate-General of Health Services (DGHS), could handle laboratory-based surveillance in Bangladesh.

Bhutan

Bhutan with a population of just over 600 000 has only four hospitals carrying out antimicrobial susceptibility testing, with inadequate human resources being the biggest constraint. Antimicrobial resistance is reportedly low and so far there has not been any major problem related to AMR. Though Bhutan does not have national guidelines on rational use of antibiotics, it recently appointed a national focal point for AMR.

There is some information and data sharing in the laboratory susceptibility pattern but there is no national surveillance, nor a national network of laboratories on AMR. Though ESBL isolates have been detected no MRSA and VRE have been reported so far. Although resistance is low in all bacteria, it is worrying since the resistance rates keep going up. Also, the most worrying aspect is that of *Acinetobacter* isolates showing pan-resistance.

Although antibiotics are prescribed only by professional staff, there is no training provided on the rational use of antibiotics. There is no monitoring of the use of antibiotics and almost all antibiotics are available over the counter. There is no awareness of problems of AMR even at the level of policy-makers. The future plans for the prevention and containment of AMR include:

(1) Initiate national laboratory-based surveillance for AMR.

(2) Share data on AMR with clinicians and formulate antibiotic guidelines.

(3) Mobilize resources for AMR surveillance:

- Establishment of an AMR programme
- Training of doctors, pharmacists and laboratory personnel.

The major challenges in Bhutan include:

- AMR is not considered a major public health problem.
- Lack of awareness of AMR at policy-makers' level.
- Absence of a national programme on AMR.

- More emphasis on public health diseases, with a consequent neglect of AMR in hospitals.
- Lack of education of doctors on AMR and rational prescription of antimicrobials.

Cambodia

The country has more than 70 referral hospitals in provinces but they do not have the capacity to perform bacterial culture. The only hospital at Kg Cham province has the capacity to do microbiology cultures and susceptibility testing. There are plans to set up two more microbiology laboratories in provinces by the end of 2011.

The National Institute of Public Health (NIPH), supported by the Ministry of Health conducts surveillance of Severe Acute Respiratory Infections (SARI) in four hospitals - two in Phnom Penh and two in provinces, as well as support outbreak investigations and publish bulletins. They are developing their own Laboratory Information System (LIS) but currently use Excel-based formats for reporting.

The major challenges faced in surveillance of AMR include:

(1) Limited human resources.

(2) Limited laboratory facilities (only three-four laboratories do microbiology tests).

(3) Lack of an EQAS programme and data analysis.

(4) No national antibiotic policy.

(5) Lack of resources.

Fiji

Currently there is no major AMR concern in Fiji. There has not been any reported case of MDR though the number of TB cases is on the rise. Also there has not been any resistant strain of *Salmonella typhi* as like TB it is found in very high numbers in Fiji. Typhoid surveillance is the main surveillance system in the country and as mentioned above it not much of concern yet in terms of AMR.

The major challenge in the country for AMR surveillance includes lack of an online network within the country.

India

Antimicrobial resistance in important disease pathogens has become a matter of great public health concern in India. The factors responsible for this are widespread use and availability of practically all antimicrobials over the counter meant for human as well as animal consumption. Though there are definite policies/guidelines for appropriate use of antimicrobials at national level, in specific national health programmes in the country for TB, AIDS and malaria, the same are not available for other pathogens of public health importance like enteric fever, diarrhoeal diseases and respiratory infections, etc.

Though a large number of laboratories in the country (in both private and public sectors) are carrying out drug susceptibility testing of microbes, data are either not analysed on a regular basis or are not being disseminated for use of clinicians/public health experts/programme managers. There also are issues of quality control and data sharing of these laboratories. There are a few examples of successful networking of laboratories carrying out antimicrobial sensitivity testing of gonococcus in the country with regional STD laboratory at Safdarjung Hospital in New Delhi being the referral laboratory. Networking of laboratories also exists in the national TB control programme, generating some useful data on drug resistance in TB in the country.

Recently, a laboratory network has also been established for antimicrobial testing of HIV under National AIDS Control Organization (NACO). Meta-analysis of the drug susceptibility results of various laboratories across the country reveal an increasing trend of development of resistance to commonly used antimicrobials in pathogens like *Salmonella* sp, *Shigella* sp, *Vibrio cholerae*, *Staph aureus*, gonococcus, meningococcus, *Klebsiella* sp, *Mycobacterium tuberculosis*, HIV, malaria and others. Recently, more and more cases of resistance to carbapenems in various Gram-negative pathogens like *Klebsiella* sp, *E. coli and Acinetobacter* sp, etc. have been reported.

Though there is no national database on surveillance of antimicrobial use in the community, few studies have been carried out in the country.

Studies carried out in Delhi and Vellore during 2003-2005 suggest a very high use of fluoroquinolones and cephalosporins in the community compared to other antimicrobials. In the last few years, a number of initiatives have been launched in the country for containment of AMR including AMR surveillance. These are:

- India-Clen (Indian Clinical Epidemiology Network) has generated some quality data on AMR in pathogens like pneumococcus and *H. influenzae* across the country.
- The IIMAR (Indian Initiative for Management of Antibiotic Resistance) launched in March 2008 by a consortium of NGOs and experts in the field of health and social sciences to promote prudent use of antimicrobials in the country.
- The INSAR (Indian Network for Surveillance of Antimicrobial Resistance) - a network of 19 laboratories in public as well as private sector, across the country, launched with WHO support to generate quality data on AMR.
- Indo-Swedish joint strategy for containment of AMR in India.
- National taskforce for containment of antimicrobial resistance, constituted in August 2010 under the chairmanship of Directorate-General of Health Services (DGHS). After a series of meetings of the taskforce, a draft national antibiotic policy was developed and submitted for approval to the health ministry.

The major challenges faced in surveillance of AMR include:

(1) Inadequate control on over-the-counter sale and availability of antimicrobials.

(2) No national programme for AMR surveillance as yet.

(3) Paucity of quality assuring laboratories for AST.

(4) Insufficient AST data analysis and dissemination.

(5) Absence of national guidelines on antimicrobial use.

Indonesia

The number of cases with antibiotic resistance isolates in Indonesia remains high. Almost all bacteriology laboratories in hospitals and district laboratories carry out antimicrobial susceptibility testing. Several hospitals regularly compile their antibiogram every six months for their own use. However, data have not been integrated yet.

The National Institute of Health Research and Development (NIHRD) is a research institution under the Ministry of Health of the Republic of Indonesia. The microbiology laboratory is a referral laboratory for outbreaks and also a research laboratory for several infectious diseases such as TB, diarrhoea, cholera and diphtheria. Currently, laboratory-based surveillance of AMR in Indonesia is not established. They have difficulties in networking of hospitals, district laboratories and research centres, but are planning to establish AMR surveillance in the country.

The major challenges faced in surveillance of AMR include:

(1) Indonesia has a large area with many provinces and islands, and it is a challenge to integrate antimicrobial resistance data that cover or represent the whole country.

(2) Lack of motivation in hospital laboratories to be involved in data collection to establish AMR surveillance, especially in public hospitals because they are very busy and lack adequate human resources.

(3) In remote areas, access to technology is difficult because of lack of facilities and human resources.

(4) Several hospital laboratories have different data management systems or lack a data management system at all, so it is a challenge to motivate and train them for AMR surveillance.

(5) Lack of human resources in NIHRD to manage/maintain the database.

Lao People's Democratic Republic

The bacteriology division of the National Centre for Laboratory and Epidemiology (NCLE) in Vientiane supervises peripheral laboratories and the laboratories in main hospitals in Vientiane. It also participates in

outbreak investigation and response, and participates in the teaching programme at the faculty of health sciences.

The major challenges faced in surveillance of AMR include lack of resources to support AMR surveillance, including funds, human resources and technical inputs.

Malaysia

The National Antibiotic Resistance Surveillance programme was established in the late 1990s, and it became full fledged by the year 2000. In the beginning only nine laboratories were involved. Later, more laboratories were enrolled in this programme over time. As of 2010, a total of 16 major laboratories, comprising 14 state hospital laboratories and two major hospital laboratories had submitted their antibiotic susceptibility data.

The antibiotic susceptibility data from each hospital is compiled by the laboratory and sent to the coordinating laboratory, which is the Bacteriology Unit, Institute for Medical Research (IMR), Kuala Lumpur. Laboratories need to send their data to IMR every three months. Initially, the data were sent by means of a compact disk but submission of data has now been made easier by email.

The antibiotic susceptibility patterns of the clinical isolates from each of the hospitals is analysed individually by the respective microbiology laboratory and presented to the infection control committee or any other department that needs the data.

The IMR collates and integrates data from all the 16 major hospitals into the national antibiotic surveillance data and submits them to the national technical committee on antibiotic resistance and usage, chaired by the Director-General of Health, Malaysia. The antibiotic resistance data are also compared with antibiotic usage in each hospital. The current antibiotic resistance situation in Malaysia and the steps needed to reduce or curb the spread of antibiotic resistance is discussed at this platform.

Malaysia plans to expand the national surveillance of AMR to include district hospitals and universities. A workshop was conducted in June 2010 to introduce the use of WHONET so that participants could send their antibiotic susceptibility data in a uniform format to IMR.

The major challenges faced in surveillance of AMR include:

(1) Some laboratory information systems are not compatible with WHONET. In such instances the laboratory staff need to enter the data manually and some laboratories enter their data into an Excel file and convert it into the WHONET format. This has led to the problem of invalid data e.g. the year of analysis, instead of 2010, became 2016 due to incorrect naming of files.

(2) Delay in data compilation because of manual data entry.

(3) Identification of bacteria – some hospital laboratories identify up to "species" level; but some hospital laboratories identify up to "genus" level only, with consequent problems in interpretation of national data.

(4) Lack of standardized testing protocols e.g. oxacillin disc susceptibility — one particular laboratory records it as methicillin susceptibility, therefore during analysis of oxacillin-resistant strains in all hospitals, this laboratory is left out because the oxacillin field is blank.

(5) Turnover of staff entering the data -- the person who takes over the data entry functions is not properly trained. This leads to errors.

Maldives

Currently antimicrobial resistance is very low compared to other countries. Ampicillin resistance has increased over the years, but co-amoxyclav and amikacin still have a good sensitivity. The commonly isolated organisms include *Escherichia coli*, *Staph aureus* and *Pseudomonas* sp. The MRSA isolation has been very low, with only one or two cases being reported each year. Uncommon isolates are sent to the Indira Gandhi Memorial Hospital laboratory in Male, which is the main reference laboratory situated in the capital city. Four of the main hospitals have the facility to perform antimicrobial susceptibility testing. Currently, the reference laboratory lacks a consultant microbiologist, and faces problems in procuring ATCC controls for maintaining quality.

Surveillance of antimicrobial resistance is needed since Maldives has a number of migrants, as well as temporary residents from different countries.

Moreover, communicable diseases continue to be a major problem. The TB control programme has been a success in the country.

The major challenges faced in surveillance of AMR include:

(1) Lack of an AMR surveillance system in the country.

(2) Inadequately trained staff doing AST throughout the country, as most of the trained staff are in the reference laboratory only.

(3) Difficulty and problems in procurement and supply of reagents.

(4) Lack of support from the health ministry and clinicians.

Mongolia

Application of disposable needles and syringes in 1997 and inclusion of nosocomial infections in the list of notifiable diseases in 1998 signalled the progress in the control of health-care associated infections (HAI) in Mongolia. From 1998 – 2009 outbreaks of HAI accounted for 40-70% (2500 cases). Although the number of outbreaks has decreased, high level of exposure is reported among hospitalized patients. There is an urgent need to establish a functional surveillance system for HAI and improve reporting at all levels, including private health facilities.

The main document currently used in the control of HAI is the ministerial order on infection control approved in 2008. Other related protocols and procedures have inadequate coverage of infection control issues.

Infection control is a priority strategic area in the Asia-Pacific Strategy for Emerging Infectious Diseases (APSED), as well as in the national plan for emerging diseases. The HAI affect quality and safety of health care services. The HAI surveillance system is not functioning optimally as many cases are underreported. Common indicators that allow inter-hospital comparison have not been developed as yet. Therefore, continuous training of epidemiologists, infection control practitioners, hospital infection control committee, and hospital staff and administration on infection control are needed.

The major actions needed in surveillance of AMR include:

(1) Government

- Should develop documents on AMR policy, strategy, action plan
- Institute control and prevention of infectious diseases
- Control inappropriate use of medicines
- Inadequate research and development for better diagnostics and medicines
- Need to strengthen surveillance and laboratory capacity

(2) Laboratory

- Should develop documents on AMR guidelines and standard operating procedures (SOP)
- Establish a system of AMR surveillance using WHONET
- Improve diagnosis of AMR
- Improve training and capacity building

Myanmar

Laboratory-based surveillance is being carried out in the bacteriology section of the National Health Laboratory, Yangon. Samples include urine, sputum, swabs – nasopharyngeal and from the wounds. Samples from the Yangon General Hospital mostly yield organisms like *Staphylococcus aureus*, *Pseudomonas* sp. and *Klebsiella* sp. The least resistance is observed against amikacin and imipenem. *Vibrio cholerae* O1 that are isolated are resistant to cotrimoxazole, ampicillin and tetracycline, and sensitive to norfloxacin, ciprofloxacin, chloramphenicol and gentamicin. Sensitivity to tetracycline varies with the serotype – Inaba serotype show 70% resistance, but Ogawa serotype exhibit only 20% resistance. *Neisseria meningitidis* isolated during 2010 is still sensitive to penicillin and chloramphenicol.

The major challenges faced in surveillance of AMR include:

(1) Lack of standard guidelines for antimicrobial susceptibility testing like those from Clinical and Laboratory Standards Institute (CLSI) and absence of commercial supply of antibiotics discs.

(2) Difficulties in purchasing basic culture media.

(3) Access to computers is difficult due to financial constraints.

(4) Lack of dedicated data entry operator for AST data.

(5) No standard system (like WHONET) being used.

Nepal

A total of 1872 surveillance isolates were reported in the year 2010. Half the isolates were reported from Patan hospital (49.6% of the total isolates). In addition to the resistance pattern analysis, data collected in 2010 were also analysed for specimen type, age and sex distribution for each organism. Of the total isolates reported in 2010, the most common organism was *Salmonella* sp. (1525, 81%) followed by *Streptococcus pneumoniae* (165, 9%), ESBL positive *E. coli* (86, 4.5%), *Vibrio cholerae* (45, 2.4%), *Haemophilus influenzae* (35, 1.8%). Only nine *Shigella* sp (9, 0.4%) were reported along with seven *Neisseria gonorrhoeae* (7, 0.3%) isolates. Among the *Salmonella* isolates, 886 isolates (58%), 611 isolates (40%) and 28 isolates (2%) were *S. typhi*, *S. paratyphi* A and other Salmonella species respectively.

Organisms under surveillance included *Salmonella* sp. *Shigella* sp. *Vibrio cholerae*, *Streptococcus pneumoniae*, *Neisseria gonorrhoeae*, *H. influenzae* and ESBL positive *E. coli*. Of the total 1525 *Salmonella* isolates reported, 86% isolates were reported from the age group <30 years. The antimicrobial resistance pattern of the *Salmonella* isolates showed that isolates were 100% susceptible to ceftriaxone and cefixime. Most *S. typhi* isolates (68%) were resistant to nalidixic acid followed by 17% resistance to ciprofloxacin and 14% to doxycycline. The resistance rate was higher for *S. paratyphi* A isolates than *S. typhi* towards most monitored antibiotics including nalidixic acid (93%). The overall prevalence of multidrug resistance in these *Salmonella* isolates was 8%.

Of the total *Vibrio cholerae* isolates reported (45), all identified *Vibrio* belonged to the biotype El Tor and serotype O1 (Ogawa). The month-wise distribution of *Vibrio cholerae* isolates showed that the majority of cases had been reported in the months of July to September. No resistance was observed against ceftriaxone, ofloxacin and ciprofloxacin in *Vibrio cholerae* isolates, but tetracycline followed by amoxycillin and erythromycin showed 71%, 18% and 10% resistance, respectively. All *Vibrio* isolates were resistant

to furazolidone and cotrimoxazole. Only nine *Shigella* isolates were reported (four *Shigella dysenteriae*, four *Shigella flexneri* and one *Shigella* sp). The isolates were 100% resistant to amoxycillin, nalidixic acid and cotrimoxazole but sensitive to ofloxacin, chloramphenicol and gentamicin.

The major challenges faced in surveillance of AMR include:

(1) Increasing problem of resistance since 2003.

(2) Difficulty in including all the laboratory personnel in AMR surveillance.

(3) Low participation of stakeholders in AMR dissemination programme.

Papua New Guinea

Papua New Guinea is a small island country consisting of many small islands and four relatively large islands. The laboratory system comprises two main components – the Central Public Health Laboratory and diagnostic laboratories in hospitals. In Port Moresby, the capital, the two systems are separate; however in provinces the function of the Public Health Laboratory is carried out by hospital diagnostic laboratories.

The Port Moresby General Hospital Diagnostic Laboratory is the only one that can carry out microbiology cultures. The Central Public Health Laboratory cannot culture microbes. There are a total of five permanent laboratory staff members in the microbiology laboratory – one head of microbiology, a microbiologist and three general pathologists.

Philippines

The reference laboratory for ARS (antimicrobial resistance surveillance) is the coordinating centre of the Antimicrobial Resistance Surveillance Programme (ARSP). It has implemented laboratory-based surveillance of AMR among aerobic bacteria in 22 tertiary-level laboratories in 17 regions in Philippines where sentinel sites report resistance patterns of all aerobic bacteria identified in their laboratories. Surveillance started in Metro Manila alone in 1988 and slowly expanded to the rest of the country. The surveillance monitors aerobic bacteria with unusual susceptibility patterns (i.e. high level resistance and new resistance patterns, etc.) and try to determine their resistance mechanisms.

Confirmatory testing for identification and AST are based on the CLSI guidelines. Feedback is provided to the sentinel sites about the confirmed results besides regular updates on updated laboratory and data management methods.

Medical technologists, pathologists and data management staff of sentinel sites and other tertiary microbiology laboratories are trained. The reference laboratory also serves as a reference centre for Salmonella serotyping. The EQAS in aerobic bacteriology is implemented as part of an accreditation process on behalf of PHILHEALTH (national health insurance). Pulse Field Gel Electrophoresis (PFGE) is done on selected bacteria like *Salmonella* species, *Shigella* sp. and *Staphylococcus aureus* for outbreak detection. They generate AMR surveillance data through WHONET software. Summary reports are provided on the ARSP data annually to all stakeholders. The AMR data are used as the basis for many clinical practice guidelines and national drug formulary, etc.

The major challenges faced in surveillance of AMR include:

(1) No regular funds from the government.

(2) Lack of personnel (not enough medical technologists or laboratory staff) both for regional and the national (ARSRL) laboratory.

(3) No linkage of data from laboratory surveillance with epidemiologic data (generated by another government agency called the National Epidemiology Centre).

(4) Lack of coordination between epidemiologists and laboratory staff in investigation of outbreaks and implementation of surveillance programme.

(5) Absence of a master plan for laboratory surveillance in Philippines, resulting in duplication of work especially in the field of bacteriology.

Sri Lanka

Currently there is no national laboratory-based surveillance programme in place. However an AMR surveillance project was started in 2009, which has completed the initial phase of two years. It covers seven centres in three provinces in the country. This project included Gram-negative organism from blood cultures and AST was done by the CLSI method. The second phase started in November 2010 and it has extended to three more hospitals for Gram-negatives. The Phase 1 results are currently being analysed.

In addition, the pneumococcal surveillance project (South Asian Pneumococcal Alliance - SAPNA) is in place since 2004 for invasive pneumococcal isolates. WHO is funding Lady Ridgeway hospital (LRH), which serves as the reference centre. Initially, only LRH isolates were analysed. Subsequently, six network recruitment hospitals were included. Now isolates from all hospitals that have services of a consultant medical microbiologist are allowed, provided the isolates can be transported to the LRH, which is a problem for some hospitals.

The Sri Lanka College of Microbiologists has identified the need to establish a national database on AMR and a subcommittee had been appointed to work on this. The country presently has at least one consultant medical microbiologist in eight out of nine provinces. None of the private sector laboratories have a full-time "on-site" microbiologist.

The major challenges faced in surveillance of AMR include:

(1) Need to establish the standard CLSI method in all laboratories where AMR surveillance is to be done. Very few laboratories are currently testing all specimens by the CLSI method (some laboratories do it only for blood cultures). Availability of quality discs, regular supply of media, availability of sheep blood and availability of disposable plastic plates are some of the other challenges in AST.

(2) Availability of infrastructure – some laboratories do not have even a single computer.

(3) Data entry officers – need to work out a solution.

(4) Almost all laboratories (except Medical Research Institute - MRI) do not have internet access but home facilities could be used.

Thailand

In Thailand, there are three networks concerning laboratory-based surveillance of AMR:

(1) Antimicrobial resistance surveillance of *S. pneumoniae* and *H. influenzae;*

(2) National Antimicrobial Resistance Surveillance (NARST); and

(3) Thailand Invasive Bacterial Infection Surveillance (Thai-IBIS)

The major challenge faced in AMR surveillance is the limited human resources, with each laboratory personnel required to do multitasking.

4.3 Hands-on training – laboratory techniques for AST

Participants prepared the MacFarland standards for adjusting turbidity and validated their preparations using the ELISA reader. They also practised the antimicrobial susceptibility testing as per the modified Kirby Bauer technique with CLSI breakpoints for the control and test strains.

The detection of MRSA and beta-lactamase screening (using Nitrocefin disc test) was demonstrated before all participants did it practically, using oxacillin salt agar, disk diffusion and Etest. Glycopeptide resistance was practised using Vancomycin screen agar, Etest and disk diffusion.

The extended spectrum beta-lactamase (ESBL) and metallo-beta-lactamase (MBL) were detected using the double disk test, Etest and the modified Hodge's test. The molecular techniques for AMR for detection of MRSA and ESBL were also demonstrated.

4.4 Hands-on training – WHONET

WHONET is a free software developed by the WHO Collaborating Centre for Surveillance of Antimicrobial Resistance for laboratory-based surveillance of infectious diseases and antimicrobial resistance.

The principal goals of the software are:

- to enhance local use of laboratory data; and
- to promote national and international collaboration through the exchange of data.

WHONET can be used by individual laboratories or as part of a national and international surveillance network. At present, the software, available in 17 languages, is used in over 80 countries around the world managing data from over 1000 clinical, public health, veterinary, and food laboratories.

The analytical tools of WHONET facilitate:

- the understanding of the local epidemiology of microbial populations;
- the selection of antimicrobial agents;
- the identification of hospital and community outbreaks; and
- the recognition of quality assurance problems in laboratory testing.

All participants were taught how to instal the WHONET programme. They also practised how to configure the WHONET laboratory database as per their requirements and needs.

Extensive hands-on exercises were done using AST data sheets provided by the faculty. Participants acquired the skills to use WHONET to enter AST data and they also discussed the establishment of a national surveillance system for AMR in their countries using WHONET.

5. Recommendations and conclusions

The following recommendations were made at the workshop:

(1) For Member States

Member States should

(1) Designate a national focal point for AMR and identify/establish/strengthen a national reference laboratory.

(2) Establish national laboratory-based surveillance of antimicrobial resistance in a step-by-step manner.

(3) Build capacity of laboratories in quality analyses of antimicrobial resistance and to provide reliable data for utilization at local level as well as for national guidelines.

(4) Accord priority to AMR given its serious consequences for clinical care as well as public health actions.

(2) For Participants

The participants of the workshop should

(1) Initiate modified Kirby Bauer Method for AST in their respective laboratories as per the WHO-recommended CLSI method.

(2) Utilize WHONET software for data analyses and be proactive in sharing these data with users and health administrators.

(3) Participate in the Asia-Pacific Network for Surveillance of AMR.

(4) Strengthen the quality system in their laboratories.

(3) For WHO

(1) Advocate with national authorities for establishing national surveillance programme for AMR.

(2) Develop and disseminate guidelines for establishing national surveillance of AMR.

(3) Provide technical assistance to Member States to build their national capacity for laboratory-based surveillance of AMR.

(4) Facilitate an external quality assessment scheme for AMR for members of the AMR network.

Annex 1

Agenda

(1) Inauguration and Introduction

(2) Introduction to WHO regional strategy on prevention and containment of antimicrobial resistance

(3) Experience sharing on laboratory based surveillance of antimicrobial resistance

(4) Hands-on training on WHO recommended laboratory techniques for determination of resistance

(5) Quality systems in antimicrobial resistance determination

(6) Introduction to WHONet5 and training on its use in labs

(7) Possible mechanism for establishment of national surveillance system for monitoring of drug resistance

(8) Development of key follow-up action points

(9) Closing session

Annex 2

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Detection of resistance and monitoring for its spread requires laboratory-based surveillance. A workshop was organized to assist national authorities in building their laboratory capacity for efficient surveillance of emergence and spread of antimicrobial resistance through use of WHO-recommended laboratory techniques for determination of antimicrobial resistance and WHO software for antimicrobial resistance data analyses. This document also briefly outlines the status of laboratory-based surveillance of antimicrobial resistance in countries in Asia-Pacific region.

World Health Organization
South-East Asia Region Western Pacific Region

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