Japan Nosocomial Infections Surveillance (JANIS): From a national AMR surveillance system to an international collaboration

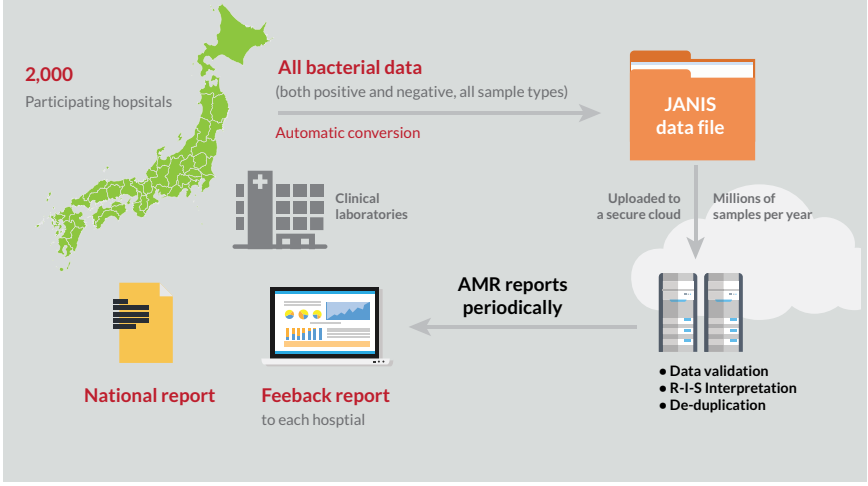
Dr Koji Yahara (top Left), Senior investigator, Antimicrobial Resistance Research Center, National Institute of Infectious Diseases, Tokyo, Japan; **Dr Sirenda Vong** (top middle), Program Area Manager, Health Emergency Information and Risk Assessment, Department of Health Emergencies, World Health Organization Regional Office for South-East Asia, New Delhi, India; **Professor Visanu Thamlikitkul** (top right), Director, WHO Collaborating Centre for Antimicrobial Resistance Prevention and Containment, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand; **Dr Rujipas Sirijatuphat** (middle Left), Assistant Professor, Department of Medicine, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand; **Dr John Stelling** (middle), Co-Director, WHO Collaborating Centre for Surveillance of Antimicrobial Resistance, Brigham and Women's Hospital, Boston, MA, USA; **Dr Aki Hirabayashi** (middle right), Researcher, Antimicrobial Resistance Research Center, National Institute of Infectious Diseases, Tokyo, Japan; **Dr Keigo Shibayama** (bottom Left), Director, Department of Bacteriology II, National Institute of Infectious Diseases, Tokyo, Japan; **Dr Motoyuki Sugai** (bottom middle), Director, Antimicrobial Resistance Research Center, National Institute of Infectious Diseases, Tokyo, Japan and **Norifumi Shigemoto** (bottom right), Deputy Director, Infectious Disease Control Division, Health Service Bureau, Ministry Health, Labour and Welfare, Tokyo, Japan.

A prerequisite for building a national antimicrobial resistance (AMR) surveillance is establishing an information technology (IT) system; this remains a challenge in many countries. Japan has used an IT-based AMR surveillance system called JANIS for over 10 years. The JANIS team has collaborated with other institutions and IT system developers, including the WHONET production team, to develop an open source international IT system for AMR surveillance that can be accessed for free, in accordance with Japan's National Action Plan on AMR. It is hoped that a JANIS-based international IT system will be useful for AMR surveillance in resource-limited countries.

Surveillance for antimicrobial resistance (AMR) is included as one of the strategic objectives of the Global Action Plan on AMR launched by the World Health Organization (WHO) in 2015 *(1)*. Information technology (IT) is required for developing an AMR surveillance platform at the national level. A systematic review of electronic systems for infectious disease surveillance with an emphasis on AMR surveillance initiatives in resource-limited settings *(2)* revealed that IT was effective and useful for supporting AMR surveillance collaborations. However, because of a lack of resources, only a few IT-based AMR surveillance systems have been implemented in low- or middle-income countries where effective and rapid surveillance systems for AMR are most needed.

Japan launched such an IT-based national AMR surveillance system in 2000, called the Japan Nosocomial Infections Surveillance (JANIS), and revised it in 2007 to include all types of specimens *(3-5)*. This was organized by the Ministry of Health, Labour and Welfare and run by the JANIS management office at the Antimicrobial Resistance Research Center of the National Institute of Infectious Diseases. JANIS is a sample-based automated electronic surveillance programme that collects laboratory data of bacterial samples from all routine specimen types (including results from both positive

Figure 1: **JANIS system**



and negative samples) (Figure 1). This is a much larger data volume than that covered in the WHO Global Antimicrobial Resistance Surveillance (GLASS) protocol, which includes four priority specimen types and eight priority pathogens. Such comprehensive data from each hospital are regularly uploaded manually through a web interface to a secure cloud system compliant with a specific data format for each sample, including the hospital ID, patient ID (de-identified), specimen ID, date of sampling, microorganisms and antimicrobial susceptibility results. In Japan, the automatic data preparation functions have been developed and installed into the automated microbiology systems such as MicroScan or Vitek or within the laboratory information systems used in the participating hospitals and commercial clinical laboratories.

The uploaded data are processed in the JANIS server-side tabulation programme, which mainly consists of three parts: First, a data quality check that flags possible erroneous data containing rare or unexpected resistance profiles or invalid data and returns automatic validation inquiry emails to each participant. Second, R-I-S interpretation of the quantitative susceptibility test data using a specific version of CLSI breakpoints. Third, data de-duplication to exclude repeated samples of a given species with consistent resistance profiles from the same patient within 30 days. The collection of both culture-positive and -negative samples under the comprehensive scheme enables JANIS to determine the total number of patients from whom the specimens were submitted; this is one of the denominators used for calculating rates as requested by GLASS. JANIS publishes annual reports, available in both English and Japanese on the JANIS website *(3)*.

Although participation in JANIS is on a voluntary basis, the number of participating hospitals increased to 2,150 (out of approximately 8,000 hospitals across Japan) at the beginning of 2018. Of these facilities, 2000 hospitals participated in the Clinical Laboratory module that collects routine microbiology test results. This increase reflects the fact that JANIS participation has become a prerequisite for reimbursement for preparing for infection control activities, an incentive structure to promote participation at national level. In 2017, the data of more than 8 million specimens submitted by the participating hospitals were imported to the JANIS system. In addition to national reports, JANIS also prepares individual facility feedback reports, which are returned to each participating hospital. The feedback reports contain data quality and isolate alerts, descriptive counts of the number of samples and priority pathogens found, and benchmarking boxplot figures, which readily highlight facility-specific isolation and resistance rates of specific AMR bacteria for each hospital compared to national findings. The monthly feedback report is automatically made available within 48 hours after data submission, supporting appropriate time use by infection control staff to respond to issues identified promptly. Public national and confidential facility-specific feedback reports are created after systematic data checks are conducted in the JANIS management office.

The Government of Japan's National Action Plan on AMR, 2016-2020, aims to improve public awareness and understanding of AMR, to continuously monitor AMR and antimicrobial usage (AMU) while studying signs of change and speed of AMR dissemination, and to promote research on AMR, amongst others. One of the priority objectives is international cooperation. To this end, Japan is developing an international version of the JANIS system that is open source and available freely and confidentially to any country wishing to utilize it. The international version is built as a secure cloud system outside Japan in which each country can own a confidential database, upload facility and national data, and create both a national report and a facility-specific feedback report (Figure 2). Technically, the system can also be installed in a local server on an optional basis, if the country covers the cost for hardware/basic software components, installation, configuration, and maintenance.

Such a system is particularly relevant in the South-East Asia (SEA) Region, where there is a good sensitization on AMR-related issues and an obvious need for national surveillance data that can help in decision-making and evidence-based policy formulation, particularly given the resource-constrained settings of the region and the availability of the system at zero cost. The international version of the JANIS system has been built based on initial discussions and assessments in such

Figure 2: **International version of the JANIS system**

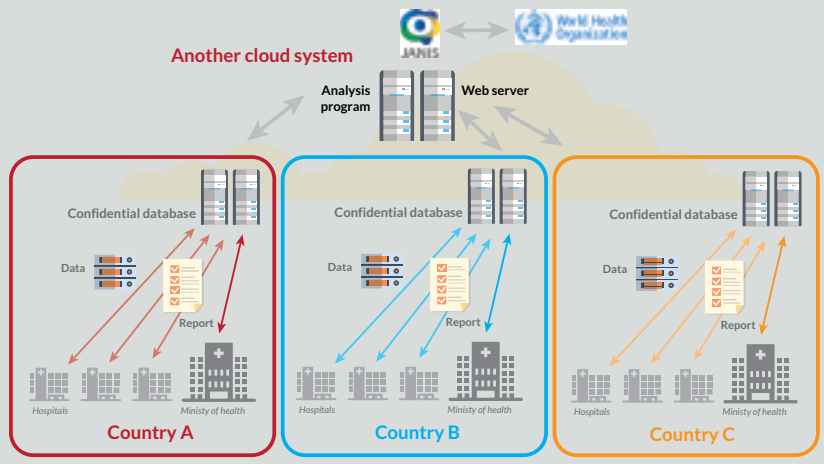


Table 1: **Comparison of WHONET and JANIS**

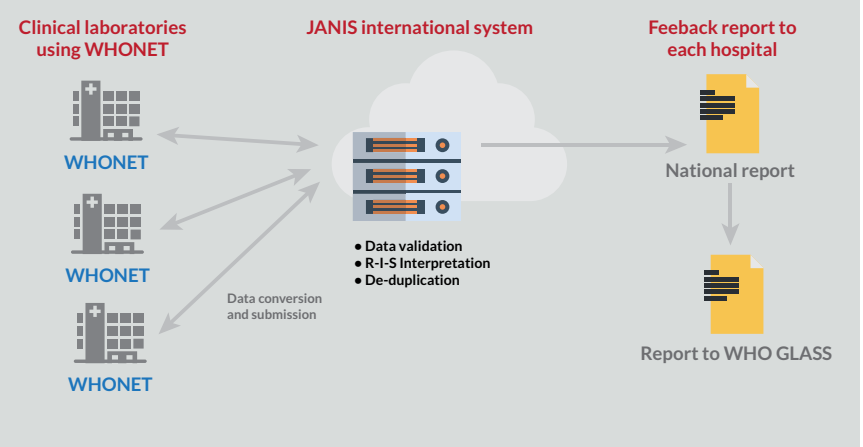
	WHONET	JANIS
Software	Stand-alone Windows software	Centrally managed Web-DB system
Data entry	Allows manual data entry or download from existing systems	Under development
Data analysis	Allows flexible analyses in a hospital or at national level	The system aggregates data automatically and enables comparison among participating hospitals
For multiple hospitals	As many as possible	As many as possible

countries, for example, Indonesia, Vietnam, and Mongolia.

The development of the JANIS system is ongoing in close collaboration with the WHO Collaborating Centre for Surveillance of Antimicrobial Resistance, which is responsible for the development, dissemination and support of the free Windows-based WHONET software (*6*, *7*); this software is the most widely used laboratory information management software that supports surveillance activities in over 2000 laboratories in over 120 countries, including in resource-limited settings. WHONET can be a perfect software for this purpose because it can collect both manual data entry and data conversion from existing automated susceptibility test instruments and laboratory information systems, using the attached BacLink software for data code and structure normalization. WHONET is installed at the hospital laboratory so that automated data analysis and reporting can be used by the facility staff. WHONET can also be utilized at the national level for purposes of inter-facility comparisons and national statistics. In contrast, JANIS is a centrally managed web-database system that does not have a manual data entry function yet, but is designed to aggregate data automatically and enables data comparison among any participating hospitals, irrespective of the number. Through active discussions with the JANIS team, a WHONET function has been developed to convert its data to a JANIS format, which can be directly uploaded to the JANIS international cloud system.

According to WHO South-East Asia Region (SEARO) at a meeting in February 2018, the combination of WHONET and JANIS (Figure 3) is regarded as a promising and relevant option for the region since it serves the objectives of electronic data storage, transmission, and data centralization seamlessly with least cost. To begin with, the WHO Collaborating Centre for AMR Prevention and Containment in Bangkok and the JANIS team started collaboration and a pilot analysis of existing AMR surveillance data in Thailand. Based on that, both WHONET and JANIS have been continuously modified and adapted. JANIS has customized the feedback report to incorporate specific AMR bacteria prioritized at the national level. JANIS has made it possible for users to create an annual/semi-annual/quarterly national report (and feedback reports) by mouse-clicking on a web page. The national and feedback reports are created separately for inpatient, outpatient, and total data. Regarding the benchmarking function using boxplots, users can now select an option to use Japanese data as a reference, which is useful when the number of participating hospitals in their country is too small to create boxplots. Each country can have

Figure 3: **Combination of WHONET and JANIS as a model for AMR surveillance**



administrators who can browse results of data submissions and download feedback reports of the participating hospitals in that country. For hospitals that can submit data of only culture-positive samples, the administrator can directly input the total number of specimen-submitting patients of each month, enabling calculation of the isolation rate of specific AMR bacteria under surveillance. The administrator can also create a report to WHO GLASS by mouse-clicking on the web. Furthermore, WHONET has made it possible to export whole data as a file rather than monthly data, and JANIS has developed a function to import such a single file containing whole data of a hospital, or even a combined file of multiple hospitals, which enables much more flexible data import into the JANIS database.

Such modifications and improvements of the international version of the JANIS system as well as the preparation of English user manuals will continue at least until 2020, based on collaboration with, and feedback from, countries that utilize it. We hope that this collaboration will enable and promote IT-based AMR surveillance and participation in GLASS for various countries. ■

Dr Koji Yahara is a senior investigator and a bio- and medical-informatician who has Ph. D in Biostatistics. A priority in his work has been statistical analysis of both genomic and epidemiological data of infectious diseases, and development and management of information technology programmes and databases in life science and medicine. He has been developing international research projects since he stayed in Europe as a JSPS Research Fellow funded by Japanese government.

Dr Sirenda Vong, MD (Fr.), DT&MH (Fr.), MSc Epid. (UK), PhD (Fr.), EIS (US), HDR (Fr.), is a Medical Epidemiologist and currently works as a Program Area Manager – Health Emergency Information and Risk Assessment and technical lead on Antimicrobial Resistance at the SEARO/WHO Health Emergencies Department. He is an author and co-author of >100 peer-reviewed articles. His main expertise for the past 20 years has been operational research in emerging infectious diseases, AMR and on strategic information to guide public health policy, risk analysis and health system analyses.

Professor Visanu Thamlikitkul is an infectious disease physician by training. He is the leader of Thailand Antimicrobial Resistance (AMR) programme and the director of World Health Organization (WHO) Collaborating Centre for AMR Prevention and Containment at Faculty of Medicine Siriraj Hospital, Mahidol University in Bangkok, Thailand.

Dr Rujipas Sirijatuphat is an infectious disease physician, with a particular interest in the field of antimicrobial resistance. His work focuses on the surveillance and treatment of antibiotic-resistant bacteria. He is currently the Assistant Professor of Infectious Diseases at Faculty of Medicine Siriraj Hospital, Mahidol University in Bangkok, Thailand.

Dr John Stelling is Co-Director of the WHO Collaborating Centre for Surveillance of Antimicrobial Resistance based at the Brigham and Women's Hospital in Boston, USA. He is a former Medical Officer with the World Health Organization Antimicrobial Resistance Monitoring Unit and created the WHONET software currently utilized to support AMR surveillance efforts in over 140 countries.

Dr Aki Hirabayashi, MD, PhD, is a physician and a researcher in laboratory surveillance at the Antimicrobial Resistance Research Center. Prior to joining NIID, she worked as a member of Infection Control Team in the department of Infectious Diseases in Nagoya University Hospital. In NIID, she works on national surveillance of infectious diseases, epidemiological research based on JANIS data and international collaboration of surveillance systems in Asian countries

Dr Keigo Shibayama is the chairman of the Steering Committee of JANIS. He is the principal investigator of the research project of antimicrobial resistance funded by Japan Agency for Medical Research and Development (JP18fk0108061). The mission is to help tackle antimicrobial resistance by strengthening the surveillance programme and basic research in Japan and Asian countries in cooperation with the Ministry of Health, Labour and Welfare and WHO.

Dr Motoyuki Sugai is the Director of the Antimicrobial Resistance Research Center. Prior to joining NIID, he served as the Professor of Bacteriology in Hiroshima University for 18 years. He established the Research Center for Nosocomial Infectious Diseases in HU in 2009 and has been leading AMR bacterial surveillance in Hiroshima. He has since expanded his focus and started National Genomic Surveillance of AMR bacteria in Japan. He is in the Roster of Experts Joint FAO/WHO Expert Meeting on Foodborne AMR.

Dr Norifumi Shigemoto is Deputy Director of Infectious Disease Control Division, Health Service Bureau, Ministry of Health, Labour and Welfare, Japan. He holds jurisdiction over JANIS and tackling AMR based on the Infectious Disease Control Law. He was a digestive surgeon, then he studied the antimicrobial-resistant mechanism of Enterobacteriaceae and made an effort for the control of infectious diseases and the treatment of the infected patients after having acquired a degree.

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