

## A Middle East subregional laboratory-based surveillance network on foodborne diseases established by Jordan, Israel, and the Palestinian Authority

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### SUMMARY

In late 2002, health professionals from the ministries of health and academia of Jordan, the Palestinian Authority and Israel formed the Middle East Consortium on Infectious Disease Surveillance (MECIDS) to facilitate trans-border cooperation in response to infectious disease outbreaks. The first mission of MECIDS was to establish a regional, laboratory-based surveillance network on foodborne diseases. The development of harmonized methodologies and laboratory capacities, the establishment of a common platform of communication, data sharing and analysis and coordination of intervention steps when needed were agreed upon. Each of the three parties selected the microbiological laboratories that would form the network of sentinel laboratories and cover the different districts of each country and also designated one laboratory as the National Reference Laboratory (NRL). Data analysis units have been established to manage the data and serve as a central point of contact in each country. The MECIDS also selected a regional data analysis unit, the Cooperative Monitoring Centre (CMC) located in Amman, Jordan, and established a mechanism for sharing data from the national systems. Joint training courses were held on interventional epidemiology and laboratory technologies. Data collection started in July 2005 with surveillance of salmonellosis as the first target. This network of collaboration and communication established in an area of continuous dispute represents an important step towards assessing the burden of foodborne diseases in the region and is expected to be fundamental for coordination of public health interventions and prevention strategies.

**Key words:** Foodborne disease, Israel, Jordan, Middle East, Palestinian Authority, *Salmonella*, surveillance.

### INTRODUCTION

Foodborne diseases are an important cause of morbidity and mortality worldwide [1–4]. Globalization of the sources of food and the trend of centralization

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of its production and distribution provide important economic advantages, but on the other hand it may increase the risk for accidental or deliberate contamination of food that may lead to large epidemics. Exchange of food products between countries can facilitate transmission of foodborne diseases internationally. Exposure to high infective doses of enteropathogens may significantly increase complications leading to higher fatality rates, especially in young children and the elderly.

Only limited information is available in the countries of the Middle East on the burden of illness resulting from foodborne pathogens. As part of the WHO's strategy to reduce the burden of foodborne diseases globally, Jordan was selected as the first sentinel site in the Eastern Mediterranean Region of the WHO to study the burden of disease due to *Salmonella* (including *S. Typhi*), *Shigella*, and *Brucella* infections through nationwide population and laboratory surveys, together with a validation study to approximate internal validity. Burden of illness calculations in Jordan revealed an estimated annual incidence (per 100 000) of 306, 124 and 130 for *Shigella*, *Salmonella* and *Brucella*, respectively [5].

Although it is probably an underestimate of the real burden of disease, study results have been used to advocate the establishment of sentinel site, laboratory-based surveillance for *Salmonella* and *Shigella* [6–9].

Salmonellosis, shigellosis and campylobacteriosis are notifiable diseases in Israel. Reports on culture-proven cases of shigellosis, salmonellosis, and campylobacteriosis are submitted by microbiological laboratories throughout the country to the Department of Epidemiology of the Ministry of Health [10]. This passive surveillance system provides capabilities for long-term assessment of the trends in the incidence of these enteric diseases in Israel, but has its disadvantages. The reporting from the various microbiological laboratories can be incomplete, it is often delayed, it lacks information on the relative distribution of the various serogroups and serotypes of the three enteropathogens, and the demographic data on the patients are often incomplete. To complete these gaps, an adjunct, sentinel laboratory-based surveillance system of enteric pathogens was established in Israel at the end of the 1990s. Despite a published update on the trends of salmonellosis in Israel [11] there has been no systematic assessment of the real burden of the disease in Israel to date.

Additional national and regional burden estimates and enhanced surveillance networks in the Middle East are essential in order to provide baseline information on specific foodborne pathogens against which outbreaks of disease can be detected early and controlled. These estimates will also contribute to the development of improved food-safety and food-trade regulations.

The first meeting towards the establishment the Middle Eastern partnership took place in November 2002 under the umbrella of two international non-governmental organizations (NGO): Search for Common Ground, and the American-based NGO, the Nuclear Threat Initiative (NTI) biologics programme. The partners came from ministries of health and universities, and NGOs in Jordan, Israel and the Palestinian Authority (PA). Participants were the Palestinian Ministry of Health in partnership with Al Quds University, the Israeli Ministry of Health in partnership with Tel Aviv University, and the Jordanian Ministry of Health in partnership with the Jordanian Royal Scientific Society. The vision which was agreed upon facilitates cross-border cooperation in response to infectious disease outbreaks through capacity building, encouraging human relationships and thus enhancing stability and security in the region. The partners founded a consortium designated MECIDS, an acronym for Middle East Consortium on Infectious Disease Surveillance; MECIDS's first endeavour was a 3-year project to develop an enhanced foodborne disease surveillance system. In view of the close proximity between the three countries, the existent foodstuff exchange and the future expectation of increasing the current level of food trade, it was anticipated that the significant upgrading in the methods of surveillance of foodborne diseases would play an important role in their prevention and control in the whole region.

The mission of the MECIDS members was to establish a regional laboratory-based foodborne diseases surveillance network comparable to existing networks in the USA (Food and PulseNet) and Europe (Enter-Net and Salm-gene) [2, 12]. It was expected that MECIDS would expand to include additional countries in the Middle East in the future, and in the long term the Middle East network would interact with the analogous networks in Europe and USA to identify potential further international spread of foodborne diseases.

The specific objectives of MECIDS were formulated by consensus of the three partners: rapid

identification of changes in the number of specific enteropathogens isolated at sentinel laboratories, detection of changes in the relative distribution of serogroups, serotypes, phage types, genetic profiles and antimicrobial susceptibility patterns of the foodborne agents at country and regional levels. It was also planned, in a further step, to examine the association between these patterns and environmental and host factors.

MECIDS agreed that the first target of the foodborne diseases surveillance should be the establishment of a *Salmonella* surveillance system based on networks of sentinel microbiological laboratories that would use a harmonized data collection methodology and a common platform of communication, data sharing and analysis. MECIDS also decided to enhance laboratory capabilities in order to identify *Salmonella* at the level of sentinel laboratories and strengthen existing capabilities and develop new ones for characterization of *Salmonella* using phenotypic (e.g. serotypes) and genotypic markers at the level of reference laboratories [13]. To reach these goals, clear protocols and budget requests were prepared by MECIDS members and subsequently agreed upon at periodical meetings. In view of differences in the existing capabilities/infrastructure between countries, it was agreed that each country would outline its specific immediate objectives that would suit the overall goal of the establishment of the regional foodborne diseases surveillance network.

### Capacity building

As part of the project, and in order to upgrade the health system dealing with infectious disease surveillance, joint training courses were held on interventional epidemiology and laboratory technologies. Thirty-five Palestinian, Jordanian, and Israeli health professionals participated in a 5-day workshop held in Istanbul in September 2004, the training focused on the key concepts of epidemiology and acquisition of knowledge on how to monitor and respond to disease outbreaks in the region. An additional training course on interventional epidemiology bringing together 33 participants from Israel and the PA took place in April 2008 at a Dead Sea accommodation resort in Israel. Palestinians, Jordanians, and Israeli microbiologists attended a *Salmonella* identification workshop in Israel in March 2005 and received 'hands-on' training as well as lectures from specialists at the

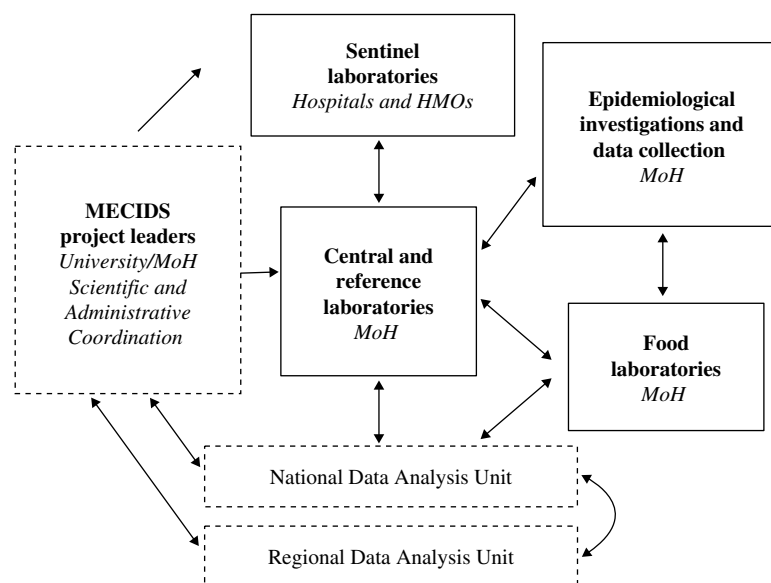
Jerusalem Central Laboratory of the Israeli Ministry of Health. The 4-day curriculum of the course included topics such as serotyping and phage typing of *Salmonella*, pulsed-field gel electrophoresis (PFGE), use of the Vitek machine, and antibiotic resistance tests. Subsequently, a panel of isolates belonging to various *Salmonella* serotypes was distributed to the reference laboratories for external quality assurance of the different steps in the phenotypic characterization of *Salmonella*.

### Establishing the laboratory networks (see Fig. 1)

Each of the three parties composing MECIDS selected the microbiological laboratories that would form the network of sentinel laboratories in their own country and cover the different districts including the designated National Reference Laboratory (NRL). In Jordan, one food laboratory and five Ministry of Health laboratories including four hospital laboratories and Amman Central Laboratory have been selected as sentinel sites. The Jordanian Ministry of Health Laboratory Directorate was chosen as the reference laboratory. In Israel, the network comprises nine sentinel laboratories, which are distributed throughout Israel and provide clinical diagnostic services to both ambulatory/community and hospitalized patients, in addition to Jerusalem Ministry of Health and Tel Aviv University central laboratories. In the PA two reference laboratories were chosen, one in the West Bank and one in the Gaza Strip, to perform *Salmonella* isolation, confirmation and serogrouping from food and clinical specimens. In addition, there are five sentinel laboratories, one in Nablus, one in Hebron, one in Ramallah, and two in Gaza.

### Designing standard procedures

The population under surveillance comprises patients attending sentinel laboratories for stool and/or blood cultures, food-handlers attending sentinel laboratories for stool cultures and food items received by food laboratories. Specimens are tested for the presence of *Salmonella* using the same standard operating procedures (SOPs). Upon receipt at the laboratory, clinical samples are processed and inoculated on MacConkey and Salmonella-Shigella (SS) agars. After overnight incubation at 37 °C, representatives of all non-lactose-fermenting colonies on MacConkey or SS agars are identified by routine



**Fig. 1.** MECIDS Foodborne Disease Surveillance System. Flowchart of operation. Solid boxes (—) indicate existing infrastructure; dashed boxes (- - -) indicate new organizations. HMO, Health maintenance organization; MoH, Ministry of Health; MECIDS, Middle East Consortium on Infectious Disease Surveillance.

morphological and biochemical testing (Kligler's iron agar, urea semi-solid agar, Simmons' citrate agar, lysine iron agar). For food specimens, serial dilutions are prepared from a homogenate sample, incubated overnight at 37 °C then inoculated onto selenite cysteine broth (SC), tetrathionate broth (TT), and Rappaport–Vassiliadis broth (RV). Incubated TT, SC and RV are then inoculated onto xylose lysine desoxycholate agar (XLD) and Brilliant Green agar (BGA) and incubated overnight at ~37 °C. Suspected *Salmonella* colonies are confirmed by biochemical tests. Organisms defined as *Salmonella* at the sentinel laboratory are submitted to NRL for serotyping and antimicrobial susceptibility tests using the Kirby–Bauer disk diffusion method following NCCLS recommendations. In Jordan and the PA, all *Salmonella* isolates have been preserved at –70 °C for further testing and genotyping. In Israel, PFGE has been performed on selected isolates using standard protocols developed by the Salm-gene network in Europe.

### Launching the surveillance system

Data analysis units have been established in each country to manage the data and serve as a central national point of contact (see Fig. 1). Data collection started in July 2005. Information on patients (sex, age, if they are in-patient or outpatient subjects, address,

etc.), specimens tested (stools, blood or urine) and isolates (*Salmonella* serogroup and serotype), has been collected at the sentinel laboratories and the NRL and recorded routinely in specifically designed data collection forms (laboratory logbooks, reporting forms). Data have been sent on a regular basis to the national data analysis units (Israel Centre for Diseases Control, Jordan Disease Control Directorate, PA Disease Control) for data entry and analysis. Furthermore, the national data analysis units should play a major role in alerting the public health authorities and initiating epidemiological investigations and studies when clusters of foodborne disease are identified, e.g. a *Salmonella* outbreak due to infected rice and chicken served during a dinner meeting in a hotel in the West Bank, PA, in which 60 patients tested positive for *Salmonella*. Another example is the significant recent increase in the relative weight of *S. Infantis* in *Salmonella* serotypes in Israel to over 30% of all *Salmonella* isolates by May 2009. A case-control study is underway to attempt to identify the source and mode of transmission of *S. Infantis*. We are currently using the network established to verify if a similar pattern has occurred in Jordan and the PA.

More than 4000 isolates of *Salmonella* have been reported to date by national data analysis units to the Regional Data Analysis Unit (see below). Eighty-two percent and 73% of the isolates were serogrouped

and serotyped, respectively. At the regional level the most common *Salmonella* serogroups were *Salmonella* C1 (24%), *Salmonella* D (21%), *Salmonella* C2 (16%) and *Salmonella* B (14%). The five leading serotypes were *S. Enteritidis*, *S. Virchow*, *S. Infantis*, *S. Typhimurium* and *S. Hadar*. The most common *Salmonella* serogroups in Israel were *Salmonella* C1 followed by *Salmonella* D; in Jordan, *Salmonella* D followed by *Salmonella* B and in the PA, *Salmonella* C2 followed by *Salmonella* C1.

### Data management, sharing and analysis

MECIDS also selected a regional data analysis unit, the Cooperative Monitoring Centre (CMC) situated in Amman, Jordan, and established a mechanism for sharing data from the national systems (Fig. 1). Country reports that have been prepared by the national data analysis units excluding patients' personal identifiers, were sent routinely to CMC Amman where data were stored and regularly posted on the specifically created MECIDS website.

National data were secured and only MECIDS members and authorized users were able to access this. It is planned that periodical regional reports of jointly analysed data will be released and published on the website [13].

IBM Research (Haifa and Almaden research laboratories) has offered to collaborate with MECIDS to develop a public health information affinity domain for data exchange at district, national and regional levels. A scalable, standards-based, hierarchical network for sharing data has been built using the MECIDS surveillance model and based on the modification and upgrading of the infrastructure that IBM used for the clinical domain as part of the Integrating Healthcare Enterprise Initiative. The use of the new software is currently being implemented. MECIDS partners will share the agreed set of data which will be available for query and retrieval via a real-time, online infrastructure. This paves the way for future sophisticated and advanced data analysis technologies using powerful new tools for visualization and modelling such as Geographical Information Systems (GIS) and Spatiotemporal Epidemiological Modeler (STEM) [14].

### Concurrent studies

In Israel, in addition to the *Salmonella* laboratory-based surveillance, other studies were conducted

as part of MECIDS project. A telephone-based population survey on the occurrence of diarrhoeal diseases was conducted in Israel during August–October 2005. A total of 3141 phone numbers were selected randomly from all the phone books of Israel. Interviews were conducted in Hebrew, Russian, Arabic and English. Respondents were asked about the occurrence of diarrhoea in the 2 weeks prior to the interview in children and adolescents. Furthermore, a physicians' survey on practices regarding diarrhoeal diseases was conducted in Israel to determine the burden of illness pyramid for diarrhoeal disease of Israeli children. In addition, a matched case-control study was conducted to determine the risk factors for enteric infections caused by *S. Virchow* in young children in Israel.

### DISCUSSION

This paper deals with the development and deployment of a public health surveillance system for three neighbouring countries in the Middle East – an area of continuous dispute. The three countries belong to two different administrative regions of the WHO – the East Mediterranean (Jordan and PA) and the European Region of which Israel is a member.

This project which was chosen by consensus by representatives of the ministries of health and academia of Israel, Jordan and the PA initially focused on surveillance of foodborne diseases caused by *Salmonella*.

The project promoted regular meetings of reporting, strategic planning and training that have built on gradual trust and mutual appreciation among the partners. The working and personal relations that have been established during the years of mutual understanding, cooperation and assistance within MECIDS played a significant role in the successful collaboration during other public health emergencies such as the avian influenza outbreaks in poultry occurring in the three countries in March 2006 [15].

It is planned that the laboratory-based surveillance network will expand further and include other enteric pathogens such as *Shigella* sp., enterotoxigenic *E. coli*, *Campylobacter jejuni*, protozoa and viruses which are of public health importance in the Middle East.

Advanced means of electronic communication at national and regional levels have been established, as well as a mode of communication and exchange of information among the three parties. Such networks

of collaboration and communication represent important steps towards estimating the burden of foodborne diseases in the region and are fundamental during disease outbreaks for the harmonization of public health interventions and prevention strategies.

The established laboratory-based surveillance systems are simple and useful. However, a significant lag time still exists between the different stages of data collection from the level of the sentinel laboratories until characterization of isolates and reporting. Thus far this situation prevents the use of the data for real-time interventions and comparisons at the regional level. In addition, system attributes such as sensitivity and representativeness should be taken into consideration when comparing data between the three countries.

The contribution of different food items and pathogens to the total disease burden should be determined using approaches such as the use of data from outbreaks, case-control studies and molecular source tracking methods [6]. With more precise food- and pathogen-specific estimates, MECIDS partners will be able to build up food-safety policies aimed at reducing the burden of foodborne diseases and improving food trade and exchange between the three countries. It is expected that through MECIDS, the three countries will develop their own Middle East subregional database and will communicate and interact with the well established European and USA analogous networks to identify and respond to the potential international spread of foodborne diseases.

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#### DECLARATION OF INTEREST

None.

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