First Scientific Conference on Acute Respiratory Infections in the Eastern Mediterranean Region

Better Understanding, Better Preparedness & Better Response

Fourth Meeting of the Eastern Mediterranean Acute Respiratory Infection Surveillance (EMARIS) Network

EMARIS
11–14 December 2017
Amman, Jordan
#EMARISCONF2017
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Welcome Note

DR JAOUAD MAHJOUR
Acting Regional Director

Dear Colleagues, Ladies and Gentlemen,
I am pleased to welcome you to this meeting organized by the WHO Regional Office for the Eastern Mediterranean, in collaboration with the Ministry of Health of Jordan. I wish to express my sincere thanks to all of you for being here today. Your presence reflects the importance of this meeting which aims to identify ways to sustain the progress that we have achieved in enhancing the quality and effectiveness of epidemiological and virological surveillance systems for influenza and other emerging respiratory viruses in WHO’s Eastern Mediterranean Region.

The meeting of the Eastern Mediterranean Acute Respiratory Infection Surveillance (EMARIS) network is a bi-annual event which has been organized by the WHO Regional Office since 2009. This is the fourth meeting and I am happy to note that based on the recommendations of the third meeting, the WHO Regional Office is holding the first scientific conference on acute respiratory infections under the theme “Better Understanding, Better Preparedness and Better Response”.

Befitting the theme, I am delighted to note that this joint meeting of the EMARIS network and the Scientific Conference is bringing together distinguished speakers and scientists from various international agencies, academic and scientific bodies and a host of young health researchers and medical professionals working in the public and private sectors throughout the Region. These speakers and researchers will be presenting their latest research findings in the areas of surveillance, transmission risk factors, disease burden and medical countermeasures for influenza and other emerging respiratory infections. We believe that these latest findings can address many of the current gaps in knowledge in our fight against the threat from any novel or new influenza or respiratory virus. The scientific evidence presented will also help the Region, collectively, to shape our public health agenda to better prepare and timely respond to pandemic threats from novel respiratory viruses.

Distinguished Participants,
The emergence and continuing transmission of Middle East respiratory syndrome coronavirus (MERS-CoV) in the Region and the surge of human infection from the highly pathogenic avian influenza A(H5N1) virus, which we witnessed in Egypt during 2014-2015, are two of the biggest threats to regional health security. In light of these and other new respiratory disease threats, Member States need to enhance epidemiological and virological surveillance for severe acute respiratory infections using a standardized, uniform and consistent approach. It is only through such comprehensive and integrated surveillance systems that Member States will be able to early detect any emerging respiratory disease threats with either epidemic or pandemic potential. Countries also need to ensure sufficient laboratory diagnostic capacities for rapid identification and detection of novel respiratory pathogens that may trigger an
epidemic or a pandemic. The ability to track and monitor the evolution of currently circulating influenza and other respiratory viruses is an essential public health requirement by all countries under the International Health Regulations (IHR 2005).

Dear Colleagues,
The unpredictability of pandemics is one of the greatest uncertainties we face. We know that novel, new and unknown influenza and respiratory viruses will emerge but a good level of preparedness can reduce the impact of a pandemic threat on the general population. I am happy to note that a session on global health security has been planned on the last day of this meeting, in which discussions will centre on accomplishments with regard to IHR capacities and how countries can accelerate progress in order to mitigate the threats posed by potential epidemics and pandemics. I assure you of WHO’s commitment to follow up with countries on the action points that will emerge from this session and the other sessions of this meeting on building, maintaining and sustaining a public health system that helps to early detect, prevent and respond to pandemic threats in the future.

Dear Participants,
One of the notable achievements that we have attained for influenza surveillance is that all countries in our Region have enhanced epidemiological and virological surveillance for either influenza-like illness or severe acute respiratory infections. Such collective and sustained efforts by countries and the Regional Office have contributed to better understanding of the epidemiology, seasonality and risk factors for influenza in the Region. Much of this information has been published in peer-reviewed medical journals, and a special supplement of our flagship journal, the Eastern Mediterranean Health Journal, was published last year; it provided valuable information and insights on influenza and other emerging respiratory viruses circulating in the Region. During this conference, new unpublished information will be presented. It is important that we continue to collaborate with young researchers, scientists and medical professionals from our Region and encourage them to present their research findings in international conferences and scientific symposiums. Research findings that are publicly available will help countries to better understand, prepare and respond to epidemic and pandemic threats, as control strategies for these emerging health threats need to be developed on the basis of evidence and best practice. I must also emphasize that only a good surveillance system with quality data can generate meaningful information on what we are looking for in general populations. I, therefore, emphasize the need for you to take renewed efforts to improve the quality and representativeness of your surveillance system for influenza and acute respiratory infections so that you can use your existing platform not only for detection of any new influenza and other respiratory viruses but also in the future for surveillance, response and monitoring the severity of diseases during a pandemic threat.

I would like to thank you all again for attending this meeting. I am particularly grateful for the continued support and cooperation that we have been receiving from the United States Centers for Disease Control and Prevention to enhance the influenza surveillance programme in the Region. I also express my thanks to Global Health Development for partnering with the Regional Office for this scientific conference. Finally, I thank the speakers and the presenters of over 30 abstracts that have been accepted for either oral or poster presentation in this Conference. I would also like to thank the editorial board of the Journal of Infection and Public Health for agreeing to issue a special supplement on this scientific conference later next year publishing all the accepted abstracts, keynote speech and abstract of all speeches made in this conference in a peer-reviewed way.

Lastly, I would like to thank the participants from our Member States and I am confident that you will leave this meeting with new ideas and information that can shape the future landscape of public health in our Region. This is part of our shared responsibilities and I am certain that collectively we will rise to the occasion.

I wish you all a successful meeting and a comfortable stay in Amman, Jordan.
General Information

Registration and Information
Onsite registration begins at 8 am on 11 December 2017 at the registration desk outside the conference hall.

Conference Hall
The meeting and conference will be held in Al Waha Ballroom on the 1st floor.

Poster Exhibit Hall
Poster presentations will be held in Al Majlis room adjacent to Al Waha Ballroom on the 1st floor.

Setup posters  |  Tuesday 12 December 2017 from 08:00 to 17:00
Presentation   |  Wednesday 13 December 2017 from 11:40 to 12:40

Printing
Limited printing and photocopying facilities are available, please enquire with the registration team outside the conference hall.

Social Evening
We welcome you to partake of a traditional Middle Eastern dinner on Wednesday December 13 2017 at Reem El Bawadi Restaurant in Amman. The cost of JOD 35/USD 50 per person includes dinner, and transportation to and from the restaurant.
**Agenda**

**Monday | 11 December 2017**

08:00–08:30  **Registration (in front of AL-WAHA BALLROOM)**

Opening Session of fourth EMARIS meeting and first scientific conference on acute respiratory infections in the Eastern Mediterranean Region

08:30–09:15  Welcome message from acting Regional Director of WHO/EMRO
Dr Maria Cristina Profili, WHO Country Representative, Jordan

Message from the Director of Influenza Division of US-CDC
Dr Jacqueline Katz, Deputy Director Influenza Division, National Center for Immunization and Respiratory Diseases, Centers for Disease Control and Prevention, Atlanta, US-CDC

Message from the Executive Director of Global Health Development
Dr Mohannad Al-Nsour, Executive Director, Global Health Development

Goals, objectives and expected outcomes of the EMARIS meeting
Dr SK. Md. Mamunur Rahman Malik, Manager, Infectious Hazard Management, Department of Health Emergencies, WHO Regional Office for the Eastern Mediterranean

**Session 1: Influenza surveillance in the 21st century: lessons from the past and vision for the future | Moderator: Professor Chakib Nejjar**

Ms Ann Moen, Chief, Influenza Preparedness and Response, WHO Health Emergency Programme, WHO/HQ

09:45–10:15  Surveillance for influenza in the WHO Eastern Mediterranean Region: achievements, lessons learned and current challenges
Dr SK. Md. Mamunur Rahman Malik, Manager, Infectious Hazard Management, Department of Health Emergencies, WHO Regional Office for the Eastern Mediterranean

10:15–10:45  Regional resources to improve influenza surveillance: influenza landscape mapping, framework for surveillance of zoonotic influenza, influenza surveillance protocol, EMFLU, and influenza virus sharing guidance documents
Dr Abdinasir Abubakar, Medical Officer, Infectious Hazard Management, Department of Health Emergencies, WHO Regional Office for the Eastern Mediterranean

10:45–10:55  Question and answer

10:55–11:15  **Coffee break & group photo**
Agenda

11:15–11:40  WHO platforms for sharing and analysis of influenza surveillance data
Ms Maja Lièvre, Technical Officer, Global Influenza Programme, Influenza Preparedness and Response, Infectious Hazard Management, WHO Health Emergency Programme, WHO/HQ

11:40–12:05  Global updates on PISA (Pandemic Influenza Severity Assessment)
Dr Aspen Hammond, Technical Officer, Global Influenza Programme, Influenza Preparedness and Response, WHO Health Emergency Programme, WHO/HQ

12:05–12:30  Defining influenza baselines and threshold values using SARI and F-SARI data from 2012 to 2017: country experience from Iran
Dr Payman Hemmati, Senior Officer of Influenza, EWARS Systems & IHR, Surveillance Department Center for Communicable Diseases Control, Ministry of Health and Medical Education, Teheran, Islamic Republic of Iran

12:30–13:00  Panel discussion: Influenza in the 21st century: what sustainable actions are needed in the countries to improve quality of data collection and analysis
Panellists: Ms Ann Moen, Dr Payman Hemmati, Dr Nada Ghosn, Professor Chakib Nejjari, Dr Vic Veguilla
Moderator: Dr Sk. Md. Mamunur Rahman Malik

13:00–14:00  Coffee break

14:00–14:25  Supporting health research in the EMR: WHO’s perspectives
Dr Ahmed Mandil, Coordinator, Research Development and Innovation, WHO Regional Office for the Eastern Mediterranean

14:25–15:05  Oral presentations (10 min for each presentation)
Moderator: Dr Ahmed Mandil
Judges: Dr Muhammad Faruque Parvez, Professor Rachid Razine, Professor Samira Serragui, Dr Musa Rahim, Professor Youssef Khabbal, Professor Mohamed Berraho, Dr Ahmed Mandil

14:25–14:35  Influenza and influenza like illness in Qatar, January–December 2015: an analysis of data from the sentinel surveillance system
Dr Hamad Al Romaihi, Manager, Health Protection and Communicable Disease, Ministry of Public Health, Doha, Qatar

Dr Enjy Abdou, Epidemiologist, Center of Disease Control, CDC Egypt Office, Cairo, Egypt

Dr Alanoud Aljifri, Influenza Surveillance Focal Point, Adult Infectious Disease Consultant, Ministry of Health, Riyadh, Saudi Arabia

Dr Hind Bouguerra, Medical Doctor, National Observatory of New and Emerging Diseases, Tunis, Tunisia

15:05–15:15  Question and answer
# Agenda

## Session 2: Epidemiological surveillance and use of surveillance data for informed policy and practice | Moderator: Dr Jacqueline Katz

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<td>Enhancing surveillance for influenza: strategies for better use of data for decision-making</td>
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<td>Dr Salah Al Awaidy, Senior Consultant Medical Epidemiologist, Communicable Disease surveillance and control Adviser to the office of the Undersecretary of Health Affairs at the Ministry of Health, Muscat, Oman</td>
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<td>15:40–16:05</td>
<td>From evidence to practice: use of SARI surveillance data to generate evidence on burden of disease and cost effectiveness of interventions</td>
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<td>Dr Eduardo Azziz-Baumgartner, Team Lead for the International Epidemiology and Research Team in the Epidemiology and Prevention Branch of the Influenza Division of the Centers for Disease Control and Prevention, Atlanta, US–CDC</td>
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<td>16:05–16:30</td>
<td>Burden of acute respiratory infections in settlements of refugee and internally displaced persons: preliminary findings from a literature review</td>
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<td>Ms Evelyn Balsells, Researcher, Centre for Global Health Research, Usher Institute of Population Health Sciences and Informatics, University of Edinburgh, Edinburgh, United Kingdom</td>
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<td>Dr Idris Al-Ubaidani, Director, Department of Communicable Diseases, Ministry of Health, Muscat, Oman</td>
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<td>17:20–17:50</td>
<td>Panel discussion: Better use of influenza surveillance data for public health decisions making: what priority settings need to be considered by the countries?</td>
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<td><strong>Panellists:</strong> Dr Salah Al Awaidy, Dr Idris Al-Ubaidani, Dr Eduardo Azziz-Baumgartner, Professor Majdouline Obtel, Dr Mohammad Abdallat</td>
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<td><strong>Moderator:</strong> Dr Jacqueline Katz</td>
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<td><strong>Evening Reception (at AL-MAJLES ROOM)</strong></td>
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<td>Dr SK. Md. Mamunur Rahman Malik, Manager, Infectious Hazard Management, Department of Health Emergencies, WHO Regional Office for the Eastern Mediterranean</td>
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<td><strong>Keynote speech:</strong> Health systems and acute respiratory infections: better understanding, better preparedness and better response</td>
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<td><strong>Professor Salman Rawaf, MD, PhD, FRCP, FFPH</strong></td>
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<td>Professor of Public Health, Director, WHO Collaborating Centre for Public Health Education and Training, Department of Primary Care and Public Health, School of Public Health, Faculty of Medicine, Imperial College London, London, United Kingdom</td>
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<td>Dr Maria Cristina Profili, WHO Country Representative, Jordan</td>
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## Agenda

### Tuesday | 12 December 2017

#### Session 2: Epidemiological surveillance and use of surveillance data for informed policy and practice (Continued)

09:00–09:20 **Oral presentations** (10 min for each presentation)

**Moderator:** Dr Ahmed Mandil  
**Judges:** Dr Muhammad Faruque Parvez, Professor Rachid Razine, Professor Samira Serragui, Dr Musa Rahim, Professor Youssef Khabbal, Professor Mohamed Berraho, Dr Ahmed Mandil

09:00–09:10 Factors associated with severity of respiratory viral illnesses in hospitalized Jordanian children  
Professor Najwa Khuri-Bulos, Professor of Paediatrics and Infectious Disease, Department of Paediatrics, University of Jordan, Amman, Jordan

09:10–09:20 Use of personal protective equipment to protect against influenza and other emerging respiratory infections  
Dr Abrar Chughtai, Lecturer in International Health, School of Public Health and community Medicine, University of New South Wales, Australia (Via Skype)

09:20–09:25 Question and answer

#### Session 3: Virological surveillance for influenza: enhancing better understanding on influenza epidemiology and better preparedness | Moderator: Ms Ann Moen

09:25–09:50 Timeliness and sharing – two essential elements for effective surveillance and response to influenza epidemics and pandemics  
Dr Wenqing Zhang, Manager, Global Influenza Programme, Influenza Preparedness and Response, Infectious Hazard Management, WHO Health Emergency Programme, WHO/HQ (via WebEx)

09:50–10:15 Influenza virus sharing in the Eastern Mediterranean Region: what has been achieved so far and ways to improve virus sharing  
Dr Rodney S Daniels, Deputy Director, Worldwide Influenza Centre, the Francis Crick Institute, WHO Collaborating Centre for Reference and Research on Influenza, London, United Kingdom

10:15–10:40 Journey of a National Influenza Center: from achieving national to international goals for enhancing preparedness for pandemic influenza  
Dr Jila Yavarian, Associate Professor, Virology Department, School of Public Health, Tehran University of Medical Sciences, Tehran, Islamic Republic of Iran

10:40–11:05 Importance of rapid analysis and public sharing of seasonal influenza sequencing data to improve vaccine strain selection and pandemic preparedness  
Dr Rodney S Daniels, Deputy Director, Worldwide Influenza Centre, the Francis Crick Institute, WHO Collaborating Centre for Reference and Research on Influenza, London, United Kingdom

11:05–11:10 Question and answer

11:10–11:30 **Coffee break**
Session 3: Virological surveillance for influenza: enhancing better understanding on influenza epidemiology and better preparedness (Continued)

11:30–12:00  Oral presentations (10 min for each presentation)
Moderator: Professor Mohamed Berraho
Judges: Dr Muhammad Faruque Parvez, Professor Rachid Razine, Professor Samira Serragui, Dr Musa Rahim, Professor Youssef Khabbal, Professor Mohamed Berraho, Dr Ahmed Mandil

11:30–11:40 Burden of ventilator-associated pneumonia and other hospital-acquired infections in a tertiary care hospital in Quetta, Pakistan
Dr Farida Khudaidad Khan, Epidemiologist, Field Epidemiology and Laboratory Training Programme (FELTP), Provincial Health Directorate, Quetta, Pakistan

11:40–11:50 Implementing the Pandemic Influenza Preparedness framework in the Eastern Mediterranean: a two-year review report
Ms Christina Banks, Public Health Consultant, Bern, Switzerland

11:50–12:00 Association between breastfeeding and acute respiratory infections in children under 2 years of age, Islamabad, Pakistan
Dr Mumtaz Ali Khan, Senior Scientific Officer/Epidemiologist, National Institute of Health, Islamabad, Pakistan

12:00–12:05 Question and answer

12:05–13:05 Lunch

13:05–14:05 Oral presentations (10 min for each presentation)
Moderator: Professor Youssef Khabbal
Judges: Dr Muhammad Faruque Parvez, Professor Rachid Razine, Professor Samira Serragui, Dr Musa Rahim, Professor Youssef Khabbal, Professor Mohamed Berraho, Dr Ahmed Mandil

13:05–13:15 Detection of adenoviruses in children under 5 years with severe acute respiratory infections in the National Influenza Center, Islamic Republic of Iran
Dr Nazanin-Zahra Shafiei Jandaghi, Virologist, National Influenza Center, School of Public Health, Tehran University of Medical Science, Tehran, Islamic Republic of Iran

Dr Hassan Zaraket, Assistant Professor, Department of Experimental Pathology, Immunology & Microbiology, Member of Center for Infectious Diseases Research, Faculty of Medicine, American University of Beirut, Beirut, Lebanon

13:25–13:35 Surveillance and molecular characterization of influenza viruses circulating in Casablanca, Morocco from 2013 to 2017
Dr Latifa Anga, Virologist, Medical Virology and BSL–3 Laboratory, Pasteur Institute of Morocco, Casablanca, Morocco

13:35–13:45 Molecular epidemiology of influenza A(H1N1)pdm09 during the post–pandemic period in Pakistan
Ms Nazish Badar, Molecular Biologist, Department of Virology and Immunology, Public Health Laboratories Division, National Institute of Health, Ministry of National Health Services, Regulations and Coordination, Islamabad, Pakistan
Agenda

13:45–13:55  Bacteria isolated from patients with nosocomial pneumonia in the intensive care unit of a secondary care hospital in Saudi Arabia, and their antibiotic susceptibility patterns
Dr Mumtaz Ahmad Khan, Microbiologist/Associate Professor, Abbas Institute of Medical Sciences, Muzaffarabad, Pakistan

13:55–14:05  Mutation analysis of the neuraminidase gene of influenza A(H1N1)pdm09 in Tunisia between 2009 and 2017 seasons
Dr Awatef El Moussi, Biologist, Virology Unit, Microbiology Laboratory, National Influenza Centre, Charles Nicolle Hospital, Tunis, Tunisia

14:05–14:15  Question and answer

14:15–14:35  Coffee break

Session 3: Virological surveillance for influenza: enhancing better understanding on influenza epidemiology and better preparedness (Continued)
Moderator: Dr Rodney S Daniels

14:35–15:00  Quality management in the virology laboratory: proficiency testing and internal quality controls, current situation in the Region and future directions
Dr Stephen Lindstrom, Team Lead, Diagnostics Development Team, Virus Surveillance and Diagnosis Branch, Influenza Division, Centers for Disease Control and Prevention, Atlanta, US–CDC

15:00–15:25  International Reagent Resource
Ms Kinda Zureick, Public Health Adviser, Influenza Division, National Center for Immunization and Respiratory Diseases, Centers for Disease Control and Prevention, Atlanta, US–CDC

15:25–15:50  The Oman Central Public Health Laboratory’s path to becoming a national influenza centre: challenges and lessons learned
Dr Hanan Alkindi, Senior Consultant, Head of Virology section, Central Public Health Laboratories, Muscat, Oman

Dr Nasir Ahmad Stanikzai, Director, Central Public Health Laboratory, Ministry of Public Health, Kabul, Afghanistan

16:15–16:45  Panel discussion: Sustaining influenza virological surveillance in the 21st century: what actions are needed to improve quality, biosafety and biosecurity practices, detection and sequencing capacities.
Panellists: Dr Hanan Alkindi, Dr Nasir Ahmad Stanikzai, Dr Stephen Lindstrom, Dr Jila Yavarian, Dr Rodney S Daniels
Moderator: Dr Vic Veguilla
Agenda

Wednesday | 13 December 2017

Session 4: Use of influenza vaccine in Eastern Mediterranean Region: challenges for increased uptake | Moderator: Professor Mohammed Hassar

09:00–09:25 Flu/Influenza vaccines: opportunities and challenges to increase availability, accessibility and uptake among high risk groups

Ms Ann Moen, Chief, Influenza Preparedness and Response, WHO Health Emergency Programme, WHO/HQ

09:25–09:50 Current seasonal influenza vaccine policies and use in the Eastern Mediterranean Region: considerations for increasing vaccine uptake

Dr Hassan Zarakat, Assistant Professor, Department of Experimental Pathology, Immunology & Microbiology, Member of Center for Infectious Diseases Research, Faculty of Medicine, American University of Beirut, Beirut, Lebanon

09:50–10:15 Achievements of the long-term national strategy to reduce influenza mortality and morbidity in Kuwait

Dr Mussab I. Alsaleh, National EPI Manager, Head of Communicable Diseases Control, Ministry of Health, Kuwait

10:15–10:25 Question and answer

10:25–10:45 Coffee break

10:45–11:05 Oral presentations (10 min for each presentation)

Moderator: Dr Muhammad Faruque Parvez

Judges: Dr Muhammad Faruque Parvez, Professor Rachid Razine, Professor Samira Serrajui, Dr Musa Rahim, Professor Youssef Khabbal, Professor Mohamed Berraho, Dr Ahmed Mandil

10:45–10:55 Decline in child mortality after the introduction of the pneumococcal conjugate vaccine in Morocco

Professor Majdouline Obtel, Professor of Epidemiology and Public Health, Laboratory of Preventive Medicine, Public Health and Hygiene & Laboratory of Epidemiology, Clinical Research and Biostatistics, Public Health Department, Faculty of Medicine and Pharmacy, University Mohammed V, Rabat, Morocco

10:55–11:05 Efficacy of the 9-valent pneumococcal conjugate vaccine against radiographically-confirmed pneumonia among children under and over 24 months of age in South Africa

Dr Ahmed Elamin, National Professional Officer, WHO Sudan country office, Khartoum, Sudan

11:05–11:10 Question and answer

11:10–11:40 Panel discussion: Increasing use and uptake of seasonal influenza vaccines in the Eastern Mediterranean Region: what strategies should be considered as a priority?

Panelists: Dr Mussab I. Alsaleh, Dr Hassan Zarakat, Ms Ann Moen, Professor Mohammed Hassar, Dr Hamad Al Romaihi

Moderator: Dr Abdinasir Abubakar
Agenda

11:40–12:40  Poster Presentations (AL-MAJLES ROOM)

Thematic area: Epidemiology

Judges: Dr Muhammad Faruque Parvez, Professor Rachid Razine, Professor Samira Serragui, Dr Musa Rahim, Professor Youssef Khabbal, Professor Mohamed Berraho, Dr Ahmed Mandil

Board #1  Role of pandemic influenza preparedness in strengthening the influenza surveillance system in Afghanistan, a chronic conflict setting
Dr Mohammad Hafiz Rasooly, Surveillance/National Influenza Coordinator, EHIS DG, Surveillance Department, Ministry of Public Health, Kabul, Afghanistan

Board #2  Epidemiological and clinical characteristics of *Streptococcus pneumoniae* infections in a tertiary care centre in Bahrain, 2010–2014
Dr Jameela Al Salman, Infectious Disease Consultant, Ministry of Health, Manama, Bahrain

Dr Fatma Osman, Coordinator of Event based Surveillance, Assistant of National Surveillance System, Coordinator Surveillance Sector, Ministry of Health and Population, Cairo, Egypt

Board #4  Burden of influenza virus infection in hospitalized and well infants in Jordan, November 2015–April 2016 and November 2016–May 2017
Dr Ilham Abu-Khader, Program Manager, Eastern Mediterranean Public Health Network (EMPHNET), Amman, Jordan

Board #5  Determinants of respiratory infections among children under 5 years in Islamabad, Pakistan
Dr Mir M Hassan Bullo, Deputy Director Admin (Fellow FELTP Pakistan 9th Cohort), Federal General Hospital Islamabad, Islamabad, Pakistan

Board #6  Multiple viral etiologies in patients with influenza-like illness and severe acute respiratory infection in Qatar, 2013–2016
Dr Shazia Nadeem, Acting Head of Surveillance and Outbreak, Public Health Department, Ministry of Public Health, Doha, Qatar

Board #7  Preventing and controlling avian influenza in the Eastern Mediterranean: a review
Ms Christina Banks, Public Health Consultant, Bern, Switzerland

Thematic area: Virology

Judges: Dr Muhammad Faruque Parvez, Professor Rachid Razine, Professor Samira Serragui, Dr Musa Rahim, Professor Youssef Khabbal, Professor Mohamed Berraho, Dr Ahmed Mandil

Board #8  Phenotypic and genotypic susceptibility profile of neuraminidase inhibitors of influenza B viruses circulating in Morocco during the 2014–2015 influenza season
Dr Fatima El Falaki, Laboratory Scientist, National Influenza Center, Virology Department, National Institute of Hygiene, Rabat, Morocco

Board #9  *Streptococcus pneumoniae* isolated from Palestinian nasopharyngeal carriers: serotype distribution and antimicrobial resistance
Mr Issa Shtayeh, Head of Molecular Diagnostic Division, Central Public Health Laboratory, Ministry of Health, Ramallah, West Bank, Palestine
Agenda

**Thematic area:** Human–Animal Interface

**Judges:** Dr Muhammad Faruque Parvez, Professor Rachid Razine, Professor Samira Serragui, Dr Musa Rahim, Professor Youssef Khabbal, Professor Mohamed Berraho, Dr Ahmed Mandil

**Board #10**
Risk factors for death in H5N1 cases in Egypt: analysis of surveillance data, 2006–2017
Dr Ibrahim Eldeyahy, Epidemiologist, Department of Epidemiology and Surveillance, Preventive Affairs Sector, Ministry of Health and Population, Cairo, Egypt

**Board #11**
Evaluation of the avian influenza surveillance system in Khyber Pakhtunkhwa, Pakistan
Dr Naeem Ud Din, Veterinary Officer, Directorate General (Extension), Livestock & Dairy Development Department, Khyber Pakhtunkhwa, Peshawar, Pakistan

**Board #12**
Seroprevalence of avian influenza virus H9 among people working with poultry in Rawalpindi Division of Punjab Province, Pakistan
Dr Muhammad Farooq Tahir, Microbiologist, Poultry Research Institute, Rawalpindi, Punjab, Pakistan/ Field Epidemiology and Laboratory Training Programme, Pakistan

**Board #13**
Middle East respiratory syndrome coronavirus (MERS-CoV): threats, gaps and containment strategies
Dr Hamid Hussain, Consultant, Family and Community Medicine, Faculty of Medicine, University of Baghdad; Dubai Health Authority, Dubai, United Arab Emirates

**Board #14**
Knowledge, attitudes and practices of poultry-keepers about avian influenza in households in high-risk governorates in Egypt, 2017
Dr Hend Elsheikh, Epidemiologist, General Organization for Veterinary Services, Ministry of Agriculture and Land Reclamation; Supervisor of Community Based Animal Health and Outreach team, Cairo, Egypt

**12:40–13:40**
Lunch

**Session 5: Influenza surveillance at the human–animal interface: better data collection for better response | Moderator: Dr Mussab I. Alsaleh**

**13:40–14:05**
Global updates & perspectives on influenza surveillance at the human–animal interface
Dr Aspen Hammond, Technical Officer, Global Influenza Programme, Influenza Preparedness and Response, WHO Health Emergency Programme, WHO/HQ

**14:05–14:30**
Surveillance of zoonotic influenza: framework for data collection and decision-making
Dr Ghazi Kayali, Chief Executive Officer, Human Link; Adjunct Assistant Professor, Department of Epidemiology, Human Genetics, and Environmental Sciences, University of Texas Health Sciences Center, Texas, United States of America
Agenda

14:30–14:50  **Oral presentations** (10 min for each presentation)

**Moderator:** Dr Musa Rahim  
**Judges:** Dr Muhammad Faruque Parvez, Professor Rachid Razine, Professor Samira Serragui, Dr Musa Rahim, Professor Youssef Khabbal, Professor Mohamed Berraha, Dr Ahmed Mandil

14:30–14:40  Insights into the current situation of avian influenza H9N2 viruses circulating in Egypt

Dr Ahmed Kandeil, Researcher, Center for Scientific Excellence for Influenza Viruses, Water Pollution Research Department, Environmental and Research Division, National Research Centre, Dokki, Giza, Egypt

14:40–14:50  One Health Framework for Action for the WHO Eastern Mediterranean Region, as applied to avian influenza

Dr Amira Sayed ElRifay, Center for Scientific Excellence for Influenza Viruses, National Research Centre, Dokki, Giza, Egypt

14:50–15:00  Question and answer

**Session 5: Influenza surveillance at the human–animal interface: better data collection for better response (Continued)**  
**Moderator:** Dr Ghazi Kayali

15:00–15:25  Emergence and changes in swine and avian influenza viruses globally and its implications for public health

Dr Stephen Lindstrom, Team Lead, Diagnostics Development Team, Virus Surveillance and Diagnosis Branch, Influenza Division, Centers for Disease Control and Prevention, Atlanta, US–CDC

15:25–15:50  Surveillance for avian influenza H5N1: what lessons have we drawn so far for early detection and response?

Dr Fatma Osman, Coordinator of Event based Surveillance, Assistant of National Surveillance System, Coordinator Surveillance Sector, Ministry of Health and Population, Cairo, Egypt

15:50–16:20  **Oral presentations** (10 min for each presentation)

**Moderator:** Professor Samira Serragui  
**Judges:** Dr Muhammad Faruque Parvez, Professor Rachid Razine, Professor Samira Serragui, Dr Musa Rahim, Professor Youssef Khabbal, Professor Mohamed Berraha, Dr Ahmed Mandil

15:50–16:00  Outbreak of avian influenza in backyard poultry, ducks and geese in a periurban area of Abbottabad, Khyber Pakhtunkhawa Province, Pakistan

Dr Ibrar ul Hussain, Veterinary Officer, Livestock and Dairy Development Department, Abbottabad, Pakistan

16:00–16:10  Seroprevalence of avian influenza H9 virus in poultry–shop workers and customers in Rawalpindi, Pakistan

Dr Saima Dil, Field Epidemiology and Laboratory Training Programme, National Institute of Health, Islamabad, Pakistan

16:10–16:20  Successful experience of Saudi Arabia in controlling highly pathogenic avian influenza

Dr Salah Abdel Rhman, Poultry Specialist, General Directorate for Animal Resources Services, Ministry of Environment, Water and Agriculture, Riyadh, Saudi Arabia
**Agenda**

**16:20–16:50**  
**Panel discussion:** One health for influenza surveillance: what actions are needed by the countries for data collection, and early response to any potential zoonotic threat?  
**Panellists:** Dr Ghazi Kayali, Dr Stephen Lindstrom, Dr Musa Rahim, Dr Alanoud Aljifri, Dr Adel Belbeisi  
**Moderator:** Dr Majid Mousa Al shamrani

**16:50–17:10**  
**Coffee break**

**Session 6: Surveillance for Respiratory Syncytial Virus (RSV): lessons learned from SARI surveillance network/platform |**  
**Moderator:** Dr Mohammad Hafiz Rasooly

17:10–17:35  
Expanding non-influenza respiratory virus surveillance using influenza virologic surveillance platforms: respiratory syncytial virus global update  
Dr Teresa Peret, Respiratory Viruses Branch, Division of Viral Diseases, Centers for Disease Control and Prevention, Atlanta, US–CDC (Via WebEx)

17:35–18:00  
Respiratory syncytial virus surveillance using influenza sentinel surveillance platforms: experience from Pakistan  
Dr Uzma Bashir, National Consultant, Public Health Laboratories, WHO Pakistan country office, Islamabad, Pakistan

18:00–18:20  
**Oral presentations** (10 min for each presentation)  
**Moderator:** Professor Rachid Razine  
**Judges:** Dr Muhammad Faruque Parvez, Professor Rachid Razine, Professor Samira Serragui, Dr Musa Rahim, Professor Youssef Khabbal, Professor Mohamed Berraho, Dr Ahmed Mandil

18:00–18:10  
Impact, epidemiology and clinical manifestations of respiratory syncytial virus in Oman  
Dr Hanan Alkindi, Senior Consultant, Head of Virology section, Central Public Health Laboratories, Muscat, Oman

18:10–18:20  
Molecular characterization of circulating respiratory syncytial virus genotypes in Pakistani children, 2010–2013  
Dr Uzma Bashir, National Consultant, Public Health Laboratories, WHO Pakistan country office, Islamabad, Pakistan

18:20–18:50  
**Panel discussion:** Using flu platform for surveillance of RSV and other emerging respiratory virus threat: are we ready yet and what needs to be done to get there?  
**Panellists:** Dr Uzma Bashir, Dr Hanan Alkindi, Dr Nasir Ahmad Stanikzai, Ms Kinda Zureick, Dr Isabel Bergeri  
**Moderator:** Professor Stephen S. Morse

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**Thursday | 14 December 2017**

**08:30–09:30**  
Discussion on EMARIS ToR, charter and structure  
**Dr Abdinasir Abubakar,** Medical Officer, Infectious Hazard Management, Department of Health Emergencies, WHO Regional Office for the Eastern Mediterranean
**Agenda**

**Session 7: Addressing pandemic influenza threats: recognition, prevention and response | Moderator: Dr Sk. Md. Mamunur Rahman Malik**

09:30–09:55  
**Threats of pandemic influenza: what are the lessons for improved detection and preparedness in the context of the Global Health Security Agenda?**  
Professor Stephen S. Morse, Professor of Epidemiology, Director of the Infectious Disease Epidemiology certificate, at Columbia University Mailman School of Public Health; Chair of the Columbia University Institutional Biosafety Committee, Columbia University, New York, United States of America

09:55–10:20  
**Pandemic risk assessment and readiness**  
Dr Jacqueline Katz, Deputy Director Influenza Division, National Center for Immunization and Respiratory Diseases, Centers for Disease Control and Prevention, Atlanta, US–CDC

10:20–10:45  
**PIP partnership contribution to laboratory and epidemiological surveillance capacity building: smooth connection and collaboration between EMRO and GIP/HQ**  
Dr Isabel Bergeri, Technical Officer, Global Influenza Programme, Influenza Preparedness and Response, Infectious Hazard Management, WHO Health Emergency Programme, WHO/HQ

10:45–11:10  
**Pandemic influenza risk and impact management: building capacity for pandemic response**  
Dr Weigong Zhou, Medical Officer, Global Influenza Programme, Influenza Preparedness and Response, Infectious Hazard Management, WHO Health Emergency Programme, WHO/HQ

11:10–11:35  
**Developing national pandemic influenza preparedness plan: Egypt’s experience**  
Dr Alaa Eldin Eid, Undersecretary of Preventive Affairs, Preventive sector, Ministry of Health and Population, Cairo, Egypt

11:35–12:00  
**MERS–CoV as a next global pandemic: what we know and what we need to know**  
Dr Majid Mousa Alshamrani, Consultant in Infectious Diseases; Deputy Executive Director, Infection Prevention and Control Program, King Abdulaziz Medical City, National Guard Health Affairs, Riyadh, Saudi Arabia

12:00–12:10  
**Question and answer**

12:10–12:30  
**Coffee break**

12:30–13:00  
**Panel discussion: Accelerating progress against pandemic threats: what we need to do to prevent, early detect and respond?**  
**Panellists:** Dr Majid Mousa Alshamrani, Dr Weigong Zhou, Professor Stephen S. Morse, Dr Alaa Eldin Eid, Dr Jacqueline Katz  
**Moderator:** Dr Sk. Md. Mamunur Rahman Malik

13:00–14:00  
**Lunch**
Agenda

Closing session of fourth EMARIS meeting and first scientific conference on acute respiratory infections in the Eastern Mediterranean Region

14:00–16:00

Award distribution to the best abstract presenters (Oral and Poster)

• Introduction by Dr Ahmed Mandil, Coordinator, Research Development and Innovation, WHO Regional Office for the Eastern Mediterranean

Closing Remarks

• Abstract presenter

• Dr Jacqueline Katz, Deputy Director Influenza Division, National Center for Immunization and Respiratory Diseases, Centers for Disease Control and Prevention, Atlanta, US–CDC

• Dr Jaouad Mahjour, Acting Regional Director, WHO Regional Office for the Eastern Mediterranean (Via video)

Vote of Thanks

• Dr Michel J.J. Thieren, Director, Department of Health Emergencies, WHO Regional Office for the Eastern Mediterranean
Keynote Speaker

Professor Salman Rawaf

Professor Salman Rawaf is Director of the WHO Collaborating Centre for Public Health Education and Training, Imperial College, London and is well known for his international work and contribution to global health. He is an adviser to the World Health Organization on primary care, public health, health systems, medical education and human resource for health development. The Collaborating Centre supports several WHO Regions and their Member States. Professor Rawaf is a Fellow of the Royal Colleges of Physicians London and the UK Faculty of Public Health, and Member of the Faculty of Public Health Medicine Ireland. He is the UK Faculty of Public Health Global Health Adviser, an Executive Member of the International Committee of the UK Academy of the Royal Medical Colleges, a Member of WHO Advisory Committee for Health Research, and Programme Leader of the Postgraduate Diploma/MSc in Family Medicine, Middlesex University. He is an Honorary Professor at Ghent University, Belgium. Professor Rawaf is recognized for his work in supporting countries to strengthen their health systems and service development, including Bahrain, Brazil, Islamic Republic of Iran, Saudi Arabia, Kuwait, Libya, Malaysia, Maldives, Malta, Oman, Poland, Tunisia, Uzbekistan, Iraq, Palestine, Qatar and Yemen. Among the many innovative approaches he has been involved in is Staying Healthy, a programme to assess risk factors for chronic diseases in community settings and enabling individuals to engage in their own health. Professor Rawaf is the Founder and Editor-in-Chief of the journal Public Health Medicine and a member of a number editorial boards. He has published numerous scientific papers, books and international reports.

Professor Salman Rawaf qualified in medicine with training in paediatrics and public health.
Dr Jacqueline Katz

Dr Jacqueline Katz is the Deputy Director of the Influenza Division at the United States Centers for Disease Control and Prevention (CDC) and the Director of the World Health Organization Collaborating Center for Surveillance, Epidemiology and Control of Influenza. Dr Katz joined CDC in 1992 as the Chief of the Immunology and Viral Pathogenesis Section, Influenza Branch, Division of Viral and Rickettsial Diseases. From 2006 until 2014, she was the Chief of the Immunology and Pathogenesis Branch, Influenza Division. She has an Adjunct appointment in the Department of Microbiology and Immunology, Emory University, Atlanta, Georgia, and is an adjunct member of the Graduate Faculty in the Division of Biological and Biomedical Sciences, Immunology and Molecular Pathogenesis Program. Dr Katz has been a Board member of the International Society for Influenza and other Respiratory Diseases since 2007 and the Deputy Chair since 2012.

Dr Katz is an Associate Editor of the journal Influenza and Other Respiratory Viruses. She is the author and co-author of over 300 research articles, reviews and book chapters, and is the recipient of three CDC Charles C. Shepard Science Awards for excellence in laboratory and methods publications. Dr Katz is recognized internationally for her studies on immunity to and pathogenesis and transmission of seasonal and pandemic influenza viruses, including studies at the animal-human interface to understand the extent of and risk factors for human infection with novel influenza viruses of animal origin.

Dr Katz received her Bachelor of Science degree in Microbiology and Biochemistry and her Doctoral degree in Microbiology from the University of Melbourne, Melbourne, Australia. She did her postdoctoral training in influenza virology and was later an Assistant Member in the Department of Virology and Molecular Biology at St. Jude Children’s Research Hospital, Memphis, Tennessee.
Dr Idris Al-Ubaidani

Dr Idris Al-Ubaidani is the Director of Communicable Disease Surveillance and Control at the Ministry of Health in Oman. He is the national focal point for the International Health Regulations (IHR) in Oman and a member of the National Zoonotic Committee and the National Immunization Technical Advisory Group. Dr Al-Ubaidani is involved in different projects including the Brucellosis Control Programme, Polio Eradication Programme and the Measles Elimination Programme. He is also involved in the MERS-CoV Emergency Response Plan, the Ebola Emergency Response Plan and the Zika Response Plan. He is Team Leader for rapid response for zoonotic outbreaks such as brucellosis, Crimean-Congo haemorrhagic fever, rabies, West Nile fever, Rift Valley fever, MERS-CoV, leptospirosis, dengue fever, acute watery diarrhoeal diseases, food poisoning and measles. His experience ranges from surveillance of infectious diseases, preparedness, risk assessment and response of infectious diseases in national, regional and international contexts. As a course director for outbreak management since 2011, Dr Al-Ubaidani has been involved in many courses conducted in Oman and abroad. He is involved in the seroepidemiological survey of infection with Middle East respiratory syndrome coronavirus (MERS-CoV) in humans and camels, Crimean-Congo haemorrhagic fever in ticks and animals, measles serosurveys and national immunization campaigns in the country. He has been a consultant in missions to Afghanistan, United Arab Emirates, Kuwait, and Oman to conduct a Joint External Evaluation of IHR capacities in 2016–2017. Dr Al-Ubaidani has published several papers related to zoonoses in peer-reviewed journals.

Dr Al-Ubaidani did his Bachelor of Medicine degree at the Arabian Gulf University in Bahrain in 1999. He received a Master of Public Health from University of New South Wales, Australia in 2006.
Dr Mussab I. Alsaleh

Dr Mussab I. Alsaleh is the National EPI Manager and Head of Communicable Diseases Control at the Kuwait Ministry of Health. He was an adviser for the World Health Organization Regional Office for the Eastern Mediterranean for surveillance and acute flaccid paralysis surveillance data management (IFA), press management in crises, and regional evaluation of countries’ measles elimination and polio eradication plans from 1994 to 2008. Since 1994, he has been involved in the supervision and implementation of the national field outbreak response and control for several outbreaks of food poisoning, measles, meningitis, tuberculosis and influenza. Dr Alsaleh has been a Member of the Kuwait National Immunization Technical Advisory Group committee since 1992 to date. He is also a member of the Gulf Cooperation Council’s Infectious Disease Control Committee, and has been the Deputy Chairman of Kuwait Public Health and Infectious Diseases Society since 2004. Dr Alsaleh has been Coordinator for many national high-level committees for infectious diseases response and control, including SARS, tuberculosis, avian influenza, pandemic influenza, MERS–CoV, viral haemorrhagic fever/Ebola virus disease, and biological threats. He initiated the national plans for polio eradication, measles elimination, anthrax, SARS, influenza, biological warfare, disease importation, and hepatitis control. He was Director of the Health Education & Health Information Department and Head of the National Health Education Board from 1999 to 2003.

Dr Alsaleh has a degree in Medicine from Alexandria University, Egypt, and a Master of Public Health in Infectious Diseases from Yale University, United States of America. He has completed several advanced courses from the United States Centers for Disease Control and Prevention and WHO in the field of vaccinology, epidemiology, biostatistics, outbreak control, medical research and IT information analysis.
Dr Payman Hemmati is Senior Expert of the Department of Surveillance and Researcher in Public Health at the Center for Communicable Disease Control, Ministry of Health and Medical Education (MOH&ME), Islamic Republic of Iran, a position he has held since 2007. From 2011 to 2016, he was the national coordinator and developer of the Early Warning Systems (syndromic surveillance system) project, which was completed in 2016 and was praised by the World Health Organization (WHO) and global authorities. He was coordinator and developer of the electronic national influenza surveillance system programme, 2009–2011. He was also principal national investigator for developing modern clinical reasoning models based on clinical presentation curriculum (2002–2006). Dr Hemmati has worked at Undersecretary of Educational Affairs of MOHME where he was involved in the organization of 13 national workshops on clinical presentation curriculum for faculty members and policy-makers of many medical universities in the Islamic Republic of Iran with Professor Peter Harasym (WHO Consultant) from the University of Calgary, Canada (2004–2009). He was also involved in the National Research Programme on Problem-Oriented Medical Education (1997–2003). Dr Hemmati has participated/been invited in numerous international conferences, forums and consultancies, including with WHO, the Robert Koch Institute, the Max Planck Institute, Bernhard Nocht Institute for Tropical Medicine, Germany and the Association of American Medical Colleges. He has published several articles in international peer-reviewed journals.

Dr Hemmati graduated with a degree in Medicine in 1995 from the Tehran University of Medical Sciences and Health Services (TUMS). He undertook the Field Epidemiology Training Program at the Bernhard Nocht Institute of Tropical Medicine, Germany, in 2015 and had a Fellowship in Medical Education with the University of Calgary, Canada in 2007. He participated in a 6–month implementation course on the International Health Regulations, held by WHO in Lyon, France from September 2010 to February 2011 ended with a certificate.
Dr Hanan Alkindi

Dr Hanan Alkindi is Head of the Virology Section at the Central Public Health Laboratories, Ministry of Health, Oman, a position she has held since January 2016. She joined the Virology Section in 2011.

Dr Alkindi has a Bachelor of Science degree in Basic Health Sciences and a degree in Medicine, graduating in 2001 from the College of Medicine, Sultan Qaboos University, Oman. In 2003, she began a residency programme with the Oman Medical Specialty Board in medical microbiology. She received a Diploma in Tropical Medicine and Hygiene from the Royal College of Physicians, London, in 2005. Dr Alkindi had specialist training in clinical virology at the Sheffield Teaching Hospital Trust, United Kingdom, in November 2006, and received her Fellowship in Clinical Virology (FRCPath) from the Royal College of Pathologist in 2011.

Dr Jila Yavarian

Dr Jila Yavarian is an Associate Professor in the Virology Department, School of Public Health at the Tehran University of Medical Sciences, Islamic Republic of Iran where she has been a faculty member since 2010. Her research interests lie in the area of respiratory viruses. She has collaborated actively with Professor Talat Mokhtari Azad in the Iran National Influenza Centre.

Dr Yavarian graduated from Urmia Medical School in 2001 and completed her doctoral degree in Virology from Tehran University of Medical Sciences in 2009.
Dr Alaa Eldin Eid

Dr Alaa Eldin Eid is the Undersecretary of Preventive Affairs, in the Preventive Sector at the Ministry of Health and Population in Egypt.

Dr Nasir Ahmad Stanikzai

Dr Nasir Ahmad Stanikzai is the Director of the Central Public Health Laboratory, Ministry of Public Health, Afghanistan. In 2003, he joined Première Urgence Internationale as a medical laboratory coordinator. In 2010, he started working with the Afghanistan National Public Health Institute as a Regional/Acute febrile illness/Diarrhoea Study Coordinator. In 2016, he became the Director of Central Public Health Laboratory and the National Influenza Centre at the Ministry of Public Health, Afghanistan. Dr Stanikzai is also the National Containment Coordinator and a member of the National Certification Committee for poliomyelitis eradication for Afghanistan. He is one of the founders and Executive Board members of the Afghanistan Biorisk Association. He is also on the Board of the Biosafety Association for Central Asia and the Caucasus, which has a good network with the international community and other stakeholders.

Dr Stanikzai obtained a degree in medicine from the Faculty of Medicine, University of Nangarhar, Afghanistan in 2002. He completed 30 Master level credits in dual use biosecurity education at Bradford University in the United Kingdom in 2012, and has a diploma in epidemiology. He has extensive experience in laboratory management, including biosafety and biosecurity programmes.
Dr Fatma Osman

Dr Fatma Osman is the Coordinator of Event-based Surveillance in the Epidemiology and Surveillance Department at the Ministry of Health and Population in Egypt. She is a fellow of Egyptian fellowship of applied epidemiology and a graduate of the Field Epidemiology Training Program.

Dr Salah Al Awaidy

Dr Salah Al Awaidy is a communicable disease surveillance and control adviser to the Office of the Undersecretary of Health Affairs at the Ministry of Health, Oman. He currently advises on eradication, elimination and control of communicable diseases of public health importance, in addition to the Expanded Programme on Immunization, vaccine supply chain system and the International Health Regulations. He headed the Communicable Disease Epidemiological Surveillance section of the Ministry of Health, Oman between 1996 and 1997. From 1997 to 2012, Dr Al Awaidy was Director of Communicable Disease Surveillance and Control, Ministry of Health, Oman. He was involved in establishing a strong National Immunization Technical Advisory Group, developing the national public health law, and formulating Oman’s Strategy on Control, Elimination and Surveillance of Communicable Diseases. Dr Al Awaidy played a pivotal role in the national preparedness, management and control of infectious diseases and establishing national surveillance for communicable diseases, adverse events following immunization and rotavirus. Under his leadership, Oman achieved polio-free status, and measles, rubella, congenital rubella syndrome and neonatal tetanus elimination and control, and near elimination of hepatitis B and other vaccine preventable diseases. In June 2012, Dr Al Awaidy was honoured by the Centers for Disease Control and Prevention as the best achieving person in Oman.

Internationally, Dr Al Awaidy has served on various international committees and global advisory groups and has represented the
Speaker

Dr Majid Mousa Alshamrani is a consultant of medicine and infectious diseases. He is Deputy Executive Director of the Infection Prevention and Control programme at the Ministry of National Guards – Health Affairs, Riyadh, Saudi Arabia. He is Assistant Professor of Medicine and Infectious Diseases at King Saud bin Abdulaziz University of Health Sciences in Riyadh. Dr Alshamrani’s clinical and research interests focus on infection control, immunization and infections in immunocompromised hosts.

Dr Al Awaidy is a medical doctor and holds a Master of Science degree in Epidemiology.

Ms Ann Moen serves as Chief, Influenza Preparedness and Response Unit, Centers for Disease Control and Prevention (CDC), Atlanta. She has worked on influenza at the CDC for the past 18 years. She served as the Associate Director for the Extramural Program from 2006 where she developed the Influenza Division’s international capacity building programme for influenza. Ms Moen has worked with more than 50 countries bilaterally to help support national capacity for laboratory, surveillance and response as well as multiple international partners. Prior to this role she was the Deputy Chief of the Influenza Branch for seven years. Ms Moen’s experience includes seven years working with the Health Resources Services Administration as a project officer for Community and Migrant Health Centers in south-eastern United States and working as a microbiologist in the Special Pathogens Branch Biosafety Level 4 laboratory on Ebola, Lassa and other haemorrhagic fever pathogens. She started her career as a Peace Corps volunteer where she worked for two years in rural Thailand at a District Hospital training on laboratory diagnostics and quality control.
Speaker

Dr Hassan Zaraket

Dr Hassan Zaraket is an Assistant Professor of Virology at the Faculty of Medicine, American University of Beirut and is a member of the Center for Infectious Diseases Research there. In 2009, he joined the World Health Organization Collaborating Centre and Center of Excellence for Influenza Research and Surveillance at St Jude Children’s Research Hospital, Memphis, Tennessee, where he studied the mechanisms underlying the emergence of novel influenza viruses, including H5N1 and H7N9. His laboratory is currently studying virus–pathogen and virus–host interactions in addition to the epidemiology and burden of respiratory and gastroenteric viruses in Lebanon and the Eastern Mediterranean region. Dr Zaraket is also studying influenza vaccination rates and policies.

Dr Zaraket is an associate editor for BMC Infectious Diseases Journal and a board member of the International Society for Influenza and Other Respiratory Viruses. He is also a member of several international scientific societies and has published many scientific articles and a book chapter.

Dr Zaraket received his doctoral degree from Niigata University in Japan in 2009, where he studied epidemiology and antiviral drug susceptibility of respiratory viruses.

Dr Ghazi Kayali

Dr Ghazi Kayali is an infectious disease epidemiologist with special interest in emerging viral infectious diseases at the human–animal interface. He is an adjunct assistant professor in the Department of Epidemiology at the University of Texas Health Sciences Center in Houston, Texas. He is also the Chief Executive Officer of Human Link Lebanon, a nongovernmental organization working on biomedical research in the Middle East and Africa. Dr Kayali’s current research activities include: surveillance for avian influenza viruses in animals and humans in Egypt; surveillance for MERS coronavirus in camels in Egypt, Tunisia, Uganda, Ethiopia and Senegal; and surveillance for coronaviruses in bats in Egypt, Tunisia and Lebanon. Dr Kayali collaborates with the WHO Regional Office for the Eastern Mediterranean on pandemic preparedness, One Health and joint external evaluations under the International Health Regulations. He has published more than 60 peer-reviewed papers.

Dr Kayali received his Bachelor of Science and Master of Public Health
Speaker

degrees from the American University of Beirut. He received his PhD in Epidemiology from the University of Iowa where he studied zoonotic viral diseases among humans exposed to turkeys. He completed his postdoctoral training at the Department of Infectious Diseases, St Jude Children’s Research Hospital in Memphis, Tennessee.

Dr Eduardo Azziz-Baumgartner

Dr Eduardo Azziz-Baumgartner serves as the Team Lead for the International Epidemiology and Research Team in the Epidemiology and Prevention Branch of the Influenza Division of the Centers for Disease Control and Prevention (CDC). He is an expert on the seasonality and burden of influenza in the tropics and works closely with ministries of health, the World Health Organization and other partners to inform vaccine policies. He was previously the head of the Influenza Program in Latin America and on secondment to icddr,b Bangladesh as part of the Influenza Division’s International Program. During the 2009 H1N1 pandemic, Dr Azziz-Baumgartner led CDC’s influenza response in Bangladesh and was deployed to Mexico to assist with the early characterization of the virus.

Dr Azziz-Baumgartner received his medical degree from the University of Alabama at Birmingham in 1997, completed his residency in Family Practice at the University of Texas in 2000, and a fellowship in minority health policy at Harvard University Medical School in 2003 where he earned a Master of Public Health at Harvard’s School of Public Health. He completed the Epidemic Intelligence Service fellowship in 2005 where he won several awards, including the Alexander D. Langmuir Prize and the Donald C. Macel Award. He serves as the Spanish language media spokesperson for the Influenza Division and mentors young research investigators at multiple international sites.
Speaker

**Dr Rodney S Daniels**

Dr Rodney S Daniels is Deputy Director of the Worldwide Influenza Centre at the Francis Crick Institute, and WHO Collaborating Centre for Reference and Research on Influenza. He had a postdoctoral position in the Division of Virology at the National Institute for Medical Research, United Kingdom with Dr John Skehel where his work focused on understanding the structure/function relationships of the influenza haemagglutinin. From 1984 to 1987, he continued influenza research as a laboratory head at the National Institute for Biological Standards and Controls, working on egg/cell selection of influenza viruses. Dr Daniels returned to the National Institute for Medical Research in 1987, running a laboratory focusing on HIV variation and structure/function of the HIV glycoprotein. He assumed his current position as Deputy Director of the Worldwide Influenza Centre in October 2006. In 2015 the National Institute for Medical Research became part of the Francis Crick Institute and the Worldwide Influenza Centre moved to 1 Midland Road, London in October 2016.

Dr Daniels obtained a BSc and PhD in biochemistry from King’s College, London from 1973 to 1979.

Professor Stephen S. Morse

Professor Stephen S. Morse is Professor of Epidemiology, Director of the Infectious Disease Epidemiology Certificate at Columbia University Mailman School of Public Health and Chair of the Columbia University Institutional Biosafety Committee. He was previously Assistant Professor (virology) at The Rockefeller University (1985–1995). His research interests focus on infectious disease surveillance, and the epidemiology and assessment of emerging infectious diseases, including influenza. He was Chair of the National Institute of Health’s “Conference on Emerging Viruses” in 1989, for which he originated the concept of emerging viruses/infections. He was also the founding chair of ProMED (Program to Monitor Emerging Diseases), best known for originating outbreak reporting on the Internet in 1994. He served on the United States National Academy of Medicine’s “Committee on Emerging Microbial Threats to Health” (1990–1992), and chaired its Virology Task Force. His book Emerging viruses (1993) was selected by American Scientist as one of the “top 100 science books of the [20th] century”. He is a founding member of the National Academies’ Forum on Emerging Infections (renamed the Forum on Microbial Threats), a founding section editor of the journal, Emerging Infectious Diseases, former Editor-in-Chief of the Pasteur Institute’s virology journal, and
Speaker

Global co-Director of PREDICT (2009–2014), a USAID project working in over 20 developing countries to strengthen global capacity for surveillance and detection of new infectious disease threats.

Professor Morse serves on the Expert Group on Pandemic Influenza Preparedness Planning of the World Health Organization’s Regional Office for the Eastern Mediterranean, and the US National Science Advisory Board for Biosecurity. He is a Fellow of the American Association for the Advancement of Science, American Academy of Microbiology, American College of Epidemiology, and other professional societies, and a Life Member of the Council on Foreign Relations.

Professor Morse received his PhD (in microbiology) from the University of Wisconsin–Madison.

Dr Stephen Lindstrom

Dr Stephen Lindstrom serves as the Team Lead of the Diagnostics Development Team in the Virology, Surveillance and Diagnosis Branch of the Influenza Division of the United States Centers for Disease Control and Prevention (CDC). Dr Lindstrom joined the CDC in 2000 as a research scientist and became the Team Lead of the Diagnostics Development Team in 2006. Under his supervision, his team has focused on the development and improvement of molecular diagnostic methods for detection of influenza viruses. Dr Lindstrom’s current responsibilities include overseeing clinical diagnostic testing for influenza viruses at CDC as well as acting as principal investigator for diagnostic assay design and validation of clinical diagnostic tests for detection and characterization of human influenza viruses and detection of Asian avian A(H5) and Eurasian avian A(H7) viruses. He oversees and directs manufacturing, quality control testing, distribution and technical support of CDC’s real-time reverse transcription polymerase chain reaction reagents and procedures used in the United States and worldwide for diagnosis and surveillance of influenza.
Speaker

Ms Kinda Zureick

Ms Kinda Zureick is a Public Health Advisor in the Influenza Division of the National Center for Immunization and Respiratory Diseases at the Centers for Disease Control and Prevention (CDC) in Atlanta, Georgia, United States of America. She serves as a Project Officer in the Division’s International Program. Prior to joining the Influenza Division, Ms Zureick worked in the Division for Public Health Performance Improvement in CDC’s Office for State, Tribal, Local and Territorial Support where she provided direct support to appointed state, local and territorial health officials.

Ms Zureick received her Bachelor of Science degree from the University of Georgia and her Master of Public Health in Epidemiology from Emory University. She is a Certified Health Education Specialist through the National Commission for Health Education Credentialing.

Dr Teresa Peret

Dr Teresa Peret has recently joined the Respiratory Viruses Immunology Team at the United States Centers for Disease Control and Prevention (CDC), where she is back to her original interest and area of expertise, molecular characterization and epidemiology of human respiratory syncytial virus (RSV). She has worked on human metapneumovirus, parainfluenza virus and coronavirus, including SARS and MERS-CoV. Dr Peret focused part of her recent years working with CDC international partners on diagnostics of non-influenza respiratory viruses. She has worked closely with the World Health Organization’s regional offices, including the Regional Office for the Eastern Mediterranean, on international trainings to deploy molecular diagnostics for MERS-CoV. Following her doctorate degree, on a joint position with CDC and the University of Sao Paulo, Dr Peret assisted in the establishment of a laboratory network to study the molecular epidemiology of RSV in Sao Paulo, Brazil. Her graduate work established RSV genotypes, which have been used to understand the circulation of this virus in different communities around the world.

Dr Peret obtained her doctorate on human RSV as a collaboration between the CDC, the University of Sao Paulo, Brazil, and the Federal University of Sao Paulo, Brazil.
Ms Evelyn Balsells

Ms Evelyn Balsells is a researcher at the Centre for Global Health Research, within the Usher Institute of Population Health Sciences and Informatics, at the University of Edinburgh, Scotland. Her research interests include addressing health information gaps related to the epidemiology of infectious diseases and quantifying the disease burden that affects populations globally. Previous projects are related to the global burden of disease associated with acute lower respiratory infections due to respiratory syncytial virus, *Streptococcus pneumoniae* and *Clostridium difficile*. Her current research focuses on the burden of acute communicable diseases in camps of displaced populations.

Ms Balsells has a Master of Public Health degree.

Dr Wenqing Zhang

Dr Wenqing Zhang has headed the World Health Organization’s (WHO) Global Influenza Programme since November 2012. Dr Zhang coordinates and leads the global activities on influenza surveillance, virus monitoring and detection of emerging novel viruses, risk assessment and evidence for policies, vaccine virus, and pandemic preparedness including pandemic vaccine response. From 2002 to 2012, Dr Zhang served as Team Lead coordinating the WHO Global Influenza Surveillance and Response System, building and functioning the global system of surveillance, preparedness and response. In response to the 2009 A(H1N1) influenza pandemic, Dr Zhang directed WHO’s Laboratory Response and Capacity. Before joining WHO, Dr Zhang worked for 9 years in the Chinese Academy of Preventive Medicine and the Ministry of Health as national technical/project officer/manager for WHO, World Bank, UNICEF and UNIDO projects of surveillance and control of tuberculosis, schistosomiasis and iodine deficiency disorders.

Dr Zhang has a degree in Medicine with postgraduate training on system evaluation and epidemiology and a bachelor degree in Biomedical Engineering.
**Speaker**

**Ms Maja Lièvre**

Ms Maja Lièvre is a health information manager and data analyst from Germany. After studies of Health Informatics, she joined the International Agency for Research on Cancer in Lyon, France in 1991 and worked as Statistical Assistant in the Unit for Intervention Studies for five years. She then returned to Germany and worked as clinical data manager for a contract research company where she managed and analysed clinical trial data for the pharmaceutical industry. Since 2001, she has been working at the World Health Organization’s headquarters in Geneva, Switzerland. Dr Lièvre set up the HIV/AIDS case reporting system and a database producing the epidemiological country fact sheets for the HIV/AIDS and STI Surveillance Team. For the Public Health Mapping and GIS Team, she coordinated and managed health and programme data in the Global Health Atlas and HealthMapper applications, and set up a semi-automatic system for the routine disease outbreak mapping activities of the Team. Since 2006, she has been working with the WHO Global Influenza Programme in charge of the web-based reporting system for the influenza virological surveillance data, FluNet, and managing communication and information platforms related to the Global Influenza Surveillance and Response System (GISRS).

**Dr Weigong Zhou**

Dr Weigong Zhou is a Medical Officer in the Global Influenza Programme (GIP) at the World Health Organization (WHO) headquarters in Geneva, Switzerland. His areas of work include influenza pandemic preparedness and research. Dr Zhou joined the United States Centers for Disease Control and Prevention (CDC) in 2001 as an Epidemic Intelligence Service officer in the National Immunization Program. From 2005 to 2009, he joined the WHO Regional Office for the Western Pacific in Manila, Philippines working on influenza surveillance, pandemic preparedness and response. Dr Zhou returned to CDC in late 2009 and became the chief of the Immigrant, Refugee, and Migrant Health Branch in January 2010, overseeing CDC’s regulatory and public health programmes for improving the health of immigrants and refugees domestically and internationally. He re-joined WHO in July 2015.

Dr Zhou graduated from Beijing Medical University and earned his doctoral degree in Molecular Biology from the same institution. He received his postdoctoral research training at the University of Cincinnati and was a Research Assistant Professor in the University of Washington. He has been a board certified physician of the American Board of Family Medicine since 2001.
Speaker

Dr Aspen Hammond

Dr Aspen Hammond works as a technical officer in the Epi and Surveillance team of the Global Influenza Programme (GIP) in the World Health Emergencies programme (WHE) of the World Health Organization (WHO). Dr Hammond first joined WHO in 2012 in the Food Safety and Zoonoses Department. Since 2015, she has worked in the Global Influenza Programme. Since 2012, she has primarily focused on zoonotic diseases, especially zoonotic influenza, and risk assessment. Since 2015, her additional responsibilities have included work on seasonal influenza epidemiology, influenza virus sharing and the pandemic influenza severity assessment tool (PISA).

Dr Hammond holds a veterinary medical degree and a master’s degree in public health. She is a United States citizen who grew up in the Middle East.

Dr Isabel Bergeri

Dr Isabel Bergeri works for the Global Influenza Programme, Health Emergency Programme, World Health Organization, Geneva. Dr Bergeri is an infectious diseases epidemiologist and laboratory specialist, with a primary focus on international health. She has been working mainly in and with developing countries in Asia, Africa, Eastern Europe and Pacific Territories. After her residency in public hospitals, she worked at WHO headquarters, Geneva, the WHO Regional Office for the Western Pacific and the WHO Cambodia Country Office. She has also worked for Médecins Sans Frontières, the Burnet Institute in Australia, the United Nations High Commissioner for Refugees (UNHCR) and the pharmaceutical company, Merck. She rejoined WHO headquarters five years ago and is now the technical focal point and project manager of the Epidemiological & Laboratory Surveillance part of the Pandemic Influenza Preparedness Partnership in the WHO Global Influenza Programme. She supports 43 countries in collaboration with the five WHO regions.

Dr Uzma Bashir

Dr Uzma Bashir worked as a senior virologist at the National Influenza Center, National Institute of Health, Islamabad, Pakistan, a World Health Organization (WHO) Collaborating Centre, from 2007 to 2017. She recently joined the WHO country office in Pakistan as the National Consultant on Public Health Laboratories. She has served as visiting faculty member at the Atta-ur-Rahman School of Applied Biosciences at the National University of Sciences and Technology, Islamabad. Dr Bashir is a WHO-certified Biorisk Manager, National Laboratory assessor and IATA shipper, and regularly conducts training on laboratory biosafety and quality management.

Dr Bashir has a degree in Medicine from the Rawalpindi Medical College, Pakistan, a master degree in Microbiology from Quaid-e-Azam University, and a doctoral degree in Virology and Immunology from the National University of Science and Technology, Islamabad. She was a postdoctoral researcher in conventional and molecular virology at the Influenza Collaborating Center in Memphis, Tennessee, United States of America.
Dr Ahmed Mandil

Dr Ahmed Mandil is Coordinator, Research Development & Innovation at the World Health Organization’s (WHO) Regional Office for the Eastern Mediterranean in Cairo, Egypt (seconded from the High Institute of Public Health, Alexandria University, Egypt, where he is Professor of Epidemiology). He was Dean of the College of Health Sciences, University of Sharjah, United Arab Emirates (2004–2006) and Secretary of the International Epidemiological Association (2002–2008). He is currently a board member/peer reviewer of several scientific journals, including the Eastern Mediterranean Health Journal (EMHJ), Journal of Epidemiology & Global Health and Journal of Family & Community Medicine. He has more than 50 publications in peer-reviewed journals, and has contributed to other publications, including Public health in the Arab World (2012), the WHO Global Assessment of National Health Sector Emergency Preparedness and Response (2008) and the report of a global survey on assessment for national capacity of non-communicable disease prevention and control (2001).

Dr Mandil has a degree in Medicine and Surgery, and a Master’s degree in Paediatrics from Alexandria University, Egypt. He received a doctorate in Public Health from the UCLA School of Public Health, United States of America, in 1991.

Dr Abdinasir Abubakar

Dr Abdinasir Abubakar is Epidemiologist/Medical Officer for the Infectious Hazard Management Unit in the Health Emergency Department of the World Health Organization’s (WHO) Regional Office for the Eastern Mediterranean in Cairo, Egypt. He joined the WHO South Sudan Country Office in 2007 as an epidemiologist to support the local health authority and partners in strengthening communicable disease surveillance and response capacities after simultaneous outbreaks of cholera and meningitis affected South Sudan and neighbouring countries. Dr Abdinasir was involved in the management of some of the worst epidemics in South Sudan and neighbouring countries, including meningococcal meningitis, cholera, Rift Valley fever, visceral leishmaniasis, anthrax and viral haemorrhagic fever. In June 2015, he was reassigned to WHO’s Regional Office in Cairo with responsibility for providing technical support to Member States on improving their epidemiological surveillance and response capacity to prevent and control emerging and re-emerging infectious diseases. He has been involved in much operational research in the area of emerging and re-emerging infectious diseases, including influenza, meningitis, cholera,
Dr Sk. Md. Mamunur Rahman Malik

Dr Sk. Md. Mamunur Rahman Malik is Manager for Infectious Hazards Management in the Department of Health Emergency of the World Health Organization’s (WHO) Regional Office for the Eastern Mediterranean. He is also an adjunct faculty member of the Bangabandhu Sheikh Mujib Medical University in Bangladesh. A medical epidemiologist by training, Dr Malik has a special interest in emerging infectious diseases and health systems’ capacity development for epidemic and pandemic-prone diseases. He has over 15 years’ experience in infectious disease surveillance and response to outbreaks and other pandemic-prone diseases in the WHO Eastern Mediterranean Region. A Bangladeshi by nationality, Dr Malik has over 50 publications in peer-reviewed medical journals and has presented scientific papers and abstracts in many international scientific meetings and conferences.

Dr Malik has a degree in Medicine and Surgery from the University of Dhaka, Bangladesh, and a postgraduate Diploma in Health Economics and a Master's in Health Economics from the University of Dhaka, Bangladesh.
Panellists

Professor Chakib Nejjari

Professor Chakib Nejjari has more than 20 years’ experience in epidemiological research, medical education and public health, working with various academic institutions within and outside Morocco. He has been an international consultant with the World Health Organization (WHO) and is a member of the Advisory Committee on Health Research of the WHO Regional Office for the Eastern Mediterranean. He was also a member of the anti-smoking commission of the International Union against Tuberculosis and Lung Disease. Professor Nejjari launched the Epidemiology and Public Health Laboratory at the Faculty of Medicine of Fez with the collaboration of a dynamic team. He was the head of this department and the outpatient centre in Fez University Hospital. He was a member of the Fez University Board and the academic and scientific councils of the University and the Faculty of Medicine. Professor Nejjari is the past president of the Association of French Speaking Epidemiologists and has been an expert consultant for several national and international organizations, particularly in the field of chronic diseases and their main risk factors (infection, lifestyle, environmental risk factors). He was the coordinator of studies for preparation of the Moroccan national plan against cancer. Professor Nejjari joined the Mohammed VI University of Health Sciences, Casablanca, Morocco in October 2015 as Vice President and Director of the International School of Public Health. At the end of 2016, he was appointed President of the Mohammed VI University of Health Sciences. Professor Nejjari has received several awards, supervised many master’s and doctoral theses and contributed to several indexed publications, reports and conferences.
Panellists

**Professor Mohammed Hassar**

Professor Mohammed Hassar, an internist and a clinical pharmacologist, is an emeritus professor at the Rabat Medical School, Morocco. He served as Director of the Institut National d’Hygiène, Rabat from 1989 to 1993 and Director of the Institut Pasteur du Maroc, Casablanca from 2001 to 2010. During this tenure, Professor Hassar started and developed several activities including: an anti-poison and a pharmacovigilance centre (now a WHO collaborating centre with an emphasis on French and Arabic countries); immunology, entomology and genetic units; a food, water and environment safety centre; and the first and only BSL3 laboratory of the Moroccan Ministry of Health. Professor Hassar has been active in global public health as well as health research for the past two decades. He has served on several WHO committees and panels, both at the headquarters and the Regional Office for the Eastern Mediterranean. He has served on several expert committees on the selection and use of essential medicines and chaired two of them. He has been on the governing board of the WHO–Uppsala Monitoring Centre for drug safety in Sweden for 9 years. Professor Hassar is also an honorary board member of the International Association of National Public Health Institutes. He is a founding member of the Mohammed VI Foundation for the Protection and Research on the Argan Tree. In the field of biosafety he is a founding member of the Moroccan Biosafety Association. His interests include rational drug use and drug safety, vaccines, food safety, biosecurity and biosafety as well as capacity building in health research and public health both at the national and international levels.

Professor Hassar has participated in numerous scientific meetings and workshops. He is also the author of several medical articles.
Professor Majdouline Obtel

Professor Majdouline Obtel is Assistant Professor in Epidemiology, Biostatistics and Public Health in the Department of Public Health of the Faculty of Medicine and Pharmacy, University Mohammed V in Rabat, Morocco. From 2011 to date, she has tutored medical students and scientists enrolled in the University Diploma of Practical Methods in Epidemiology, ISEPD, Victor Segalen University, Bordeaux, France. From 2011 to 2016 she worked as medical epidemiologist in charge of epidemiological research which included: epidemic intelligence and event-based surveillance; early warning, risk assessment of acute public health events and surveillance and alert of emerging diseases (e.g. Ebola, MERS-CoV). Professor Obtel was a Member of the Alert and Response Committee of Emerging Diseases in the Directorate of Epidemiology and Diseases Control, and was also in charge of other public health missions in the Ministry of Health of Morocco from 2011 to 2016. From 2007 to 2011, she was Medical Resident in Epidemiology and responsible for conducting research and epidemiological studies, developing research protocols, and teaching in the Department of Epidemiology, Clinical Research and Public Health, Faculty of Medicine and Pharmacy of Fez, Morocco. Since 2012, Professor Obtel has been a consultant for the World Health Organization.

Professor Obtel is author and co-author of many publications related to her areas of work. She has a doctorate degree in Medicine and holds Master of Epidemiology and Research from Bordeaux University in France and Public Health PhD degree from University of Sidi Mohammed Ben Abdellah of Fez in Morocco.
Panellists

Dr Musa Rahim

Dr Musa Rahim has a long professional career working in systems and programme operations, and training and research in various positions, both in development of programmes and emergency humanitarian response. Dr Rahim joined the Field Epidemiology and Laboratory Training Program (FELTP) Pakistan in December 2015 as Technical Officer, coordinating the establishment and operations of the disease surveillance and response units at the regional, provincial and federal level in Pakistan. He started his professional career in public health in 1988 in a primary health care project with the Aga Khan Health Services, Pakistan. He later worked with them in different districts and at the provincial level. In 2002, Dr Rahim joined the Community Health Sciences Department, at The Aga Khan University in Karachi as a faculty member. He worked with the World Health Organization (WHO) as Public Health Officer/National Professional Officer in Emergency Humanitarian Response from 2005 to 2015. At WHO, he was responsible for: coordination, implementation and expansion of the Disease Early Warning System (DEWS) during emergencies; leading teams in disease surveillance, outbreak investigation and response; and capacity building of provincial health department and humanitarian partner staff.

Dr Rahim graduated with a degree in Medicine from the Ayub Medical College, Abbottabad University of Peshawar, Pakistan in 1986. He received a Master of Science degree in Epidemiology from the London School of Hygiene & Tropical Medicine, University of London, in 1995.

Dr Alanoud A. Aljifri

Dr Alanoud A. Aljifri is the manager of the National Influenza Sentinel Sites Surveillance Programme at the Ministry of Health, Saudi Arabia. She is a board certified internist, and infectious diseases Fellow of the University of Alberta, Edmonton, Canada. Formerly she was an assistant professor at the King Abdulaziz University, College of Medicine in Jeddah, Saudi Arabia. She has experience in infection control.

Dr Aljifri is a graduate of the King Abdulaziz University, College of Medicine, Jeddah, Saudi Arabia.
Judges

Professor Mohamed Berraho

Professor Mohamed Berraho joined the Faculty of Medicine of Fez in 2009 as Assistant Professor in Clinical Epidemiology where he undertakes teaching and research activities. He is the coordinator of the Societal Role Committee at the Faculty and member of the Patrimony Committee. He was also member of the Faculty Council and the Research Committee. Professor Berraho has led or contributed to numerous research projects and has supervised many scientific theses. His main topics of research include cervical cancer epidemiology, diabetes epidemiology and tuberculosis epidemiology. He has been a team member of numerous internationally-funded research projects such as the Maroc Tabagisme survey, Etude Tuberculose-Tabac au Maroc and Projet International DISCOMOB, among others, and coordinator of more than six nationally-funded projects. He is the author of several publications in indexed international journals, and a member of the organizing committee of several scientific events.

Professor Berraho has a degree in Medicine from the Faculty of Medicine and Pharmacy of Rabat, Morocco. After working as a general practitioner for five years, he obtained a degree in clinical epidemiology. He has master and doctoral degrees in Epidemiology and Public Health from the University of Bordeaux, France, and a doctoral degree in Biology (microbiology option) from the University of Sidi Mohammed Ben Abdellah, Fez-Morocco.

Professor Youssef Khabbal

Professor Youssef Khabbal is Professor of Clinical Pharmacology and Vice Dean of the School of Medicine and Pharmacy, Ibn Zohr University, Agadir, Morocco. He is responsible for the Department of Pharmacology and Pharmacovigilance at the university hospital. He is also responsible for the drug science team for biomedical and translational research at the Medical Centre.
Judges

Professor Samira Serragui

**Professor Samira Serragui** is Professor of Pharmacology at the Faculty of Medicine and Pharmacy, Rabat, Morocco. She is a member of the Pharmacoeconomic and Pharmacoepidemiology team at the Laboratory of Pharmacology and Toxicology in Faculty of Medicine and Pharmacy at the University Mohamed V, Rabat. Dr Serragui is also a member of the World Health Organization Collaborating Centre for Strengthening Pharmacovigilance Practices, Rabat and a technical expert for the WHO Special Programme for Research and Training in Tropical Diseases.

Professor Rachid Razine

**Professor Rachid Razine** is Professor of Public Health and head of the Laboratory of Public Health at the School of Medicine and Pharmacy, Rabat, Morocco. Within the School of Medicine and Pharmacy, he is a member of the research team for biostatistics, epidemiology and clinical research, a member of the Research Center for Epidemiology and Clinical Trials, and a member of the research team for health and nutrition of mother–child pairs. Professor Razine is a reviewer for several national and international journals.

Judges

Dr Muhammad Faruque Parvez

Dr Muhammad Faruque Parvez is an international public health researcher with over 20 years of experience in research and health service delivery in the private sector and in academia. He has been actively engaged in health care research, and training in and establishing surveillance systems and health care programmes in resource-poor settings. Dr Parvez has also been involved in respiratory infection surveillance in the Eastern Mediterranean Region and is conducting an investigation to examine the role of different pathogens in the etiology and severity of respiratory infections among hospitalized patients in Jordan. In 2000, Dr Parvez and his colleagues at Columbia University established the Health Effects of Arsenic Longitudinal Study (HEALS), a cohort of over 35,000 adults and their children in Bangladesh. He has been a director of the HEALS cohort since then. His primary research interest is to elucidate the etiology and mechanisms of respiratory outcomes and the therapeutic implications. He is an investigator in a number of large epidemiological studies and is also a principal investigator of two ongoing research studies, funded by the United States National Institute of Health, that aim to understand the roles of immune function and vitamin D in lung function. Dr Parvez has published over 110 scientific papers on many health issues including respiratory outcomes.

Dr Parvez is a graduate of the University of Dhaka, Bangladesh. He holds a master degree in Health Care Administration from Long Island University, United States, a master degree in Public Health in International Health from Yale University and a doctorate in Public Health from Columbia University.
Guest Editor for the special supplement of the Journal of Infection and Public Health (JIPH) – Elsevier

Dr Huma Qureshi

Dr Huma Qureshi is a Consultant Gastroenterologist with a focus on liver diseases. She recently retired as Executive Director of the Pakistan Health Research Council, Islamabad and as National Lead on the prevention and control of viral hepatitis in Pakistan. She also served as Member of and Secretary for the Pakistan National Bioethics Committee from October 2004 to September 2017, and on the Technical Advisory Group on Hepatitis in Pakistan from September 2013 to September 2017. In 2008, she conducted a National Survey on the Prevalence of Hepatitis B and C in the General Population of Pakistan.

Dr Qureshi worked as Associate Editor-in-Chief of the Journal of Pakistan Medical Association and Editor of the Pakistan Journal of Medical Research. She has published numerous research papers. For her research contributions, she was decorated with Tamgha-e-Imtiaz (Pakistan State medal of honour for achievements of civilians) and awarded an honorary Fellowship from Royal College of Physicians, Ireland.

Dr Qureshi graduated in Medicine from Dow Medical College, Karachi, Pakistan in 1979.
Summary of presentations

Keynote Speech

Professor Salman Rawaf
Professor of Public Health, Director, WHO Collaborating Centre for Public Health Education and Training, Department of Primary Care and Public Health, School of Public Health, Faculty of Medicine, Imperial College London, London, United Kingdom

Health systems and acute respiratory infections: better understanding, better preparedness and better response

Acute respiratory infections (ARIs) represent a wide range of viral and bacterial infections found in all age group with varying epidemiology between countries. The health and economic consequences of even relatively benign/mild ARI are substantial. While differences in systems exist between countries, despite “standardization” by the World Health Organization, what is sure is that we have the means and the measures to prevent the range of ARIs and their serious consequence both in developed and developing countries. A lack of proper surveillance systems, mechanisms of alert and financial resources are some of the key barriers in developing countries. However, health is global and bacteria and viruses know no boundaries and collective, and international efforts work, if there is good planning, projections, collective actions, pooling of resources and solidarity. This presentation draws on my experience in the United Kingdom and elsewhere on: how, in an era of big data, we should have a better understanding of this group of conditions and be able to accurately predict its occurrence; how better preparedness, through strategic and operational frameworks, will help lessen the impact; and how better responses, by all agencies and institutions, in an orchestrated and precise manner will save lives and reduce the impact of ARIs. I also propose some future directions taking into account the changes in the health and health care landscape in the next few decades. This presentation is based on an extensive review of the literature, my experience with the 2015 pandemic influenza in my capacity as director of public health at that time and the reshaping of emergency preparedness in the UK at the local and national level, and my recent academic work on the topic.
Summary of presentations

Session 1 | Influenza surveillance in the 21st century: lessons from the past and vision for the future

Ms Ann Moen
Chief, Influenza Preparedness and Response, WHO Health Emergency Programme, WHO/HQ


Influenza is one of the greatest global threats to public health. Seasonal influenza creates a burden for young and old every year around the world. The prospects of a pandemic emerging is a major public health fear and preparation for a pandemic is at the heart of the capacity-building efforts of many countries. The Global Influenza Surveillance and Response System, with 143 national influenza centres in 111 countries, celebrated its 65th anniversary this year. This presentation focuses on the history of the GISRS and its contribution to global health and preparedness, and charts the course for future improvements.

Ms Maja Lièvre
Technical Officer, Global Influenza Programme, Influenza Preparedness and Response, Infectious Hazard Management, WHO Health Emergency Programme, WHO/HQ

WHO platforms for sharing and analysis of influenza surveillance data

The World Health Organization (WHO) has coordinated the Global Influenza Surveillance and Response System (GISRS) since its establishment in 1952 as the Global Influenza Surveillance and Response System (GISN). Already in the early days of this global collaboration, the importance of worldwide and timely sharing of influenza viruses and surveillance data was clearly recognized. The World Influenza Centre in London, United Kingdom, which was set up in 1947, had the responsibility to collect and distribute information and to cooperate internationally with influenza laboratories. Information technology has evolved from the radio-telegraphic communication of the 1950s to web-based reporting and analysis. Since 1997, influenza virus activity can be shared and monitored on the Internet through FluNet. Virological data reporting was complemented by FluID in 2009 for reporting epidemiological data. The FluNet and FluID databases support the interpretation of the influenza situation globally but they also allow a perspective of local and regional influenza situations. In 2017, a surveillance pilot project for respiratory syncytial virus (RSV) was launched. Today FluNet, FluID, RSV and other influenza-related databases are hosted on the same platform, the FluMart, which is managed by WHO as one of its XMART platforms. The data sets in FluMart can include/link data from different sources, e.g. data collected through WHO regional systems as well as data directly uploaded by national institutes. The FluMart data can be managed jointly by different WHO offices. Analysis across data sets is easy as the data are available in a standardized format on the same platform. Aggregated FluID and FluNet data and charts are available publicly on the website of the WHO Global Influenza Programme, and FluMart data and outputs tailored to regional needs can be viewed through dashboards on the websites of WHO regional offices. Direct web-linking to specific FluMart outputs, e.g. a FluNet chart showing the data of a selected country, is possible.
Summary of presentations

Dr Aspen Hammond
Technical Officer, Global Influenza Programme, Influenza Preparedness and Response, WHO
Health Emergency Programme, WHO/HQ

Global updates on PISA (Pandemic Influenza Severity Assessment)

The events of the 2009 H1N1 pandemic revealed that the World Health Organization (WHO) and other organizations did not have a robust and standardized method for making a timely assessment of the national severity of pandemic influenza. They also showed that WHO Member States were not fully prepared to rapidly assess the severity of a pandemic, or to implement the necessary risk management and communications plans. In 2011, the World Health Assembly adopted a report by the Review Committee on the Functioning of the International Health Regulations (2005) and on Pandemic Influenza (H1N1) 2009. The Committee recommended that WHO develop and apply measures that can be used to assess the severity of every influenza epidemic, whether seasonal or pandemic. The report stated that, “by applying, evaluating and refining tools to measure severity every year, WHO and Member States can be better prepared to assess severity in a timely manner in the next pandemic”. A severity assessment provides the scientific information needed to determine the timing, scale, emphasis, intensity and urgency of pandemic response actions. The framework was developed through several meetings, expert consultations, collaborative WHO projects and the establishment of a technical working group on pandemic influenza severity assessment. The framework defines influenza severity in terms of three indicators: transmission, seriousness of disease and impact. From 2014 to 2016, pilot testing of the interim guidance continued in selected Member States. In March 2017, the PISA approach was launched and Member States were encouraged to start implementation. In order to encourage its use, the PISA guidance has just been published on the WHO website. Upcoming activities include implementing the communications strategy just developed and completing an online training module on PISA and the methodology involved.

Dr Payman Hemmati
Senior Officer of Influenza, EWAR Systems & IHR, Surveillance Department Center for Communicable Diseases Control, Ministry of Health and Medical Education, Teheran, Islamic Republic of Iran

Defining influenza baselines and threshold values using SARI and F-SARI data from 2012 to 2017: country experience from Iran

A significant proportion of the global burden of acute lower respiratory infections is attributable to influenza and respiratory syncytial virus. There are few estimates of seasonal epidemic thresholds for influenza and acute respiratory infections in the Eastern Mediterranean Region of the World Health Organization. This presentation reports on a study in Iran that estimated the pre-epidemic, epidemic and post-epidemic thresholds using three indicators, namely severe acute respiratory infection (SARI), flu-associated SARI (F-SARI) and influenza-like illness (ILI). The data for the indicators were extracted from the Iranian Influenza Surveillance System, which has been operational for the past five years across the country. An R-based open-source application called the moving epidemic method was used to estimate the thresholds for the
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indicators. The intensity thresholds of the past five seasons were also calculated. Based on the moving epidemic method, the average epidemic start week is weeks 49, 48 and 41 for SARI, F–SARI and ILI indicators respectively. The sensitivities and specificities of the modelling based on the indicators were calculated as 0.86 & 0.92, 0.88 & 0.94, 0.79 & 0.76 respectively. The ILI indicator is able to predict the seasonal flu at least 2–8 weeks earlier than F–SARI and SARI (early warning and response capacity). Based on the estimated thresholds, it would be possible to evaluate the intensity of the influenza season compared to the past five years.

Session 2 | Epidemiological surveillance and use of surveillance data for informed policy and practice

Dr Salah Al Awaidy
Senior Consultant Medical Epidemiologist, Communicable Disease surveillance and control Adviser to the office of the Undersecretary of Health Affairs at the Ministry of Health, Muscat, Oman

Enhancing surveillance for influenza: strategies for better use of data for decision-making

Over the past decade, an increasing number of low- and middle-income countries have established influenza surveillance at all levels of government. Most surveillance is performed by a heterogeneous set of state and local public health departments that voluntarily collaborate with the federal government. Many separate systems are engaged in activities that contribute to public health surveillance at local, state and national levels. In addition, many countries have considered introducing or expanding seasonal influenza vaccination in their national immunization programme. Seasonal influenza activity in the tropics and subtropics, e.g. multiple peaks and identifiable year-round activity, causes complexities. This raises two challenging questions: first, when to vaccinate and second, which formulation (northern or southern hemisphere) to use. The World Health Organization’s Global Influenza Programme recommends an evidence–based practical approach to group countries that share the same seasonality pattern and virus antigenic characteristics. These countries are grouped as Influenza Vaccination Zones to maximize the effect of vaccination and address the needs of the country.

Dr Eduardo Azziz-Baumgartner
Team Lead for the International Epidemiology and Research Team in the Epidemiology and Prevention Branch of the Influenza Division of the Centers for Disease Control and Prevention, Atlanta, US–CDC

From evidence to practice: use of SARI surveillance data to generate evidence on burden of disease and cost effectiveness of interventions

Each year, influenza illness causes a substantial disease and economic burden throughout the world.
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To mitigate the impact of influenza epidemics and pandemics, 115 countries have drafted policies that recommend influenza vaccination among subpopulations at high risk of illness complications. A subset of these countries has recently introduced or expanded influenza vaccination use as a result of local analyses of influenza burden and the likely impact of interventions. In an effort to make such analyses readily accessible to additional ministries of health and national immunization technical advisory groups, the World Health Organization (WHO) and its partners have developed simple methods to estimate local influenza burden and costs. In this presentation, some of the methods used to estimate influenza-associated rates as well as the direct and indirect costs associated with illness will be discussed. Important factors to consider when analysing and interpreting such information will be outlined. Last, a preview of how such information can be used to estimate the impact of vaccination programmes will be presented and the investment case for influenza vaccination explored.

Ms Evelyn Balsells
Researcher, Centre for Global Health Research, Usher Institute of Population Health Sciences and Informatics, University of Edinburgh, Edinburgh, United Kingdom

Burden of acute respiratory infections in settlements of refugee and internally displaced persons: preliminary findings from a literature review

Acute respiratory infections (ARI) are a major cause of morbidity and mortality among crisis-affected people. In view of their significant role in public health and the gaps in knowledge of disease burden, we aimed to provide evidence on ARI among displaced populations living in settlements. Three medical databases and humanitarian websites were systematically searched for publications reporting epidemiological data for ARI in settlements of refugees and internally displaced persons. Publications reporting on acute upper or lower respiratory tract infections (AURI and ALRI respectively), influenza-like illness (ILI) and severe respiratory tract infections (SARI) published during 2000–2017 were reviewed. This review is part of a larger systematic review including other common communicable diseases. A total of 34 publications with data on the burden of ARI in settlements of refugees (n=19) and internally displaced persons (n=16) were identified. Monthly ARI incidence rates (available from long-term refugee camps) ranged from 52.1 to 173.9 cases/1 000 population of all ages and from 59.2 to 361.5 cases/1 000 children <5 years. Incidence rates of ILI were available from refugee camps in Jordan; monthly rates were 54.4 cases/1 000 children <5 years and 22.2 cases/1 000 people ≥5 years. On average, ALRI accounted for about 10% of visits to outpatient services and 15% of reported deaths. Regarding viral etiology, 50.9%–53.7% of SARI or hospitalized pneumonia cases (all ages) tested positive for at least one virus in refugee camps in Kenya (surveillance period: 2007–2010) and Thailand (2009–2011). Data on the role of bacteria were limited. Surveillance data provide insights into the large burden of medically attended ARI in settlements of displaced populations. Considering the unstable conditions in these settings, efforts are needed to close existing knowledge gaps. Where feasible, approaches to describe the burden of ARI for high-risk groups and its etiology can help guide public health action in settlements.
Summary of presentations

Dr Idris Al-Ubaidani
Director, Department of Communicable Diseases, Ministry of Health, Muscat, Oman

Estimating the burden of influenza-associated hospitalizations and deaths in Oman, 2012–2015

Influenza is a serious vaccine-preventable disease with high incidence, hospitalization and mortality in high-risk groups. In Oman, despite advances in influenza surveillance, the clinical burden and seasonality of influenza is still not fully understood. This presentation reports on a study to estimate the incidence of influenza-associated hospitalizations and in-hospital deaths in Oman. Influenza-associated hospitalizations and in-hospital deaths were estimated using hospital discharge records based on ICD-10 codes (J09–J18) and the results of virological analyses for 2012–2015. During the study period, we identified 19,405 influenza-associated hospitalizations and 847 deaths. Influenza positivity percentage ranged between 6.4% in 2013 and 20.6% in 2015. The influenza-associated incidence rate was 7.3 (95% CI: 6.4–8.1) per 100,000 in 2013 and 27.5 (95% CI: 25.9–29.1) per 100,000 in 2015 with an overall rate of 20.6 (95% CI: 19.9–21.3) per 100,000. The highest incidence of influenza-associated death was among those aged ≥65 years and ranged between 39.5 (95% CI: 27.3–51.8) per 100,000 in 2014 and 11.3 (95% CI: 7.5–15.1) per 100,000 in 2015. Influenza causes a substantial number of hospitalizations and deaths in Oman. The results of this estimation helped the Ministry of Health prepare and respond to seasonal influenza. For example, seasonal influenza vaccination was introduced for high-risk groups including the elderly, the needed stock of antivirals, seasonal flu vaccine and laboratory materials was more accurately estimated, and a seasonal influenza guideline for healthcare workers was developed. Studies to further stratify the age group <1 year into 0–<6 months and ≥6 months to give practical evidence for the vaccination strategy for this age group, and to estimate the influenza burden in risk groups other than age-based groups are recommended.

Session 3  |  Virological surveillance for influenza: enhancing better understanding on influenza epidemiology and better preparedness

Dr Wenqing Zhang
Manager, Global Influenza Programme, Influenza Preparedness and Response, Infectious Hazard Management, WHO Health Emergency Programme, WHO/HQ

Timeliness and sharing – two essential elements for effective surveillance and response to influenza epidemics and pandemics

Because of the constant evolutionary nature of influenza viruses, and the limitations of knowledge and control measures so far, two essential elements of surveillance and response are sharing and timeliness in order to achieve maximum disease control. The Global Influenza Surveillance and Response System (GISRS), which has been functioning for 65 years, is the foundation of global surveillance and response. Functioning under the World Health Organization (WHO), members of GISRS share virus samples and
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information to develop timely counter measures, e.g. vaccines, to the viral disease threat. Since 2006, WHO has developed a Shipping Fund Project to support countries sending viruses to the WHO collaborating centres of GISRS. Benefit-sharing was raised in 2007 and in 2011 the World Health Assembly adopted the Pandemic Influenza Preparedness Framework to put virus sharing and benefit sharing on an equal footing. Effective from 1 July 2017, practical operational guidance has been implemented by GISRS to improve timeliness and sharing of PIP Biological Materials. Furthermore, the terms of reference of national influenza centres were updated in October 2017, providing more clarity on sharing of viruses among other critical activities. With new technologies, genetic sequence data (GSD) sharing is becoming more important. As demonstrated in 2013 when the H7N9 outbreak started, GISAID has been used as a powerful platform by GISRS for sharing GSD. GISAID has been in continuous development with support from the WHO collaborating centres of GISRS. In the dynamics of a changing world, there is never a lack of challenges in sharing of viruses and information, including GSD. The very solution to these complexities is trust – the 65-years of GISRS is a path of trust-based global collaboration.

Dr Rodney S Daniels
Deputy Director, Worldwide Influenza Centre, the Francis Crick Institute, WHO Collaborating Centre for Reference and Research on Influenza, London, United Kingdom

Influenza virus sharing in the Eastern Mediterranean Region: what has been achieved so far and ways to improve virus sharing

An update on sharing of specimens with the World Health Organization’s (WHO) collaborating centres is provided in this presentation for the period July 2015 to the present, following the publication by Asghar et al., which covered the period 2010–June 2015 (East Mediterr Health J. 2016;22(7):445–452). Improvement in the numbers of specimens being shared was observed over the period July 2015–October 2017, largely by a core of 10 countries which had shared specimens during the previous period; two countries did not share while three additional countries have shared. Most countries of the WHO Eastern Mediterranean Region (EMR) have influenza surveillance systems in place but only 13 are currently reporting to FluNet/FluID and this is sometimes done retrospectively. Regular (weekly) reporting would enable monitoring of the situation in countries to allow prompting of shipments of specimens in a timely manner to fit with the twice yearly WHO VCMs, with shipments containing specimens with collection dates of 1–8 weeks before shipment. A current lack of timeliness can be seen in terms of sequence data submitted to GISAID, the great majority of which is done by the WHO collaborating centres in Atlanta and London. This presentation discusses ways to improve virus sharing including: initial specimen collection and transport to national influenza centres or national influenza laboratories; reporting to FluNet/FluID; efficient use of the GIP shipping fund which currently supports four shipments per country per year; guidance on the quality/volumes/number of specimens to be shared with a shift to sharing more clinical specimens in a timely manner.
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Dr Jila Yavarian
Associate Professor, Virology Department, School of Public Health, Tehran University of Medical Sciences, Tehran, Islamic Republic of Iran

Journey of a National Influenza Center: from achieving national to international goals for enhancing preparedness for pandemic influenza

In 1969, the influenza laboratory, located in the Virology Department, School of Public Health, Tehran University of Medical Sciences, was recognized by the Ministry of Health and Medical Education as the National Influenza Laboratory. In 1976, this Center was designated by the World Health Organization (WHO) as the National Influenza Center of Iran and a member of the WHO Global Influenza Surveillance Network. According to the Communicable Disease Control of Iran’s Ministry of Health and Medical Education, all cases of severe acute respiratory infections (SARI) must be reported and specimens collected and sent to the National Influenza Center and sub-national laboratories. Currently, there are 14 sub-national laboratories, distributed in northern, central, southern and eastern Iran, and this laboratory network covers all provinces. In line with WHO terms of reference, the National Influenza Center undertakes detection of influenza viruses from clinical specimens of patients with influenza-like illness, especially during the influenza season; this includes isolation of influenza viruses and identification of influenza virus types and subtypes. The Center reports the influenza types and subtypes, preferably weekly, on the FluNet, and sends representative influenza samples to a WHO Collaborating Center for vaccine composition. In addition, the National Influenza Center undertakes further activities as follow:

- Sequence analysis of drug-resistant mutations in each season
- Training courses and workshops for sub-national laboratories annually
- Proficiency test panels for sub-national laboratories to check their activities regularly
- Detection of other respiratory viruses upon request.

Dr Rodney S Daniels
Deputy Director, Worldwide Influenza Centre, the Francis Crick Institute, WHO Collaborating Centre for Reference and Research on Influenza, London, United Kingdom

Importance of rapid analysis and public sharing of seasonal influenza sequencing data to improve vaccine strain selection and pandemic preparedness

Traditionally, an “isolate first” approach to assess antigenic characteristics of influenza viruses has been used, followed by gene sequencing of seasonal influenza viruses showing antigenic drift and those with pandemic potential that may show antigenic shift. Antigenic drift compared to an existing vaccine virus is the driving force for change when making vaccine recommendations. Following real-time reverse transcriptase polymerase chain reaction detection/diagnosis of influenza, the advent of next-generation sequencing technologies is driving influenza surveillance to a “sequence first” approach (with isolation of representative viruses for antigenic characterization). The sensitivity of next-generation sequencing has
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resulted in an exponential increase in sequences, notably for complete haemagglutinin genes, derived directly from influenza-positive clinical specimens – thereby giving greater insight into the propensity of different genetic clades (potentially with altered antigenic properties) within particular virus subtypes and lineages. This can lead to better prioritization of viruses to be developed as potential vaccine candidates through isolation in embryonated hens' eggs (for egg-propagated vaccines, which still constitute the great majority of worldwide production), isolation in vaccine approved cell-lines and molecular means (gene synthesis and reverse genetics). For this approach to be effective, sequences of the most recently circulating viruses should be determined and shared in a timely manner (within one week of sequence determination) through submission to a publically accessible database such as GISAID. In this presentation, examples of how this approach is working and improvements in timely sharing of genetic sequence data through GISAID are given.

Dr Stephen Lindstrom
Team Lead, Diagnostics Development Team, Virus Surveillance and Diagnosis Branch, Influenza Division, Centers for Disease Control and Prevention, Atlanta, US-CDC

Quality management in the virology laboratory: proficiency testing and internal quality controls, current situation in the Region and future directions

This presentation addresses the importance of quality management in the virology laboratory, and discusses proficiency testing and internal quality controls. It provides an overview of the current situation in the Eastern Mediterranean Region and future directions. Current information on the emergence and changes in swine and avian influenza viruses globally and their implications for public health are also discussed.

Ms Kinda Zureick
Public Health Adviser, Influenza Division, National Center for Immunization and Respiratory Diseases, Centers for Disease Control and Prevention, Atlanta, US-CDC

International Reagent Resource

This presentation introduces the Centers for Disease Control and Prevention’s International Reagent Resource (IRR). Topics discussed include the process of account registration, the navigation of the IRR website and the process of ordering IRR material. Web links and customer service contact information are also included.
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**Dr Hanan Alkindi**  
Senior Consultant, Head of Virology section, Central Public Health Laboratories, Muscat, Oman

*The Oman Central Public Health Laboratory’s path to becoming a national influenza centre: challenges and lessons learned*

Founded in 1993, the Central Public Health Laboratory (CPHL) was the first centre for viral culture and molecular testing in Oman. It serves the public health interests of the country, providing diagnostic health services, training, quality assessment and general public health surveillance. It is also currently one of the leading institutes in the region for the World Health Organization's (WHO) related programmes including polio, measles, rubella, and influenza virus molecular, culture and genotyping testing. Located in Muscat, it provides support to Oman public and private health sectors in areas related to infectious diseases, and also to chemical, toxicology and biochemistry screening of public health interest. The National Influenza Centre (NIC) in Oman was accredited by WHO in 2009; however the CPHL started providing influenza isolation and typing in 2002 in collaboration with the Naval Medical Research Unit Three (NAMRU-3) in Cairo, Egypt. Since then, building the capacity of the Oman NIC has been a priority of the Ministry of Health in close collaboration with the WHO Global Influenza Surveillance and Response System (GISRS) and the WHO Regional Office for the Eastern Mediterranean. The Oman NIC has continued to improve over the years and now provides the backbone of molecular-based influenza and other respiratory virus surveillance in the country, including the screening for MERS-CoV. The laboratory is also a fully functioning NIC in terms of sharing isolates with the influenza collaborating centres of the GISRS and immediate reporting of unusual influenza activity. Since its accreditation, the NIC has successfully addressed several public health emergencies such as the 2009 H1N1 pandemic and the emergence of MERS-CoV in 2012. It is has achieved good scores in external quality assessment programmes and maintains a high level of technical proficiency.

**Dr Nasir Ahmad Stanikzai**  
Director, Central Public Health Laboratory, Ministry of Public Health, Kabul, Afghanistan

*Performance of Afghanistan’s National Influenza Centre for isolating and sharing influenza virus isolates during 2015–2017: challenges for a crisis affected country*

The Afghanistan National Influenza Centre (NIC) was established at the Central Public Health Laboratories and recognized by the World Health Organization (WHO) in 2009 with the support of the Naval Medical Research Unit Three (NAMRU-3). However, it had been non-functional since 2012 for virus isolation after NAMRU-3 support ended. Virus isolation work re-started in September 2015 and, in December 2015, NIC for the first time isolated and shipped three influenza virus isolates to the WHO collaborating centre at the Centers for Disease Control and Prevention (CDC), Atlanta. Between December 2015 and September 2017, 35 influenza virus isolates, one non-influenza virus (unidentified) and 120 original samples were shipped to the collaborating centre in seven shipments. All influenza virus isolates sent to the collaborating centre were reconfirmed and studies showed that these circulating viruses matched the globally circulating
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Influenza viruses and were sensitive to the common antiviral medicines. CDC also isolated two additional influenza A(H3N2) isolates in the MDCK-SIAT-1 cell line. The viruses isolated were: 14 influenza A(H1N1)pdm09, 5 influenza A(H3N2), 11 influenza B (Victoria lineage) and 7 influenza B (Yamagata lineage). With this, a database of circulating influenza virus isolates has been documented in Afghanistan. NIC also tested specimens received in 2015–2017 by real time polymerase chain reaction: 1 421 samples in 2015, 3 123 in 2016, and 2 179 in 2017 until 15 November. All influenza A viruses in the country could be subtyped. NIC passed the WHO proficiency external quality assurance programme panels with 100% scores for 2015, 2016 and 2017. Results were regularly uploaded on the global influenza databases FluNet, FluID and EMFLU. A fully independent and functional NIC is now in place for Afghanistan, although there are challenges in sustainability and expansion of the diagnostic capacity for additional functions.

Session 4 | Use of influenza vaccine in Eastern Mediterranean Region: challenges for increased uptake

Dr Hassan Zaraket
Assistant Professor, Department of Experimental Pathology, Immunology & Microbiology, Member of Center for Infectious Diseases Research, Faculty of Medicine, American University of Beirut, Beirut, Lebanon

Current seasonal influenza vaccine policies and use in the Eastern Mediterranean Region: considerations for increasing vaccine uptake

Seasonal influenza viruses cause mild to severe infections that are associated with significant morbidity and mortality worldwide. Influenza vaccines are highly effective in mitigating the influenza burden, especially in high-risk groups. The current policies, vaccination coverage (VC), and attitudes to influenza vaccination in the Eastern Mediterranean Region (EMR) of the World Health Organization were assessed through a review of all studies published in English between 2006 and 2016, and a survey administered to ministries of health. Fifty-two publications were eligible for review, the majority of which originated from a few countries in the region, which highlights gaps in influenza vaccination research in the Region. Most studies reported low vaccination coverage in the general population and in high-risk groups, which was mainly attributed to misconceptions about vaccine safety, efficacy and recommendations. Desirable coverage levels for some of the at-risk groups, such as healthcare workers and pilgrims, were achieved in few countries. Analysis of the number of vaccine doses distributed in the EMR countries confirmed the low vaccination coverage rates. Furthermore, a comprehensive survey was conducted among the 22 EMR countries. It included questions on influenza surveillance, vaccine policies, coverage and the specific risk groups for which influenza vaccination is recommended. Twenty countries completed the survey; of these, 14 countries indicated the implementation of an influenza vaccine policy, a significant improvement from the past. Importantly, five countries have included influenza vaccine in their national immunization programmes. Seven countries reported that they measure vaccination coverage, but the data varied widely between these countries and among different age groups. The implemented influenza vaccine policies commonly covered the main risk groups, with some variability between EMR countries. Recommendations for the implementation of influenza vaccination policies and improving vaccination coverage in the EMR will be discussed on the basis of the literature review and survey findings.
Achievements of the long-term national strategy to reduce influenza mortality and morbidity in Kuwait

In 2014, the national media highlighted the impact of seasonal influenza on the local population in Kuwait because of several deaths from the disease. This caused national panic and grave concern among national leaders. It provided the impetus for the public health department to put in place a long-term national strategy to improve the influenza control activities. With the help of the World Health Organization’s (WHO) Regional Office for the Eastern Mediterranean, we started to evaluate our influenza disease control activities through data analysis and field visits to both the government and private health sector. The data analysis at the time did not show any escalation in disease mortality or morbidity, but we found many gaps at all levels, such as low level of vaccination among high-risk groups, delay in administration of antiviral medication, gaps in infection control measures in some sites, and a lack of compliance with proper management policies. Therefore, with the support of the WHO Regional Office, we took the opportunity to implement a new strategy. Our new strategy addressed all these concerns. We started with a series of media conferences and annual workshops for key clinicians and public health staff. In addition, we updated the algorithm for laboratory diagnosis and antiviral management, introduced new improved hospital and intensive care unit admission and treatment policies, and held annual national campaigns to increase the uptake of the influenza vaccine among high-risk groups and the community at large. Over the course of three years, the new strategy has reduced influenza mortality by 55% and morbidity by 33%. This presentation outlines the new strategy and the achievements and challenges of this national–WHO collaboration to reduce the impact of influenza in Kuwait.
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in-depth, ad hoc virus-specific risk assessments with the objectives of sharing information and identifying knowledge gaps and prompting further investigations. Through risk assessments and routine sharing of information, there is almost daily communications with our animal health partners as collaboration with the animal health sector is crucial. Challenges specific to influenza at the human–animal interface include the diversity and constantly evolving nature of the viruses, the incidence of severe disease in humans, food security and political issues, and influenza fatigue.

Dr Ghazi Kayali
Chief Executive Officer, Human Link; Adjunct Assistant Professor, Department of Epidemiology, Human Genetics, and Environmental Sciences, University of Texas Health Sciences Center, Texas, United States of America

Surveillance of zoonotic influenza: framework for data collection and decision-making

Zoonotic influenza viruses pose a significant global public health risk. The location of the Eastern Mediterranean Region (EMR) of the World Health Organization (WHO) makes it an important region for influenza A virus circulation. EMR countries lie under four of the eight global migratory bird flyways, hence permitting transmission of avian influenza viruses from migratory birds to the resident wild birds, domestic poultry, mammalian species and humans in the region. Highly pathogenic H5N1 avian influenza spread rapidly through the EMR in 2006. Transmission of H5N1 from infected birds to humans has been confirmed mostly in Egypt, but also in Iraq, Djibouti and Pakistan. Recently, several EMR countries reported the newly emerged H5N8 virus in wild birds and poultry. In addition, H9N2 viruses are endemic in several EMR countries, and seroepidemiological studies from different countries found evidence of H9N2 antibodies. Surveillance is an important tool to combat zoonotic influenza. It allows the determination of the characteristics of the circulating viruses and an understanding of the epidemiological factors associated with viral circulation. Furthermore, surveillance is an integral part of influenza pandemic preparedness and response. Review of the scientific peer-reviewed and grey literature showed that very little surveillance is being conducted in the EMR. Hence, surveillance at the human–animal interface needs to be increased in the region. This will require a One Health approach that will enable coordination of the various sectors to maximize benefits. The WHO Regional Office for the Eastern Mediterranean has prepared a One Health framework and applied it to influenza. Furthermore, surveillance protocols for zoonotic influenza at the human–animal interface are being finalized. Details of these projects are discussed in this presentation.

Dr Fatma Osman
Coordinator of Event based Surveillance, Assistant of National Surveillance System, Coordinator Surveillance Sector, Ministry of Health and Population, Cairo, Egypt

Surveillance for avian influenza H5N1: what lessons have we drawn so far for early detection and response?

Since February 2006, the highly pathogenic avian influenza (HPAI) subtype H5N1 virus has been circulating
in poultry in Egypt, and it was declared enzootic in 2008. In March 2006, the first human case was reported. As an initial response, a comprehensive response plan for avian influenza viruses was developed with collaborative efforts of stakeholders. In Egypt, 359 confirmed H5N1 cases were recorded from 2006 to August 2017, with 122 deaths, a case fatality rate of 34%. Of confirmed cases, 59% were females, median age was 18 years (IQR: 3.5–33.5 years), and 70% reported exposure to household birds, 58% to breeding, 49% to live poultry and 34% to dead birds. Several lessons have been learnt in Egypt in light of the experience with avian influenza H5N1.

- Implementation of the response plan for avian influenza viruses with collaborative efforts of stakeholders was very helpful for mitigation and containment of the avian outbreak
- An enhanced integrated surveillance system for influenza was useful for early detection, and for preventive measures and decision-making
- Forecasting the seasonality, severity and any unexpected events using multiple approaches helped provide early warning of potential outbreaks
- Extensive communication with all stakeholders, especially the four-way linking (human–animal interface), was critical for the success of preventive and mitigating measures
- Effective risk communication played a key role in acceptability of and response to actions taken by individuals and the community
- Risk assessment helped allocation of resources according to priorities
- Strengthening of laboratory capacity for the detection of etiological agents and follow up of results of full gene sequencing helped to detect new strains.

**Session 6 | Surveillance for Respiratory Syncytial Virus (RSV): lessons learned from SARI surveillance network/platform**

**Dr Uzma Bashir**

National Consultant, Public Health Laboratories, WHO Pakistan country office, Islamabad, Pakistan

**Respiratory syncytial virus surveillance using influenza sentinel surveillance platforms: experience from Pakistan**

Since 2007, Pakistan’s National Institute of Health has had coordinated laboratory–based influenza–like illness (ILI)/severe acute respiratory infections (SARI) surveillance for influenza which includes eight sentinel sites across the country. This presentation reports on a study that determined the frequency of non-influenza respiratory virus infections through the existing ILI/SARI surveillance system. Using the World Health Organization case definitions for ILI and SARI for case selection, 1 941 children under 5 years of age were enrolled from the influenza sentinel sites from October to April each year between 2010 and 2013. Demographic and clinical data and respiratory swab forms were collected. All samples were tested for: influenza (A and B), and non-influenza
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respiratory viruses; respiratory syncytial virus (RSV) (A and B); human adenovirus; human metapneumovirus (HmPV); and human rhinovirus using real-time polymerase chain reaction (protocols of the US Centers for Disease Control and Prevention). Among the children enrolled, 1,337 (69%) presented with ILI and 604 (31%) were diagnosed as SARI cases. In total, 1,478 (76%) samples were positive for respiratory viral pathogens. In the 2010–2011 season, 672 of 797 (84%) samples had viral pathogens, in 2011–2012, 391 of 610 (64%) had respiratory viral pathogens and in 2012–2013, 415 of 534 (78%) were positive for respiratory viruses. The frequency of detection of respiratory viruses was: influenza A (21%), influenza B (7%), RSV A (19%), RSV B (5%), HmPV (5%), adenovirus (7%) and rhinovirus (12%). A single viral pathogen was detected in 55% of positive cases, two pathogens in 9% and co-infection with up to three agents was seen in only 1%. Being a simple system, the influenza surveillance system provided adequate flexibility to detect non-influenza respiratory viruses and can serve as an effective platform for surveillance of RSV and other non-influenza respiratory viruses. Etiological studies focusing on respiratory viruses are required, not only to facilitate diagnosis but also for proper antiviral treatments and preventive planning, such as vaccination of susceptible age groups.

Session 7 | Addressing pandemic influenza threats: recognition, prevention and response

Professor Stephen S. Morse

Professor of Epidemiology, Director of the Infectious Disease Epidemiology certificate, at Columbia University Mailman School of Public Health; Chair of the Columbia University Institutional Biosafety Committee, Columbia University, New York, United States of America

Threats of pandemic influenza: what are the lessons for improved detection and preparedness in the context of the Global Health Security Agenda?

Next year marks the 100th anniversary of the greatest influenza pandemic in history (and the greatest natural disaster known), the 1918 “Spanish flu”. In those 100 years, there have been four influenza pandemics (1918, 1957, 1968 and 2009), and future pandemics appear inevitable. However, no pandemic has ever been correctly predicted before it began its rapid spread within the human population. Despite hopes for improved prediction, this still remains beyond our abilities. In recent years, new respiratory infections of zoonotic origin, including H5N1 avian influenza and MERS-CoV in this region, have added to the potential threats and further demonstrate the gaps in our knowledge. As we are not currently able to predict influenza pandemics and “novel” infectious disease threats such as MERS, effective respiratory disease surveillance for early warning, together with strong preparedness measures, are essential. The foundation for this exists in the influenza surveillance systems. Building on these systems will require an enhanced capability to collect and coordinate data across national borders and identify the pathogens in real time (or near real time), and agreement on triggers for appropriate response activities. As many pandemic influenzas appear to have a zoonotic origin, cross-species surveillance (a One Health approach) is essential. Technological advances in detection, reporting, communications, and data analysis make it increasingly feasible and cost-effective to develop a more comprehensive system from these building blocks. The Global Health Security Agenda and the revised International Health Regulations provide mechanisms and assistance for encouraging these enhancements and implementing consistent standards for surveillance and preparedness.
Dr Jacqueline Katz
Deputy Director, Influenza Division, National Center for Immunization and Respiratory Diseases, Centers for Disease Control and Prevention, Atlanta, US-CDC

Pandemic risk assessment and readiness

The number of reported novel influenza A virus infections in humans has increased over 30-fold in the past 20 years. This is due, in part, to the convergence of an ever increasing and well-connected human population, and the global expansion of domestic poultry and pig populations. Multiple subtypes of novel influenza A viruses have emerged from these animal reservoirs to cause zoonotic infections. The United States Centers for Disease Control and Prevention’s (CDC) Influenza Risk Assessment Tool is a global public health tool that evaluates the pandemic risk of novel influenza viruses currently circulating in animals. The Tool assesses both the potential to cause a pandemic and the public health impact. It is used to prioritize preparedness efforts and resources in the pre-pandemic phase. Pandemic readiness is linked to seasonal readiness – the capacity to detect, assess and respond to continually changing seasonal influenza viruses. Global surveillance capacity to detect influenza in humans is greater than ever before, but gaps remain and surveillance in animal reservoirs remains sub-optimal. Distributed doses of seasonal influenza vaccines have progressively increased but substantial regional disparities exist and in a pandemic, current vaccine production and deployment capacity will not meet the global need. Next generation vaccines that are more broadly protective and elicit longer lasting immunity are a high priority global health need.

Dr Isabel Bergeri
Technical Officer, Global Influenza Programme, Influenza Preparedness and Response, Infectious Hazard Management, WHO Health Emergency Programme, WHO/HQ

PIP partnership contribution to laboratory and epidemiological surveillance capacity building: smooth connection and collaboration between EMRO and GIP/HQ

The Pandemic Influenza Preparedness (PIP) Framework for the sharing of influenza viruses and access to vaccines and other benefits is an international arrangement adopted by the World Health Assembly in May 2011 to improve global pandemic preparedness and response. The Framework establishes a PIP benefit-sharing system that includes an annual partnership contribution (PC) to WHO from influenza vaccine, diagnostic and pharmaceutical manufacturers using the WHO global Influenza Surveillance and Response System (GISRS). The implementation plan has a results’ hierarchy that consists of six outputs, each with specific deliverables and indicative activities. Output 1 is about laboratory and surveillance capacity building. This output supports countries to improve their laboratory and surveillance system capacities, and to actively participate in GISRS. These different actions enhance virus- and information-sharing, risk and severity assessment, including at the human–animal interface, and improve response measures. This presentation describes the seamless connection and strong collaboration between the World Health Organization’s Regional Office for the Eastern Mediterranean and the Global Influenza Programme in WHO headquarters (GIP/HQ) in supporting countries in the Region, including countries receiving partnership contributions.
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**Dr Weigong Zhou**
Medical Officer, Global Influenza Programme, Influenza Preparedness and Response, Infectious Hazard Management, WHO Health Emergency Programme, WHO/HQ

**Pandemic influenza risk and impact management: building capacity for pandemic response**

An influenza pandemic is an unpredictable but recurring events that can have serious consequences on human health and economic well-being worldwide. Advanced planning and preparedness are critical to help mitigate the impact of a pandemic. The 2009 influenza A(H1N1) pandemic was the first since the World Health organization (WHO) had produced pandemic preparedness guidance. It provided a wealth of additional information for the established and growing body of knowledge on pandemic preparedness and response. Taking account of the lessons learned from the 2009 influenza A(H1N1) pandemic and of other relevant developments, the WHO guidance Pandemic influenza risk management (PIRM) was developed to update and replace the Pandemic influenza preparedness and response: a WHO guidance document published in 2009. PIRM was initially published in its interim version in 2013 and subsequently finalized in 2017. The guidance emphasizes risk-based and integrated approaches in pandemic preparedness. It also describes the roles and responsibilities of WHO related to pandemic preparedness, in terms of global leadership and support to Member States. The guidance can be used to inform and harmonize national and international pandemic preparedness and response. Countries should consider reviewing and/or updating national influenza preparedness and response plans to reflect the approach taken in this guidance.

**Dr Alaa Eldin Eid**
Undersecretary of Preventive Affairs, Preventive sector, Ministry of Health and Population, Cairo, Egypt

**Developing national pandemic influenza preparedness plan: Egypt’s experience**

An influenza pandemic occurs when an influenza A virus undergoes continuous mutation that causes sustained human-to-human transmission leading to community-wide outbreaks. The first Egyptian Influenza Pandemic Plan was completed in 2007 by the Egyptian Ministry of Health and Population (MoHP). The 2009 influenza A(HINI) pandemic was a real test for Egypt’s pandemic preparedness planning efforts. This presentation discusses the following key aspects of Egypt’s Influenza Pandemic Plan.

**Goal:** to reduce morbidity and mortality due to a pandemic influenza virus

Pandemic phases: inter-pandemic phase; alert phase; pandemic phase; and transition phase

**Key components:** surveillance activities; laboratory services; hospital preparedness & case management; strategic national stockpile; information and risk communications; intersectoral collaboration; international collaboration; research; and evaluation

**Success indicators:** lower transmission rates of a pandemic virus; fewer cases, hospitalizations and deaths; continuity of basic services; and minimization of the social and economic consequences of the pandemic
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Levels of command control: first strategic level (political) – a supreme ministerial committee headed by the Cabinet; second level (planning & preparation) – national inter-ministerial committee headed alternatively by MoHP/Ministry of Agriculture/MoE; and executive level (operational) – governorate high committees headed by Governors

Crisis management: crisis management committees at central and provincial levels; raised state of emergency at all levels; operations room at MoPH; and enhanced preventive emergency rooms at provincial and health districts levels

Preparedness cycle: planning, organization, training; availability of needed equipment, practical exercises, continuous evaluation, taking corrective actions and re-planning.

Dr Majid Mousa Alshamrani
Consultant in Infectious Diseases; Deputy Executive Director, Infection Prevention and Control Program, King Abdulaziz Medical City, National Guard Health Affairs, Riyadh, Saudi Arabia

MERS-CoV as a next global pandemic: what we know and what we need to know

MERS-CoV is an emerging respiratory virus. The virus emerged in Saudi Arabia in 2012. Since then, laboratory-confirmed cases of MERS-Cov have been reported to the World Health Organization (WHO) by 27 countries. Many of these infections were linked directly or indirectly to the Arabian Peninsula. There have been more than 2 081 confirmed cases worldwide, with at least 722 deaths, a fatality rate of around 35% – 80% of these cases have been reported from Saudi Arabia. The largest outbreak outside of Saudi Arabia occurred in South Korea in 2015. The South Korean outbreak had 186 confirmed cases and 36 deaths over a two-month period. Although most of these outbreaks and clusters of cases had limited transmissibility with a tendency to spread among people and patients within health care facilities, WHO considers MERS-CoV a pathogen of public health concern that poses a global threat. This is based on its impact on human health and the economic consequences. Moreover, there is limited information on how the virus circulates and currently there is no available vaccine or known effective treatment. Dromedary camels are strongly believed to be the natural reservoir of MERS-CoV. This is based on epidemiological studies that link confirmed cases to exposure to camels. Furthermore, viral surveillance based on polymerase chain reaction among dromedary camels has confirmed the presence of the virus in upper airway secretions of camels. For the present, optimizing infection prevention and control practices, identification of acute respiratory illness cases and implementation of proper infection prevention and control precautions are the only methods that are effective in decreasing the MERS-CoV impact on our health care systems. In line with the One Health approach, we need to have more collaboration and research between human health and animal health agencies. This will close the gap in our knowledge about infection transmission, prevention and possible therapeutic options.
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Thematic area: Epidemiology

Use of personal protective equipment to protect against influenza and other emerging respiratory infections

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Presenter: Aabbrar Chughtai, Lecturer in International Health, School of Public Health and community Medicine, University of New South Wales, Australia

Background: Personal protective equipment (PPE) is commonly used to protect from respiratory and other infections. PPE is particularly important during the early stage of epidemics and pandemics, when drugs, vaccine and other control measures are not available. PPE includes facemasks, respirators, gloves, gowns, coveralls, goggles, face-shields and surgical caps. However, there is an ongoing debate and a lack of evidence on effectiveness of various PPE and there are very limited data from low-resource countries.

Purpose: We aimed to examine policies and practices around the use of PPE for influenza and other respiratory infections in healthcare and community settings in Pakistan.

Methodology: Studies on policies and practices on PPE in a low-resource setting were reviewed. Articles were searched on MEDLINE, Embase and Google Scholar. Clinical, epidemiological and laboratory-based studies, published in English were included in this review.

Findings: We only found epidemiological (observational/cross-sectional) studies on the use of PPE for various infectious diseases in healthcare and community settings in Pakistan. There were no clinical trials or laboratory based studies on the use of PPE in such settings. Most studies examined the use of PPE in healthcare settings, including hospitals, and dental or laboratory workers. Compliance with the use of PPE, particularly facemasks and respirators, was reported to be lower among the healthcare workers. Among the PPE, facemasks were considered most bothersome to use by wearers. Policies and practices on the use of facemasks/ respirators for various infectious diseases varied and different types of products were recommended and used. Medical masks were used to protect from influenza and other respiratory infections, while the use of respirators was not very common. A shortage of PPE was observed during outbreaks and pandemics, and healthcare workers followed many non-standard practices, such as extended use and reuse of facemasks and respirators.
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Conclusions: There is very little evidence on the use of PPE to protect from respiratory infections in Pakistan. Various policies and practices exist around on the use of PPE, which may be due to different recommendations by the World Health Organization and the United States Centers for Disease Control and Prevention. Further studies are recommended on the role of facemasks/respirators and other PPE in low-resource settings.

Keywords: Personal protective equipment, Influenza, Respiratory infections.

Characteristics of influenza patients and risk factors for death: retrospective analysis of sentinel surveillance data, Saudi Arabia, 2017

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Background: Influenza virus infection is a contagious respiratory infection that can be a major public health problem. In January 2017, sentinel-site surveillance for severe acute respiratory infections and influenza-like illnesses was started in Saudi Arabia in 11 hospitals and six primary health care centres.

Purpose: This study examined the characteristics of influenza cases identified through the sentinel surveillance system in 2017 (from January 1 to October 31), and identified the mortality predictors among positive cases.

Methodology: A retrospective analysis was conducted of cases of severe acute respiratory infection and influenza-like illness using data from the sentinel-site surveillance. Swabs were collected and tested from all cases meeting the definition of severe acute respiratory infection. Test results and characteristics of all cases were analysed.

Findings: During the study period, 273 confirmed influenza cases were identified, 73% of which were influenza A virus. About half (49%) of the cases were females and 57.5% were over 50 years of age. Of the 273 cases, 24% had diabetes mellitus and 15% had chronic heart disease. Death was recorded in 11% of the cases. Admission to the intensive care unit and history of chronic liver disease were significantly
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associated with death. Mortality was significantly associated with absence of fever at the time of hospital presentation among influenza A cases, and with history of diabetes and chronic lung disease in influenza B cases. In logistic regression analysis, absence of fever at hospital presentation and history of chronic liver disease were predictors of death in cases with influenza A. The cycle threshold value level was a predictor of death in influenza B cases.

Conclusions: Mortality risk for patients with influenza A may be elevated in the presence of history of chronic liver disease and absence of fever at hospital presentation. An increase in cycle threshold level could increase the risk of death in patients with influenza B. Further studies in larger samples should be conducted to further identify the mortality predictors.

Keywords: Sentinel surveillance, Influenza, Mortality, Saudi Arabia


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Background: Influenza-associated mortality varies depending on the circulating virus strain and host factors. It is important to identify high-risk groups to reduce influenza-related mortality.

Purpose: This study aimed to examine influenza-associated mortality in several countries of the Eastern Mediterranean Region (EMR) of the World Health Organization (WHO).

Methodology: Data were collected through sentinel surveillance programmes for severe acute respiratory infections (SARI) in 18 hospitals in Egypt, Jordan, Oman and Yemen from October 2007 to July 2017. Demographic and clinical information, and oropharyngeal and nasopharyngeal swabs were collected from hospitalized patients meeting the 2014 SARI case definition of WHO. Patients were followed up until they were discharged or died. Specimens were tested for influenza A and influenza B; influenza A viruses were subtyped using real–time polymerase chain reaction. Multivariable analysis was used to determine risk factors for influenza-associated mortality.
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Findings: A total of 40,718 patients were recorded in the sentinel SARI surveillance programme up to July 2017. Overall mortality of patients with SARI was 2.3% (939/40,718). The proportion of SARI patients testing positive for influenza was 13.9% (5,656/40,718) and 3.1% (177/5,656) of patients with influenza died. Of the 177 patients who died of influenza, 98 (55.4%) were males; the median age was 40 years (range 60 days–90 years) and 52.0% (92/177) had chronic diseases, the most frequent being endocrine diseases (18.6%). Influenza A(H1N1)pdm09 infection was the most common influenza subtype (n=121, 68.4%) among those who died, followed by influenza A(H3N2) (n=30, 16.9%) and influenza B (n=23, 13.0%). Multivariable analysis found that patients infected with influenza A(H1N1)pdm09 (OR=3.0, 95% CI: 2.84–9.00) and having chronic conditions (OR=2.65, 95% CI:1.81–3.88) had a higher risk of influenza-associated mortality.

Conclusions: The findings highlight certain risk factors associated with influenza-associated mortality which should be considered when planning influenza vaccination and treatment strategies.

Keywords: Influenza, Mortality, Risk factors, Eastern Mediterranean Region

Burden of ventilator-associated pneumonia and other hospital-acquired infections in a tertiary care hospital in Quetta, Pakistan

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Presenter: Farida Khudaidad Khan, Epidemiologist, Field Epidemiology and Laboratory Training Programme (FELTP), Provincial Health Directorate, Quetta, Pakistan

Background: Ventilator-associated pneumonia complicates the course of 8–28% of patients receiving mechanical ventilation. Pneumonia is considerably higher among patients hospitalized in intensive care units (ICUs). Mortality rates for ventilator-associated pneumonia range from 24% to 50% and can reach 76% when caused by high-risk pathogens. Pakistan currently has no national surveillance for hospital-acquired infections.

Purpose: This study determined the frequency of ventilator-associated pneumonia in patients in the ICU, and the relative proportion of hospital-acquired infections attributed to: ventilator-associated pneumonia, catheter-associated urinary tract infections and central line-associated bloodstream infections.

Methodology: An observational study was conducted in a tertiary care hospital in Quetta during March–June 2017. All patients over 16 years admitted to the ICU for >48 hours who developed a clinical infection that did not originate from his/her original diagnosis were included. Data were collected on ICU infrastructure, reason for admission, location of patient at admission to the ICU, co-morbidity, current interventions and presence of hospital-acquired infection.
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**Findings:** During the study period, 94 out of 315 (29.8%) patients in the ICU developed hospital-acquired infections. Ventilator-associated pneumonia was seen in 27 (28.7%), catheter-associated urinary tract infection in 35 (37.2%) and central line-associated bloodstream infection in 20 (21.2%) patients. Other infections identified were skin, soft tissue, wound and gastrointestinal tract infections in 12 (12.8%) patients. Mortality from ventilator-associated pneumonia was 66% (18/27) and from central line-associated bloodstream infection was 10% (2/20). No deaths occurred from urinary tract infections.

**Conclusions:** Patients admitted to the ICU were at greater risk of developing hospital-acquired infection than those admitted to general wards. The lack of nursing staff allows little time for the infection control measures, which may lead to an increased rate of hospital-acquired infections. Given the overall rate of hospital-acquired infections and high mortality due to ventilator-associated pneumonia, efforts are needed to reduce these through good nursing care, sterilization and disinfection of instruments and equipment, and careful handling of invasive procedures.

**Keywords:** Ventilator-associated pneumonia, Hospital-acquired infections, Pakistan

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**Influenza and influenza like illness in Qatar, January–December 2015: an analysis of data from the sentinel surveillance system**

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**Background:** Influenza contributes globally to the burden of infectious diseases by an annual increase in mortality rates of 40 to 50 million cases across the world. The risk groups are predominantly young children and the elderly. Qatar started its National Influenza Surveillance system in June 2010.

**Purpose:** This study determined the distribution of influenza virus infection in Qatar in the period January–December 2015.

**Methodology:** A retrospective epidemiological study was conducted based on national influenza surveillance data obtained from sentinel sites and the National Influenza Centre. For laboratory-confirmed cases, nasopharyngeal and/or oropharyngeal swabs were collected from eligible patients (standardized ILI case definitions) and samples were transferred for viral isolation by real-time polymerase chain reaction (RT–PCR) at the National Influenza Centre.

**Findings:** During the study period, 12 648 patients were included and tested by RT–PCR, of which 9 903 (78.3%) were positive for influenza. Among positive specimens, 3 250 (32.8%) were influenza A and
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Influenza B virus; 2,820 (86.8%) influenza A and 430 (13.2%) influenza B virus. Of the influenza A viruses, 2,219 (78.7%) were influenza A(H1N1)pdm09 and 601 (21.3%) were not subtyped. Influenza A and B virus infection was higher in the age group 18–49 years compared with all other age groups. Among those who tested positive, influenza A was higher among females (66.8%) than males (33.2%), and among Qataris (52.7%) than non-Qataris (47.3%). However, laboratory-confirmed influenza B virus infection was higher among non-Qataris (74.0%) than Qataris (26.0%) and this strain partially circulated among both males [258 (60.0%)] and females [172 (40.0%)].

Conclusions: Respiratory viruses play an important role in the etiology of influenza-like illnesses in Qatar, particularly in adults aged 18–49 years. Influenza A(H1N1)pdm09 viruses was the predominant strain reported from all health regions. Further characterization of the clinical and financial burden of influenza in Qatar is needed to support decisions on disease control activities.

Keywords: Influenza and influenza-like illness, Influenza A and B, Influenza A(H1N1)pdm09, National Influenza Centre, Qatar

Impact, epidemiology and clinical manifestations of respiratory syncytial virus in Oman

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Presenter: Hanan Alkindi, Senior Consultant, Head of Virology section, Central Public Health Laboratories, Muscat, Oman

Background: Respiratory syncytial virus (RSV) causes acute respiratory tract illness in people of all ages. Globally, it causes around 34 million episodes of acute lower respiratory infections in children younger than five years, with 3.4 million hospitalizations per year. New treatments are being researched, including immunoglobulin prophylaxis and an RSV vaccine. In Oman, more information is needed about the impact of RSV infection in the clinical setting, and therapy and outcomes to guide future treatment decisions.

Purpose: We aimed to study the impact of RSV infection in Oman and review the seasonality, epidemiology and clinical manifestations of RSV infection.

Methodology: This was a retrospective study of all RSV tests sent to the Central Public Health Laboratory (CPHL) between January 2013 and December 2014. In addition, the clinical presentation, risk factors and outcome details of hospitalized patients with RSV infection were collected from a tertiary care hospital (Royal Hospital) in Muscat for the same period. RSV testing for the Royal Hospital is done by the CPHL.
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**Seasonal influenza activity in Tunisia during 2016–2017**

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**Background:** Seasonal influenza is a highly contagious disease with a considerable socioeconomic impact in the world and in Tunisia. It is usually a minor illness but it may lead to serious complications, especially among vulnerable people. Surveillance and control of influenza require a global vision of the dynamics of the disease.

**Purpose:** The study aimed to describe the epidemiological situation of influenza in Tunisia in the 2016–2017 season and to compare it with 2015–2016 season.

**Methodology:** A descriptive analysis was conducted of data provided by the network of sentinel sites for influenza-like illness (ILI) and severe acute respiratory infection (SARI) and the National Influenza Centre during the 2016–2017 influenza season. Data were analysed using Epi Info, version 3.5.1.

**Findings:** Surveillance of influenza started from week 40/2016 (1 October 2016) to week 17/2017 (30 April 2017). During this season, 86 614 cases of ILI were recorded from 1 173 058 patients seen at ILI sentinel sites. This represented 7.4% of total patients compared with 6.9% in the 2015–2016 season. The influenza epidemic started from W1 (1 January 2017) and lasted 8 weeks compared with 14 weeks in the previous season. As for SARI cases, 52 were recorded during this season, compared with 41 in the previous season.

**Conclusions:** There is a clear seasonality for influenza, which is around October. Preventive and control measures targeting these risk groups before the season of influenza might be beneficial. Further studies should be conducted to evaluate the cost–effectiveness of such measures and the need for influenza surveillance.

**Keywords:** Influenza, Sentinel sites, Epidemiological surveillance, Tunisia, public health

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**Findings:** In the study period, 207 RSV cases were detected. The peak season was between September and November. Clinical review was available for 139 cases. The majority of the cases (96%) were under 5 years of age. Prematurity was the most common risk factor, found in 15.8% of cases. Cough, fever and tachycardia were the predominant signs and symptoms. Close to half (48%) of the cases required admission to the intensive care unit (ICU) and 17% were intubated. The mortality rate was 2.9%, with high-risk patients having the highest mortality.

**Conclusions:** There is a clear seasonality for RSV infection, which is around October. Prematurity was the main risk factor for RSV infection. The high-risk groups had longer ICU/hospital stay, higher mortality and worse outcomes. Preventive and control measures targeting these risk groups before the season of RSV infection might be beneficial. Further studies should be conducted to evaluate the cost–effectiveness of such measures and the need for RSV surveillance.

**Keywords:** Respiratory syncytial virus, Risk factors, Mortality, Oman
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season. The peak occurred in W3 (10.9%). All 24 governorates of the country were affected with higher rates in 5 regions: Jendouba (19.3%), Tataouine (17.5%), Tunis (12.3%), Kasserine (11.2%) and Gabes (11.1%). Children aged 5–16 years were the most affected followed by children under 5 years. Among ILI patients, 614 severe cases were hospitalized (0.7%). The majority of these severe cases were children (64%), mean age 13.5 years. The seasonal distribution of the types of influenza viruses was: influenza A(H1N1)pmd09: 0.2%, A(H3N2): 6.2%, and influenza B: 5.8%. The co-circulation of these three types began in late December 2016. The positivity rate for influenza virus was 12.8% compared with 24.4% in the previous season.

Conclusions: The 2016–2017 influenza activity was moderate and the influenza epidemic was shorter than the previous season. Virological analysis showed that Influenza A(H3N2) virus predominated. However, the positivity rate was low, thus there is a need to strengthen laboratory capacity, especially at the regional level, and raise awareness of epidemiologists about the importance of influenza surveillance.

Keywords: Sentinel surveillance, Influenza, Tunisia

Association between breastfeeding and acute respiratory infections in children under 2 years of age, Islamabad, Pakistan

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Presenter: Mumtaz Ali Khan, Senior Scientific Officer/Epidemiologist, National Institute of Health, Islamabad, Pakistan

Background: Breastfeeding provides significant protection against infections in new-borns and infants. It is estimated that an increase in breastfeeding worldwide by 40% would reduce deaths from respiratory infection by 50% in children under 18 months of age. Adequate data are lacking on respiratory infections in infants in Pakistan.

Purpose: This study aimed to examine the association between breastfeeding and respiratory infection in the children under 2 years of age in Islamabad, Pakistan.

Methodology: A cross-sectional study was conducted of children under 2 years of age attending the Federal Government Hospital, Islamabad in February 2016. Children aged 60 days to 2 years with symptoms of respiratory infections were included. A pretested questionnaire was used to collect information from mothers about feeding practices and history of episodes of acute respiratory infection (ARI) in the previous month.

Findings: A total of 500 children were examined and a convenience sample of 155 children were selected according to the inclusion criteria; 24 declined to participate (84% response rate). Of the 131 children
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enrolled, 130 had complaints compatible with an ARI; 38 had had at least 2 episodes of respiratory tract infection in the previous month, while 93 had had 1 episode of ARI. Of the 130, 76 were males while 55 were females. The mean age of the children was 1.6 years. Of the 130 enrolled cases, 61 (47%) were exclusively breastfed for their first six months, 56 (43%) bottle-fed and 13 (10%) had mixed feeding. Among the 38 children with at least 2 respiratory tract infections in the previous month, 4 (10%) were breastfed and the rest were either bottle-fed or had partial breastfeeding. Of the 61 breastfed children, only 5 (8%) had had recurrent episodes of respiratory tract infections in the previous month, while 32 of the 56 (57%) bottle-fed children had had recurrent episodes.

Conclusions: Efforts should be made to encourage women in Islamabad to exclusively breastfeed their babies for at least six months and continue partial breastfeeding for up to two years.

Keywords: Acute respiratory infection, Infants, Breastfeeding, Pakistan

Implementing the Pandemic Influenza Preparedness framework in the Eastern Mediterranean: a two-year review report

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Background: The Pandemic Influenza Preparedness (PIP) framework was developed by the World Health Organization (WHO) in 2007 in response to the risk of an imminent influenza pandemic. It was unanimously adopted by the World Health Assembly in 2011, with a multi-faceted Partnership Contribution Plan 2013–2016 developed to guide implementation. The framework includes components such as virus sharing, benefit sharing and governance. Between 2014 and 2016, the PIP framework was implemented in seven countries in the Eastern Mediterranean Region.

Purpose: The aim of this report is to detail the activities carried out in the seven countries during the period 2014–2016 as part of PIP implementation, highlighting progress against key deliverables, financial expenditure and influenza cases reported.

Methodology: Data were collected from the countries by the WHO Regional Office for the Eastern Mediterranean. FluNet data were extracted from the FluMart websites.

Findings: Promising progress was made for deliverables related to the sharing of epidemiological information (via the EMFLU platform), the strengthening of national influenza centre/influenza laboratories and the reinforcement of disease surveillance throughout the Region. Financial contributions towards
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Implementation from the WHO Regional Office rose from US$ 335 000 in 2014 to US$ 849 000 in 2016, with three of the seven countries (Afghanistan, Egypt and Lebanon) spending PIP funds during 2014, 2015 and 2016. The number of specimens positive for influenza peaked during the winter season, i.e. the end of 2015 and beginning of 2016. Challenges faced include lack of political commitment, inadequate infrastructure, and issues with capacity and implementation.

Conclusions: The countries have made progress in putting the infrastructure in place and building robust sustainable systems which cater to local needs. The WHO Regional Office and the individual countries must continue to strengthen and maintain influenza surveillance, enhance regional and in-country partnerships, and take steps to build capacity and further PIP implementation.

Keywords: Influenza, Pandemics, Public health, Disease outbreaks, Eastern Mediterranean region

Factors associated with severity of respiratory viral illnesses in hospitalized Jordanian children

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Background: Data on the seasonality, burden and epidemiology of respiratory viruses in the Middle East are sparse and urgently needed. Moreover, the severity of illness and virus-specific infection rates associated with acute respiratory illnesses in the region are poorly defined.

Purpose: This study investigated the viruses detected in Jordanian children hospitalized with acute respiratory illnesses and the factors associated with severity of illness.

Methodology: A three-year prospective viral surveillance study was conducted in Jordanian children under 2 years of age hospitalized with acute respiratory illnesses between 16 March 2010 and 31 March 2013. The infection rates and risk factors for severe illness, i.e. oxygen use, mechanical ventilation, intensive
care unit admission, length of stay and death, were assessed. Nose and throat swabs were tested for 11 respiratory viruses with polymerase chain reaction, and vitamin D levels were measured.

Findings: A total of 3 168 children were hospitalized with acute respiratory illnesses in the three-year period. The median age was 3.5 months, 60% were male, 77% had been exposed to tobacco smoke, 82% had viruses detected and 12% were diagnosed with pneumonia at admission. While hospitalized, 32% of the children received supplemental oxygen therapy, 9% were admitted to the intensive care unit, 4% were placed on mechanical ventilation, and 31 children died. Respiratory syncytial virus was the most common virus detected (found in 44% of the children) and was associated with more severe illness compared with other viruses. Oxygen use was associated with younger age, lower gestational age, lack of breastfeeding, lower vitamin D levels, having an underlying medical condition, viral detection, female sex and pneumonia diagnosis. Young age, underlying medical condition and pneumonia diagnosis were risk factors for all the markers of illness severity. Hospitalization rates for the different viruses ranged from 0.5 to 10.5 per 1 000 children.

Conclusions: Respiratory viruses, especially respiratory syncytial virus, are associated with severe disease in young, hospitalized Jordanian children. Prevention strategies such as infant and maternal influenza vaccination, breastfeeding promotion, vitamin D supplementation, elimination of indoor cigarette and hookah pollution, widespread introduction of pneumococcal vaccine in the region, and future respiratory syncytial virus vaccines could reduce the regional burden of acute respiratory illness.

Keywords: Acute respiratory illness, Viruses, Risk factors, Jordan
Insights into the current situation of avian influenza H9N2 viruses circulating in Egypt

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Background: The endemicity of avian influenza viruses in Egyptian poultry represents a public health risk. Co-circulation of low pathogenic avian influenza virus H9N2 subtype with highly pathogenic avian influenza H5N1 and H5N8 subtypes in Egypt provides a possibility to generate new reassortant viruses.

Purpose: This study evaluated the genetic and antigenic characteristics of avian influenza H9N2 viruses circulating in Egypt between 2011 and 2016.

Methodology: The genetic characteristics of surface glycoproteins of Egyptian H9N2 viruses, isolated between 2011 and 2016 during active surveillance of avian influenza viruses in poultry in Egypt, were analysed. To elucidate the potential of genetic reassortment, 12 H9N2 isolates were selected based on different avian hosts, and phylogenetic analyses of their full genome sequences were conducted. Additionally, antigenic analysis was done to further investigate the antigenic evolution of H9N2 viruses isolated during 2011–2016. Different viral characteristics, including receptor-binding affinity of representative Egyptian H9N2 viruses, were further investigated.

Findings: The surface glycoproteins of current Egyptian H9N2 viruses are closely related to viruses of the G1-like lineage isolated in Egypt. Several genetic markers that enhance virulence in poultry and transmission to humans were detected. Analysis of the full genome of 12 H9N2 isolates indicated that recent H9N2 isolates inherited five internal genes from Eurasian avian influenza viruses circulating in wild birds. Antigenic conservation of different Egyptian H9N2 isolates from chickens, pigeons and ducks was observed, whereas quail isolates showed antigenic drift. The Egyptian H9N2 viruses preferentially bound to the human-like receptor rather than the avian-like receptor.
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Conclusions: The results suggest that the endemic H9N2 viruses in Egypt contain elements that may favour avian-to-human transmission and thus represent a public health risk.

Keywords: Avian influenza viruses, H9N2, Reassortant, Antigenic analysis, Egypt

One Health Framework for Action for the WHO Eastern Mediterranean Region, as applied to avian influenza

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Background: Emerging infectious diseases have a considerable impact on health. Of all the emerging infectious diseases of humans, 75% are zoonotic. Controlling zoonotic pathogens at their animal source is the appropriate way to protect people. The global response to emerging viruses has been inadequate, and a growing transdisciplinary community has called for a more comprehensive approach to prevention and preparedness, namely “One Health”. Countries of the World Health Organization Eastern Mediterranean Region face the same threats as any other region. However, there are many challenges in this region because of the shortage of accurate data, the lack of continuous systematic surveillance, economic restrictions, conflict and political instability, and weak intersectoral national policies, strategies and programmes. Hence, adoption of the One Health approach in this region is urgently needed.

Purpose: This paper describes the development of a framework for action on the emergence of zoonotic viruses and a logistical framework for its implementation which was tried out with avian influenza.

Methodology: A systematic review was conducted in January 2017 of grey and peer-reviewed published literature on One Health with a focus on the Eastern Mediterranean region. Based on the review, a nine-component framework for action on implementing the One Health approach was developed. The components were then integrated within a logistical framework designed for practical implementation. Avian influenza was used as an example of how to use the framework to address a specific disease.

Findings: One Health activities currently ongoing in the region are sparse. A comprehensive communication plan for the One Health Framework was prepared and applied to avian influenza.
Abstracts

**Conclusions:** The One Health framework for action and its logistical framework are useful in planning for and response to avian influenza and other emerging infectious diseases.

**Keywords:** One Health, Emerging viruses, Avian influenza, Eastern Mediterranean region.

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**Outbreak of avian influenza in backyard poultry, ducks and geese in a periurban area of Abbottabad, Khyber Pakhtunkhawa Province, Pakistan**

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**Background:** Avian influenza viruses are responsible for respiratory disease in commercial poultry as well as in domestic and wild birds across the world. Among the influenza viruses, serotypes H5 and H7 are particularly important because of the potential for mutation in their viral genome which has caused high mortality in all types of avian species. Geese and ducks also raised as backyard birds are natural hosts to a variety of avian influenza virus subtypes. In April 2017, high morbidity and mortality was seen in geese and ducks and other domestic poultry in areas of Nawan Sher, Abbottabad, Pakistan.

**Purpose:** The aim of this study was to investigate the cause of the high mortality in backyard poultry, geese and ducks in Nawan Sher, a periurban area of Abbottabad.

**Methodology:** An outbreak investigation was carried out in Nawan Sher. A comprehensive cross-sectional survey was conducted and samples of tissues/swabs from dead birds and cloacal/oral swabs from live birds were collected and submitted for diagnosis to the National Reference Laboratory for Poultry Diseases, Islamabad.

**Findings:** Geese, ducks and domestic poultry raised in backyards in Abbottabad and surrounding areas live in close proximity to the human population and other domestic animals in the urban and periurban areas of Abbottabad. The overall morbidity rate [(no. animals manifesting the disease/no. animals at risk) × 100] was 100% in all species of domestic poultry, geese and ducks, while mortality rate was 100%, 84% and 75% in domestic poultry, ducks and geese respectively. Post-mortem findings showed involvement of lungs, trachea and gastrointestinal tract. Sneezing and clinical flu-like symptoms were seen with some torticollis and lameness also. Influenza-like symptoms were also observed in some humans in the area and in domestic and wild animals. Involvement of highly pathogenic avian influenza H5 or H7 was suspected.
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clinically. However, the laboratory confirmed only the presence of low pathogenic avian influenza H9 along with some Newcastle disease virus in the samples submitted. None of the samples was confirmed for H5 or H7 avian influenza types.

Conclusions: Mortality in backyard poultry, geese and ducks was due to respiratory illness caused by a mutant type of H9 avian influenza virus and Newcastle disease virus in Abbottabad.

Keywords: Avian influenza, Outbreak, Poultry, Pakistan

Seroprevalence of avian influenza H9 virus in poultry-shop workers and customers in Rawalpindi, Pakistan

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Background: Influenza A viruses are responsible for respiratory infections in avian species and have the potential to infect other mammalian species, including humans. Mild respiratory tract infections from avian influenza H9 virus have been previously reported in Pakistan. Avian influenza H9 viruses can become virulent through antigenic drift or shift.

Purpose: This study aimed to estimate the seroprevalence of avian influenza H9 virus in workers in poultry shops and customers visiting poultry shops and create awareness among the general public as well as poultry shop workers about avian influenza H9 virus.

Methodology: Poultry shops dealing with live commercial broiler and native backyard breeds in Rawalpindi were identified. Sample size was calculated assuming a 46.6% seroprevalence of avian influenza H9 virus based on similar published studies in Pakistan. With the consent of the participants, serum samples and epidemiological information were collected from shop owners, shop slaughterers, shop cleaners, van drivers, van helpers/loaders and customers visiting the shops. A total of 383 serum samples were collected from 64 locations of Rawalpindi. Antibody titre against avian influenza H9 virus was determined with the haemagglutination inhibition test. Frequencies were calculated and odd ratios were determined to estimate the probability of seropositivity.
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Findings: Avian influenza H9 virus seroprevalence was highest among poultry shop cleaners (9.6%) followed by slaughterers (9.5%), van helpers/loaders (5.0%), van drivers (3.2%), shop owners (2.7%) and customers (2.4%). Personnel with direct contact with birds were more likely to be seropositive for avian influenza H9 virus than those with indirect contact (OR=4.63, 95% CI: 1.699–12.598, \( P = 0.001 \)).

Conclusions: People in direct contact with birds were more likely to be infected. The presence of avian influenza H9 virus in humans in Rawalpindi suggests its presence across the country. The seroprevalence of avian influenza H9 virus in poultry shop workers and customer reported here is lower than previously reported seroprevalence in poultry farm attendants in Pakistan.

Keywords: Avian influenza H9 virus, Prevalence, Poultry shops, Pakistan

Successful experience of Saudi Arabia in controlling highly pathogenic avian influenza

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Background: Highly pathogenic avian influenza (HPAI) in commercial poultry farms was identified for the first time in Saudi Arabia in November 2007. The epidemic was caused by HPAI virus subtype H5N1. A total of 19 outbreaks were identified in different kinds of poultry farms (2 broiler breeders, 1 layer breeder, 15 layer and 1 ostrich) in four governorates in Riyadh area. However, no human cases of H5N1 have yet been recorded in Saudi Arabia.

Purpose: This paper shares the successful experience and measures taken by Saudi Arabia in controlling HPAI in poultry.

Methodology: We studied 19 farms which had high mortality during highly pathogenic avian influenza (H5N1) outbreak in poultry from November 2007 to January 2008. A case of a confirmed HPAI (H5N1) infected farm was based on a positive laboratory result using real-time reverse transcriptase polymerase chain reaction. A standardized questionnaire was designed and used to collect information about the poultry farm, including date of the start of the disease, type of production, mortality and morbidity.

Findings: According to the national emergency and preparedness plan for HPAI, vaccination against the disease was prohibited in Saudi Arabia. Therefore, the control strategy for the outbreaks was based mainly on a “stamping out” policy. Thus, 4 749 597 birds in infected poultry farms or in farms located within a
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5-km radius of the infected farm and 849,094 backyard birds were hygienically destroyed. Other control measures included: closure of live bird markets; movement controls and intensive surveillance of the disease; strict biosecurity measures, including proper cleaning and disinfection of infected farms and the placement of sentinel birds to detect the potential presence of the virus in the cleaned and disinfected farms. Compensation, which is a key measure to encourage farm owners to promptly report any suspected case of HPAI, was paid to farm owners for the birds culled during the outbreak at 80% of the market price based on the animal resources regulations. After the outbreak was resolved, monitoring of avian influenza virus continued on a regular basis through testing imported live birds and hatching eggs, surveillance of the disease in live birds markets and wild birds, and inspecting commercial poultry farms to detect any cases of avian influenza.

Conclusions: The efficient preparedness and rapid planned response to the outbreaks allowed the successful control and eradication of the disease within 3 months. Saudi Arabia was declared free of HPAI on 30 April 2008 according to the recommendations of the World Organisation for Animal Health and has remained free until now. Continuous monitoring of the disease has helped to maintain the HPAI-free status of the country for 10 years since its first introduction in 2007.

Keywords: Highly pathogenic avian influenza, H5N1, Saudi Arabia.
Thematic area: **Vaccine**

**Efficacy of the 9-valent pneumococcal conjugate vaccine against radiographically-confirmed pneumonia among children under and over 24 months of age in South Africa**

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**Background:** *Streptococcus pneumoniae* (pneumococcus) is a leading cause of death in children under 5 years. The HIV/AIDS epidemic in sub-Saharan Africa contributes substantially to the pneumonia burden in the region. Vaccination against pneumococcus is a practical and cost-effective option to overcome some of the difficulties related to factors that facilitate the occurrence of pneumococcal disease.

**Purpose:** The aim of this study was to assess the persistence of efficacy of the 9-valent pneumococcal conjugate vaccine (PCV9) against radiographically-confirmed pneumonia in children over 24 months of age compared with children under 6 months and between 6 and 24 months of age in South Africa.

**Methodology:** The study was an analytic cohort study using secondary data from a randomized controlled trial of PCV9 from the Respiratory and Meningeal Pathogens Research Unit, University of the Witwatersrand, South Africa. STATA and Epi Info software programs were used in the analysis.

**Findings:** A total of 3,700 PCV9 trial participants, who had chest X-ray records, were the cohort of the study. Overall PCV9 efficacy against radiographically-confirmed pneumococcal disease was 7%. PCV9 was more efficacious against radiographically-confirmed pneumonia in the children aged 6–24 months (21%) than in those under 6 months (0%) and over 24 months (−5%). Partial PCV9 vaccination was more efficacious against radiographically-confirmed pneumonia than a full vaccination course (given at 6, 10 and 14 weeks of age); however, the association between partial and complete vaccination and radiographically-confirmed pneumonia was not statistically significant. HIV infection profoundly affected the efficacy of PCV9 in all age groups. Other factors associated with radiographically-confirmed pneumonia were clinical pneumonia, more than 2 previous pneumonia admissions and the presence of pneumonia predisposing factors, such as ventricular septal defect, chronic lung disease, prematurity or post-maturity.
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**Conclusions:** PCV9 vaccination had limited efficacy against radiographically-confirmed pneumonia. However, it was more effective in children aged 6–24 months. Partial vaccination was more efficacious than a full course. Adoption of 2 primary doses of PCV9 with 1 booster dose, in-depth studies to investigate the factors that affect PCV9 efficacy, raising awareness about the potential effect of these factors on radiographically-confirmed pneumonia and improvement of HIV/AIDS interventions are recommended.

**Keywords:** PCV9, Radiographically-confirmed pneumonia, HIV/AIDS, Vaccine efficacy, Randomized controlled trial, South Africa

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**Decline in child mortality after the introduction of the pneumococcal conjugate vaccine in Morocco**

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**Background:** In Morocco, acute lower respiratory infection (ALRI) is a major cause of death in children under 5 years. The 10-valent pneumococcal conjugate vaccine (PCV) was introduced in the national immunization programme in 2010 and was generalized to the whole country in 2011. The vaccination consists of 3 injections at 2 months, 4 months and 12 months.

**Purpose:** The objective of this study was to analyse the effect of the introduction of the PCV vaccine on the reduction in mortality from respiratory infections in children under 5 years in Morocco.

**Methodology:** Data of child mortality cause from 2007 to 2013 were collected from the child mortality database at the Directorate of Planning and Financial Resources after authorization of the Director. Child mortality rates from respiratory infections from 2007 to 2013 were analysed using an interrupted time series analysis based on a Poisson regression with over-dispersion correction and introducing an offset term equal to the log of the population divided by 100 000. Mortality rates from congenital and chromosomal causes were also analysed for comparative purposes.
Abstracts

Results: A total of 1,334 deaths from respiratory causes and 1,992 deaths from congenital and chromosomal causes occurred in children under 5 years in Morocco from 2007 to 2013. In the post-vaccination period, the overall mortality rate from respiratory causes in children under 5 years decreased significantly by 28% [incidence rate ratio (IRR) = 0.72, 95% CI: 0.58–0.83]. When stratified by age, mortality from respiratory causes decreased significantly by 30% (IRR = 0.70, 95% CI: 0.50–0.98) in children under 1 year, while in children aged 1–5 years, the decrease was not statistically significant (IRR = 0.99, 95% CI: 0.91–1.08). However, child mortality rates from congenital and chromosomal causes were stable in the post-vaccination period in children under 5 years (IRR = 1.19, 95% CI: 0.97–1.48), under 1 year (IRR = 1.15, 95% CI: 0.94–1.40) and in children aged 1–5 years (IRR = 1.19, 95% CI: 0.97–1.48), as the observed trends were not statistically significant.

Conclusions: The decrease in child mortality rates from respiratory causes in the post-vaccination period supports vaccine effectiveness in the prevention of respiratory infections in children under 5 years in Morocco.

Keywords: Pneumococcal conjugate vaccine, Child mortality, Interrupted–time–series analysis, Morocco
Abstracts

ORAL PRESENTATIONS

Thematic area: Virology

Mutation analysis of the neuraminidase gene of influenza A(H1N1)pdm09 in Tunisia between 2009 and 2017 seasons

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Background: Neuraminidase proteins are produced from the outer surface of influenza virions and are key determinants of the molecular epidemiology of the virus because they interact most actively with the immune systems of vertebrate hosts. The 2009 influenza pandemic provided an opportunity to observe dynamic changes of neuraminidase proteins of pandemic H1N1 strains, which have spread in Tunisia during seven seasons from 2009 to 2017 (except for 2011–2012).

Purpose: This study assessed mutations in the neuraminidase gene of influenza A(H1N1)pdm09 isolated in severe and fatal cases in Tunisia and their effect on the resistance of the virus to antiviral medicines.

Methodology: Reverse transcription–polymerase chain reaction (RT-PCR) was used on 55 extracted viral RNA samples to amplify the partial full length of the NI gene (836 nucleotide residues). In addition, RT-PCR assays were conducted in our laboratory and the World Health Organization collaborating centre in London in order to get the full length of the NI gene. The resulting PCR products were subjected to direct sequencing.

Findings: One virus out of the 55 isolated in 2013 had the mutation H275Y that confers resistance to oseltamivir and all these viruses remained sensitive to zanamivir. Using phylogenetic analysis of neuraminidase sequences, the 55 viruses fell in clade 6B and subclade 6B.1. Some viruses isolated in 2016 formed small groups of three or four viruses carrying out amino acid substitutions of V81I, V394I, D416G, A138T and Q64H.
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Conclusions: As oseltamivir is key to preparedness for and treatment of pandemic H1N1, the potential for resistance to oseltamivir is an ongoing concern. Reassortment and, more likely, point mutations have the potential to create a strain of pandemic H1N1 against which we have a reduced number of treatment options. We expect to test more strains in the future to evaluate diffusion of other mutations related to oseltamivir resistance.

Keywords: Neuraminidase, Mutation, Influenza A(H1N1)pdm09, Oseltamivir, Tunisia

Frequencies of mutations conferring resistance against adamantanes and neuraminidase inhibitors in human influenza A viruses in the Eastern Mediterranean Region

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Background: Two classes of antiviral drugs are available for influenza antiviral therapy: adamantanes and neuraminidase inhibitors. Because of the emergence of adamantane (M2)–resistant variants, the use of these drugs has been largely limited and neuraminidase inhibitors have become the drugs of choice for treatment of influenza A infections. However, amino acid substitutions in the neuraminidase protein might lead to reduced sensitivity of influenza A viruses to neuraminidase inhibitors.

Purpose: This study investigated the frequency and distribution of M2 and neuraminidase mutations in resistant influenza variants circulating in the Eastern Mediterranean region (EMR) between 2005 and 2016.

Methodology: We analysed a total of 314 M2 and 1 209 neuraminidase protein sequences from influenza A(H1N1), A(H1N1)pdm09, A(H3N2) and A(H5N1) that were reported to the database of EMR countries.

Findings: Most (85.7%) of the influenza A viruses circulating in the Eastern Mediterranean region were resistant to adamantanes, with A(H3N2) strains showing the highest (95.3%) level of adamantane resistance. Almost all resistant viruses (99.2%) had the S31N substitution in their M2 sequences. The V27A mutation was the only amino acid change found in A(H5N1) viruses and was detectable in 7.4% of the viruses investigated. L26F, A30T, G34E and L38F mutations were not detected in any of the resistant
Abstracts

Surveillance and molecular characterization of influenza viruses circulating in Casablanca, Morocco from 2013 to 2017

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Background: Influenza viruses are a major cause of acute respiratory infections and a public health problem that causes high morbidity and mortality and an economic burden. Therefore, surveillance and molecular characterization of influenza viruses remains a crucial tool of both preventive and curative control.

Purpose: The objectives of this study were the identification and molecular characterization of human influenza viruses circulating in Casablanca, Morocco from seasons 2013–2014 to 2016–2017.

Methodology: A total of 714 nasopharyngeal samples from outpatients with clinical influenza-like illness from health care units and private clinics were collected from week 45/2013 to week 42/2017. All samples were analysed by real-time polymerase chain reaction targeting the hemagglutinin and neuraminidase genes. Positive samples for influenza viruses were inoculated on MDCK (Madin–Darby canine kidney) cell line for virus isolation followed by nucleotide sequencing.

Findings: Of the 714 samples, 251 (35.2%) were positive for influenza viruses. Influenza A viruses were detected in 184 (73.3%) influenza samples, of which 65 (35.3%) were influenza A(H1N1)pdm09 and 112 (60.9%) were influenza A(H3) subtype. Influenza B virus was detected in 67 (26.7%) influenza samples. Seasonal A(H3N2) was the predominant circulating strain in 2013–2014, 2014–2015 and 2016–2017, while pandemic influenza A(H1N1)pdm09 was the predominant circulating strain in 2015–2016. The predominant strain of influenza B during 2014–2015 was the B/Yamagata recommended in influenza trivalent vaccines.

Conclusions: This comprehensive study emphasizes the importance of enhancing and continuing monitoring of resistance among influenza A viruses in the EMR and the effectiveness of antiviral medications against these viruses.

Keywords: Influenza A viruses, Antiviral resistance, Eastern Mediterranean region

variants. Of the reported neuraminidase sequences from influenza A viruses, 2.8% (34/1 209) had at least one resistance mutation to neuraminidase inhibitors, and 79.4% (27/34) of resistant viruses had the H274Y mutation. The frequency of resistant viruses was 3.3% (24/729) for the A(H1N1)pdm09, 10.6% (5/47) for seasonal H1N1 and 4.1% (5/123) for A(H5N1) viruses. No resistant A(H3N2) virus was detected.

Conclusions: This comprehensive study emphasizes the importance of enhancing and continuing monitoring of resistance among influenza A viruses in the EMR and the effectiveness of antiviral medications against these viruses.

Keywords: Influenza A viruses, Antiviral resistance, Eastern Mediterranean region
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Compared with 2015–2016, influenza B/Victoria lineage was detected but not included in the trivalent influenza vaccines, which are the most widely used in Casablanca. Based on the phylogenetic analysis of nucleotide and amino acid sequences of the haemagglutinin gene, influenza A (H1N1)pdm09 and influenza A (H3N2) isolates were closely related to the vaccine viral strains during the study period.

Conclusions: The findings confirm the variability of influenza strains circulating from one season to another. The continuous monitoring and molecular characterization of influenza viruses is an essential tool for understanding their epidemiological and virological characteristics and their match with seasonal vaccine strains.

Keywords: Influenza viruses, Molecular characterization, Vaccine viral strains, Morocco

Bacteria isolated from patients with nosocomial pneumonia in the intensive care unit of a secondary care hospital in Saudi Arabia, and their antibiotic susceptibility patterns

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Background: Nosocomial pneumonia is the most common infection acquired in the hospital with the highest prevalence in intensive care units (ICUs). Antimicrobial resistance is an important factor in predicting outcomes and resources used in ICUs. Globally ICUs are facing the emergence and spread of antibiotic-resistant pathogens, and for some pathogens there are few therapeutic options available.

Purpose: The objective of this study was to evaluate the bacterial spectrum from patients with nosocomial pneumonia in intensive care units of a secondary care hospital in Saudi Arabia, and their antibiotic susceptibility patterns.

Methodology: This prospective, descriptive study was carried out at the Department of Microbiology, King Abdullah Hospital in Bisha from June 2011 to May 2012. Lower respiratory tract samples were obtained from suspected cases of nosocomial pneumonia in the ICU. The specimens were cultured on appropriate media. The identification of bacteria and susceptibility testing were done by using BD Phoenix™ Automated Microbiology system. In vitro antibiotic susceptibility patterns were analysed using WHONET software.

Findings: A total of 301 clinical isolates were analysed. The frequencies of Gram-positive and Gram-negative bacteria were 16% and 84% respectively. Acinetobacter, Klebsiella and Pseudomonas species were the most common Gram-negative isolates, while methicillin-sensitive Staphylococcus aureus (MSSA) and methicillin-resistant S. aureus (MRSA) were the main Gram-positive isolates. Most (79%) isolates
of *Acinetobacter* species were resistant to carbapenem, while three were resistant to all the antibiotics tested. Extended-spectrum beta-lactamase–producing *K. pneumoniae* accounted for 28% of all *Klebsiella* species isolated and 24% of *Pseudomonas* species were resistant to ceftazidime.

**Conclusions:** The high prevalence of reduced antibiotic susceptibility among Gram-negative bacteria in the ICU units suggests that more effective strategies are needed to control the selection and spread of resistant organisms. Empirical antibiotic therapy of nosocomial pneumonia in critical patient areas should be based both on evidence-based guidelines and on local data about antibiotic susceptibility patterns.

**Keywords:** Drug resistance, Susceptibility patterns, Nosocomial pneumonia, Saudi Arabia

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**Detection of adenoviruses in children under 5 years with severe acute respiratory infections in the National Influenza Center, Islamic Republic of Iran**

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**Background:** Acute respiratory tract infections are associated with significant morbidity and mortality in children worldwide, especially in developing countries. Most of these cases are due to viral infections; human adenoviruses (HAdVs) are among the main contributing pathogens. HAdV respiratory infections can cause a wide range of symptoms from mild to severe, and can be fatal diseases, even in previously healthy children.

**Purpose:** The aim of this study was to detect HAdV in respiratory samples from children under 5 years with severe acute respiratory infection (SARI).

**Methodology:** This cross-sectional study was conducted between December 2013 and August 2014. A total of 200 respiratory samples (throat swabs and nasal washes) were collected from children under 5 years with SARI at the National Influenza Center, School of Public Health, Tehran University of Medical Sciences. A semi-nested polymerase chain reaction with self-designed primers for HAdV was used for all samples.

**Findings:** Among the 200 respiratory samples, HAdV was detected in 71 (35.5%). All positive samples were analysed by sequencing and a phylogenetic tree was drawn. Information on clinical characteristics showed that common symptoms associated with HAdV infections were cough, fever and sore throat. Demographic information was also analysed. Among suspected cases, males accounted for 68%; similarly in HAdV–confirmed cases, 66.2% were male. The greatest number of both suspected and confirmed cases
Molecular characterization of circulating respiratory syncytial virus genotypes in Pakistani children, 2010–2013

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Background: Data on the viral etiology of acute lower respiratory infections are scarce in Pakistan. Human respiratory syncytial virus (RSV) is a significant cause of morbidity in children but no efficacious vaccine or antiviral therapy is currently available. As vaccines are expected to become available in the future, it is important to understand the epidemiology of locally prevalent RSV subtypes.

Purpose: This study aimed to define the molecular epidemiology of RSV (A & B) genotypes in Pakistani children under five years infected during 2010–2013.

Methodology: The standard World Health Organization case definitions for influenza-like illness (ILI) and severe acute respiratory illness (SARI) were used for case selection. Patients under 5 years of age presenting with ILI/SARI at major tertiary care hospitals were enrolled from all provinces/regions, including the eight influenza sentinel sites. Demographic and clinical data of the selected children were collected and nasopharyngeal/throat swabs were taken for analysis. All samples were tested for RSV (A & B) using real-time polymerase chain reaction (United States Centers for Disease Control and Prevention) for non-influenza respiratory viruses. RSV-A and RSV-B specific oligonucleotide primers were used for subtype detection and sequencing of the G and F proteins, followed by phylogenetic analysis.

Findings: A total of 1 941 samples were included from children aged < 5 years presenting with upper and/or lower respiratory tract infections from October to April each year between 2010 and 2013. RSV was detected in 472 (24%) children, with RSV-A detected in 367 (78%) and RSV-B in 105 (22%). The G protein of all RSV-A strains clustered in the NA1/GA2 genotype while RSV-B strains carried the signature 60-nucleotide duplication and were assigned to three BA genotypes: BA–9, BA–10 and the new BA–13 genotype. Detailed analysis of the F protein in RSV–A isolates at the binding sites for the monoclonal antibodies palivizumab
and motavizumab showed that the N276S substitution was present in over 90% of the analysed RSV-A viruses and all the RSV-B (natural mutation) viruses.

Conclusions: This study highlights the significance of RSV as a dominant viral etiologic agent of acute respiratory infections in children in Pakistan, and the need for further studies on the incidence of viral pneumonias and their impact on public health.

Keywords: Respiratory syncytial virus, Molecular analysis, Children, Pakistan

Molecular epidemiology of influenza A(H1N1)pdm09 during the post-pandemic period in Pakistan

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Background: Pandemic influenza A(H1N1) virus was first detected in Pakistan in June 2009 and continued to circulate causing considerable morbidity and mortality.

Purpose: This study aimed to characterize influenza A(H1N1)pdm09 viruses circulating in the post-pandemic period in Pakistan and their relevance to the current vaccine viruses.

Methodology: Respiratory specimens were collected from patients with influenza-like illness and severe acute respiratory illness across Pakistan. Samples were tested by real-time polymerase chain reaction following the protocol of the United States Centers for Disease Control and Prevention. Representative Pakistani isolates were used in phylogenetic analysis of haemagglutinin and neuraminidase genes.

Findings: During 2009-2016, influenza A was isolated from 1 870 of 14 086 (13.3%) specimens. During the pandemic period (2009–2010), influenza A(H1N1)pdm09 was the dominant strain with 366 (45%) of total influenza positives. In the post-pandemic period (2011–2016), a total of 1 066 (59.6%) specimens were positive for influenza A(H1N1)pdm09 with co-circulation of different influenza A subtypes. Overall, influenza A(H1N1)pdm09 viruses in Pakistan belonged to two genetic clades; to clade 7 only during the pandemic period and to clade 7 (2011) and clade 6B (2015-2016) in post-pandemic years. Amino acid analysis of the haemagglutinin gene showed mutations at positions S220T, I338V and P100S, reported to be associated with outbreaks in all the analysed strains. Sequence analyses of post-pandemic A(H1N1)pdm09 viruses showed additional substitutions at antigenic sites S179N, K180Q (SA), D185N, D239N (CA), S202T (SB), and at receptor binding sites A13T and S200P compared with the pandemic period. Analysis of neuraminidase gene showed outbreak markers, V106I (23%) in pandemic and N248D (100%) in post-pandemic Pakistan viruses.
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Conclusions: Influenza A(H1N1)pdm09 viruses in Pakistan clustered in two genetic clades, with co-circulation of some variants. Certain key substitutions in the receptor binding site and a few changes indicative of virulence were also detected in post-pandemic strains. Therefore, it is imperative to continue monitoring the viruses for early identification of potential variants of high virulence or emergence of drug-resistant strains.

Keywords: Molecular epidemiology, Influenza A(H1N1)pdm09, Pakistan
Abstracts

POSTER PRESENTATIONS

Thematic area: Epidemiology

Burden of influenza virus infection in hospitalized and well infants in Jordan, November 2015–April 2016 and November 2016–May 2017

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Background: Acute respiratory illness is a leading cause of morbidity and mortality in infants and young children worldwide. Influenza virus and respiratory syncytial virus (RSV) infections are major causes of severe acute respiratory disease although there are significant gaps in knowledge about the manifestation of these viral infections among infants, especially in low- and middle-income countries.

Purpose: This study aimed to determine the frequency of influenza and RSV infection in hospitalized infants with any acute illness and non-and well infants in Amman, Jordan.

Methodology: A prospective study was conducted during two local influenza seasons, November 2015–April 2016 and November 2016–May 2017. Sick infants aged under 1 year who were hospitalized in Al Bashir hospital with any acute illness and with an onset <10 days and well infants presenting to the primary health care centre for routine immunization were enrolled. Infants eligible for screening were randomly prioritized within REDCap. Descriptive and medical information on the infant and mother were collected by interview and review of medical records. Within 24 hours of admission nasal/throat swabs were collected for all infants eligible for virus analysis. Influenza and RSV infection were confirmed by real–time reverse transcriptase and transcriptase polymerase chain reaction.

Findings: A total of 1 458 infants were enrolled in the study, of whom 1 058 (72.5%) were hospitalized and 400 (27.4%) were attending for routine immunization. Of the 1 458 infants, 57 (3.9%) were positive for influenza A, 12 (0.8%) for influenza B and 377 (25.8%) for RSV. Among the hospitalized and well infants, 48 (4.5%) and 9 (2.2%) children respectively had influenza A, 10 (0.9%) and 2 (0.5%) had influenza B, and 358 (33.8%) and 19 (4.8%) had RSV. The incidence of influenza A was highest among infants < 6 months 41 (71.9%). The highest percentage of positive results were from hospitalized infants.
Abstracts

Conclusions: The incidence of influenza A among infants aged <6 months was high. Influenza vaccine is recommended to be given only to infants >6 months, thus, decisions about the potential value of existing and new vaccines, prevention and treatment would be beneficial.

Keywords: Respiratory syncytial virus, Influenza, Infants, Jordan

Epidemiological and clinical characteristics of *Streptococcus pneumoniae* infections in a tertiary care centre in Bahrain, 2010–2014


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Background: There are limited data on the clinical characteristics and epidemiology of streptococcus pneumonia in Bahrain.

Purpose: This study investigated the epidemiology of invasive and non-invasive pneumococcal disease during a five-year period (2010–2014) in a major hospital in Bahrain.

Methodology: This retrospective study investigated cases of pneumococcal diseases among patients ≥14 years who attended Salmaniya Medical Complex, Bahrain during 2010–2014. Laboratory data were obtained on inpatient and outpatient samples with positive *Streptococcus pneumoniae* cultures. Demographic and clinical records from medical files of the patients were then reviewed.

Findings: A total of 144 samples were positive for *S. pneumoniae* and 139 patients met the inclusion criteria (≥14 years with a positive culture for *S. pneumoniae*). Of the 139 patients, 95 had non-invasive pneumococcal disease and 44 had invasive pneumococcal disease. Pneumococcal disease was more common in male patients (59%) and the mean age was 56 (range: 15–95) years for all patients. The most common co-morbidities were hypertension, diabetes mellitus and cardiovascular disease. Of the 139 patients, 27 (19%) received mechanical ventilation during their admission and 13 (9%) were admitted to the intensive care unit. The mortality rate was 14%.

Conclusions: This study supports the current literature where pneumococcal infection is more prevalent in the elderly and those with co-morbidities. Mortality was low and related to age, certain chronic medical illness, admission to the intensive care unit and need for mechanical ventilation.

Keywords: *Streptococcus pneumoniae* infection, Tertiary care centre, Bahrain
Abstracts


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Background: In January 2016, electronic reporting of acute respiratory illness (ARI) from 420 hospitals nationwide was added to the National Disease Surveillance System in Egypt, replacing paper reporting of ARI. Few data have been published on ARI and influenza as causes of death in Egypt.

Purpose: This study assessed whether the current system could provide insight into influenza-associated mortality among patients hospitalized with ARI in Egypt.

Methodology: National data on ARI from January 2016 to September 2017 were extracted to review ARI-associated deaths from influenza. Oro/nasopharyngeal swabs were taken according to the World Health Organization case definition and clinician judgement, and were tested for influenza types and subtypes by polymerase chain reaction.

Findings: Of the total hospital admissions (217,621), 12% (26,279) were for ARI, making it the third highest reported disease on the list of communicable diseases in the national routine surveillance system. The age of cases ranged from 1 month to 99 years (median 18 years), 54% were males, and death occurred in 686/26,279 (2.6%). Of the 26,279 ARI cases, 17,154 (65%) had swabs taken, of which 3,290 (19%) tested positive for influenza virus. Influenza-associated case fatality proportion was 5% (169/3,290) compared with 3% (418/13,864) for influenza virus-negative cases ($P<0.001$). The highest mortality from influenza was among the age group 35–<65 years (57.4%) followed by the age group 15–<35 years (18.3%) and those aged >65 years (17.8%), while it was 6.5% in the age group <5 years. Mortality in influenza-positive cases was significantly associated with co-morbidity ($P<0.01$); 72% (121/169) of those with influenza who died had chronic diseases, including chest, cardiac and renal diseases, or were pregnant/in the puerperium.

Conclusions: Stronger surveillance for deaths due to respiratory illness may identify risk groups for targeted immunization and other prevention strategies.

Keywords: Acute respiratory illness, Influenza, Mortality, Egypt
Determinants of respiratory infections among children under 5 years in Islamabad, Pakistan

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Background: According to World Health Organization estimates, acute respiratory infections (ARI) account for 6% of the total global burden of disease and are responsible for 20–30% of all deaths in children under the age of 5 years. ARIs are the main cause of death in children under 5 years in Pakistan.

Purpose: The objective of this study was to assess the magnitude and determinants of respiratory infections in children under five years in Islamabad, Pakistan.

Methodology: A cross-sectional study was conducted at the Federal General Hospital, Islamabad. A case was defined as sudden onset of fever (>38 °C) and cough in a child under 5 years presenting to the Federal General Hospital between 1 September and 30 November 2016. A simple random technique was used to select children. Parents were interviewed for data collection. Frequencies for all the variables and cross tabulations were performed using SPSS. The Pearson chi-squared test of independence was used to identify significant factors.

Findings: Of a total of 156 study participants, 68 (44%) were girls. The median age was 8 months (range: 1–60 months). Among the participants, 98 (63%) were diagnosed as pneumonia, 25 (16%) as bronchiolitis and 33 (21%) as severe pneumonia. Factors significantly associated with respiratory infections were: low socioeconomic status (P=0.03), rural residence (P=0.02), low maternal education (P<0.0001), younger maternal age (P=0.025), low awareness of ARI (P<0.0001), not exclusively breastfed for the first 6 months (P=0.04), low birth weight (P=0.04) and being fed on cow’s milk (P=0.002).

Conclusions: Several behavioural factors among others given above, and especially mother’s education, were the determinants of ARIs. Simple interventions, such as enhancing the awareness and knowledge of mothers about ARIs, especially in low socioeconomic settings, are recommended. On the recommendation of this study, awareness campaigns among mothers were started at the Federal General Hospital about the risk factors and prevention of ARI.

Keywords: Respiratory infections, Children, Risk factors, Pakistan.
Role of pandemic influenza preparedness in strengthening the influenza surveillance system in Afghanistan, a chronic conflict setting

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Background: Afghanistan, as a chronic-conflict country, is a high-risk setting for influenza virus circulation. The main cause of under-five mortality is acute respiratory infections. The country has long borders with Pakistan and the Islamic Republic of Iran where epidemics of influenza in humans and poultry, including confirmed H5N1 outbreaks, have been reported in the past. To strengthen the capacity of the county in influenza surveillance, the Pandemic Influenza Preparedness (PIP) Framework has supported Afghanistan for the past two years.

Purpose: This paper reviews the progress made in strengthening national influenza surveillance in Afghanistan through PIP technical and financial support.

Methodology: A desk review was undertaken of the surveillance reports and surveillance data collected during 2016 by the National Disease Surveillance and Response system in the Ministry of Public Health, Afghanistan.

Findings: Before 2016, the system focused only on influenza laboratory testing and there were no dedicated surveillance sites. In 2016, nine representative and dedicated influenza sentinel sites were established in major provinces to collect regular epidemiological data and specimens for testing. In addition, the National Influenza Centre regained its capacity to isolate influenza viruses after a gap of five years. In 2016, the National Influenza Centre submitted 26 isolates (AH1, H3, B Yamgata and Victoria) with the World Health Organization (WHO) to the United States Centers for Disease Control and Prevention for genetic characterization and influenza vaccine studies. In addition, Afghanistan has been able to share its epidemiological and virology information on global databases such as FluID, FluNet, Emflu and GISAID. Furthermore, 34 provincial rapid response teams have been established and trained. Timely procurement of laboratory reagents for the National Influenza Centre and lack of a facility for direct shipment between Kabul and WHO are the main challenges in the current system.

Conclusions: The influenza surveillance system has regained its capacity in epidemiological and laboratory areas. Nonetheless, the National Influenza Centre requires more technical support to maintain its performance and meet the surveillance objectives.

Keywords: Surveillance, Influenza, Afghanistan
Abstracts

Multiple viral etiologies in patients with influenza–like illness and severe acute respiratory infection in Qatar, 2013–2016

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Background: Respiratory illnesses are a significant cause of morbidity and mortality. Qatar has a comprehensive surveillance system which includes influenza–like illness (ILI) and severe acute respiratory infection (SARI) and identification of the influenza and non–influenza viruses causing the infections.

Purpose: The aim of this study was to determine the viruses causing acute respiratory illness in Qatar during 2013–2016.

Methodology: Respiratory samples were collected from selected patients using WHO standard case definitions with ILI at the sentinel primary health care centre sites of the National Influenza Centre and patients with SARI admitted to sentinel hospitals. Nasopharyngeal and/or oropharyngeal swabs were collected from eligible patients (standardized case definitions) for the period 2013–2016. Samples were analysed by real–time polymerase chain reaction at the National Influenza Centre, which tests for 22 types and subtypes of virus.

Findings: In the study period, 43 106 patients were included and tested, 29 626 (68.7%) of whom tested positive for infection. Out of these, 8 829 (29.8%) were influenza positive, 6 655 (75.4%) of whom were influenza A and 2 174 (24.6%) were influenza B. Sub–typing of influenza A showed 3 721 (55.9%) were influenza A(H1N1)pdm09. Other respiratory viruses isolated included rhinovirus 4 626 (15.6%), respiratory syncytial virus 3 259 (11.0%), coronaviruses 1 824 (6.2%), adenovirus 1 689 (5.7%), parainfluenza virus 1 645 (5.6%), human metapneumovirus 1 357 (4.6%) Mycoplasma pneumoniae 1 053 (3.6%), bocavirus 874 (3.0%) and parechovirus 178 (0.6%). Seasonal variation was observed for influenza with the peak season being from October to March with an unexpected surge of cases seen in October to December 2016.

Conclusions: Influenza viruses A and B are responsible for the majority of the ILI and SARI cases reported in Qatar; however many other viruses also contribute to the burden of respiratory illness in the country. The findings indicate other viral etiologies besides influenza which may influence the clinical management and outcome of the patient.

Keywords: Influenza, Influenza–like illness, Severe acute respiratory infection, Respiratory pathogens, Qatar
Abstracts

Preventing and controlling avian influenza in the Eastern Mediterranean: a review

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Background: Avian influenza poses a significant public health risk worldwide, with outbreaks of the H5N1 strand affecting more than 50 countries between 2003 and 2006. Between 2003 and 2016, transmission from infected birds to humans was confirmed in four countries of the World Health Organization’s (WHO) Eastern Mediterranean Region, the most affected country being Egypt with 356 human cases, including 121 deaths, as of October 2016. Countries in the Region must implement stringent measures against the threat of an avian influenza pandemic.

Purpose: This review aimed to assess the ongoing strategies to prevent and control avian influenza in human and animal populations in the Region and identify potential ways to improve prevention and control.

Methodology: Relevant literature was identified through searches of literature databases, grey literature, and the snowballing technique, and extracted and synthesized in a narrative format. Data from the WHO comparative analysis of national pandemic preparedness plans were also analysed.

Findings: Strategies implemented by other countries affected by avian influenza were identified. Ten countries of the Region had pandemic preparedness plans which were available for analysis, the majority of which addressed routine (70%) and animal (90%) surveillance, overall prevention and containment (90%), and health system response (90%). The areas of weakness that were identified included many planning and coordination indicators, and no country had carried out simulation or desktop pandemic exercises. Little improvement was evident upon re-examination five years later.

Conclusions: Many evidence-based measures can be implemented to prevent and control avian influenza, from those specific to the handling of poultry to health system preparedness and response. However, their implementation in the Region is not widespread and adequate improvements were not made between 2011 and 2016. The capacity of epidemic-prone countries in the Region must be strengthened to control the source of infection. Rigorous biosecurity measures and regular vaccination programmes must be implemented in poultry farms.

Keywords: Influenza, Pandemics, Public health, Disease outbreaks, Eastern Mediterranean Region
Abstracts

POSTER PRESENTATIONS

Thematic area: Human–Animal Interface

Middle East respiratory syndrome coronavirus (MERS-CoV): threats, gaps and containment strategies

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Presenter: Hamid Hussain, Consultant, Family and Community Medicine, Faculty of Medicine, University of Baghdad; Dubai Health Authority, Dubai, United Arab Emirates

Background: Middle East respiratory syndrome coronavirus (MERS-CoV) causing acute severe respiratory diseases was first reported in 2012 in Saudi Arabia. The causative agent was identified as a coronavirus which was named MERS-CoV.

Purpose: This study reviewed the published literature to investigate the incidence and mortality rate of MERS-CoV to identify the main threats and gaps and frame containment strategies.

Methodology: MEDLINE and CINAHL electronic databases were searched using a pre-defined search strategy. Additional references from the bibliographies of retrieved articles were also reviewed and experts (respiratory disease consultants) involved in case management in the United Arab Emirates were contacted. Selection criteria were: original research articles on MERS-CoV incidence. The initial literature search identified 47 papers. Of these, 16 original articles met the selection criteria. All were type II evidence—population-based clinical MERS-CoV studies.

Findings: Since 2012 cases have been reported in 14 countries, with most of the reporting from the Arabian Peninsula region. A total of 212 cases have been reported in Saudi Arabia up to April 2014, of which 88 died. The countries most affected by the disease are Saudi Arabia with 183 cases, of which 74 (40%) died and the United Arab Emirates with 19 cases, of which 7 (37%) died. So far, all the cases have been linked to six countries in or near the Arabian Peninsula. No cases have been identified in the United States of America. The virus has spread from sick people to others through close contact.

Conclusions: The disease is following a propagated epidemic curve and trending to more spreading and adding more and more cases. In time, increasing numbers of index cases will lead to a change in the epidemiological curve pattern to an explosive epidemic curve, which is considered threatening for coronavirus as the case fatality rate is extremely high and mortality rate can reach up to 50%. Gap analysis studies are needed to determine why the virus is still circulating and propagating in spite of the
Knowledge, attitudes and practices of poultry-keepers about avian influenza in households in high-risk governorates in Egypt, 2017

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Abstract:

Background: Avian influenza viruses are highly contagious among birds and recurrence of human infection has raised concerns of a possible H5N1 influenza pandemic. Keeping poultry in households for breeding is the main pathway for transmission of the disease to humans. Therefore, raising awareness of proper poultry breeding and improving keepers’ knowledge of the disease reduces the risk of bird flu.

Objectives: This study explored the knowledge, attitudes and practices (KAP) about avian influenza among poultry-keepers in households in Egypt.

Methodology: A cross-sectional survey was conducted in 2017 in six high-risk governorates (three in Upper and three in Lower Egypt) using a structured pretested questionnaire administered in face-to-face interviews with 300 poultry-keepers. The questionnaire included demographic data and questions exploring KAP. The total score for each KAP was categorized as: poor/negative = 0–50%; fair/neutral = >50–70%; and good/positive = >70–100%.

Findings: The mean age of the respondents was 33 (range: 19–55) years; females represented 64% of the respondents. Of the 300 poultry-keepers, 55% had good knowledge. Just over half (51%) knew that the disease was transmitted to humans through handling infected birds. Only 40% of poultry-keepers recognized the risk of slaughtering sick birds and their ability to transmit the infection to humans. With regard to attitude, 42% of respondents had a neutral attitude and 40% agreed that following the correct breeding methods would help prevent transmission of the disease to humans. Practice scores were poor among 46% of keepers. The preventive practice reported by >65% was avoiding the exchange of birds between neighbours. KAP was significantly higher among females, respondents with a higher educational level and economic status, and participants reporting the media as their source of avian influenza information (P>0.05).
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Conclusions: Intensification of health awareness programmes on proper methods of keeping poultry among poultry-keepers is essential to enhance their understanding and prevent the spread of avian influenza to humans.

Keywords: Highly pathogenic avian influenza, Knowledge, Attitudes and practices, Poultry-keeping, Households, Egypt

Risk factors for death in H5N1 cases in Egypt: analysis of surveillance data, 2006–2017

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Presenter: Ibrahim Eldeyahy, Epidemiologist, Department of Epidemiology and Surveillance, Preventive Affairs Sector, Ministry of Health and Population, Cairo, Egypt

Background: Egypt is the country most affected by H5N1 with 41.7% of the reported human cases worldwide. From March 2006 to April 2017, 359 laboratory-confirmed human cases were reported in Egypt; these cases occurred during the months when seasonal influenza typically occurs in the country.

Purpose: This study investigated the case fatality rate (CFR) of H5N1 cases in Egypt and identified the risk factors associated with death.

Methodology: Between 2006 and 2017, 359 cases of laboratory-confirmed H5N1 infection were recorded, of which 122 (34%) died. Data were retrieved from the avian influenza database and collected from detailed case investigation forms completed for each case. The variables analysed for association with H5N1 fatality were: sex, residence, type of hospital managing the case, presence of respiratory distress at admission, existence of co-morbidities, and duration of illness before receiving oseltamivir. The chi-squared or Student t tests were used to examine the effect of each variable on the CFR.

Findings: The CFR was 34% (122/359). The risk factors significantly associated with death were: longer duration between disease onset and receiving oseltamivir [6.2 (SD 5.0) days in those who died versus 4.4 (SD 4.1) days in those who recovered (P=0.014)]; presence of co-morbidity (CFR 54.5%) versus no co-morbidity (CFR 31.9%) (P=0.009); managed outside fever hospitals (CFR 48.6%) versus in fever hospitals (CFR 18.8%) (P<0.001); and presence of respiratory distress at first presentation (CFR 40.9%) versus free of respiratory distress (CFR 25.9%) (P=0.003). Other variables (sex, urban/rural residence, Lower/Upper Egypt residence) were not statistically significantly associated with death.

Conclusions: More attention needs to be paid to management of patients with H5N1 who have co-morbidities and present with respiratory distress. Hospitals, especially non-fever hospitals, need to enhance...
management of patients with H5N1. Oseltamivir should be given immediately to any suspected case of avian influenza and public awareness needs to be raised about the importance of seeking early medical advice for any person with influenza symptoms and exposure to birds.

Keywords: Avian influenza, H5N1, Mortality, Surveillance, Egypt.

Seroprevalence of avian influenza virus H9 among people working with poultry in Rawalpindi Division of Punjab Province, Pakistan

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Background: Avian influenza H9 is endemic in commercial and backyard poultry in Pakistan, posing a serious occupational health hazard to industry workers.

Purpose: This study aimed to determine the seroprevalence of avian influenza H9 infection in people working with poultry in the Rawalpindi Division, Punjab, Pakistan.

Methodology: A cross-sectional study was conducted from December 2016 to May 2017. People working with poultry, including farm workers, vaccinators, field veterinarians, butchers and laboratory staff working within Rawalpindi Division, were the target population. With an expected seroprevalence of avian influenza of 46%, the sample was calculated to be 381; this was increased to 419 in case of non-response. Potential participants were randomly approached and gave written consent to participate. Data were collected using a standardized questionnaire. Serum samples were processed to detect H9 antibodies using the haemagglutination inhibition test.

Findings: Of the 419 people included in the study, 406 (96.9%) were male. The mean age of the participants was 36.41 (SD 10.86) years. A total of 332 participants agreed to a blood test, 167 of whom were positive for H9 antibodies, giving an overall seroprevalence of 50.3%. The laboratory staff had the highest seroprevalence of 100% (19/19) while veterinarians had the lowest at 38.5% (15/39). Vaccinators, butchers and farm workers showed a seroprevalence of 83.3% (15/18), 52.4% (11/21) and 45.5% (107/235) respectively. Personnel who always used face masks had a considerably lower seroprevalence of 29.6% (48/162) compared with 90.6% (48/53) in those who never used them. Similarly those who always used gloves and washed their hands with soap had a seroprevalence of 32.8% (43/131) compared with 89.0% (161/181) in those who never did. Of the participants who handled antigens, 92.3% were seropositive.
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Conclusions: Laboratory staff are exposed to viral cultures and antigens because of the use of traditional viral detection tools. Similarly, vaccinators handle influenza vaccines that may be the reason for their high seroprevalence. Recommendations were made to limit the use of traditional virus detection tools and adopt proper standard operating procedures for vaccine disposal.

Keywords: Avian influenza, Seroprevalence, Poultry, Pakistan

Evaluation of the avian influenza surveillance system in Khyber Pakhtunkhwa, Pakistan

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Background: In February 2006 avian influenza virus subtype H5N1 was found for the first time in two isolated commercial poultry flocks in northern Pakistan. The areas most affected by highly pathogenic avian influenza included areas in the province of Khyber Pakhtunkhwa during 2006–2008. The surveillance system for avian influenza virus in Khyber Pakhtunkhwa monitors the pathogens circulating in the area, adopts control strategies in case of any emergency and maintains continuous surveillance in the field to prevent any disease outbreak.

Purpose: The objective of this study was to identify the strengths and weaknesses of the avian influenza surveillance system in Khyber Pakhtunkhwa and to formulate recommendations for its improvement.

Methodology: The surveillance system for avian influenza in Khyber Pakhtunkhwa was evaluated using the Updated guidelines for evaluating public health surveillance systems (2001) of the United States Centers for Disease Control and Prevention. The surveillance system (2012–2013) was evaluated in March 2014.

Findings: The surveillance system was very well implemented because of its simplicity and flexibility. Data quality was good until 2013. However, after that, data quality was adversely affected when computerization of data was not done. The system is well accepted by partners and technical field staff. Because of the absence of any cases since 2009, the sensitivity and positive predictive value were not measured. However, samples collected represented all type of birds and farms and were good, representative samples. Usually
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it took 14 days for the samples collected to reach national reference laboratories for investigation, which indicates poor timelines. Projects and funding have been closed by donors and the federal government since 2009 when avian influenza was officially declared controlled and no further case was detected through active surveillance. However, the provincial government funds the system to meet a minimum level of surveillance.

Conclusions: Overall the system is operating well. It is recommended that field and veterinary staff are trained to improve the quality of the data collected. The reporting time should be decreased to 7 days for timely detection of and response to potential outbreaks.

Keywords: Avian influenza, Surveillance, Khyber Pakhtunkhwa, Pakistan

POSTER PRESENTATIONS

Thematic area: Virology

Phenotypic and genotypic susceptibility profile of neuraminidase inhibitors of influenza B viruses circulating in Morocco during the 2014–2015 influenza season

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Background: Although influenza virus prophylaxis is mainly based on vaccination, antivirals – mainly the neuraminidase inhibitors oseltamivir and zanamivir – play an important role in the fight against influenza epidemics.

Purpose: This study aimed to assess the phenotypic and genotypic susceptibility profile of neuraminidase inhibitors of influenza B viruses circulating in Morocco during the 2014–2015 influenza season.

Methodology: Data were obtained from eight sentinel sites across the country, and nasopharyngeal samples from 440 patients with influenza-like illness or severe acute respiratory infection (SARI) were analysed. Influenza A and B virus detection was carried out by real–time polymerase chain reaction. Positive influenza B specimens were isolated on MDCK cells. Susceptibility of the strains to the neuraminidase
inhibitors, oseltamivir and zanamivir, was assessed with a fluorimetric test determining the enzymatic activity of neuraminidase. Complete sequencing of the neuraminidase gene was performed according to a protocol of the United States Centers for Disease Control and Prevention.

**Findings:** Of the 440 specimens, 135 (31%) were positive for influenza B Yamagata virus, 38 (9%) for influenza A(H1N1)pdm09 and 25 (6%) for influenza A(H3N2). The 60 influenza B viruses isolated on MDCK and tested for susceptibility to neuraminidase inhibitors showed a normal sensitivity except for two strains. These two showed a reduced susceptibility to oseltamivir. The genotypic analysis of the sixth segment of the viral genome showed a substitution of one amino acid at the K371N position in one virus.

**Conclusions:** Although the use of neuraminidase inhibitors is low, the reduced susceptibility to oseltamivir in influenza B isolates in Morocco demonstrates the importance of ongoing monitoring of neuraminidase inhibitor sensitivity to detect any appearance of resistant mutations. To ascertain the likely role of the K371N mutation in neuraminidase inhibitor resistance, reverse genetic analysis is needed.

**Keywords:** Influenza B, Neuraminidase inhibitors, Morocco

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### Streptococcus pneumoniae isolated from Palestinian nasopharyngeal carriers: serotype distribution and antimicrobial resistance

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**Background:** Infections of *Streptococcus pneumoniae* in children can be prevented by vaccination. Left untreated, they can result in high morbidity and mortality.

**Purpose:** This study aimed to determine the nasopharyngeal carrier rates, serotype distribution and antimicrobial resistance patterns of *S. pneumoniae* in healthy Palestinian children less than 2 years prior to the full introduction of the pneumococcal 7-valent conjugate vaccine (PCV7), which was piloted in Palestine in September, 2010.

**Methodology:** In a cross-sectional study, nasopharyngeal specimens were collected from 397 healthy children from different Palestinian districts between November 2012 and January 2013. Samples were
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inoculated into blood agar and suspected colonies were examined by amplifying the pneumococcal-specific autolysin gene using a real-time polymerase chain reaction (PCR). Serotypes were identified by a PCR that incorporated different sets of specific primers. Antimicrobial susceptibility was measured by disk diffusion and minimum inhibitory concentration methods.

Findings: The carrier rate of *S. pneumoniae* was 55.7% (221/397). The main serotypes were PCV7 serotypes 19F (12.2%), 23F (9.0%), 6B (8.6%) and 14 (4.0%), and PCV13 serotypes 6A (13.6%) and 19A (4.1%). Serotype 6A, not included in the pilot trial (PCV7) vaccine, was the most prevalent. Resistance to more than 2 antibiotics was found in 72 of 211 (34.1%) specimens that included *S. pneumoniae*, while 47/211 (22.3%) were susceptible to all tested antibiotics. All the isolates were sensitive to cefotaxime and vancomycin.

Conclusions: Any or all of these factors might affect the type and efficacy of the pneumococcal conjugate vaccines and the antibiotics to be used for prevention and treatment of pneumococcal disease in the country.

Keywords: *Streptococcus pneumoniae*, Serotypes, Antimicrobial resistance, Palestine
Participants: Member States

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