World Health Organization

REGIONAL OFFICE FOR THE Eastern Mediterranean

Fifth meeting of the Eastern Mediterranean Acute Respiratory Infection Surveillance (EMARIS) Network

Second scientific conference on acute respiratory infection in the Eastern Mediterranean

Better data, better policy, better action

Casablanca, Morocco | 12–15 November 2019

Suggested citation. Second Scientific Conference on Acute Respiratory Infection in the Eastern Mediterranean Region and the fifth Meeting of the Eastern Mediterranean Acute Respiratory Infection Surveillance (EMARIS) Network. Cairo: WHO Regional Office for the Eastern Mediterranean; 2019. Licence: CC BY-NC-SA 3.0 IGO.

Cataloguing-in-Publication (CIP) data. CIP data are available at http://apps.who.int/iris.

Written by Sian Lewis.
All icons from Noun Project. Credits (in order of appearance): Luis Prado, Adriano Emerick, Vijay Sekhar Sadineni, Alvaro Cabrera, *anon*, Gray, *anon*, Max Hancock, John Caserta, *anon*, *anon*, Jhun Capaya, b farias, *anon*, b farias, Andrew Doane, Gregor Cresnar, *anon*, *anon*, *anon*, *anon*.

Contents

Acronyms and abbreviations

ARI	acute respiratory infection
BSL	biosafety level
CAHO	Community Animal Health Outreach
CC	collaborating centre
CDC	US Centers for Disease Control
COM	capability, opportunity and motivation
CVV	candidate vaccine virus
EMARIS	Eastern Mediterranean Acute Respiratory Infection Surveillance Network
EMR	WHO's Eastern Mediterranean Region
EMRO	WHO Regional Office for EMR
EQA	external quality assessment
EQAP	WHO External Quality Assessment Project
EV-D68	Enterovirus D68
FETP	Field epidemiology training programme
GIP	WHO Global Influenza Programme
GISAID	Global Initiative on Sharing All Influenza Data
GISRS	Global Influenza Surveillance and Response System
GOARN	The Global Outbreak Alert and Response Network
HAdV	Respiratory adenovirus
IHR	International Health Regulations
ILI	influenza-like illnesses
IPC	infection prevention and control
JEE	Joint External Evaluation
LMICs	low- and middle-income countries
MERS-CoV	Middle Eastern Respiratory Syndrome Coronavirus
NAPHS	National Action Plan for Health Security
NGS	next-generation sequencing
NIC	National Influenza Centre
NITAG	national immunization technical advisory group
NPI	non-pharmaceutical intervention
OHZDP	One Health Zoonotic Disease Prioritization Tool
PIP	Pandemic Influenza Preparedness
PISA	Pandemic Influenza Severity Assessment
PIVI	Partnership for Influenza Vaccine Introduction
PPE	personal protective equipment
RSV	respiratory syncytial virus
SARI	severe acute respiratory infections
TIPRA	Tool for Influenza Pandemic Risk Assessment
WHO	World Health Organization

Note to reader

This report aims to capture key messages that emerged from the presentations and discussion rather than a strictly chronological account of the meeting. The priorities and recommendations for action include suggestions made by all participants over the four days of the meeting, and do not necessarily imply consensus.

The scientific proceedings of the conference will be published in the Oman Medical Journal in due course.

Executive summary

In brief

Emerging and re-emerging respiratory pathogens pose a major threat to global public health security. In the WHO's Eastern Mediterranean Region (EMR), acute respiratory infections (ARIs) are one of the leading causes of illness and death and significantly impact regional health and economic development.

The Eastern Mediterranean Acute Respiratory Infection Surveillance network (EMARIS) was set up in 2006 as a means to enhance surveillance and response capacities for ARIs in the region, especially influenza. It meets every two years, to share best practices in influenza surveillance, track regional progress, address knowledge gaps and draw lessons on public health preparedness and response.

In November 2019, EMARIS met for the fifth time, in Casablanca, Morocco, in conjunction with the second Scientific Conference on Acute Respiratory Infections. Centred on the theme of 'better data, better policy, better action', the conference was designed to support data-driven public health policy-making.

Over four days of presentation and discussion, meeting participants shared their achievements and challenges, presented their best practices and showcased their latest research findings across nine themes: global and regional strategies, surveillance in EMR, disease burden estimates, leveraging outbreak structures for influenza, MERS-CoV and other ARIs, influenza vaccination, biosafety and biosecurity, One Health for influenza, and pandemic preparedness.

More than 180 people, including representatives from all 22 countries in the region, attended the meeting. More than 170 abstracts were submitted by researchers in the region; 50 were presented at the conference as oral or poster presentations. The broader meeting also included 46 other expert speakers as well as 7 panel discussions and 4 skills-building workshops on pandemic preparedness, outbreak investigation, data quality and epidemiological analysis, and vaccine coverage.

Special awards to recognize the most innovative abstract and the best oral and poster presentations were given to Farag Elmoubasher from Qatar, Hind Bouguerra from Tunisia and Fatimah Alghawi from Saudi Arabia respectively.

Influenza capacities in EMR

At both global and regional levels, the world's collective capacity to detect influenza has improved significantly over the past half-century. The backbone of this capacity is the Global Influenza Surveillance and Response System (GISRS); and EMR's contribution to this critical network is growing steadily. Today 19 out of the region's 22 countries have functioning surveillance systems; the other three are not far behind. There is good data coverage at national and regional levels and growing laboratory capacity for generating robust epidemiological and virological data and reporting it to GISRS.

The region also has its own data-sharing platform, EMFLU, which produces weekly and monthly bulletins and receives regular data from 18 countries across the region. Every year, the region tests and reports 84,668 influenza specimens to EMFLU, contributing around 20–25% of all influenza detections that are used in the biannual global vaccine composition meetings.

EMR's capacities in influenza prevention and control are also increasing, with a growing number of influenza policies in place, more rapid response teams present in the region and increasing use of seasonal vaccines in several nations. Five countries have used their surveillance data to estimate the burden of influenza; a further seven are in progress. Several countries have also carried out cross-

sectional studies on influenza vaccine hesitancy, acceptance, and demand among healthcare workers.

Challenges to tacking influenza in EMR

EMARIS participants highlighted the challenges they face in doing influenza surveillance, implementing prevention and control and preparing for the next pandemic. Key challenges cited include:

- **Complex operational contexts and increasing fragility**: more than half of the region is dealing with ongoing conflict, which poses significant operational challenges.
- **Limited animal surveillance**: animal surveillance is critical in EMR where human-animal interaction is high, yet it remains weak in many countries.
- **Limited use and uptake of vaccines**: vaccine coverage in EMR remains low. Vaccine hesitancy is partly to blame; but so too are political barriers, industry constraints and technical challenges.
- **Inconsistent data sharing**: the timeliness and quality of data shared varies across the region.
- **Limited cross-sectoral involvement**: influenza requires a One Health approach but cross-sectoral collaboration in many countries remains informal at best.
- **Lack of preparedness planning**: only six countries in EMR have a publicly available pandemic influenza preparedness plan; and only two have been published or revised since WHO's new guidance was released in 2013.

Priorities for action

Across the four days of EMARIS 2019, meeting participants considered what countries can do to strengthen influenza detection, prevention and control in EMR. A broad range of recommendations emerged from their deliberations. These are summarized below and outlined in more detail in Part III below).

1. **Support early detection.** Strengthen human & animal virological surveillance, fill related knowledge gaps strategically, and build lab capacity to support GISRS.
2. **Enhance and expand prevention.** Improve seasonal influenza vaccination programmes, develop a regional roadmap for vaccination and invest in non-pharmaceutical preventive measures.
3. **Prepare for pandemic influenza.** Update and test national preparedness plans and develop national pandemic vaccine deployment plans.
4. **Strengthen the evidence base.** Improve understanding of influenza seasonality, estimate burden of disease in more countries, scale up severity assessments, and translate research outcomes into policy.
5. **Search for synergies across diseases.** Use influenza infrastructure to strengthen other respiratory disease surveillance capacities, and integrate influenza into national disease surveillance systems.
6. **Work together to align efforts.** Build partnerships in research and practice, foster regional collaboration, align plans with global strategies and promote greater data sharing.
7. **Promote a One Health approach.** Build political will for animal health, prioritize zoonotic disease threats together and develop mechanisms for integration.
8. **Boost awareness and vaccine uptake.** Tailor and target messages to key groups, engage new partners in communication and harness behaviour change theory.
9. **Engage and mobilize communities.** Involve communities as equal partners and engage marginalized groups and political leaders.
10. **Be flexible and pragmatic.** Adapt systems to evolving situations and tailor solutions to local contexts.

Participants also made six broad recommendations for WHO and partners (see Part III below for the recommendations in full):

1. Support countries to strengthen influenza systems and structures.
2. Build capacities for influenza detection, prevention and control, including seasonal vaccination.
3. Facilitate research for policy.

4. Link global efforts to country priorities.
5. Facilitate knowledge exchange and collaboration, for influenza and other respiratory diseases.
6. Promote a One Health approach.

PART I. INTRODUCTION

Influenza: a global and regional threat

Emerging and re-emerging respiratory pathogens pose a major threat to global public health security; every year seasonal influenza alone affects an estimated billion people, causing up to 650,000 deaths worldwide. An influenza pandemic could be even more fatal, depending on when and where it emerges and how severe the disease is. The 2009 pandemic of A(H1N1) spread to more than 214 countries in less than nine weeks, killing up to 395,000 people. But the previous pandemic in 1968 was even more deadly, killing an estimated one to three million people.

Influenza pandemics are predictably unpredictable. But the World Bank estimates that even a moderate pandemic would cost up to US$570 billion, or 0.7% of global income, every year. And WHO cites a global influenza pandemic as one of the world's top ten threats to global health in 2019.

Just as with many diseases, influenza hits poor and vulnerable groups the hardest. It is among the most fatal illnesses in low- and middle-income countries (LMICs); and it is typically more deadly in very young or elderly people, as well as pregnant women and people with underlying conditions.

In the WHO's Eastern Mediterranean Region (EMR), ARIs are one of the leading causes of illness and death and significantly impact regional health and economic development. Across all countries in the region, influenza is the biggest cause of morbidity and mortality associated with ARIs, although other respiratory viruses, such as RSV and rhinovirus, are also important; so too are emerging respiratory viruses, including the Middle East Respiratory Syndrome (MERS-CoV).

Characteristics of influenza seasons in the region vary from country to country, and year to year. Both influenza A and B are present in the region. Over the past two years, influenza B has been more deadly in some countries, such as Yemen, while the opposite has been true in other countries, like Tunisia. Subtypes similarly vary across countries; A(H1N1)pdm09 was the most prevalent virus in 2018/19 across the region as a whole (see Figures 1a and 1b), although in some countries, including Morocco and Oman, A(H3) has dominated the latest season. Across all countries, young children and the elderly are particularly adversely affected (especially during winter), as well as those living with chronic disease and those living in cold climates.

The region is also home to many emerging strains of influenza in animals that have pandemic potential.

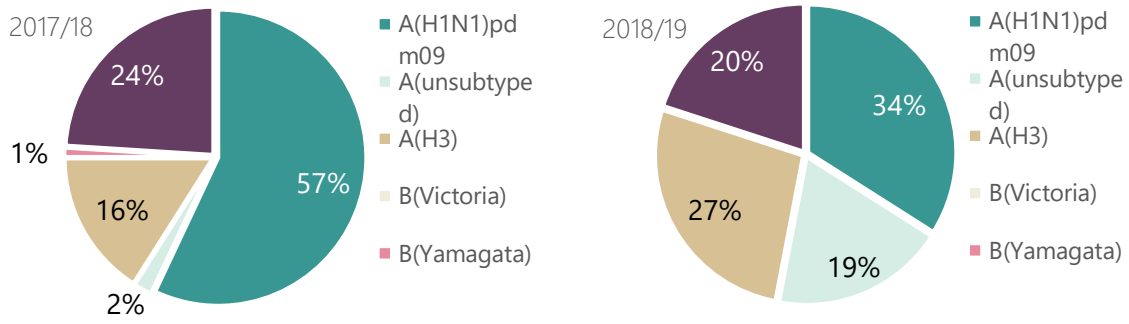

Figure 1a. Circulating strains of influenza in EMR in 2018/19 (source of data: EMFLU and FluMart).

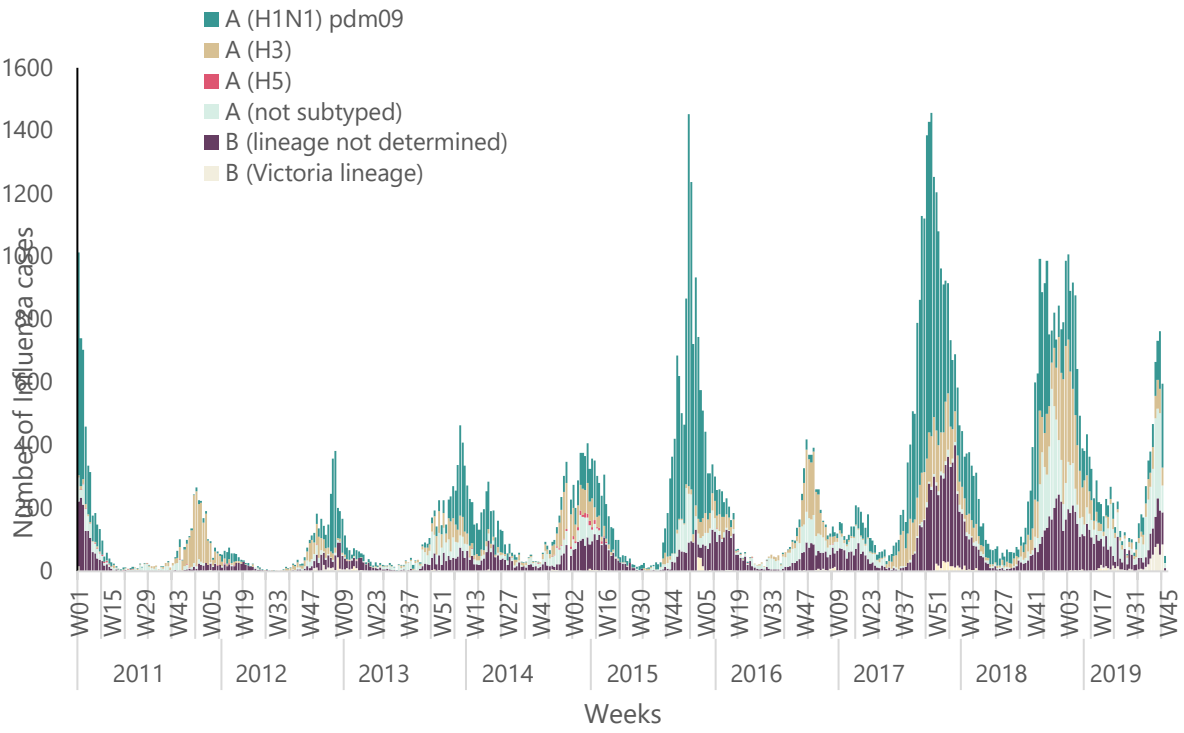

Figure 1b. Weekly positive influenza cases by subtype, 2011–19 (source of data: FluNet and EMFLU).

EMARIS

The Eastern Mediterranean Acute Respiratory Infection Surveillance network (EMARIS) was set up in 2006 as a means to enhance surveillance and response capacities for ARIs in the region, especially influenza. The network, which is made up of national and international policy-makers, researchers and scientists, doctors and clinicians and other stakeholders in EMR, meets every two years to share best practices in influenza surveillance, track regional progress, and draw lessons on public health preparedness and response. In 2017, to enable a review of interesting and relevant research on ARIs in the region during its meetings, EMARIS integrated the first Scientific Conference on Acute Respiratory Infections for young researchers into its agenda. A review of this last meeting can be found at: https://emarisconference.com/review-of-2017/.

Since the network was established, a range of initiatives have combined to strengthen the region's capacity to detect, prepare and respond to both seasonal and pandemic influenza. As the availability of surveillance data continues to increase, countries across the region have started to use their data to improve decision-making to prevent, detect and control ARIs.

About this meeting

In November 2019, the technical unit of Infectious Hazard Management in the WHO Regional Office for EMR convened the fifth meeting of EMARIS, in Casablanca, Morocco. Centred on the theme of 'better data, better policy, better action', the meeting was designed to support the growing focus on data-driven public health policy-making.

The meeting was held alongside the second Scientific Conference on Acute Respiratory Infections. During the combined meeting, participants shared their achievements and challenges, presented evidence and best practices and showcased their latest research findings on influenza and other respiratory viruses.

Over four days of presentation and discussion, the meeting specifically aimed to:

- review the progress and challenges in influenza surveillance in the region;
- enable information-exchange on influenza and other respiratory diseases;
- share evidence and best practices on using surveillance data to estimate influenza burdens, assess severity and detect outbreaks;
- consider how surveillance data can drive evidence-based policies and practice;
- share scientific achievements and research findings; and
- facilitate the interaction of researchers, experts and policy-makers.

Presentations and discussions were split across nine themes, covering topics like detecting respiratory infections, estimating influenza burdens, preventative action and outbreak response (see Figure 2). The agenda also included 50 oral and poster presentations on the latest research findings as well as 46 expert presentations and four skills-building workshops.

Figure 2. EMARIS 2019 in numbers.

PART II. SUMMARY OF DISCUSSIONS

1. Global and regional influenza strategies, capacities and challenges

1.1. International frameworks

Individual countries may or may not have their own strategies for tackling seasonal and/or pandemic influenza. At a global and regional level, the recently launched Global Influenza Strategy sets the framework for driving and shaping a coherent approach to tackling influenza in EMR.

WHO Global Influenza Strategy
In March 2019, WHO launched the Global Influenza Strategy for 2019–2030, aimed at protecting people in all countries from the threat of influenza. The strategy provides a common framework for WHO, countries and partners to jointly enhance global and national pandemic preparedness, combat the ongoing threat of zoonotic influenza, and improve seasonal influenza prevention and control.

With strong links to major existing global health strategies (including the WHO General Programme of Work, the International Health Regulations (IHR) (2005) and the Public Health Research Agenda for Influenza), the new strategy places a large focus on two key areas of activity:

- the development of better global tools, such as vaccines, antivirals and treatments; and
- stronger country capacities, which are integrated within national health security planning.

The first focuses on promoting research and innovation to address unmet needs. This includes developing improved, novel and universal vaccines as well as more effective treatments. It also includes establishing better detection methods and improving the collective understanding of both the virus and host response, to better predict virus evolution, forecast spread and improve vaccine selection.

The second key area includes strengthening global surveillance and data use (for example by improving countries' understanding of severity, continuing to enhance GISRS and coordinating across sectors) as well as expanding national seasonal influenza prevention and control policies and programmes, and improving countries' pandemic preparedness by developing, updating and testing pandemic preparedness plans.

Regional strategic framework
At a regional level, the WHO Regional Office for EMR (EMRO) has translated the WHO Global Influenza Strategy to the Eastern Mediterranean context, launching its *Strategic Framework for the Prevention and Control of Emerging and Epidemic-prone Infectious Diseases for 2019–2023* (see Figure 3).

Acknowledging the multiple threats facing the region, the framework aims to ensure that countries are better prepared to prevent, detect and respond to a range of infectious hazards and are better protected from their impacts. It will do this through a range of activities aimed at fulling four strategic objectives, as outlined in Figure 3.

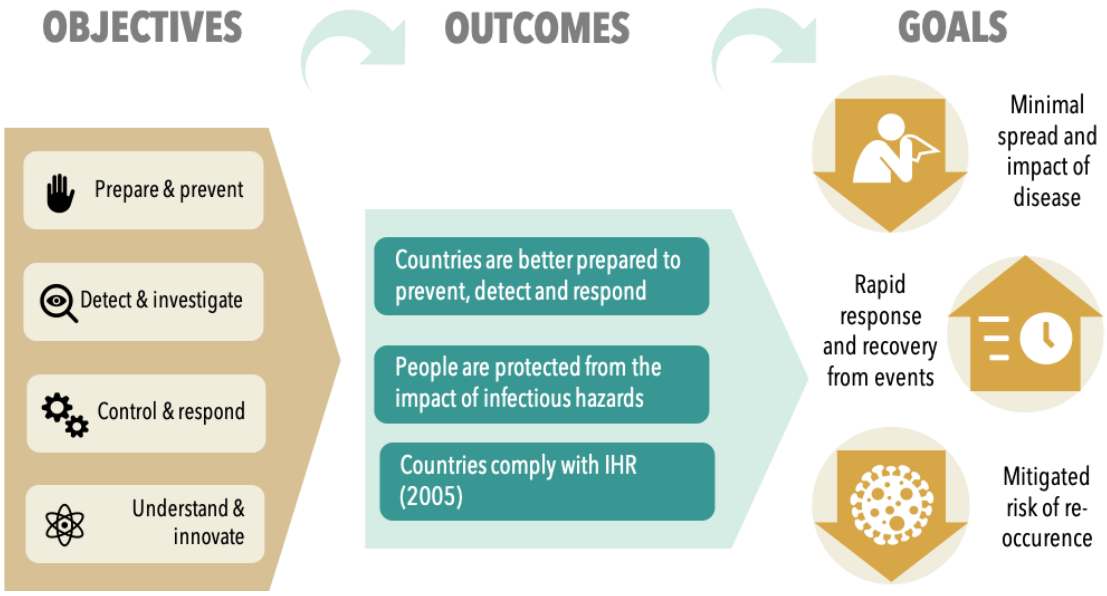

Figure 3. The EMR strategic framework for the prevention and control of emerging and epidemic-prone infectious diseases, 2019–2023.

1.2. Capacities for tackling influenza

The influenza virus is constantly evolving so effective prevention and control relies on access to the most recent information. Because a new strain can emerge anywhere in the world, at any time, constant surveillance and worldwide coordination are essential to catch and contain it quickly.

"GISRS is a global asset…that has been the mainstay of influenza surveillance and control for 67 years."

At both global and regional levels, the world's collective capacity to detect influenza is growing as surveillance improves. The backbone of this capacity is the network of National Influenza Centres, WHO Collaborating Centres, Essential Regulatory Laboratories and H5 Reference Laboratories called the Global Influenza Surveillance and Response System (GISRS). GISRS provides continuous seasonal and zoonotic influenza surveillance and virus sharing across the world. Made up of 153 institutions in 114 countries, GISRS tests up to four million specimens each year to identify new strains of influenza with pandemic potential as and when they emerge. GISRS also provides the backdrop for the free exchange of epidemiological data (through FluID), virological data (through FluNet) and sequencing data (through the Global Initiative on Sharing All Influenza Data, GISAID). Established in 2008, GISAID now contains HA sequencing data for more than 270,000 viruses from 198 countries.

Twice a year, WHO convenes a global group of experts to analyse the latest genetic and antigenic data generated by GISRS, and issue recommendations on the composition of the influenza vaccines for the next influenza season. These recommendations are used by national regulatory agencies and pharmaceutical companies to develop, produce and license influenza vaccines.

In the Eastern Mediterranean, capacities to monitor influenza and contribute to GISRS have increased significantly in recent years. Today, 19 out of the region's 22 countries have functioning surveillance systems using sentinel sites for influenza-like illnesses (ILI) and severe acute respiratory infections (SARI); the remaining three countries are not far behind. There is good data coverage at national and regional levels and growing laboratory capacity for generating robust epidemiological and virological data (see Figure 4).

Data-sharing is similarly improving: EMR has its own data-sharing platform, EMFLU, which produces weekly and monthly bulletins and receives regular data from 18 countries across the region. The number of specimens tested and reported from EMR has nearly tripled since 2011; and the number of viruses shared has more than quadrupled in the same time. Today, the region tests and reports 84,668 influenza specimens to EMFLU every year; it contributes around 20–25% of all influenza detections that are used in the biannual vaccine composition meetings.

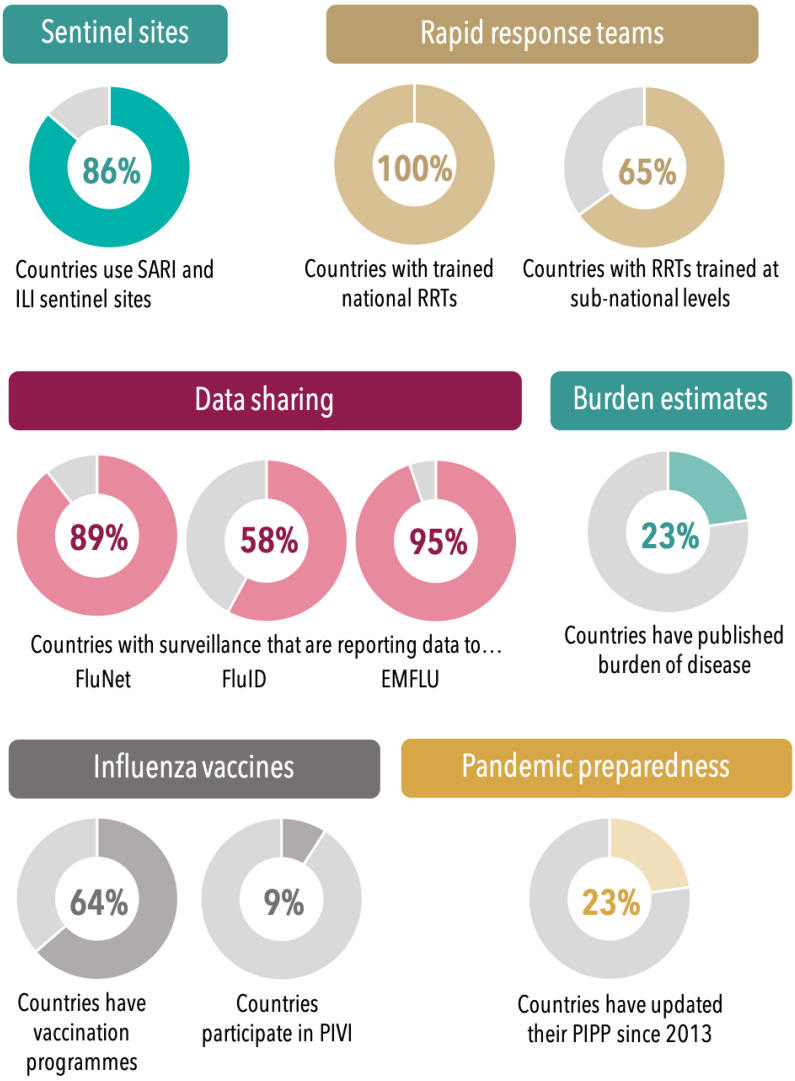

Figure 4. Main components, and current status, of influenza programmes in EMR. (Number of countries in EMR = 22; number of countries that have surveillance = 19).

Other capacities in EMR are similarly increasing, with growing use of seasonal vaccines and an increasing number of laboratories able to use RT-PCR, cell culture and gene sequencing technologies. Research and data analysis are ongoing, particularly in estimating disease burden and understanding vaccine use.

Vaccination coverage across the region remains low, even in countries with vaccination programmes in place. And influenza preparedness planning is similarly weak, with less than half of EMR countries having no publicly available preparedness plan for pandemic influenza.

1.3. Challenges to tackling influenza

Despite progress in influenza detection, prevention and control in EMR and beyond, many challenges remain. Some of the most significant, as identified by participants at the EMARIS meeting, are listed below.

Complex operational contexts and increasing fragility. More and more countries are having to work against a backdrop of conflicts, displacements, disease outbreaks and natural disasters. More than half the countries in EMR have ongoing conflict, with 10 countries classified as fragile states by the World Bank. The region is the source of two-thirds of the world's refugees; and is home to more than half (53%) of world's population in need of humanitarian assistance. Today, there are 16 active emergencies ongoing in the region. Complex contexts like these challenge the logistics of an influenza programme.

Tackling influenza in complex emergencies: Lessons from the field

Countries facing complex emergencies tend to have fragile health systems, displaced populations, limited health workforce, security concerns and limited or no laboratory networks. Business as usual will not work for influenza programmes in these situations. But progress can still be made; experience from the field suggests that the key lies in staying flexible and building on existing assets.

EMARIS participants shared practical advice for operating within complex emergencies:

- **Surveillance**. Start with ILI surveillance using whatever systems exist, such as Early Warning, Alert and Response Networks. Choose one sentinel site for SARI if the situation allows, using value judgements to choose the right site. Use data from neighbouring countries as proxies if needs be.
- **Lab capacity**. Integrate lab functions for influenza with other public health programmes, for example by drawing on ex-Global Fund projects. Maximise capacity-building opportunities for sample collection, shipment and laboratory testing through other programmes. Where available, use the polio network for sample shipment and transport.
- **Data analysis**. Build on existing infrastructure, including case-based measles surveillance, polio surveillance, and programmes for tuberculosis, malaria and HIV/AIDS. Make use of any data analysis systems that already exist for immunization, polio or other disease control programmes.
- **Response**. Tap into existing capacity for outbreak alert, detection and investigation, including field epidemiology training programmes and rapid response teams.
- **Preparedness**. Build influenza into the National Action Plan for Health Security (NAPHS) for implementing the International Health Regulations (2005); or into any other existing

A dynamic virus with multiple hosts. Influenza can be found across a broad range of hosts from birds, bats and pigs to horses, tigers and seals. It constantly evolves and diversifies over time and space, and can jump across species anywhere, at any time. This limits our predictive power and is particularly challenging to vaccine composition, since recommendations have to be made in advance.

Variable host immunity. Immunity to influenza is known to vary significantly across individuals. In many cases, immunity is compromised by comorbidities and lack of vaccination. For example, recent data from Morocco, Oman, Tunis and Yemen show that SARI and deaths are more common among influenza patients with underlying chronic conditions, such as asthma, diabetes and heart disease. In other cases, variable immunity may be associated with waning immunity over time (of up to 7% per month) for some groups, the impact of repeat vaccination, or imprinting (where a person's first infection with influenza determines how they respond to influenza virus infection or vaccination for the rest of their life).

Patchy vaccine performance. Vaccine effectiveness varies from year to year. Since 2015, there has been a steady decrease in influenza vaccine effectiveness, largely driven by the decreasing effectiveness of the A(H3) vaccine. In part, this may be because the use of egg-based production introduces structural changes into the virus.

Slow manufacturing timelines. It takes around six months from the time vaccine recommendations are made by WHO to the time when vaccines are available for use. In the case of a pandemic, this is

far too slow and means that vaccines can only be made available at late stages in the epidemiological curve. Manufacturing vaccines is a complex process, which needs to include a number of steps beyond producing the vaccine itself, such as packaging, potency testing, regulation and distribution.

Limited use and uptake of vaccines. This represents a gap in implementation: even in countries with vaccination policies, programmes are weak. The lack of vaccination programmes poses a double challenge to tackling influenza: it limits the use of vaccines for seasonal influenza; and evidence shows that it can also hold up access to a vaccine during a pandemic.

"Despite widespread policy recommendations on influenza vaccination, attaining high coverage rates remains a challenge in the Eastern Mediterranean region."

Vaccine hesitancy. Listed by WHO as one of the top ten threats to global health, vaccine hesitancy is a growing concern, and not only for influenza. The reasons why people do not choose to vaccinate are complex and vary significantly across different countries, contexts and communities. They are thought to include complacency, inconvenience in accessing vaccines, and lack of confidence.

Global barriers to sharing. Global treaties, trade sanctions and legal bindings can put up barriers to sharing data and viruses for influenza surveillance. For example, the recent trade sanctions against Iran have made preparing and shipping influenza specimens particularly difficult. In other countries, national influenza centres have had problems sharing influenza viruses because of conflicts with national legislation on access and benefit sharing arising from the recent implementation of the Nagoya Protocol that is part of the Convention on Biological Diversity.

Inconsistent and incomplete surveillance data. The timeliness, quality and representativeness of data shared to global and regional platforms varies from country to country. In many cases, data is reported too late to be included in the bi-weekly influenza updates issued by WHO.

"In competency building, we need both all-hazard capacities and hazard-specific capacities."

Lack of preparedness planning. Globally, more than half of the world (99 countries, including 14 in EMR) still have no publicly available pandemic influenza preparedness plan. This represents a big gap in the fight against influenza; but it is also an opportunity for introducing a multisectoral approach to planning that can simultaneously build IHR core capacities and address other hazards beyond influenza.

2. Virological surveillance in the Eastern Mediterranean

2.1. Virological surveillance networks

Countries undertake virological surveillance for many reasons, including, for example, to:

- detect and characterize circulating influenza viruses;
- identify novel strains of influenza, including zoonotic ones with pandemic potential;
- contribute to global vaccine strain selection by isolating and sharing viruses;
- evaluate susceptibility of influenza viruses to antivirals;
- identify groups at high risk of severe disease to target education and prevention measures; and
- report data to ministries of health and WHO;

From physicians and National Influenza Centres (NICs) to WHO CCs and regulatory laboratories, there are well-developed and developing global and regional networks of stakeholders involved in collecting and analysing data to support virological surveillance (see Figure 5). The outputs of these networks feed into routine surveillance and virus characterization at country and global levels; and enable the development of country-specific risk assessments and recommendations for action. They also inform the biannual vaccine composition meeting convened by WHO.

The EMR influenza laboratory network includes 17 NICs in 16 countries and a further 4 national influenza laboratories. The network forms the basis for regional preparedness; and it tests beyond influenza (including, for example, MERS-CoV, RSV and other high-threat pathogens).

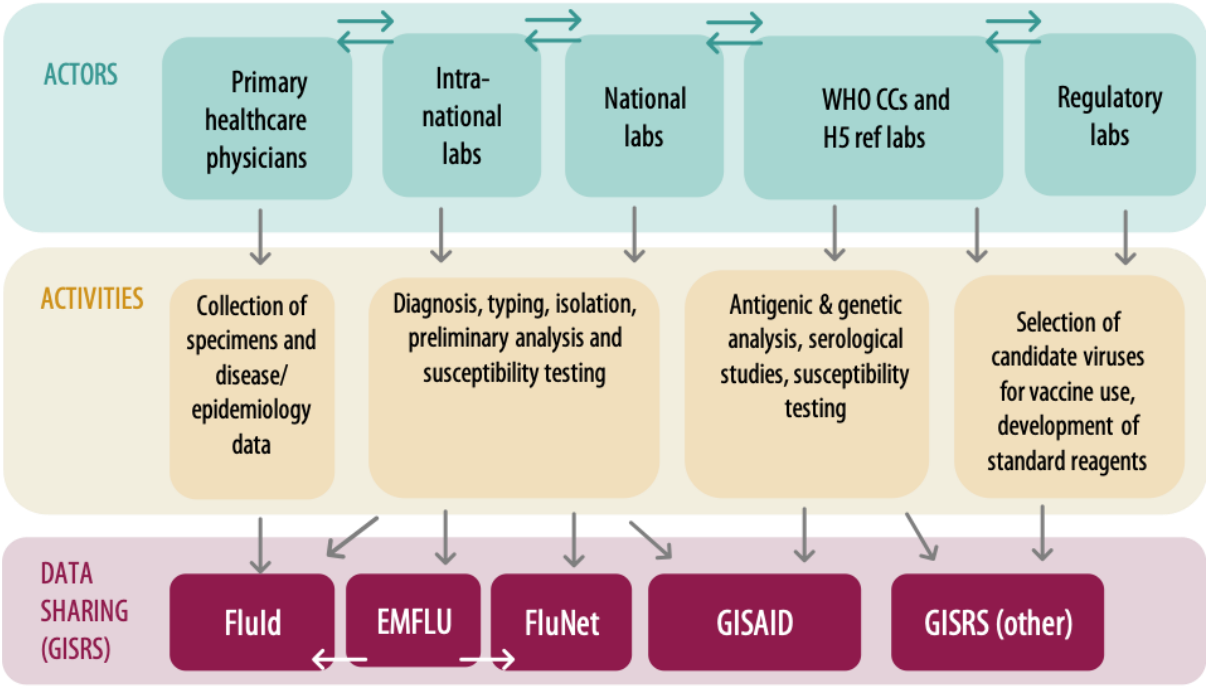

Figure 5. Each link in the global and regional virological surveillance chain has a distinct role.

To work effectively, virological surveillance relies on timely and consistent data sharing through GISRS. This, in turn, relies on rapid diagnosis and initial characterization (of both type and subtype) at NICs followed by timely reporting of data to FluNet and regular shipment of specimens to WHO CCs and H5 reference laboratories. To support this, the WHO Shipping Fund project provides shipping services for all NICs and other influenza laboratories to cover the cost of sending samples to a CC or H5 reference laboratory; and to provide logistical and technical support.

While most specimen collection is done within the public sector, private physicians supplement the public network in some countries, providing a huge asset to surveillance. In Morocco, for example, up to 24 long-term voluntary partners in the private sector collect samples and ship them (free of charge) to the NIC for testing. Experience suggests that good participatory involvement is critical to engaging the private sector in this way. Private volunteers in Morocco are given no rewards or incentives for contributing to influenza surveillance; but they are invited to all the relevant meetings, included in briefings and trainings and regularly contacted through scientific organizations.

NICs are an important link in the surveillance chain, in EMR as elsewhere. In many countries, their role extends beyond diagnosis, typing, virus isolation and preliminary analysis or sequencing. For example, the NIC in Palestine has multiple other functions, including:

- providing epidemiological data to health directorates and government departments;
- providing physicians with equipment to collect, store and transport samples;
- detecting any significant shift in the virus type and informing national and global health officials; and
- providing technical help and training in the fields of sample collection, diagnosis, storage, transport and biosafety and biosecurity issues and good safe practices.

WHO CCs and H5 reference laboratories are equally critical to the global surveillance network. In addition to providing detailed antigenic and genetic analysis, these laboratories support NICs by providing updated diagnostic reagents, reference viruses, ferret anti-sera and cell lines for isolation. They also provide technical support, training courses and learning exchanges; and develop updated protocols and sequences of primers for NICs to use.

CDC yearly lab work on influenza viruses

CDC's Influenza Division has served as a WHO CC since 1956 and is the world's largest reference centre for public health interventions to control and prevent pandemic and seasonal influenza. Every year, the centre:

- develops, manufactures and deploys **diagnostic kits** to support the testing of 100,000 specimens in 93 state and local public health labs;
- does full **genetic sequencing**, on about 7,000 influenza viruses;
- tests about 2,000 flu viruses for **immune properties**;
- prepares as many as 50 **candidate viruses** for use in vaccine production; and
- **integrates all data** from the same specimens to support vaccine virus selection.

2.2. Assessing and assuring lab quality

External quality assessment (EQA) is a system for objectively checking a laboratory's performance and is a critical aspect of laboratory quality management. Participating in an EQA programme gives laboratories objective evidence of their testing quality. It also delivers valuable data for comparing performance across sites, identifying systematic problems with kits or operations, and highlighting training needs.

The EMR influenza laboratory network participates in several EQA programmes. Most recently, this includes:

- **A CDC Influenza Molecular Quality Assessment**. This started in April 2019 and is ongoing.
- **An EQA of proficiency for isolation and identification of influenza viruses** using three different cell culture techniques (CPE, HA assay and ID). Eight laboratories in EMR participated; only one got 100% correct results for all three techniques. Most participating laboratories could detect influenza virus growth and could identify virus amplified from samples. Some laboratories failed to isolate and identify viruses from samples with lower titres of virus, highlighting issues in the sensitivity of influenza virus isolation methods between laboratories.
- **A second EQA for detecting MERS-CoV** using molecular technologies, for which 17 out of 20 labs from EMR returned correct results. Follow up action includes on-site and sub-regional training, which will be conducted in 2020 in collaboration with CDC.
- **The annual WHO EQA Project (EQAP) assessment for detecting influenza viruses by RT-PCR**. Results from this show significant improvement over the past decade, with the proportion of correct results up from 50% in 2007 to 90% in 2019.

"The EQAP has allowed EMRO to identify the capacities and resources need by countries for sustainable improvement."

The results of annual assessments form the basis for EMRO to identify capacity and resource needs across the region. And in all cases, EQAs in the region are followed up by corrective actions, such as national or regional trainings. But capacity building also happens across the laboratory network outside EQAs, for example through training in CCs, regional exchange visits, technical missions and NIC assessments.

2.3. Challenges to virological surveillance

EMARIS participants raised several challenges to effective virological surveillance, as listed below.

Limited animal surveillance. Animal surveillance is important for influenza, not least because of the pandemic potential that zoonotic strains can have. But systems for animal surveillance are weak in many countries; and the wide range of animal hosts (across wild and domestic populations) makes comprehensive animal surveillance very difficult in practice.

Barriers to EQAP. Several laboratories in EMR are excluded from participating in EQAP because they have no access to the resources required to meet stringent shipping requirements (for example, the use of dry ice). Oher laboratories at a sub-national level are excluded because the EQAP only targets national capacity; although this barrier can also be seen as an opportunity for reference laboratories to develop and run their own sub-national assessments.

Other operational challenges. EMARIS participants from across EMR cited a range of operational challenges including the presence of complex emergencies as well as a lack of diagnostic and safety equipment, a lack of appropriate infrastructure (such as a biosafety level 3 laboratory), limited experience and training opportunities, a lack of funding and limited access to resources because of international sanctions.

2.4. Emerging technologies to watch out for

Active research and development throughout the global surveillance network drives continuous improvement. This includes the development of new techniques, methods and reagents, as well as innovations to resolve problems in specific tests or processes and analytical improvements to increase the potential use of data.

Asked to name the most exciting innovations on the horizon, speakers at EMARIS identified six emerging technologies that could make a big difference to influenza surveillance and understanding: next-generation sequencing (NGS), bioinformatics, increased computer power, minIon rapid sequencing, new vaccine technologies, and point of care diagnostics and molecular testing (see Figure 6).

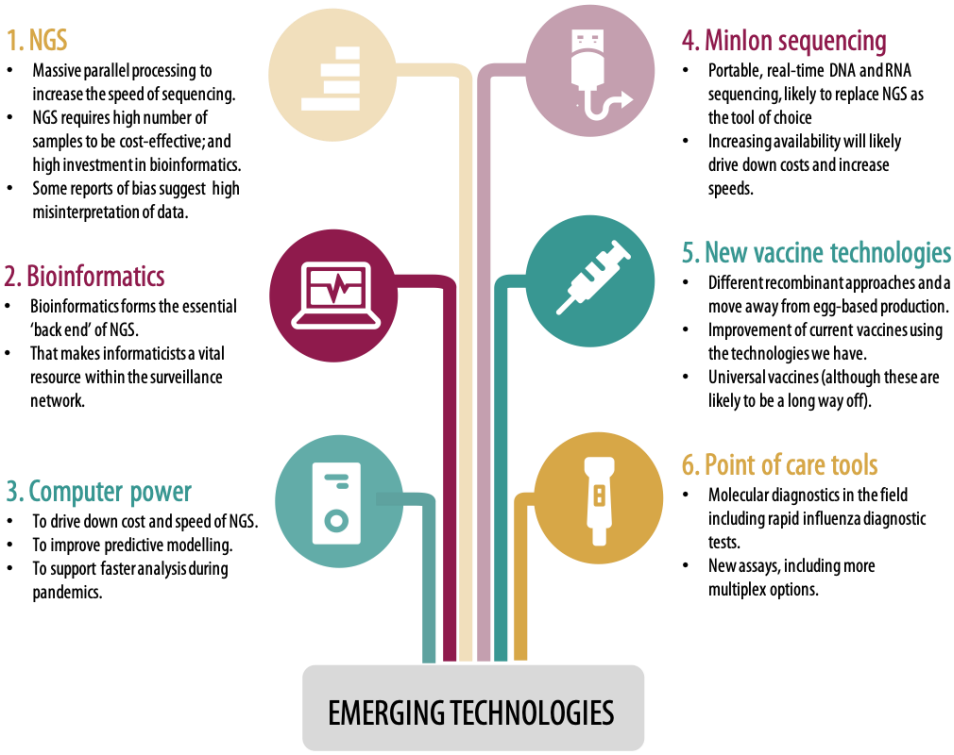

Figure 6. Six areas of emerging technologies that could significantly improve influenza surveillance and understanding.

3. Estimating the burden of influenza

3.1. Data reporting

Influenza surveillance data enable a range of activities, including monitoring disease, tracking viruses, establishing subtypes, identifying threats at the human-animal interface, informing decisions and guiding capacity building. In all cases, surveillance data must be robust enough to be used with confidence. That means that data should be:

- of the best quality possible;
- up to date (with a historical record where possible);
- representative;
- easy to share;
- standardized; and
- interlinked.

WHO's Global Influenza Programme (GIP) collects multiple types of influenza surveillance data through global and regional platforms, including FluID, FluNET and EMFLU. To standardize these data and ensure they are easy to use, they are all combined into a single platform, FluMart. FluMart accepts data from multiple sources and in multiple formats; it can be managed and supported anywhere. Today, the platform includes data from 198 countries and 380 reporting sites.

FluMart data are used by GIP to develop outputs for different purposes and audiences, including:

- **Outputs for countries**, for example, severity thresholds and average curve applications.
- **Outputs for modelling groups**, including tailored data downloads.
- **Outputs for influenza focal points**, including charts on timeliness and consistency in reporting, analyses to support vaccine composition and virus selection, and pandemic preparedness indicators.

Every two weeks, the WHO uses FluMart data to publish a global influenza situation update.

3.2. Estimating burdens: tools and tactics

Reporting data is important to monitor disease and inform decisions on influenza prevention and control. EMARIS speakers described four further types of studies that can be particularly useful in communicating the value of influenza policies and programmes.

Burden of disease studies
Burden of disease studies estimate the socio-economic burden of influenza in terms of, for example, lives lost, impact on GDP, or cost-effectiveness of government action. They can be used to support policy development, communicate disease severity, strengthen surveillance and expand knowledge and understanding among other things. In particular, by estimating the national burden of influenza, countries can more effectively prioritize their resources, evaluate their influenza strategies, inform their treatment guidelines and support decisions about vaccination.

In EMR, work on estimating the burden of influenza has increased significantly over the past seven years. Since 2012, WHO has done four workshops on the subject in the region and supported several countries to calculate their influenza burden. Today, five countries have published their results, with another seven countries almost ready to publish. All twelve studies have broadly followed the WHO protocol for estimating burden of disease, but with a flexible approach to allow for variable country contexts, since each country has its own way of thinking about influenza.

"WHO protocols are very good but they need to be modified to fit local contexts because each country is different."

Across the region, work to estimate the burden of disease has already proved useful in securing investment in influenza prevention. This includes, for example, supporting decisions to implement vaccine policies and programmes, participate in the Partnership for Influenza Vaccine Introduction (PIVI), secure manufacturing capacity (even if only for a limited time), and ensure uptake among some target groups.

Impact modelling
Impact modelling estimates the value of a vaccination programme in terms of lives saved. It is done through a four-step process that begins with quantifying the number of observed influenza cases and estimating illness among susceptible population before calculating the illness in a counterfactual population and finally working out the difference between the observed and estimated illnesses.

Impact modelling estimates can improve situational awareness about influenza activity and risk, especially among people targeted for vaccination. Experience from the United States, where these estimates have been regularly calculated for nearly a decade, suggests that impact modelling can demonstrate huge benefits of vaccination to the economy. For example, the results of impact modelling during the 2017-18 influenza season show that vaccination prevented 7 million influenza illnesses and 8,000 deaths.

Cost of illness estimates
Cost of illness studies estimate how much money is spent treating and diagnosing illness, and how much income is lost from patients or caretakers missing work. They also identify who pays for these costs. These estimates allow for an impact assessment of vaccination in terms of number of cases and total cost.

"If you know the cost of illness, you can estimate the impact that flu vaccine would have."

Studies on the societal costs of influenza in Mongolia and elsewhere suggest that:
- The direct cost of illness from seasonal influenza hits poorest households hardest; and is higher for influenza-positive patients.
- The costs of illness to government can be significant, amounting to 2–8% of national GDP.

Pandemic Influenza Severity Assessment (PISA) assessments
Developed by WHO in 2016, the PISA tool offers a standard, quantitative approach to defining whether an influenza outbreak is mild, moderate or severe. In PISA, severity is defined using three

indicators that are based on surveillance data: transmissibility, seriousness of disease and impact. Data for each indicator are collected and used to establish thresholds for describing an influenza event as no, low, moderate, high or extraordinary severity.

Knowing the severity of an outbreak can help policy-makers decide what action to take. For example: at season onset, the government may remind people about vaccination; at low severity, the government confirms that beds are ready; at moderate severity the government starts using community messaging; at high severity the government considers more drastic measures such as closing schools and cancelling mass gatherings; and at extraordinary severity the government may call a meeting to decide whether or not to declare an emergency.

Today, 26 countries are using the PISA tool to set thresholds and report severity to WHO. Some countries have further linked thresholds to non-pharmaceutical interventions.

PISA in Morocco

Morocco started using the PISA tool in March 2019, with the triple aim of:

- describing the epidemiological situation and assess the severity of an influenza outbreak;
- informing national and global risk assessments; and
- informing public health preparedness, response and recovery measures and resource allocation.

In the six months since the project started, the country has reached national consensus on the parameters to be used for each indicator; and, using a moving epidemic method, established thresholds for the transmissibility indicator. Next steps focus on achieving the same for the

3.3. Driving policy with data: Lessons learnt

Drawing on their experience in driving policy with data, EMARIS speakers and participants shared a number of the lessons learnt, both in EMR and beyond.

Timeliness of data sharing is critical.
In all cases, FluMart-derived products are only as good as the data available. This makes timely and consistent data sharing critical to these products' accuracy. Analysis of EMR reporting in 2019 shows that 15 countries reported data to FluID and FluNet in 2019, but only 2 did so consistently and on time.

Estimating influenza burden requires a flexible approach.
Different countries have different data sources and different data requirements, so there is no one-size-fits-all protocol for estimating burden of disease. Each study must be carefully tailored to respond to country needs and priorities. In some cases, countries may need to devise an alternative method to estimate the burden on special populations, such as refugees who have no access to sentinel sites. To that end, EMRO has developed a manual for estimating the burden of communicable disease in high-risk populations.

How data are communicated matters.
Communicating the value of influenza policies and programmes is important for all stakeholders, including leaders, government ministries, healthcare providers and the general public. Such communications should be user-friendly and tailored to meet the priorities and concerns of each audience. Preparing key messages and soundbites before the influenza season starts can help ensure that people talking to the media or others stay on-message. Media schools, where journalists are brought in for special influenza briefings, have been used successfully in the United States to ensure the media serves as an equal partner influenza control.

"The media can be a key ally in mobilising communities to protect themselves."

Systems thinking could provide insights to behaviours.
While not yet widely used in this context, a systems approach could prove useful in understanding the drivers behind the behaviours of specific groups, such as healthcare workers who refuse to vaccinate. Similarly, mixed method approaches that combine quantitative data with qualitative approaches could also provide more explanatory information and enable a stronger understanding of the attitudes and perceptions behind certain behaviours.

Money is often the limiting factor in increasing investment in influenza.
Many countries—especially LMICs—have limited resources and many competing health priorities. In these countries, even with robust burden of disease data and compelling communications it can be difficult to secure a greater budget for influenza prevention and control. In all cases, it is the ministries of finance that hold the purse strings and they are a primary target for advocacy and communication.

4. Leveraging outbreak structures for influenza

4.1. Outbreak investigation and response networks

In considering how to leverage existing outbreak investigation and response structures for influenza, EMARIS speakers highlighted the potential contribution of three types of network: rapid response teams, field epidemiology training programmes and the global outbreak alert and response network.

Rapid response teams
The overarching goal of rapid response teams is to swiftly detect and effectively respond to public health events. They fit into the response arm of the 'prevent, detect, response' health security framework; and their value is emphasized in the IHR (2005). Rapid response teams have multiple roles; their presence enables countries to rapidly deploy people to the scene of an emerging outbreak, do timely field investigations and implement measures to control and contain the problem.

Having rapid response capacity has become a national priority across EMR and since 2015, WHO has supported countries throughout the region to develop and strengthen their rapid response teams through targeted training. Tailored to fit each country's needs, this training emphasizes the development of a multidisciplinary team of people with complementary skills (see Figure 7).

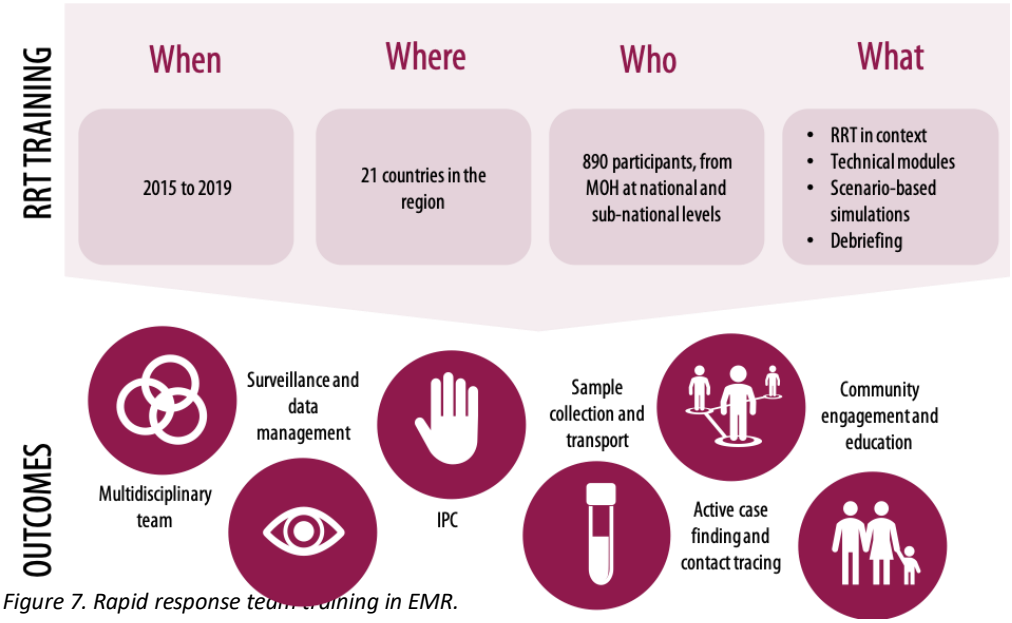

Figure 7. Rapid response team training in EMR.

Field epidemiology training programmes (FETPs)
FETPs, which are typically two-year programmes, provide longer-term training opportunities for outbreak investigation and response. Rooted in practical education, these programmes focus on learning by doing, equipping residents with the skills they need through rotations in public health institutes or deployments to the field as first responders to outbreaks. Residents of FETPs also do research as part of their training, for example outbreak investigations or epidemiological studies.

"FETPs train 'disease detectives' that can detect and respond to outbreaks as and when they occur."

Harnessing FETPs for MERS-CoV in the Kingdom of Saudi Arabia

In Saudi Arabia, MERS-CoV has provided a unique training opportunity for FETP residents. From 2014–2019, 38 residents of the national FETP investigated 13 outbreaks of MERS-CoV, spending more than 400 days in the field.

In supporting the country's MERS-CoV response, FETP residents have also conducted analyses of surveillance data and gained practical experience in the field. Through placements within the Ministry of Health, they have learned about communicating to the general public during outbreaks. And through scientific research and publication, they have also learned about communicating to the broader global community of experts.

In EMR, there are seven national FETPs, all linked through The Eastern Mediterranean Public Health Network. The presence of an FETP in a country is acknowledged as an important component of the IHR (2005) requirements for outbreak detection. But the benefits of an FETP extend much further than early detection. A strong FETP can deliver:

- better data, by contributing to surveillance;
- better policy, by providing guidelines and recommendations; and
- better action, by supporting the first response to an outbreak.

The Global Outbreak Alert and Response Network (GOARN)
GOARN is a global partnership for alert and response that is a network of technical partners coordinated by WHO. Established in 2000, the network has grown over two decades to include more than 250 partners around the world. GOARN pools human and technical resources for rapid identification, confirmation and response to outbreaks of international importance.

"GOARN wants to tap into networks like EMARIS to expand our collective ability to respond to global events."

Since 2016, GOARN's scope has expanded to include activities in risk assessment, rapid response capacity, outbreak response training, operational research and governance. And most recently, the network has been considering how it can provide more sustained support and contribute to pre-outbreak readiness efforts as well as post-outbreak follow-up activities. As GOARN continues to search for ways to increase its potential to respond to global events, in EMR and beyond, there is a potential role for networks like EMARIS in contributing technical experience and expertise.

4.2. Lessons learnt from EMR experience

Reflecting on their experience in influenza outbreak investigation and response, speakers highlighted two key lessons learnt.

The media can both help or hinder influenza investigation and response.
In Morocco in 2019, the death of a pregnant woman with influenza A(H1N1) in Casablanca attracted enormous interest from the press and generated a lot of activity on social media. The media

coverage caused panic among general public, increased pressure for data on influenza lethality and prompted a high demand for antiviral drugs. The crisis emphasized the power of the media in informing and influencing the public. It unveiled a clear need for more education and awareness on influenza among the media and the public and led the government to develop a social media plan and a sensitization strategy, which includes sharing information before the influenza season starts, adapting communications to local contexts and communicating quickly during any future event.

Community engagement and mobilization enables faster, more effective detection.
In Egypt, the Community Animal Health Outreach (CAHO) programme provides the foundation for detecting disease at village level. Through CAHO, veterinarians use participatory epidemiology tools and community outreach to engage households, avoiding stigma and ensuring cooperation in influenza surveillance. The programme has been so successful that it has even managed to detect diseases during the most disturbing situations when all other systems failed. While CAHO is primarily a veterinary-led programme, it has recently been expanded on a trial basis to include Ministry of Health physicians.

5. MERS-CoV and other emerging respiratory infections

5.1. MERS-CoV

With the first human case reported in 2012, MERS-CoV is a relatively new disease. But it has already proved to be a deadly one, with a mortality rate of 34%. Over the past seven years, MERS-CoV in humans has been detected in 27 countries, mostly in the Middle East (85% of all cases reported have been in the Kingdom of Saudi Arabia).

The disease has nonspecific symptoms that can range from no symptoms at all (in around a fifth of all cases) to severe pneumonia and death. Many patients present without any respiratory symptoms but with comorbidities, such as cardiac and renal disease; these are almost always the source of nosocomial transmission.

Outside healthcare settings, the source of human infection is dromedary camels, in which the virus is known to circulate widely, not only in Middle East but also across north, east and west Africa. This means that MERS-CoV infections are more likely to be present in areas where people are highly exposed to camels, for example in markets, farms, festivals, races, and abattoirs. Not all cases have links to camels though.

"Not all community-acquired cases of MERS-CoV have links to camels."

Despite being a recently emerging disease, there has been much progress in understanding MERS-CoV and in developing global tools to tackle it. There are good diagnostics available for humans and animals, including point of care testing solutions for camels. Therapeutics are advancing quickly, with most focus on monoclonal and polyclonal antibodies. And there are several human and camel vaccine candidates in development (camel vaccines are more promising at this stage, with two candidates already being evaluated in field trials).

WHO priorities for MERS-CoV

In the seven years since MERS-CoV emerged, efforts to strengthen surveillance, collaborate with animal and environmental sectors and implement new systems for treatment and response have had a direct impact on reducing human to human transmission and minimizing outbreaks in health care settings.

But there is much room for improvement. WHO identifies seven priorities for action in the global fight against MERS-CoV:

- Significantly improving infection prevention and control measures.
- Enhancing hospital readiness in affected and at-risk countries.
- Building advanced laboratory capacity, including full genome sequencing in affected regions.
- Improving cross-sectoral collaboration at regional and local levels.
- Implementing clinical trials for MERS-CoV therapeutics and vaccines.
- Progressing licensure of MERS-CoV camel vaccine candidates
- Further implementing the public health research agenda.

5.1.1. MERS-CoV: Lessons learnt from country experience

At EMARIS 2019, presenters from Morocco, Oman, Qatar and Saudi Arabia shared their experience of investigating, detecting, preventing and controlling MERS-CoV. Some of their lessons learnt are summarized below.

Infection prevention and control (IPC) is single most important area for improvement.
Experts broadly agree that failures in IPC have the potential to prompt superspreading outbreaks of MERS-CoV. This applies for humans and camels alike. A recent analysis of the drivers behind two hospital clusters of MERS-CoV infections in Oman during 2019 suggests that high traffic in affected wards, poor adherence to IPC measures and lack of terminal cleaning were all partially responsible. At the same time, camels living in crowded conditions where IPC is poor are also more likely to be MERS-positive compared with free range camels.

In many cases, the presence of MERS-CoV can serve as an opportunity for improving IPC. In Oman, for example, the 2019 outbreaks of nosocomial infection prompted the implementation of stricter IPC measures alongside an awareness and training programme for healthcare workers.

"We couldn't have done the competency-based IPC training without this [MERS-CoV] event."

Effective IPC measures for controlling and containing MERS-CoV in healthcare settings are thought to include: strict isolation and monitoring of IPC practices; enhanced triage; restrictions on visitors and attendants; contact screening; and environment decontamination.

Early detection is key, which requires quick and accurate case identification and good reporting.
Early diagnosis is complicated by the large number of asymptomatic cases which makes developing an effective case definition tricky. Yet clearly defined criteria for testing are important as outbreaks are known to prompt panic and a tendency to over-test. In the Kingdom of Saudi Arabia, the case definition for MERS-CoV was revised in 2018 based on learnings since 2012 and is more robust as a result. It is sensitive enough to detect most cases.

Timely and consistent reporting is also important to detect new outbreaks early. Experience in the Kingdom of Saudi Arabia suggests that linking the provision of testing services to the status of reporting can improve compliance in reporting. Indeed, this was cited as one of the seven best practices used in the country to effectively tackle MERS-CoV (see Figure 8).

Figure 8. Best practices for tackling MERS-CoV, tried and tested in the Kingdom of Saudi Arabia.

Efforts should build on existing systems wherever possible.
When it comes to tackling MERS-CoV, there is no one-size-fits-all approach. Countries should look for solutions that require minimal adaptation and extra cost. Existing systems and structures should be adjusted to account for differences in risk (for example, by tweaking transportation systems to be more responsive, by targeting risk communications at high-risk groups such as camel herders and owners, or by expanding the laboratory network for testing into camel-dense areas).

An integrated approach is a more effective approach.
As with any zoonotic disease, a One Health approach that integrates activities across human health, animal health and environment is essential. This is not always easy, especially as there remains some denial of camels being carriers for MERS-CoV. Countries that have successfully implemented an integrated approach cite joint ownership with clear roles and responsibilities as the basis for success.

Efforts must include clear communications and strong community engagement.
Regular, transparent communications and community engagement are key to building awareness and trust, avoiding panic and over- or under-testing, and to overcome problems associated with stigma and denial. They can also help ensure that interventions like contact tracing work in practice; and they can be instrumental in reducing risky behaviours. In Qatar, community service teams are regularly mobilized to help in education, risk communications, investigation, home quarantine, and referral of suspected cases. Media awareness sessions and strategic use of social media have been proven to be effective in keeping the community updated before, during and after an outbreak. In all cases, communications and engagement must cover all relevant stakeholders, including individual camel owners, camel industry representatives, veterinarians, healthcare professionals and social workers.

5.1.2. MERS-CoV: Knowledge gaps

The WHO's roadmap for MERS-CoV identifies five areas of research that are needed to prevent human infection and reduce severe illness and death:

- Virus origin, characteristics & research in animals.
- Epidemiology and transmission.
- Clinical management and infection prevention and control.

- Product development and implementation of diagnostics, therapies and vaccines.
- Impact of interventions and operational research.

Within this framework, speakers at EMARIS 2019 highlighted the second of these areas (epidemiology and transmission) as a priority in EMR, pointing to four key 'unknowns' (see Figure 9).

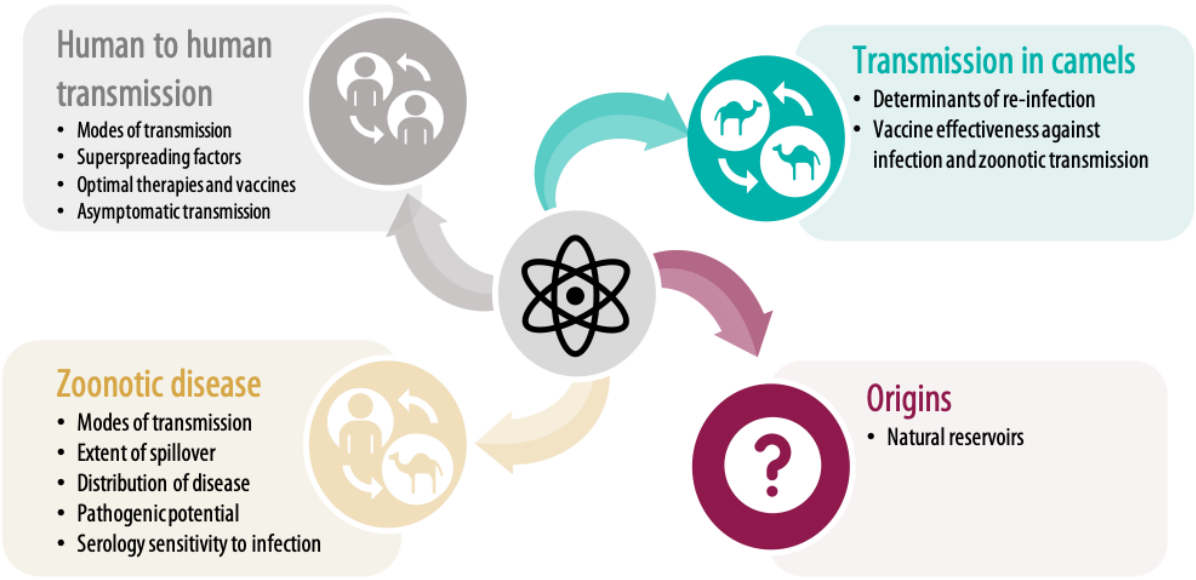

Figure 9. Key knowledge gaps in our understanding of MERS-CoV.

Our limited knowledge about zoonotic disease from MERS-CoV is particularly worrying, not least because while MERS-CoV is known to be widely circulating in north, east and west Africa, there have been no reports of disease in these areas. This may be because of behavioural differences in these regions; or it may be because the virus itself is different here. Or it may simply be that disease is there but is not being picked up because of a lack of awareness and testing.

"Why has no zoonotic disease been reported in Africa when 70% of the world's MERS-CoV infected camels are found there?"

Solving the African conundrum requires introducing and scaling up activities to collect and analyse epidemiological and virological data from areas in Africa where camel densities are high. This includes doing more testing of SARI surveillance samples in camel-herding areas (which may require the introduction of new sentinel sites), and the use of tests with a different index of infection (because not all patients with MERS-CoV make antibody responses, which makes serology tests unreliable).

5.2. Other emerging respiratory viruses

5.2.1. Respiratory syncytial virus (RSV)

RSV has long been recognized as the leading cause of illness and death from acute lower respiratory infections in young children and the elderly. Every year, there are 33 million cases of RSV in children under five, and around 60,000 RSV-related deaths.

RSV has many symptoms but importantly, fever may be absent; this makes case definition difficult. There are lots of products in development to treat and prevent RSV, with a vaccine nearly ready. But surveillance of the disease remains patchy, varying from country to country. Successfully deploying a vaccine once its available requires a better understanding of seasonality, risk factors and burden of disease.

Harnessing GISRS for RSV surveillance

Amid concerns about the world's capacity to monitor RSV and target vaccines effectively, WHO launched a project in 2016 to test whether the influenza surveillance platform, GISRS, could be adapted to the task. The project, which was funded by the Gates Foundation, aimed to test the feasibility of using GISRS for RSV surveillance; and to establish standards and mechanisms for doing so in a cost-effective way that does not negatively impact flu surveillance.

The first phase of the project (2016–19) was about developing a strategy and piloting it. That included developing a case definition, establishing a new algorithm for transporting and testing, producing reagents, carrying out training, and trialling the system in sentinel sites and laboratories. Results from this phase show that the RSV case definition works well and that using the GISRS network for surveillance can be done with incremental costs to, and minimal impact on, influenza surveillance.

Phase 2 of the project (2019–21) will focus on scaling up the number of countries involved, refining the target group (to concentrate on young inpatients) and expanding the scope (to include typing, gene sequencing and seasonality assessments).

5.2.2. Respiratory adenovirus (HAdV)

HAdV is a DNA virus that is very diverse, covering 7 species and more than 90 genotypes. It is a hardy virus that circulates all year round and can persist in the environment for a long time. HAdV causes lots of different syndromes and has multiple manifestations depending on type; many cause ARIs. The epidemiology and severity of HAdV tends to vary by type and can be different in immunocompromised populations.

"Respiratory adenoviruses may be an overlooked cause of severe respiratory illness."

Recent studies suggest that several emerging and re-emerging HAdV types may be associated with outbreaks of ARIs, including severe respiratory illnesses in the United States and severe pneumonia in Asia.

5.2.3. Enterovirus D68 (EV-D68)

EV-D68 is one of more than 100 non-polio enteroviruses. An unpredictable virus, EV-D68 can cause mild to severe respiratory illness, or no symptoms at all. Until 2014, EV-D68 was poorly resourced: it was not a notifiable disease, there were no diagnostics for it and epidemiologic and clinical knowledge about it was limited. Then there was a major outbreak in the United States, during which there were more than 1,100 confirmed cases, some of which were associated with acute flaccid myelitis. Since then, EV-D68 has received more attention, although it remains under-resourced. Recent studies suggest that the virus may have a role in severe respiratory infections among children with asthma.

6. Vaccinating high-risk groups

6.1. Use of influenza vaccines in Eastern Mediterranean

Expanding seasonal influenza vaccination programmes is an important objective of WHO and other global, regional and increasingly national stakeholders. This is because such programmes are increasingly recognized to serve as:

- **A tool for reducing disease burden.** Vaccination reduces hospitalizations and deaths, leads to fewer clinic visits, and minimizes the financial and societal costs of missed work days.

- **A mechanism for strengthening health systems.** Influenza vaccination programmes build systems, capacities and infrastructure that can be equally used for other diseases, for example cold chain storage, healthcare worker skills, and programme integration.
- **A way of improving pandemic preparedness.** Influenza vaccination programmes can serve as systems for timely delivery of vaccines during pandemics. Moreover, evidence from previous pandemics suggests that countries lacking seasonal vaccination infrastructure are less likely to receive pandemic vaccines first.

"Donors of vaccines may favour countries with proven records of strong vaccine programs."

Across the world, the number of countries with influenza vaccine policies in place has steadily grown over the past decade, from 74 countries in 2006 to 115 countries in 2016. Yet, even in countries where policies exist, influenza vaccination programmes remain weak. Overall, vaccines remain significantly underused, especially in LMICs, where 47% of the world's population receive just 4% of the world's influenza vaccines.

In several regions, vaccine coverage is even low among high-risk groups like healthcare workers. For example, a review of recent publications from EMR shows that coverage rates for seasonal influenza vaccination in healthcare workers is less than 30% across the region as a whole, with large variability from country to country (ranging from 8.8% in Pakistan to 87% in Saudi Arabia).

6.2. Barriers to influenza vaccines in EMR

There are many reasons why countries may find it difficult to introduce or maintain a vaccination programme. Barriers tend to fall into four categories:

Political barriers include perceptions of affordability and relative value as well as lack of national policies, operational plans and regulatory experience and expertise. A lack of availability and the limited number of approved products can also dissuade policy-makers from embarking on a vaccination programme for seasonal influenza.

Industry constraints include the uncertainty of future markets, the low profit margins and high competition as well as the high costs of approval in many countries.

Technical challenges include difficulties in calculating the influenza burden and matching supply with demand, the increasing variety in products available and the fact that many target groups are not infants, which makes it hard to integrate influenza vaccines into existing routine immunization programmes. Measuring the impact of vaccination is also both complex and expensive.

Public hesitancy is driven by many complex factors that include doubts about efficacy, concerns about adverse effects, lack of understanding about influenza and the risks it poses, and limited availability of vaccines (or lack of awareness of availability).

6.3. Increasing vaccination coverage: Lessons from EMR

Establishing a sustainable seasonal influenza vaccination programme doesn't happen overnight. CDC identifies five critical steps in developing a national programme (see Figure 10); and the agency works with various countries in EMR and beyond to support each one of them.

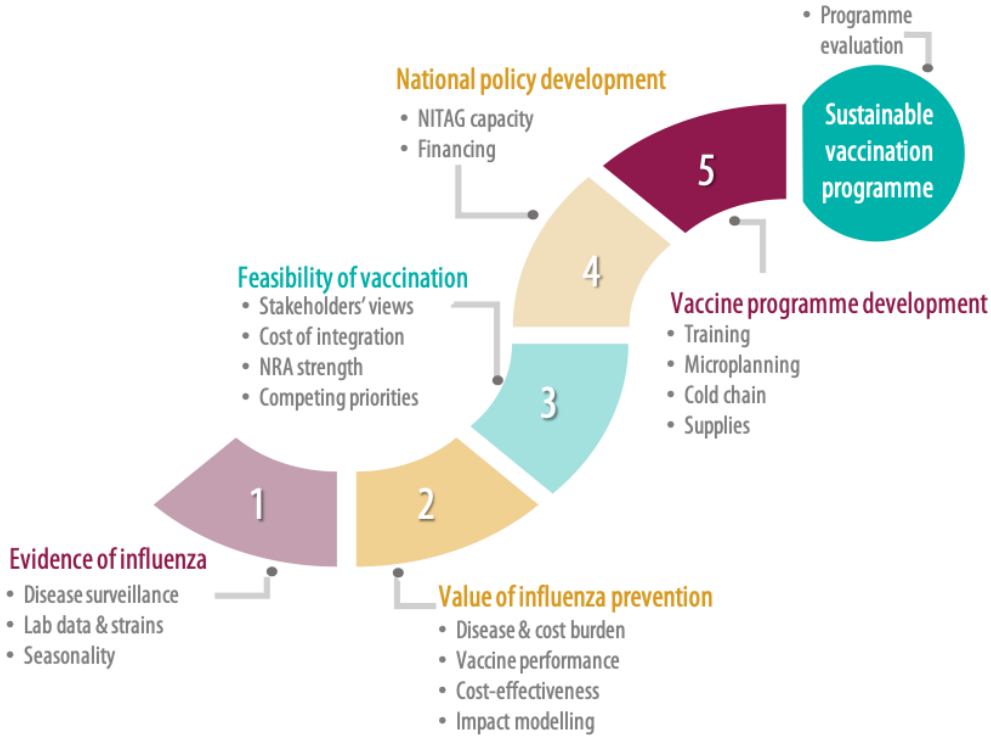

Figure 10. Five key steps to establishing a national influenza vaccination programme.

There are also several programmes across EMR that offer models for successful implementation. Speakers from Egypt, Morocco, Oman, Pakistan and Saudi Arabia shared tools and tactics for increasing vaccination coverage based on their experience. The key enablers that they cited are listed below, although they all agreed that there is no single action that will enable a sudden surge in vaccine uptake. Rather, it is a mix of interventions that is required to succeed.

Strong leadership and oversight.
At the highest level, this includes political will, understanding and endorsement. A strong recommendation from the national immunization technical advisory group (NITAG) is often critical to gaining the political backing for an influenza vaccination programme. Visible participation of country leaders, business leaders and other key influencers in the programme can help secure public buy-in. For some target groups, including healthcare workers, mandated vaccines in the workplace have been proven to be effective in improving vaccine uptake.

"Ensuring that the NITAG has the right, evidence-based, information to make a decision can make a huge difference in driving policy."

Robust planning and evaluation.
Both before and after a new vaccination programme is established, a range of activities are needed to plan for and later evaluate success (see Table 2).

Table 2. Activities to support planning and evaluation of a new seasonal influenza vaccination programme.

Activity	Why it's important
PLANNING	
Understanding acceptability and communication needs of target groups	• To forecast uptake and demand • To decide in which group to launch a programme • To design effective communication campaigns
Developing the local and regional evidence base	• To understand the out of pocket costs to patients • To calculate the cost to government • To assess the indirect, societal costs
Strengthening NITAGs	• To improve technical expertise • To secure a recommendation
EVALUATION	
Monitoring, evaluation and follow up	• To monitor safety • To develop key messages • To ensure growth
Economic evaluations, effectiveness evaluations and impact modelling	• To build the evidence base on value for money • To convince policy-makers to invest

Strategic targeting of high-risk groups.
WHO recommends starting with a single target group when establishing an influenza vaccination programme for the first time. Several EMARIS speakers echoed this advice, suggesting the need to plan vaccination programmes according to the target groups selected. For example, in Saudi Arabia, Hajj pilgrims have been a target group for influenza vaccination since 2016. Freely available at fixed health centres across the country, the vaccine is linked to the Hajj permit application process as a way of improving vaccine uptake. The approach seems to be working: uptake among local pilgrims has increased from 29% in 2016 to 50% in 2019, including 90% among healthcare workers.

Healthcare workers are often among the first groups targeted for vaccination, not least because vaccination among this group is known to reduce healthcare-associated infections and save treatment costs. Healthcare workers are also known to be key influencers in securing public uptake. For example, a study to assess the acceptability of influenza vaccines in Morocco among pregnant women found that a recommendation by a healthcare worker was among the top three factors that would persuade pregnant women to get the vaccine.

Communications rooted in behaviour change theory.
While communications are important to increase awareness and understanding of flu, experience suggests that they rarely work on their own but require other interventions to be implemented at the same time (for example, the introduction of mobile vaccination clinics to increase availability).

"Vaccine hesitancy is complex, context-specific and varies across time and

The drivers of vaccine hesitancy are diverse and complex and in many cases changing current practices will require communication approaches and tools that are grounded in behaviour change theory. This includes, for example, the use of COM-based strategies that assume vaccine behaviour is influenced by capability, opportunity and motivation (COM) and that identify and target deficits in these areas to increase vaccine uptake.

Increased access and availability.
Regardless of which group may be targeted for influenza vaccination, experience suggests that making vaccines free and easy to access (both in space and time) is a basic step to securing uptake.

Increasing vaccine coverage in Oman: Best practices

In 2005 Oman introduced seasonal influenza vaccines for healthcare workers, Hajj pilgrims and immunocompromised patients. Since then the programme has expanded to include pregnant women and the elderly. All vaccines are provided free of charge, through fixed immunization centres throughout the country.

The programme achieves extremely high coverage rates (80–100%) in most of the target groups, with the exception of older patients (65%) and those with underlying conditions (45%). The country's success is down to a combination of approaches including:

- **A strong surveillance system** that provides real-time digital information on severity of disease, risk categories, morbidity and mortality.
- **Robust estimates of disease burden** calculated through a WHO-modified method to assess hospitalization and mortality data and regularly analysed to better understand risk groups.
- **Tailored vaccination strategies** for different target groups (for example, vaccinating healthcare workers in health facilities, pregnant women in fixed clinics as part of their prenatal care and immunocompromised patients at disease-specific clinics).
- **Increased vaccine stocks and improved deployment** to ensure sufficient and efficient supply for the target populations.
- **Effective communication for acceptance** in health facilities and in communities, for example through workshops, awareness-raising campaigns, educational materials and the use of peer vaccinators and mobile teams
- **Public-private partnerships** to share guidelines and ensure vaccines are available for all target groups in the private sector.
- **Ongoing evaluations** for continuous improvement.

7. Biosafety and biosecurity

7.1. Biosafety and biosecurity in EMR

Interest in biosafety and biosecurity in EMR has grown steadily over the past decade as recognition grows that working with dangerous pathogens and chemicals in laboratories involves a lot of risk to workers, the public and the environment at large. The importance of biosafety and biosecurity has been further underscored by the global health security agenda, where it is listed as one of the requirements for core competency in laboratory systems under the IHR (2005).

In EMR, as elsewhere, access to biosafety laboratories varies from country to country. The infrastructure available for implementing biosafety and biosecurity is diverse and so too are the legal frameworks in place. Most countries have access to a Biosafety Level 2 laboratory; there is one Biosafety Level 3 laboratory in the region, in the United Arab Emirates (UAE).

7.2. Global guidance and standards

7.2.1. WHO Laboratory Biosafety Manual

The WHO Laboratory Biosafety Manual was first published in 1983 as a means to provide the global community with practical guidance on how to implement biosafety in laboratories. The manual has evolved over time, establishing four levels of biosafety that define proper laboratory techniques, safety equipment and design, depending on the types of biological agents or toxins being studied.

The latest revision remains in progress, with an expected publication date of 2020. The new manual will differ from previous editions in several ways. In particular, it will move away from making a direct relationship between risk group of pathogen and biosafety level (BSL) of laboratory. Instead, the new manual will support a more practical risk-based approach where control measures increase with increased risk. Under this new method, each laboratory will evaluate the pathogens and procedures it deals with and assess the risks these pose in terms of likelihood of exposure and severity of harm. The risk will never be zero; and depending on the results, the laboratory will then adopt appropriate control measures.

"You can't ever completely eliminate the risk unless you don't do the work."

The new manual describes what risk assessment is, how it should be performed and what control measures should be in place depending on the results, including:

- **Core requirements**: these set out the minimum requirements for safe working practices at any facility. They include good microbiological practices and procedures, competent and appropriately trained staff, availability of laboratory and personal protective equipment (PPE), and effective decontamination and waste management.
- **Heightened control measures**: these can be anything from extra PPE, a segregated workspace, limited staff entry during processing, a biological safety cabinet, an anti-room, or a combination of these.
- **Maximum containment measures**: these are the highest type of control measures available and will only be required in a small number of cases.

Beyond risk assessment, the new manual covers various other elements of biosafety and biosecurity, including transfer and transport, programme management and national oversight. It will be accompanied by seven monographs that provide more detail on related topics such as laboratory design and maintenance, PPE and emergency response (see Figure 11).

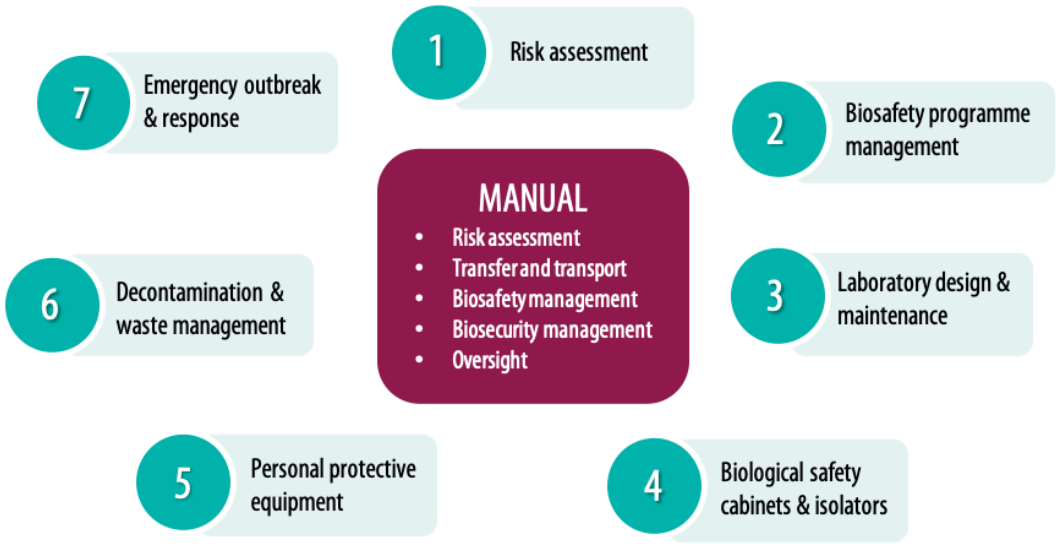

Figure 11. Topics covered by the new WHO biosafety manual and accompanying monographs.

7.2.2. CWA 15793 Standard

The CWA 15793 is a voluntary laboratory biorisk management standard that can be adopted by any facility handling biological agents or toxins. Developed by a global group of biosafety and biosecurity experts in 2008, the standard is based on a management system approach and articulates expectations for all aspects of the system including: policy, planning, implementation and operation, checking and corrective action, and review.

While CWA 15793 takes a risk-based approach, it does not use any type of risk classification for pathogens; nor does it use laboratory safety levels. The standard is fully compatible with related

standards developed by the International Organization for Standardization and the Occupational Health and Safety Assessment Series, as well as WHO guidance on biosafety and biosecurity.

7.3. Implementing biosafety and biosecurity: Lessons learnt

The IHR (2005) can open the door to better biosafety and biosecurity.
Experience from several countries shows that a Joint External Evaluation (JEE) under the IHR (2005) framework can prompt action to strengthen biosafety and biosecurity. For example, in Pakistan a National Laboratory Working Group was established to guide policy development and planning to strengthen the country's laboratory sector after a JEE in 2016 emphasized the need for stronger biosafety and biosecurity systems. The development of a NAPHS can also be used as an opportunity for better biosafety and biosecurity by endorsing their importance, establishing a national focal point and including objectives to develop a national biorisk management system.

Establishing a biorisk management system requires a flexible approach.
A flexible approach includes action to:

- Decouple risk group from biosafety level. This will avoid the desire for unnecessarily complex and unsustainably expensive facilities that are often underused. Experience in working with the Ebola virus proves that although the virus is often categorized as risk group 4, not all procedures for handling it require a BSL-4 environment.
- Prioritize improvement plans according to need. Where resources are limited, biorisk management should be based on the specific biosafety needs of individual laboratories. Having a dedicated department for biorisk management can help in this regard; in Sudan such a department uses gap analyses to identify needs, develops action plans based on results and implements them gradually.
- Adapt systems to local contexts. For example, in Abu Dhabi, where the UAE built a BSL-3 laboratory, temperatures can rise to 50°C, with 85% humidity. To ensure proper air conditioning in this kind of environment the laboratory was equipped with a double back-up air conditioning system. It was also given extra filters to account for sand in the air, which is not a usual concern.

"The department reviews the effectiveness of action plans and modifies the system accordingly to improve biosafety and biosecurity."

Much can be achieved with low-cost changes.
Biorisk management plans may include several types of activity. But they can be implemented incrementally; and many activities can be done with little to no budget. Morocco's NIC, the Institut Naitonal d'Hygiène, has been improving biorisk management consistently for a decade and a 2019 audit shows 80% compliance against the CWA 15793 across 16 areas of biosafety and biosecurity.

"Our first activities focused on things that didn't require budget."

Talking about their experience in improving biosafety, speakers from the institute stressed the importance of starting with low-cost, easy-to-implement activities. This includes, for example, defining roles and responsibilities, establishing housekeeping rules, delineating technical areas, carrying out inventories of biological agents and toxins, disposing of obsolete chemicals, and establishing a washing system for lab coats, among other things.

8. The human-animal interface

8.1. Regional tools and tactics for implementing one health

Zoonotic diseases and emerging pathogens pose a significant threat to public health: at least 75% of emerging infectious diseases, including influenza, have an animal origin. EMR is home to endemic and emerging zoonoses and lies at the epicentre of many zoonotic disease outbreaks.

In past two decades, emerging zoonotic diseases were reported in 18 out of 22 countries in the region. Across EMR, the prevalence of zoonotic disease and the emphasis placed on cross-sectoral collaboration by international frameworks such as the Pandemic Influenza Preparedness Framework and the IHR (2005) are fuelling interest in and action towards a One Health approach to tackling ARIs. There are several global tools available to support countries in their efforts; EMARIS speakers highlighted two in particular.

8.1.1. EMRO's One Health Framework

EMRO's One Health Framework was developed to help countries integrate human, animal and environmental systems for a joint approach. It is designed to allow for incremental implementation and covers nine potential areas for integration:

- **Governance and management:** mechanisms to ensure a system for joint leadership and decision-making, including managing, coordinating, and overseeing all joint activities.
- **Networks and partnerships:** collaborations between governments, partners and stakeholders to implement joint activities at all levels, from local communities to global forums.
- **Capacity assessment:** activities to identify capacity needs for joint working.
- **Capacity building:** collaborative training and infrastructure strengthening to develop multidisciplinary capacity for tackling infectious diseases at the human-animal interface.
- **Links to other plans:** integration of joint activities and systems into national plans, including NAPHS, pandemic influenza preparedness plans, and sectoral plans for animal health, public health and environment.
- **Coordinated surveillance:** mechanisms to support coordinated surveillance, including integrated databases for reporting, data sharing across animal and human health laboratories and joint community outreach.
- **Preparedness and response:** mechanisms for joint planning (for example, integrated strategies and action plans) and response (for example, joint investigation teams).
- **Applied research:** joint research agendas and activities to generate evidence for addressing priority disease impacts.
- **Risk communications:** activities to align key messages and disseminate them to all stakeholders.

The framework includes other tools that have been developed to support specific components of integration. This includes, for example, a framework for translating research into policy that supports One Health integration across the four steps of putting research into use (see Figure 12).

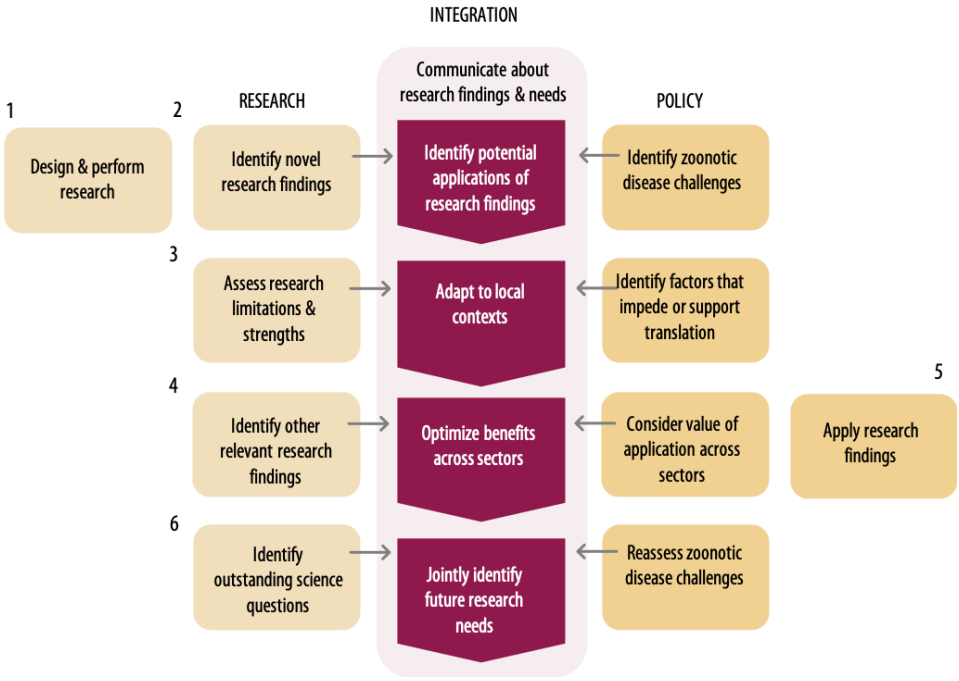

Figure 12. An integrated approach to translating research into policy.

8.1.2. One Health Zoonotic Disease Prioritization Tool (OHZDP)

In the face of finite funding, little cross-sectoral collaboration and limited equipment, many countries cannot afford to tackle all zoonotic disease threats at once. In these cases, developing a thoughtful list of priority disease threats can help countries allocate their limited resources to maximum effect. It can also help donors and partners direct their efforts to match country-specific needs.

To that end, the OHZDP enables countries to use a multisectoral approach to identifying their most urgent zoonotic disease threats and planning how to address them. Developed by CDC, the tool is both flexible and scalable so it can be easily adapted to suit many different country contexts. It emphasizes transparency, soliciting equal input from human, animal and environmental health sectors as a way of building mutual trust and cooperation.

"The process of collaborative prioritization builds the foundations for mutual trust and joint action."

Through the OHZDP, countries can end up with a list of priority disease threats that are accepted by all one health sectors, which makes subsequent action planning and strategy implementation more likely to succeed. The tool is also proven to help establish communication channels, clarify roles and responsibilities and strengthen coordination mechanisms across one health sectors.

8.2. One health in practice: Examples from the field

Efforts to implement One Health come in all shapes and sizes. Some countries are investigating different risk factors for influenza at the human-animal interface. This includes studies to track and characterize circulating strains of H9N2 viruses in the region; as well as studies to identify risky practices and inappropriate behaviours.

Some countries are implementing One Health on a broader scale as a means to tackling disease. For example, in Egypt, the government is integrating action across human and animal health to try and understand what is happening at the human-animal interface and address the threat of avian influenza there. Its approach integrates activities in six areas: laboratory systems, surveillance, data sharing, risk assessment, investigation and response.

In Qatar, the government is using a One Health approach to tackle MERS-CoV, implementing a range of activities to turn integration from theory into practice (see Figure 13). Here it is not only government stakeholders from animal health, human health and environment sectors that are involved. Industry and community participation in both planning and implementing activities have been instrumental in enabling success.

Figure 13. Mechanisms that enable a One Health approach to tackling MERS-CoV in Qatar.

8.3. Challenges for one health

EMARIS speakers and discussants highlighted three key challenges in adopting a One Health approach to tackling influenza.

Surveillance in animals.
Assessing risk of zoonotic disease and developing control strategies is impossible without effective surveillance in animal populations. Such surveillance is also important not only because it poses a public health threat but also because of the threat it poses to animal health, agricultural productivity, food security and livelihoods. And yet influenza surveillance in animals remains patchy across EMR (and beyond), dependant on multiple factors ranging from the capacity of veterinary services and whether the disease is notifiable or not to local geographies and the availability of control strategies.

Carrying out influenza surveillance in animals is particularly difficult because of:

"The wild reservoir is as relevant as domestic animals."

- the diversity of viruses involved and their continued evolution both genetically and antigenically;
- the wide range of hosts and huge reservoir of potential viruses, including in wild animals;
- the complexity in host population context, which depends on the local behaviours of farmers, market workers and traders as well as local trade networks; and
- the limited veterinary services capacity in some countries.

It may be unfeasible to achieve fully comprehensive influenza surveillance across all potential animal hosts, but surveillance can still be fit for purpose if it is well-structured to address key populations and if it includes stakeholders beyond public health and animal health. Compensation policies are known to support surveillance by improving self-reporting of sick animals, although these are not always practical or affordable.

Limited political leadership and commitment.
Across EMR, there is plenty of informal collaboration across human and animal health that happens through individual networks and interests. But few countries have formal mechanisms, or dedicated resources, for conducting or coordinating One Health activities. The ad-hoc nature of collaboration means that it is often under-resourced and unsustainable because it relies on personal relationships rather than established channels.

Limited cross-sectoral involvement.
Many One Health initiatives tend to focus on linking human and animal health. Involvement of environment stakeholders is often minimal; and other stakeholders are very rarely involved. And yet an effective response to influenza requires the active participation of many different stakeholders, from government ministries and departments (for example, the ministries of finance, trade and education) to industry representatives (industry associations) to communities (influencers, leaders and opinion makers).

9. Pandemic influenza preparedness

9.1. Pandemic threat

Influenza pandemics carry the threat of enormous impact both on health and society as a whole. The cost of a major outbreak far outweighs the price of preparedness. A severe pandemic would result in millions of deaths globally, and cost as much as US$570 billion. By comparison, the cost of pandemic preparedness has been estimated at less than US$1 per person per year.

Influenza pandemics always come as a surprise; yet the threat of one is ever-present and another influenza pandemic is inevitable. It could emerge anywhere in the world. That is why all countries and all health systems must be prepared. Countries suffering from active conflict or protracted emergencies both natural and man-made—including many of those in EMR—face additional constraints to pandemic influenza preparedness, including limited access to affected populations, insecurity, high operational costs and staff shortages.

In EMR, five countries (23%) have updated their pandemic influenza preparedness plans since WHO released its new guidance on pandemic preparedness in 2013; two have made their plans publicly available online. All countries in the region have, however, committed to develop or update their plans, using a multisectoral approach, as a matter of priority.

9.2. Global tools for preparedness

9.2.1. The Pandemic Influenza Preparedness (PIP) Framework

The PIP Framework was established in 2011 to improve global pandemic influenza preparedness and response. Adopted by all WHO Member States, the framework works as a policy and finance enabler by balancing virus sharing by countries with benefit sharing by companies. The benefit sharing raises US$28 million each year in preparedness funds, which are used to strengthen capacities at global, regional and country levels.

The PIP Framework's capacity building work covers six areas of activity:

- **Laboratory and surveillance** strengthening, including establishing new NICs, increasing the number of countries contributing to GISRS by sharing data and viruses, and supporting the shipment of specimens to WHO CCs through WHO's Shipping Fund Project.
- **Burden of disease** estimates, including global estimates for respiratory deaths as well as country estimates of burden of disease.
- **Regulatory capacity building** activities, such as self-benchmarking, trainings and accelerated approval pathways to ensure rapid access to products during emergencies.
- **Risk communications and community engagement**, including the development of a global online learning resource, OpenWHO, as well as guidance materials, advocacy events and technical support to integrate risk communications and community engagement into national preparedness plans.
- **Planning for deployment** activities, such as gaming exercises, sustainability assessments, the development of global guidance and technical support to establish a national deployment and vaccination plan for pandemic influenza.
- **Influenza pandemic preparedness planning**, with a focus on supporting countries to develop, test and update their pandemic influenza preparedness plan.

9.2.2. Pandemic influenza vaccine production

In the event of an influenza pandemic, vaccine production would essentially follow the same process that is currently used for seasonal vaccine production. This includes several steps that begins with surveillance and strain selection and continues with reassortant and reagent preparation, production and then finally formulation, filling and distribution.

"There is no single fix to improving the timeliness of current systems; it needs lots of smaller

The biggest concern in pandemic influenza vaccine production remains the timeline involved: it will take a minimum of five or six months to get a pandemic vaccine out using current platforms. This is too late to help most people hit by a pandemic.

But speeding up the process is not easy. This is because the production process is very complex, involving many different entities, activities and actions. Two elements in particular are very tricky:

- **Candidate vaccine virus (CVV) development**, which follows the typical GISRS vaccine composition meeting process for seasonal influenza and which is constrained by the limited global capacity for CVV production.
- **The 'switch'**, that is, the point at which manufacturers switch from producing seasonal vaccine to producing pandemic vaccine. Production facilities cannot be used for both but defining the switch date is complicated by several factors, including downtime requirements, uncertainties about decision-making authority and the need to balance risks.

9.2.3. Tool for Influenza Pandemic Risk Assessment (TIPRA)

TIPRA is a global tool that is used to assess the pandemic risk of influenza viruses with pandemic potential. Launched in 2016, the tool is based on nine risk elements that together assess the likelihood and impact of an influenza virus leading to a pandemic (see Figure 14).

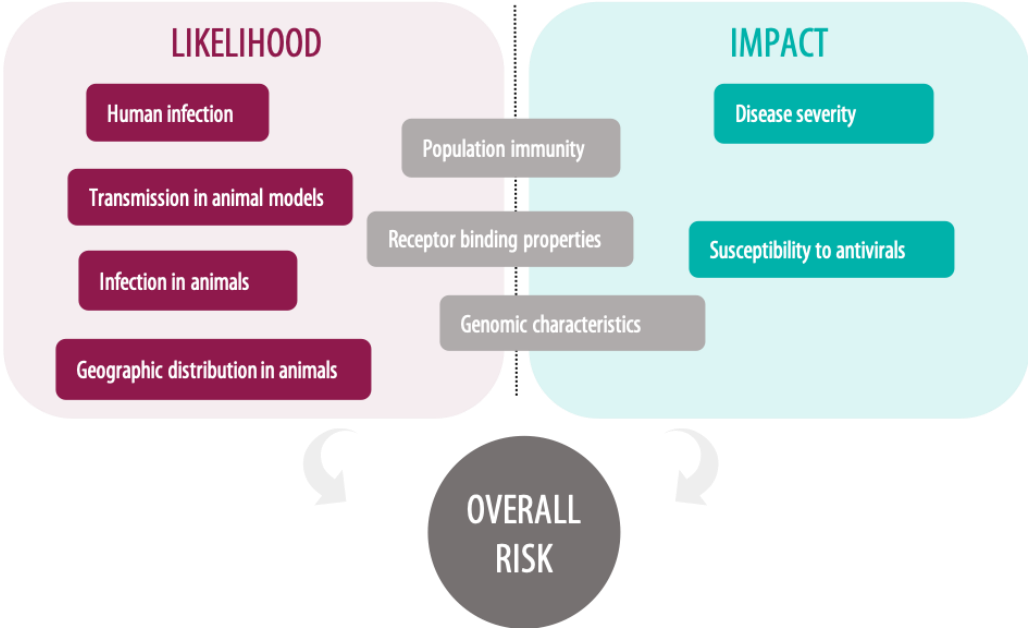

Figure 14. Nine risk elements used to assess the overall risk of an influenza virus with pandemic potential.

TIPRA provides a qualitative assessment that can be used to compare viruses. It has been used regularly by WHO since 2016 to assess known and emerging viruses, including H5N6, H1N1, H7N9, H9N2, H5N1. It is designed to consider the general extent to which a specific virus will cause a pandemic and as such does not take national contexts or capacities into account.

9.3. Essential readiness activities

In considering whether or not the world is ready to face another influenza pandemic, experts at EMARIS 2019 agreed that despite much progress over the past decade, many gaps in preparedness remain. Speakers pointed to seven types of readiness activities that countries should focus on.

Surveillance
Surveillance is one of the cornerstones of preparedness. It can be indicator-based or event-based and can be collected from formal and informal sources, both within and beyond the health system.

Vaccination
Having a seasonal vaccination programme in place is known to facilitate the acquisition and deployment of pandemic vaccines. An effective programme requires robust systems and processes for keeping vaccine records, managing the supply chain, monitoring population health, addressing coverage gaps and reaching target groups.

Risk communications
Effective risk communications during a pandemic encourage individuals and communities to make decisions and engage in practices that minimise the spread of disease. This type of communications is not simply about disseminating information to the public about health risks and events. Rather, it is about two-way and multi-directional communications and engagement with affected communities using appropriate and trusted channels.

Managing surveillance and vaccinations: best practices from Qatar

The Surveillance and Vaccinations Electronic System (SAVES) is an electronic platform for managing surveillance and vaccinations information in Qatar. It is an integral part of Qatar's e-health system and is used for real-time community surveillance. Linked to laboratories and registries across the country, SAVES supports complex data sharing and provides seamless integration at national level.

The framework has been customised to meet Qatar's needs and is specifically designed to allow users to:

- Detect outbreaks and monitor trends.
- Give policy-makers with situational awareness updates.
- Investigate incidents and implement control measures.
- Trace contacts and track disease transmission.
- Manage treatment and administer vaccines.
- Share data across public and private sectors.
- Meet reporting standards on timeliness and completeness
- Assess performance and plan for improvement

Community engagement
During a pandemic, community engagement at all levels is required to help detect, prevent and treat outbreaks. Experience with outbreaks of other infectious diseases suggests community engagement is also essential to building trust and public confidence.

Non-pharmaceutical interventions (NPIs)
In the early stages of an influenza pandemic, NPIs may be the only set of countermeasures available to countries. Such measures, which include social distancing, staying at home when sick and hand and respiratory hygiene, won't stop a pandemic, but their use could slow its spread and potentially give more time for the development and deployment of a vaccine.

Research
Research to support pandemic preparedness includes studies to better understand the determinants of pandemics. It also includes studies on the effectiveness of different interventions, which can serve as evidence to support government action.

"As we learn more, we can do more."

Planning
A national pandemic influenza preparedness plan serves as a country's guiding document for planning, prioritizing and implementing strategies around preparedness and response. Such plans are only effective if they are routinely tested through tabletop exercises and drills and kept up to date. They may include plans within the plan, including for example deployment plans to make sure that vaccines reach those who need them, plans for mass gatherings and plans for vulnerable and high-risk groups, such as healthcare workers and migrants.

PART III. CONCLUSION

Recommendations for action

Across the four days of EMARIS 2019, much of the discussion focused on exploring options for practical action to strengthen influenza detection, prevention and control. Participants considered what could be done—by Member States, WHO and partners—to improve efforts to tackle influenza in EMR. A broad range of recommendations emerged from their deliberations. These are listed below, grouped by broad category but presented in no particular order.

For Member States

1. Support early detection

Strengthen human surveillance networks in hospitals and communities, sentinel and non-sentinel sites, and public and private sectors. Surveillance needs to work all year round. Priorities in EMR include expanding surveillance to cover 100% of countries over the next two years; and increasing capacity for subtyping across the region.

Expand animal surveillance. This is critical, especially in areas with high human-animal interaction like EMR. In all cases, it should be structured to address country priorities and should contribute to the global OFFLU network.

"Animal surveillance needs to be well-structured and at scale in key populations; and diagnostics need to be fit for purpose."

Fill knowledge gaps strategically. For human and animal surveillance, focus on smart testing that targets high-risk groups and regions.

Build laboratory capacity to support GISRS. Ensure timeliness of characterization and reporting; and share data and viruses in a consistent way. Encourage participation in EQAP and follow up assessments with corrective actions as and where appropriate.

2. Enhance and expand prevention programmes, including vaccination

Build capacity for seasonal influenza vaccination. Establishing seasonal influenza programmes and infrastructure sustains pandemic preparedness. Countries should start their vaccination programmes with a single target group and increase coverage slowly and steadily, learning from experience.

"We as club of flu experts have an obligation to create a coordination plan for vaccination."

Develop a regional roadmap for expanding vaccine programmes. This should outline data needs by country or region, alongside a data collection plan. It should also prioritize activities for understanding local challenges, building capacities, establishing supply mechanisms and developing links between seasonal and pandemic vaccination.

Invest in non-pharmaceutical preventive measures including for example, hand and respiratory hygiene, breastfeeding promotion and education. IPC measures are particularly important to limit the spread of both seasonal and pandemic influenza and other ARIs.

3. Prepare for pandemic influenza

Update and test pandemic influenza preparedness plans. Plans are only effective if they are routinely tested and kept up to date. Influenza planning and preparedness should be linked wherever possible with other plans including health security plans, infectious disease plans and emergency plans. Non-pharmaceutical interventions should be integrated into plans.

Develop deployment plans. These are essential to ensure that vaccines reach those who need them during a pandemic. Countries can get support in developing deployment plans through the PIP Framework.

4. Strengthen the evidence base for policy-making

Improve understanding of influenza in EMR. This requires continued effort to conduct studies to characterize pathogens, monitor trends, evaluate systems and understand local contexts, behaviours and target groups (including refugees, healthcare workers, and animal-owners).

Expand initiatives to estimate the burden of influenza. More representative burden of influenza estimates are needed in EMR to feed into regional and global estimates, to understand the disease in the region, and to drive effective public health policies. Impact modelling and cost of illness studies in particular would be useful in quantifying the value of influenza prevention programmes and driving policy to support them.

"All initiatives for assessing the burden of influenza need to be scaled up."

Scale up severity assessments in the region to inform risk assessments and drive policy. Scaling up PISA in the region requires further validation of parameters, more interaction with clinical networks and more guidance to facilitate threshold setting.

Implement the research translation framework. Work with One Health stakeholders and policy-makers to develop joint research agendas that can fill critical knowledge gaps. And use the research translation framework to ensure research findings inform and drive policy.

Build an effective case for investment. Develop a strong narrative, supported by robust evidence, that can convince finance ministers that influenza poses an unacceptable threat to productivity and that investing in detection, prevention and control makes financial sense.

"Ultimately programme decisions rely on having a compelling financial case."

5. Search for synergies across diseases

Use influenza to strengthen capacities for other pathogens. Harness influenza infrastructure for other diseases; and use influenza preparedness to help prepare for other emerging pathogens. Influenza can act as a poster child for capacity building and help strengthen almost all JEE technical areas.

Look for opportunities to integrate influenza into other disease programmes. For example, by being creative in donor-funded projects and introducing elements for influenza as and where you can. Leverage global initiatives such as IHR (2005) and the PIP Framework to invest in focus areas. And make the most of relevant country-specific events, for example by leveraging outbreaks of other infectious diseases as an opportunity to ramp up IPC, surveillance and lab capacity; or using mass gathering planning as an opportunity to strengthen pandemic influenza preparedness.

6. Work together to align and strengthen regional efforts

Build partnerships in research and practice to support influenza detection, prevention and control in EMR. This includes partnerships across disciplines and sectors (beyond human, animal and environmental health) as well as stakeholders and scales. Public-private partnerships are particularly important, as are horizontal health partnerships that cut across diseases. Partnerships in education and training could support both research and practice, for example by enhancing rapid response teams, expanding FETPs and boosting access to veterinary curricula.

Foster regional collaboration. Create opportunities for knowledge exchange across the region through forums such as EMARIS. Bringing stakeholders together within the region to share experience and expertise would foster best practices, strengthen advocacy and education efforts and create regional market strength. Collaboration is also important to enable countries to build on successes and lessons learnt, to develop standardised approaches for comparison of results and to enable peer exchange and mentoring.

"Collaboration is vital to support new ways of working, for example to link humanitarian and development partners during protracted emergencies."

Align plans with global strategies. Harmonize regional and national policies and programmes with global strategies and advice where relevant, including the global influenza strategy as well as recommendations from the Global Preparedness Monitoring Board and the SAGE Working Group on Influenza.

Promote greater data sharing. In part, this is about making better use of existing tools for sharing data through national, regional and global platforms, for example by advocating for more timely and consistent sharing of data through GISAID, FluID and FluNet. But it is also about developing new tools for data sharing. This includes developing new channels of communication and mechanisms for collaboration between animal and human laboratories (for example shared databases or

memorandums of understanding). It also includes tailoring information systems to easily share national data with professionals and policy-makers.

7. Promote a One Health approach

Build political will for animal health. Advocate for stronger veterinary services and better animal surveillance, looking to build on existing systems wherever possible.
Prioritize zoonotic disease threats together. Using the OHZDP tool, bring One Health stakeholders together to develop a joint list of priority zoonotic disease threats and recommendations for how to address these.

"Action planning and strategy implementation are more likely to succeed if all One Health partners are equally involved in planning and prioritizing."

Develop mechanisms for cross-sectoral integration. Promote quick and transparent communications across sectors and stakeholders; and develop mechanisms to enable integration across: laboratories, surveillance, data sharing, risk assessment, and investigation and response.

8. Boost awareness and uptake

Tailor and target messages to key groups. Find the right channels and media to reach your audience; use multiple platforms and local languages where needed. Tailor your messages so that it resonates with your audience and convinces them to act.
Engage new partners in communication, including key influencers such as media, healthcare workers, private practitioners, veterinarians, animal owners, and industry and community leaders.
Think beyond communications to behaviour change. Communications rarely works to prompt action on its own; while approaches that are grounded in behaviour change theory—including COM-based strategies—may be more successful.

9. Engage and mobilize communities

Involve communities as equal partners. Communities should be involved in all efforts to detect, prevent and control influenza, from surveillance and operational research to education, outbreak response and pandemic preparedness.
Engage vulnerable and marginalised communities such as migrants and refugees; and integrate these groups into all influenza plans and programmes, without stigma.

Integrating migrants into influenza plans

Across the world, 250 million people are migrants whose social vulnerabilities can heighten the risk of illness, disease spread and death. It is important to include migrants in all influenza plans and programmes. It is not always easy to do but has been achieved in several cases, using tools such as mobility mapping. Mobility mapping identifies the profiles of travelers and finds out where they gather and where they interact to assess where transmission can happen and project the potential risk of health threats like influenza.

Such information can be used to deliver more targeted and evidence-informed public health measures at critical locations. For example, by prioritizing locations for capacity building, infrastructure improvement and stockpiling; as well as identifying key sites for enhanced surveillance and additional control measures such as health screening or IPC.

10. Be flexible and pragmatic

Adapt systems to evolving situations. This includes a diverse range of approaches. First is staying flexible to respond to volatile situations, such as fragility and conflict. Second is adapting surveillance to match changing patterns of infection, for example by collecting more data from new high-risk areas. Third is adapting vaccination programmes to new realities, for example by using mobile carts to improve uptake among healthcare workers or by using enhanced vaccines to tackle immunity waning among the elderly.
Tailor solutions to local contexts, for example tailoring capacity building to meet country-specific needs, modifying global tools (such as the WHO manual on burden of disease) to fit country

contexts, and adapting biosafety and biosecurity measures to reflect local realities. In all cases, countries should look for solutions that require minimal extra cost to implement.

For WHO

Several of the recommendations for action made throughout EMARIS were specifically aimed at WHO and global partners, rather than at countries. These fell into six broad categories of recommendation, which are summarized in Table 3 below.

Table 3. Recommendations to WHO and partners.

	Recommendations to WHO and partners
1	**Support countries to strengthen influenza systems and structures** In particular, WHO and partners should provide tools, guidance and technical support to countries to strengthen their contribution to GISRS, including maintaining reporting platforms, updating lab techniques, methods and reagents and improving bioinformatics analysis to potentially increase the use of data. Fostering innovation is also important, to evolve surveillance and sequencing technologies; and to develop operational innovations (such as the WHO Shipping Fund Project or integrated disease surveillance).
2	**Build capacities for influenza detection, prevention and control, including vaccination.** This includes technical assistance and direct support for countries to develop or update their pandemic influenza preparedness plans; as well as the provision of training materials and opportunities tailored to meet country-specific needs and priorities. Enhanced support for seasonal influenza vaccination programmes is essential to expanding influenza prevention in EMR. And continued support through the PIP Framework is similarly critical to enhancing regional capacities for influenza detection, prevention and control.
3	**Facilitate research for policy** WHO and partners can facilitate research for policy by prioritizing research questions at the global and regional level; and supporting implementation of national or regional research agendas. This includes helping to scale up initiatives to characterize and estimate the burden of influenza in the region.
4	**Link global efforts to country priorities** In part this is about 'translating' the global influenza strategy to regional and country contexts and linking global efforts to develop better tools with country efforts to control disease. In part, it is about leveraging the WHO transformation to apply the new focus on preparedness and prevention in headquarters to regional and country levels. WHO and partners can also help align global and country priorities by advocating for influenza in high-level national and international forums.
5	**Facilitate knowledge exchange and collaboration** In particular, WHO and partners should support forums and create opportunities for exchanging experience and expertise across the region, including for other respiratory diseases beyond influenza. This includes continuing to support and organize the biennial EMARIS meetings; and improving the infrastructure for alignment and collaboration, for example by developing standard protocols. It also includes advocating for other respiratory diseases in global and regional forums and programmes.
6	**Promote a One Health approach** WHO and partners should continue to work across sectors at the global level through the Tripartite (WHO, OIE and FAO) while advocating and facilitating a One Health approach at regional and country

	levels. This includes developing operational advice on how to implement a One Health approach in practice; and supporting the use of specific tools and tactics such as the EMRO One Health Framework, the OHZDP, and the One Health research translation framework.

Closing session

Three researchers received special awards for their exceptional contribution to EMARIS 2019:
- Hind Bouguerra from Tunisia, for the best oral presentation.
- Fatimah Alghawi from Saudi Arabia, for the best poster.
- Farag Elmoubasher from Qatar, for the most innovative abstract.

NIC awards went to
- NIC Oman: for sharing viruses consistently in 2018-19 and achieving annual targets.
- NIC Saudi Arabia: for reporting data regularly and in a timely manner for all weeks.
- NIC Iran: for maintaining functions in spite of very challenging circumstances.

Other recognitions for contributions made were given to the Ministry of Health, Morocco, the Francis Crick Insitute, UK, CDC, USA, Prof Malik Peiris, University of Hong Kong, Influenza Division for Prevention and Control, USA, WHO Morocco Country Office, and the influenza team in WHO Headquarters.

Dr Abdinasir Abubakar, Acting Programme Area Manager for Infectious Hazard Preparedness in EMRO congratulated all winners and thanked the planning committee, judges and EMRO team for their hard work in making EMARIS 2019 happen.

Dr Mohamed Youbi from the Moroccan Ministry of Health congratulated all EMARIS participants and organisers for a successful meeting and wished them safe travel home.

Next steps

Before the close of the meeting, WHO articulated its next steps, which include:
- producing a meeting report and sharing it with all participants;
- meeting with colleagues and partners to review and prioritize suggestions for action; and
- convening a planning committee for EMARIS 2021 and starting the planning process.

Annex I. Meeting agenda

12 Nov	Session	Facilitators/Presenters
8.00-8.30	Registration	
8.30-9.30	Message from WHO regional director	Ahmed Al-Mandhari Richard Brennan, Daniel Jernigan, Maryam Bigdeli, Ehsan Mostafavi, Abdinasir Abubakar
SESSION 1. GLOBAL INFLUENZA STRATEGY		
9.30-9.45	The Global Influenza Strategy	Ann Moen
9.45-10.00	Challenges in influenza prevention and control	Daniel Jernigan
10.00-10.15	Influenza in EMR	Abdinasir Abubakar
10.15-10.45	Coffee break	
10.45-11.00	Current and regional status of influenza subtypes	Rodney Daniels
11.00-11.15	GISRS	Wenqing Zhang
11.15-11.30	Tackling influenza in emergencies	Sk Md Mamunur Malik
11.30-11.45	CDC's International Influenza Program	Kinda Zureick
11.45-12.15	*Panel discussion: Reducing the threat of seasonal influenza: where do we stand in EMR?*	*Moderator: Richard Brennan* Ann Moen, Daniel Jernigan, Wenqing Zhang, Sk Md Mamunur Malik, Abdinasir Abubakar
12.15-13.15	Lunch	
13:15-14:15	Oral abstract presentations • Factors associated with LRTI, Pakistan, 2018-19 • Influenza morbidity & mortality, Tunisia, 2017-18 • Influenza epidemic, Yemen, 2018-19 • SARI database, Lebanon, 2018 • ILI and SARI, Pakistan, 2008-17	*Moderator: Muhammad Safdar* Asim Minallah Hind Bouguerra Mohamed Al Amad Nada Ghosn Nadia Nisar
14.15-14.30	Coffee break	
SESSION 2. INFLUENZA DYNAMICS AND CHARACTERISTICS IN EMR		
14.30-14.45	Virological surveillance networks	John McCauley
14.45-15.00	Detection and characterization of zoonotic influenza	David Wentworth
15.00-15.15	EQAP for influenza	Amal Barakat
15.15-15.30	Improving surveillance: NIC in Palestine	Ibrahim Salem
15.30-15.45	Detecting influenza in NIC Oman	Amina Al Jardani
15.45-16.15	*Panel discussion: How can emerging technologies enhance surveillance and understanding?*	*Moderator: Wenqing Zhang* David Wentworth, John McCauley, Rodney Daniels, Amal Barakat, Amina Al Jardani
19.00-21.00	Evening reception	

13 Nov	Session	Facilitators/Presenters
9.00-10.00	Oral abstract presentations • Genetic characterization of flu, Oman, 2018-19 • Detecting non-influenza in Hajj pilgrims, Iran, 2017 • Non-influenza respiratory viruses, Pakistan • ILI in public and private sectors, Morocco, 2016-19 • EV-D68 and rhinovirus C, Iran	*Moderator: Omar Elahmer* Samira Al Mahrouqi Kaveh Sadeghi Hamza Mirza Hicham Oumzil Farhad Rezaei

10.00-10.30	Coffee break	
SESSION 3. ESTIMATING INFLUENZA BURDEN		
10.30-10.45	Reporting platforms	Maja Lievre
10.45-11.00	Estimating national influenza burden in EMR	Amgad Elkholy
11.00-11.15	Impact modelling	Eduardo Azziz-Baumgartner
11.15-11.30	PISA threshold setting	Katelijn Vandemael
11.30-11.45	Measuring the cost of seasonal influenza	Bill Davis
11.45-12.30	Oral abstract presentations • SARI cases, Jordan, 2015 • SARI cases, Morocco, 2014-19 • Influenza in Hajj pilgrims, Saudi Arabia, 2019	*Moderator: Leila Bouabid* Nasha'at Ta'anni Hind Ezzine Ahmad Alowfi
12.20-13.00	*Panel discussion: How can burden data be used to advocate for better public health policies?*	*Moderator: Mahmood Nabavi* Eduardo Azziz-Baumgartner, Katelijn Vandemael, Bill Davis
13.00-14.00	Lunch	
SESSION 4. LEVERAGING OUTBREAK INVESTIGATION AND RESPONSE STRUCTURES		
14.00-14.15	Rapid response teams in EMR	Evans Buliva
14.15-14.30	Saudi FETP experience investigating MERS	Sami Almudarra
14.30-14.45	Influenza upsurge, Morocco, 2018-19	Mohamed Youbi
14.45-15.00	Human-animal surveillance in Egypt	Amira Abdelnabi
15.00-15.15	Oral abstract presentations • MERS-CoV outbreak, Saudi Arabia, 2017	*Moderator: Abdulkader Afrah* Nada Saeed AlGhawi
15.15-15.45	*Panel discussion: Can EMR investigate and respond to potential novel flu outbreaks?*	*Moderator: Abdulkader Afrah* Evans Buliva, Sami Almudarra, Mohamed Youbi, Amira Abdelnabi, Rana Asghar
15.45-16.15	Coffee break	
16.15-18.1 5	Skill-building workshops • Pandemic preparedness in fragile contexts • Data quality and epidemiologic analysis • Increasing vaccine coverage • Outbreak investigation and response	

14 Nov	Session	Facilitators/Presenters
SESSION 5. MERS-CoV AND OTHER EMERGING RESPIRATORY INFECTIONS		
9.00-9.15	Response to MERS in Saudi Arabia	Abdullah Assiri
9.15-9.30	MERS-CoV: global perspective	Maria Van Kerkhove
9.30-9.45	Fulfilling knowledge gaps on MERS	Malik Peiris
9.45-10.00	WHO global RSV surveillance	Wenqing Zhang
10.00-10.15	Beyond influenza: RSV, HaDV, EV-D68	Holly Biggs
10.15-10.30	Coffee break	
10.30-11.20	Oral abstract presentations • MERS-CoV surveillance, Saudi Arabia, 2016-19 • Zoonotic MERS-CoV, Morocco • MERS-CoV outbreak, Oman • One Health for MERS, Qatar, 2012-17	*Moderator: Badar Al-Rawahi* Abdullah Al Zahrani Anass Abbad Amal Al-Maani Elmoubasher Farag
11.20-11.50	*Panel discussion: How do we leverage influenza surveillance infrastructure for other diseases?*	*Moderator: Ann Moen* Abdulla Assiri, Maria Van Kerkhove, Malik Peiris, Holly Biggs, Wenqing Zhang
11.50-12.50	**POSTER PRESENTATIONS**	
SESSION 6. VACCINATION OF HIGH-RISK GROUPS		
13.30-13.45	Expanding vaccination in EMR	Joseph Bressee
13.45-14.00	Improving uptake for Hajj and Umra visitors	Abdullah Assiri
14.00-14.15	CDC's support for influenza vaccination	Margaret McCarron

14.30-14.45	Successful vaccination among healthcare workers	Hassan Zaraket
14.45-15.00	Increasing vaccine uptake and use in Oman	Fatma Al-Yaqoubi
15.00-15.50	Oral abstract presentations • Vaccination among healthcare workers in EMR • Vaccination in healthcare workers, Egypt, 2018 • KAP in pregnant women, Morocco, 2018 • Influenza B lineages, Pakistan, 2011-19	*Moderator: Amjad Mohamed* Mohamed Farouk Allam Shereen Elghazaly Loubna Alj Nazish Badar
15.50-16.15	*Panel discussion: How to improve vaccine introduction and uptake in EMR?*	*Moderator: Hadeel Al Sayeh* Joseph Bressee, Hassan Zaraket, Fatma Al-Yaqoubi, Abdulla Assiri, Sonja Olsen
16.15-16.30	Coffee break	
SESSION 7. BIOSAFETY AND BIOSECURITY		
16.30-16.45	The revised WHO lab biosafety manual	Uzma Bashir
16.45-17.00	Biosafety and biosecurity system in Pakistan	Aamer Ikram
17.00-17.15	Biosafety and biosecurity in Morocco	Rhizlane Selka
17.15-17.45	Oral abstract presentations • Compliance with CWA 15793, Morocco • The role of biorisk departments, Sudan • Establishing a BSL-3 lab, United Arab Emirates	*Moderator: Ghada Flaieh* Hassan Ihazmade Siza Obied Mukhtar Stefan Weber

15 Nov	Session	Facilitators/Presenters
SESSION 8. THE HUMAN-ANIMAL INTERFACE		
9.00-9.15	One Health Framework in EMR	Ghazi Kayali
9.15-9.30	Animal surveillance: implications for human health	Nicola Lewis
9.30-9.45	Prioritizing zoonotic diseases to One Health	Salah AlAwaidy
9.45-10.25	Oral abstract presentations • Risky practices for avian flu, Egypt, 2014-17 • Evolution of LPAI H9N2 in north Africa • H9N2 infection in poultry, Lebanon, 2017	*Moderator: Nada Ghosn* Hend Elsheikh Mariette Ducatez Rebecca Badra
10.25-10.40	Coffee break	
10.40-11.00	*Panel discussion: How can we help improve and integrate human and animal surveillance systems?*	*Moderator: Manal Morcos* Ghazi Kayali, Nicola Lewis, Salah AlAwaidy, Amira Abdelnabi
SESSION 9. PANDEMIC INFLUENZA PREPAREDNESS		
11.00-11.15	Progress in PIP Framework implementation	Gina Samaan
11.15-11.30	Pandemic flu threat among refugees	Alice Wimmer
11.30-11.45	Can we get pandemic preparedness right?	Stephen Morse
11.45-12.00	Influenza readiness for World Cup 2022, Qatar	Hamad Al Romaihi
12.00-12.15	Pandemic influenza vaccine development	Richard Webby
12.15-12.30	Pandemic preparedness from regulatory perspective	Houda Langer
12.30-12.45	Using TIPRA to assess the potential for pandemic	Magdi Samaan
12.45-13.00	GOARN	Patrick Drury
13.00-13.30	Oral abstract presentations • Defining influenza thresholds, Afghanistan, 2018-19 • Using PISA in Morocco, 2018-19	*Moderator: Eyad Muhanna* Mohammad Nadir Sahak Soumia Triki
13.30-14.00	*Panel discussion: Are we ready for the next pandemic?*	*Moderator: Said Saddat* Hamad Al Romaihi, Stephen Morse, Gina Samaan, Richard Webby, Alice Wimmer
14.00-14.30	Closing session	*Moderator: Ibrahim El-Kerdany*

	Rana Hajjeh, Abdinasir Abubakar, Mohamed Youbi

Annex II. List of participants

[insert list of participants here]

For more information, please contact:

Infectious Hazard Management (IHM)
unit
World Health Organization
Eastern Mediterranean Regional Office

Email: emrgohspoutbreak@who.int