1. Scope and purpose

Zoonoses are defined as those diseases and infections naturally transmitted between people and vertebrate animals. There are three classes as follows: a) endemic zoonoses which are present in many places and affect many people and animals; b) epidemic zoonoses which are sporadic in temporal and spatial distribution; and c) emerging and re-emerging zoonoses which are newly appearing in a population or have existed previously but are rapidly increasing in incidence or geographical range. Examples of the latter include Rift Valley fever, SARS, pandemic influenza H1N1 2009, Yellow fever, Avian Influenza (H5N1) and (H7N9), West Nile virus and the Middle East respiratory syndrome coronavirus (MERS-CoV) reported in the recent past.

It is estimated that, globally, about one billion cases of illness and millions of death occur every year from zoonoses. Some 60% of emerging infectious diseases that are reported globally are zoonoses. Over 30 new human pathogens have been detected in the last three decades, 75% of which have originated in animals [1]. The emerging zoonoses are a growing public health threat in the Eastern Mediterranean Region of WHO. In last two decades, emerging zoonotic diseases have been reported from 18 out of 22 countries in the region, often, with explosive outbreaks and high fatalities never seen in any other WHO region [2]. The recent emergence of MERS-CoV exemplifies that the occurrence of these infections are unpredictable as they originate from animals, often these infections are caused by novel viruses and are only detected when outbreaks occur. The Eastern Mediterranean Region of WHO remains particularly prone to zoonotic infections owing to large number of people in the region living in close proximity to animals, increased volume of international trade, including trans-boundary mass population and livestock movement within neighbouring countries. As the region remains at the cross road of repeated outbreaks from emerging infectious diseases, international travel to and from the region either due to tourism, business or religious reasons, globalization and variable levels of health systems capacity to early detect epidemics have been identified as significant risk factors for emergence and rapid international spread of infectious diseases with zoonotic origin. Varying levels of surveillance and response capacity of the countries at the animal-human interface have often exacerbated these outbreaks.These zoonotic infections are also a concern to global health security owing to its ability to rapidly spread internationally due to global connectivity and proliferation of trade, including trans-boundary movement of animals. The emerging zoonoses have also economic consequences due to loss of animal trade, travel and loss of economic opportunities for the people through loss of livestock.

Given the scale and burden of emerging zoonotic infections in the region, this paper will highlight the (i) growing public health threats of emerging zoonotic infections in the region; (ii) challenges in controlling these infections; and (iii) underpin a strategic approach for predicting, detecting and controlling these infections through an integrated and interdisciplinary approach between the animal and human health sectors.

2. Current situation in the Region

The exact extent of the burden of zoonotic diseases in the Eastern Mediterranean Region of WHO is not known. While endemic zoonoses like brucellosis, anthrax and rabies have not been eliminated from the countries, the region continues to witness both sporadic and epidemic occurrence of emerging zoonoses (Table-1). The region has recently seen outbreaks from Yellow fever in Sudan [3], Chikungunya in Yemen [4], West Nile fever in Tunisia [5] and Q fever in Afghanistan [6, 7] and Iraq [8]. The region is home to a number of arbo and filoviruses. While outbreaks from Crimean –Congo haemorrhagic fever (CCHF) occur periodically in Afghanistan [9], Iran [10] and Pakistan [11-14], as a seasonal surge, nosocomial outbreaks of the disease have been reported in recent years in Iraq [12], United Arab Emirates [14] and Sudan [16-18] in the region. The viral haemorrhagic fevers are perpetual risks in the region. The Ebola Haemorrhagic Fever in Sudan in 2004 was the only viral haemorrhagic fever seen the region which is caused by a filovirus [18]. The sudden expansion of Rift Valley fever, endemic in sub-Saharan Africa along the animal trade routes to Yemen [19], Saudi Arabia [20-21] and Sudan [22] is a characteristic example of geographic expansion of emerging zoonoses in the region.

The highly pathogenic avian influenza spread rapidly through the Eastern Mediterranean Region in 2006 with large epizootics reported in a number of countries while human infections have occurred in Djibouti [23], Iraq [24], Pakistan [25] and Egypt [26]. The avian influenza is now presumed entrenched in Egypt with a low level of transmission throughout the year [27]. In 2009, the influenza A (H1N1)pdm 09 of swine origin affected all the countries in the region [28]. Other emerging zoonotic diseases have occurred in the region whose occurrence is rare but still can cause high morbidities. These include Monkey pox [29], Sandfly fever [30] and Plague [31]. As illustrated by the Alkhurma virus, this region is also home to newly emerging pathogens from zoonotic origin [32-34]. As if to remind the region that emerging zoonoses can occur anywhere anytime and that no country is immune to the threats of these diseases, human infection with a novel coronavirus (MERS-CoV) occurred in the region in 2012 [35-36] that rapidly focused global attention on this new virus [40]. Till date, the affected countries for MERS-CoV in the region are Egypt, Iran (Islamic Republic of), Jordan, Kingdom of Saudi Arabia, Kuwait, Lebanon, Oman, Qatar, Tunisia, United Arab Emirates and Yemen.

All countries in the region are at risk from these diseases, and cross-border outbreaks occur frequently. But countries in the region, often plagued by complex emergency situations and often characterized by a failure or inability to effectively address the emergence of new diseases or the re-emergence of endemic ones are probably at greatest risk. Lack of effective control programmes for zoonoses, limited inter-sectoral collaboration between the human and animal health sector with little consensus on the roles and responsibilities of each sector and low priority given to zoonoses are attributed as significant factors for high burden and emergence of repeated zoonotic infections in the region, often with explosive outbreaks. . Certain disease amplifiers like population movement, fragmented health systems, weak response and laboratory diagnostic capacity and disruption of routine public health services in crisis affected countries have also contributed significantly to the surge of emerging zoonoses in the region.

3. Why do the zoonotic infections matter

An observation of the trend of these zoonotic diseases is that new pathogens from animals particularly viruses remain unpredictable and continue to emerge and spread across the countries. The diseases are also a concern to global health owing to their epidemic potential, high case fatality ratio and the absence of specific treatment and vaccines available to control the spread of most of these zoonotic diseases (with the exception of the yellow fever vaccine) As the world is increasingly inter-connected, emerging zoonoses in one country can potentially constitute a threat to global health security. Ultimately, however, zoonoses matter not just because they are so common, but because they cause morbidity and mortality, high burden on health systems but more importantly, it causes significant economic loses to the countries by way of losing animal trade, travel as well as loss of economic opportunities for the people through loss of livestock.

Therefore, zoonotic diseases can have devastating impact with severe economic consequences for the countries through loss of trade, tourism and consumer confidence. Just to give an example how zoonosis can adversely impact the economy of a country- the emergence of SARS in 2003 has the cost the world economy over USD 50 billion on account of medical treatment and loss of revenue associated with abrupt halt of tourism industry. Another example is that during the outbreak of RVF in Kenya, each household lost on average US$500 as a result of low productivity and cost related to RVF disease control.

4. Challenges of managing zoonotic infections

Globalization has resulted in the unparalleled passage of people, animals and goods across national borders, which in turn has fuelled the international spread of zoonotic infections. Many of the zoonoses are trans-boundary diseases, they spread across borders from their origin, to impact on trade, commerce, tourism and consumer confidence with devastating economic consequences.

The experiences drawn from the region have shown that most of the zoonotic infection outbreaks have occurred in remote areas, making it sometimes impossible to provide public

health services to these hard-to-reach populations. The detection and diagnosis of the disease has been considerably delayed due to difficulties in deploying teams for field investigation, lack of appropriate and safe sample shipment mechanism, lack of appropriate laboratory diagnostic facilities on-site or in-country, and insufficient capacities of the countries to plan, mobilize and implement appropriate control measures in such settings and to monitor the progress of control measures in geographically dispersed areas. The detection of these disease threats require functional sub-national surveillance capacity and therefore the need for investing in strengthening subnational outbreak surveillance and response capacities in the countries frequently affected by these diseases.

Many viral pathogens causing emerging zoonotic infections in humans originated from animals (specifically wildlife) or from products of animal origin. Knowledge of extra-human reservoirs of these pathogens remains essential for understanding the epidemiology and potential control measures of these zoonotic diseases.

There is also inadequate transparency regarding timely reporting of emerging zoonotic infections to WHO or any other international agency that is mandated to investigate and respond appropriately for global health security. Often medical authorities in the countries deny the existence of human cases, making it difficult for these agencies to understand the epidemiology, disease progression and use the opportunity to understand which methods work and do not work for control of these diseases in different settings.

The major limitation in controlling the zoonotic infections in the region include the lack of effective collaboration between the animal and human health sectors under the concept of “One Health” approach, which links the human with the animal health sector integrating the animal and human disease surveillance and response system that could, otherwise have helped controlling the zoonotic infections in animal reservoirs, enable early outbreak detection, and prevent deadly epidemics and pandemics.

The other challenges of prevention and control of zoonotic diseases in Member States include weak surveillance and reporting systems and limited capacity for laboratory diagnosis of emerging zoonotic diseases such as SARS, Ebola, Marburg, and new strains of influenza. Response capacity at the local level is limited in most countries due to lack of awareness, inadequate supplies and human resource quality and quantities. There are limited institutionalized inter-sectoral collaboration mechanisms between the key sectors. There are difficulties in obtaining accurate and current information and reports on zoonotic disease situations because of the inability to obtain quality information from the grassroot level and inadequate communication between Ministries of Health and Agriculture (Veterinary Services). There is also lack of effective community participation and health education on zoonotic diseases in the Region. In addition, there is limited harmonisation of the various regulatory public health frameworks. Research on new emerging diseases is limited or absent.

In summary, the main challenges are:

4.1 . Organizational

(i) Poor level of awareness among policy and decision-makers about the serious nature of the disease;

(ii) Insufficient information on the burden , trend and risks of zoonotic diseases;

(iii) Inadequate resources and skilled manpower for control of zoonotic diseases;

(iv) Presence of other competitive health priorities often taking precedence;

(v) Lack of transparency of the countries to report emergence or occurrence of zoonotic disease for fear of repercussions;

(vi) Weakness or absence of collaboration and cooperation between the public health , veterinary, agriculture and wildlife sectors;

(vii) Inadequate collaboration and partnerships to harness resources to support the prevention and control programme of zoonotic diseases

(viii) Absence of cross-talk within the health sector between the surveillance, clinical services and laboratory services departments.

(ix) Breakdown of weakness of health infrastructures specially in countries with complex emergencies;

4.2 . Diagnosis and detection

(i) Lack of integration of human and veterinary sector for exchange of epidemiological and laboratory surveillance data of the human and health sectors;

(ii) Weak disease surveillance system and inadequate diagnostic capacities to detect zoonotic infections;

(iii) Difficulties in international transfer of samples for logistic and economic reasons.

(iv) Difficulties in conducting field investigation in remote areas where most of the emerging zoonotic outbreaks occur.

(v) Weak cross-border collaboration, surveillance and information exchange between the countries

(vi) Inadequate community engagement in the zoonotic control programme

4.3 Control and interruption of transmission

(i) Insufficient capacities of countries to plan, mobilize and implement appropriate control measures.

(ii) High probability of nosocomial transmission of some of the newly emerging zoonoses in health-care settings;

(iii) Poor application of strict barrier nursing and other appropriate infection control measures in health-care facilities.

(iv) Lack of information on high-risk behaviours, including cultural and social factors, that are associated with risk of transmission of emerging zoonoses in the community;

(v) Inappropriate or inadequate vector control operations.

(vi) Lack or insufficient evidence on some of the public health control measures.

5. Current strategies for control of zoonotic infections

The current strategies for prevention and control of zoonotic diseases remain fragmented with no coherence between the animal and human health sectors. Globally, no strategies exist, either, for prevention and control of emerging zoonotic infections. Due to lack of resources and appropriate policy response, there have not been any focussed efforts in the region to develop any plan for management and control of zoonotic diseases and its public health risks. Despite the public health threats from emerging zoonotic infections, the efforts taken by the Regional Office to advocate for control of zoonotic diseases remain on the margin. Two Regional Committee resolutions-(i) EM/RC54/R.4 Growing threats of viral haemorrhagic fevers in the Eastern Mediterranean Region: a call for action; and (ii) EM/RC58/R.4(D) Dengue: Call for urgent interventions for a rapidly expanding emerging disease have elaborated on the need to control zoonotic infections but efforts are far from adequate.

Given the scale and magnitude of the problem and the evolving public health risks associated with zoonotic infections, now is the time, perhaps, for a paradigm shift and make changes to the way WHO wants to address this imminent threat to global and regional health.

6. Strategic directions for control of zoonotic infections

Considering the growing importance of zoonotic diseases in the region, the most appropriate direction for the Regional Office would be to develop a strategic framework for prevention and control/elimination of zoonotic diseases in the region with a view to minimizing the health, social and economic impact of zoonotic diseases in the countries of the region. The most important and critical technical areas that will need to be considered will include the following strategic approaches:

(i) Building effective collaboration between animal and human health sectors

As it is difficult to predict when or where the next zoonotic disease will emerge, close collaboration between veterinary and public health specialists is important. The goal of this inter-sectoral collaboration would be to enhance inter-personal and inter-organizational communication. An inter-agency taskforce can lead this process of fostering collaboration through regular exchange of scientific information proactively between the two sectors. The task force can also guide joint field investigation and share institutional resources within a coordinated framework of partnerships and agreement for the One Health concept. This would synergize effective prevention and control efforts at the animal–human interface.

(ii) Improving surveillance for early detection of disease threats in humans

As most of the emerging zoonotic infections have reservoirs in animals or/and in arthropods, and the occurrence of such diseases in humans often cannot be precisely predicted, investigation at the first sign of emergence of a new disease in animals that has the potential to jump species barrier is particularly important to early detect any disease threats from zoonoses. The integration of disease surveillance system between the animal and human health sectors is critical for timely gathering and analysis of animal disease data that have the potential to cross species barrier. The use of syndromic surveillance system may also be helpful in detection of any threats in real-time and can accelerate appropriate mitigation and prevention efforts.

(iii) Strengthening laboratory diagnostic capacities for novel pathogens

Laboratory services would be more effective in early detection of any zoonoses when there is a common and agreed communication protocol for sharing laboratory surveillance data between animal and human health sectors in real-time. In addition, a mechanism needs to be put in place for sharing of laboratory investigation data within the health sector, principally between the disease surveillance and the clinical services departments. Establishing laboratory networks both within and outside the countries will enhance rapid transfer and shipment of specimens for timely diagnosis of zoonotic disease threats.

(iv) Improving case management and infection control

To ensure preparedness of health care facilities to the threats of zoonotic infections, an infection prevention and control program should be implemented before the emergence of a disease with the standard precautions as an essential component. Standard precautions should be used in the care and treatment of all patients irrespective of their perceived or confirmed infectious status. If consistently applied, the standard precautions would help prevent most transmission through exposure to blood and body fluids before any zoonotic disease with unknown origin are recognized. As the clinical manifestations of many of the emerging zoonoses are often indistinguishable, leading to confusion and misdiagnosis by health-care workers, the use of a clinical decision algorithm for acute febrile illnesses with a more sensitive case definition may be useful for early detection of any suspected cases. Use of such a decision tree will help in guiding initial therapeutic decisions and trigger the protocol steps for further laboratory diagnosis and follow-up. Implementation of this clinical algorithm needs to be backed up with training of health-care workers on case management and infection control measures as well pre-positioning of strategic supplies.

(v) Integrating vector control management

An integrated vector control management (IVM) approach should be considered for all arthropod-borne viruses as the most rational decision-making process to optimize the use of resources for effective vector control. The IVM strategy is based on evidence and integrated management of mosquito vectors including rodents and promotes the use of a range of interventions, either alone or in combination, which are selected on the basis of local knowledge about the vectors, diseases and disease determinants. IVM would therefore be the most effective strategy for the control of vectors including rodents that are responsible for transmission of a number of arthropod-borne viral haemorrhagic fevers. As a first step, countries need to carry out a detailed mapping of the vectors, and their breeding sites to identify the spatio-temporal distribution of the vector species. Such information may be useful for targeting control measures for breeding sites during the inter-epidemic period. The vector control measures should seek to reduce the potential breeding sites of adult mosquito populations or their interactions with human below that which can sustain an epidemic. Setting up a sentinel site for entomological surveillance in areas of high vector densities and integrating it with that of epidemiological and viral surveillance systems can provide meaningful information through reporting of unusual clusters of acute febrile illnesses, a suddenly rise in vector density or a fortuitous isolation of a novel zoonotic virus. Such information can be helpful to understand the anticipated, prevailing or evolving risk.

(vi) Reducing transmission through social and behavioural interventions

The success or failure of interrupting the transmission chain for most of the emerging zoonoses especially those involving intermediate vertebrate hosts, will rely on the relevance of the behavioural response of the exposed populations. To design appropriate social and behavioural interventions for sich disease threats, the community's risk perception and how this relate to actual or intended behaviour, socio- or psycho-cognitive factors that characterize the exposed population's behaviour and the cultural factors that influence protective factors and sustainability of adherence to such protective behaviour will need to be considered.

(vii) Developing epidemic preparedness and response capacities for emerging zoonoses

The main strategy should begin with developing a national plan involving all important stakeholders. The plan should consider developing a geographic map of the distribution of zoonoses occurring in the countries using geographic information systems and other information technologies, and conducting a detailed risk assessment. Furthermore, areas at

risk for expansion of zoonosis should also be identified. Human, animal and vector surveillance should be strengthened and if possible integrated with data and shared, so that vital information on risks are exchanged on a regular basis between the partners through a well-coordinated mechanism. The plan should encompass pre-positioning of strategic supplies (investigation kits, personal protective equipment, etc.), development of appropriate guidelines and standards to measure the effectiveness of response operations and public education programmes aimed at limiting exposure to risk. Setting up a multi-disciplinary coordinating body to foster collaboration and integration between all partners and to guide, lead and provide emergency response operations during an outbreak would be the key for a successful epidemic preparedness and response plan.

Finally, there will be need to develop appropriate monitoring and evaluation tools and indicators to measure the progress of implementation of the strategic framework over time. For ensuring that the programme for prevention and control of emerging zoonotic infections are sustainable, the countries will require to consider the followings while developing their own programme:

(i) Enhancing political commitment, national planning and coordination mechanisms: Policies will be required to be developed for building effective inter-sectoral collaboration between the animal and human health sectors through increased communication between the sectors, joint planning and setting up an effective coordination structure between these two sectors;

(ii) Strengthening preparedness, surveillance and response: Developing a multi-sectoral preparedness and response plans for control of zoonotic diseases through a comprehensive risk assessment, improving laboratory diagnostic capacities, joint surveillance activities at the animal-human interface, etc;

(iii) National capacity building and promoting research: This will include developing plans for national capacity building for prevention and control programme of zoonotic diseases including building a robust scientific evidence-base for new approaches to control zoonotic diseases in the country;

(iv) Enhancing regional and international cooperation and collaboration: Reducing public health risks from zoonotic diseases will require commitment and extensive cooperation and collaboration from all partners towards a common vision, goal and purpose. This will need to be incorporated in the proposed strategic framework;

(v) Health education, risk communication and social mobilization: Policies will need to be established in the countries on the effective use of risk communication and community engagement for addressing the public health risk associated with the emergence of zoonoses;

7. Conclusion and future perspectives

The region is now an emerging focus for global health after the discovery of MERS-CoV. The region has borne the brunt of several emerging zoonotic infections. The lessons of our present time is that emerging zoonotic infections are unexpected and unpredictable events. Another lesson that has been learned is that any disease outbreak anywhere today could be a problem for the world tomorrow. These novel diseases will continue to confront and challenge the national health authorities' resilience and responsiveness to respond in a timely manner. Likewise, the ability of regional and global communities to cooperate to control these diseases that cross national boundaries will be a real test for the global health security.

While the global efforts should continue to fill the current gaps in knowledge associated with the origin and transmission of many zoonotic infections much of which are novel in origin, much greater regional cooperation would be needed to protect the health of the people from all types of zoonotic infections. The current situation in the region with regards to the global and regional response to MERS-CoV should trigger a clear and articulated need for establishing a sustainable public health programme for detection, prevention and control of emerging zoonoses in the region

The premise for strategic framework for control of zoonotic infections should lie on the concept of “One Health” approach which is a common coordination mechanism, joint planning, joint implementation, community participation, capacity building and joint monitoring and evaluation framework between the animal health and human health sector. The “one Health” approach also identifies five key areas where One Health is likely to make a difference. These are:

(i) sharing health resources between the medical and veterinary sectors;

(ii) controlling zoonotic diseases in animal reservoirs;

(iii) early detection of and response to emerging diseases;

(iv) prevention of epidemics and pandemics; and

(v) generating insights and adding value to health research and development.

The strategy will also require the Member States to initiate and consolidate measures, which integrate technical, social, political, policy and regulatory issues to strengthen their capacities adequately to reduce the public health burden and economic impact imposed on their people and livestock by zoonotic diseases. The implementation of a viable strategy is the way forward for the prevention and control of emerging and re-emerging zoonotic diseases in the Eastern Mediterranean Region of WHO. The Regional Committee is invited to consider and adopt the strategic directions described in this paper. Effective control of emerging zoonoses will present an opportunity for containing health risks of zoonotic infections that are of international concern as has been stipulated in the IHR (2005) and make the world safer from emerging and re-emerging pathogens

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Table-1: selected outbreaks from emerging zoonoses in the Eastern Mediterranean Region of WHO, 2000-March 2013

Disease	Country	Period	Host/reservoir	Human health impact	
				Cases*	Fatalities
Rift Valley Fever	Yemen	10 September-19 October 2000	Cattle, sheep, goats; Aedes mosquitoes (vector)	653	80

Saudi Arabia 26 August 2000-

22 September 2001

886 123

Sudan 18 October 2007-

15 January 2008 747 230

CCHF Pakistan # 2000-2012 Wild and domestic animals (Cattle, goat and sheep);

Hyalomma tick 585 113

Iran 2000-2011 3235 122

Afghanistan 2007-2012 104 15

Sudan **

Yellow Fever Sudan September-December 2005 Primates (mainly monkey); Aedes mosquitoes (vector)

605 163

02 Sep-24 Dec 2012 849 171

South Sudan May-June 2003

178 27

Ebola haemorrhagic fever South Sudan

24 May-26 June 2004 Monkeys 17 7

Monkey pox Sudan, Unity state

20 September 2005–31 January 2006 Unknown but rodents, sun squirrels even monkeys are implicated 49 0

Al-khurma haemorrhagic fever ## Saudi Arabia

2001-2009 Camel and sheep;

Mammalian tick

Sand fly fever Lebanon

01 July-18 September 2007 Phlebotomine sandflies 800 -

Avian Influenza (H5N1) Iraq Jan-March 2006 Poultry, Birds, wild fowl 3 2**

Djibouti 23 April 2006 1 -

Pakistan 29 October-21 November 2007 4 2

Egypt Jan 2006-march 2013 172 62

Plague Libya 09-18 June 2009 Rodents; Fleas 5 1

Pandemic influenza All countries

25 May 2009-6 August 2010 Swine 1019

Q Fever *

Afghanistan 29 May-02 June 2011 Domestic animals (sheep, cattle, goats)/Birds

147

Chikungunya Yemen Oct 2010-Mar 2011

Monkey

Aedes mosquitoes (vector) 1657

West Nile virus fever

Tunisia 14 August-14 November 2012 Birds; mosquitoes (vector) 63 10

Novel coronavirus infection

Saudi Arabia, Qatar , Jordan and UAE 21 March 2012-30 April 2013 Unknown but bats are being suspected 14 9

* Suspected cases including those laboratory-confirmed

** Laboratory-confirmed cases

*** World Health Organization. Eastern Mediterranean Regional Office. Weekly Epidemiological Monitor. Vol-5; Issue-28 & 29, Sunday 17 July 2011.

**** Nosocomial transmission

Cases reported during the outbreak are included

Sporadic cases continue to be reported since 2001

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