



## Implementation of one health approach in Jordan: Joint risk assessment of rabies and avian influenza utilizing the tripartite operational tool

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### ABSTRACT

#### Background

Health challenges at the human-animal-environment interface vary and include zoonotic and food-borne diseases as well as antimicrobial resistance. These are serious threats to animal and public health, and account for the majority of emerging and re-emerging conditions or infectious diseases. Reducing zoonotic disease threats requires an understanding of where and why risks exist. To support countries in building multi-sectoral mechanisms to jointly assess the risks at the human-animal-environment interface, a new operational tool is available to complement the existing tripartite guide to addressing zoonotic diseases in countries. The aim of this study is to conduct joint risk assessment (JRA) of rabies and avian influenza in Jordan utilizing the tripartite Joint Risk Assessment Operational Tool (JRA OT).

#### Methods

Representatives of sectors that are involved in zoonotic diseases outbreak investigation, control, surveillance and risk assessment, were trained on JRA OT. The operational tool of tripartite guide to addressing zoonotic diseases in countries that was developed by WHO (World Health Organization), FAO (Food and Agriculture Organization of the United Nations) and WOAHA (World Organization for Animal Health) was utilized to conduct risk assessment for rabies and H5N1 avian influenza in Jordan.

#### Results

The risk assessment outcome for rabies were as follows: Likelihood is high; impact is moderate with moderate level of uncertainty. The impact of the disease is moderate because the virus transmitted only by animal bite in Jordan. The level of uncertainty is moderate due to existence of some gaps in data available from the ministries regarding the surveillance and collection areas of wild animals with feral dogs. The risk assessment outcome for H5N1 AI indicated a low likelihood estimate with moderate uncertainty level. The impact estimate for H5N1 AI in Jordan is moderate with a low level of uncertainty.

#### Conclusions

The tripartite JRA OT provides a helpful and easy to follow guide to bring together expertise and information from all relevant sectors to jointly assess risks from zoonotic diseases and contributes to the understanding and management of shared threats at the human-animal-environment interface.

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## 1. Introduction

Health challenges at the human-animal-environment interface vary and include zoonotic and food-borne diseases as well as antimicrobial resistance. These are serious threats to animal and public health, and account for the majority of emerging and re-emerging conditions or infectious diseases [1].

Reducing zoonotic disease threats requires an understanding of where and why risks exist. In the past, outbreak investigation, surveillance and risk assessment of zoonotic diseases have been dealt with individually by different health related sectors. However, this has proven to be inefficient and may affect the response to health threat negatively in many aspects. Currently, there is a great need for multi-disciplinary and multi-sectoral collaboration, coordination and cooperation between the human, animal and environmental sectors to respond to various health challenges and implement the One Health (OH) approach.

To support joint risk assessment at the human-animal-environment interface, a new operational tool called Joint Risk Assessment Operational Tool (JRA) OT was developed by the tripartite organizations FAO, WHO and WOAHA (formerly OIE). This tool ensure a consistent and harmonized approach to evaluating risks posed by zoonotic disease hazards. Utilizing the tool enable countries to create a system for conducting joint qualitative risk assessments through providing technical experts and decision-makers with a 10-step approach. Eventually, this tool will lead to policy communication and risk mitigation support, and improved planning and preparedness for zoonotic diseases, and this will contribute to health security at the national, regional, and global levels [2]. Also, model templates are provided to support its implementation by national ministries in charge of the management of zoonotic diseases [3].

In Jordan, the need for implementing the OH approach has been clearly and highly recognized by health sectors officials, and the roadmap has been drawn and followed.

Zoonotic diseases prioritization in Jordan was done in 2019 as one of the initial steps in the OH approach implementation [4]. It was done utilizing a semi qualitative method developed by the U.S. CDC's OH Office. Seven zoonotic diseases were identified as being of great significance including rabies, Middle East respiratory syndrome, avian influenza (AI), brucellosis, leishmaniasis, rickettsiosis, and salmonellosis [4].

Avian Influenza is a highly contagious disease, which occurs worldwide and has been reported in Jordan before [5]. In addition to affecting humans, the disease is associated with significant economical losses. Rabies is endemic in Jordan [6]. It is a severe, but preventable, viral disease that affects mammals. The disease is associated with high case fatality rate and only a few humans or animals have ever recovered without severe neurological deficits.

To advance the implementation of OH approach in Jordan, JRA training and implementation was done utilizing the JRA OT, of the Tripartite Zoonoses Guide [2]. The aim of this study is to share the Jordanian experience of JRA OT implementation and results for JRA for AI and Rabies in Jordan.

## 2. Materials and methods

### 2.1. Training workshop design

Sectors that are involved in zoonotic diseases outbreak investigation, control, surveillance and risk assessment, were invited to attend the training and jointly assess the risk of both AI and Rabies diseases. The training was delivered throughout 3 days and was preceded with one day training of trainers (ToT) for key representatives from Human-animal and environmental health sectors in Jordan who will lead the JRA process in the country. Both trainings was delivered by international experts from WHO Eastern Mediterranean Regional office for (WHO EMRO) and FAO Regional Office for Near East (FAO RNE).

### 2.2. Joint risk assessment operational tool (JRA) OT

The JRA tool encompasses a 10-step approach to create a system for conducting qualitative joint risk assessments. The 10 steps of the JRA process are divided into 5 modules. This allows different participants to be included in various modules of the JRA.

2.2.1. Module 0 is an introduction to the joint risk assessment and overview of the operational tool.

2.2.2. Module number one is setting up the joint risk assessment. It consists of 4 steps, and these are: establish and convene a national JRA steering committee, identify a JRA lead, establish and convene a JRA technical team, and establish and convene a JRA stakeholder group.

2.2.3. Module number two is risk framing for JRA. It consists of one step, which is risk framing. This step encompasses defining the specific hazard and scope as well as agree on purpose and key objectives of the assessment in consensus among the participating sectors.

2.2.4 Module number three is conducting the JRA. It consists of three steps, and these include identifying and diagramming the risk pathway, formulating and documenting risk assessment questions, and characterizing the risk.

2.2.5 Module number four is conducting the utilizing the JRA outputs. It consists of two steps and these include identifying risk management options and communication messages and documenting the assessment.

2.2.6 The JRA OT is accompanied by user-friendly templates to be used in conducting the JRA, and there are JRA report and risk framing templates.

### 2.3. JRA of AI and Rabies

The workshop was also designed to enable trainees to jointly conduct risk assessment, using the JRA OT for two selected priority zoonotic diseases in Jordan; AI and Rabies, as decided earlier by the sectors, while preparing for the training workshop in collaboration with the international experts from the tripartite organizations.

## 3. Results and discussion

Representatives of the national public, animal (domestic, wildlife) and environmental health sectors, and other stakeholders, were enrolled in the JRA OT workshop training and piloting. These sectors included ministry of health (MOH), ministry of agriculture (MOA), ministry of environment (MOEn), WHO, FAO, and NGOs such as GHD/EMPHNET.

The first section of the workshop was assigned to technical staff with high levels of expertise from all different sectors. They were specifically trained to master the use of the JRA OT, to be able to guide other trainees in the second section of the training workshop and lead the JRA process in the country.

Participants from the different sectors completed the 5 modules training and 10-step approach, and a system was created for conducting joint qualitative risk assessments in Jordan.

### 3.1. Summarized JRA for rabies as an event in Jordan

#### 3.1.1. A brief summary of the event or hazard being assessed (rabies in Northern Jordan)

In Jordan, stray dogs are the most likely animal species that spread rabies to people, especially in the northern part of Jordan. Animal bites continue to be a major problem in Jordan, mainly for the upcoming months. Efforts to protect people against animal bites are essential for preventing rabies. Ministry of Agriculture has started implementing sterilization programs in dogs (Animal Birth Control Program), providing some vaccines for owned dogs and cooperating with neighboring countries to control the disease. Meanwhile, MOH is providing vaccines and immunoglobulin to humans exposed to animal bites, in addition to performing confirmatory diagnostic tests for suspected cases.

There is a need to raise awareness regarding epidemiology and management of animal bites among the service providers and general community.

3.1.2. Rabies risk framing

**Hazard:** Rabies Virus.

**Scope:** Mainly human population in western-northern governorates of Jordan, but also animal farms in the same areas during the period from July to December 2022,

**Purpose:** to support the mitigation of risks associated with rabies on human and animals in northern governorates.

**Objectives:** To increase the readiness of relevant sectors to mitigate the risk of rabies.

3.1.3. Key assumptions underlying rabies JRA

This assessment is built on the assumption that there is an epidemiological link between the rabies disease in animal and human population based on surveillance system at MOH and MOA. Wild animals moving among the three countries (Jordan, Syria and Palestinian territories) result in collection of feral or stray dogs in the rural areas. This cause transmission and circulation of rabies virus, which poses imminent threats human population in the rural areas as well as the cities.

**Documents:** annual reports of MOH, MOA, maps, and literature review.

3.1.4. Risk assessment question assessed

What is the likelihood and impact of increasing number of human deaths near the waste dumps in the northern governorates of Jordan due to rabies infection transmitted by stray dogs bite in the next six month (July–December 2022)?

3.1.5. Likelihood estimate of question assessed and rationale

The estimated likelihood for this risk assessment question is high. The rationale for that includes increasing number of stray dogs' population at this time of the year, increasing number of infected wild and stray dogs, insufficient vaccination for wild and domesticated animals, increasing number of animal bites among human and animal population, and uncontrolled waste dumps sites.

3.1.6. Uncertainty level for likelihood estimate and rationale

Uncertainty level for likelihood estimate in moderate. This is because no reliable data is available about surveillance, notification, and follow up to the patients. In addition, there is shortage in publications, documentation, or expert consensus at the national and subnational level.

3.1.7. Impact estimate and rationale

The estimated impact for this risk assessment question is minor. Number of affected human cases is very low despite the high case fatality rate (almost 100%). The disease is transmitted only by infected animal bites therefore it is low. Number of cases in animals may increase but still do not reach significant levels. There will be an impact on tourism as many historical places are located in geographical areas at risk. Food security may be affected due to the mortalities and morbidities in livestock.

3.1.8. Uncertainty level for impact estimate and rationale

Uncertainty level for impact estimate is moderate. This is justified by the lack of socioeconomic studies and detailed disease assessment. Assessment of uncertainty was based on expert opinion due to lack of available data.

3.1.9. Risk matrix for risk assessment question

The risk matrix is illustrated in Fig. 1.

3.1.10. Technical interpretation of risk assessment question

The result of this assessment shows the need to review and adjust the

<b>Likelihood</b>	High		●		
	Moderate				
	Low				
	Negligible				
		Negligible	Minor	Moderate	Severe
		<b>Impact</b>			

Fig. 1. Risk matrix of the likelihood and impact of increasing human deaths due to rabies infection in Northern Jordan in the next six month (July–December 2022).

control measures in place by relevant ministries. Rabies is preventable, and several steps should be taken to ensure that in Jordan. Strengthening the surveillance systems, enhanced laboratory diagnosis, mapping the animal population and locations of wild and stray dogs, conducting mass vaccination for wild animals and stray dogs, with adherence to animal welfare regulations, building capacities for personnel, raising awareness for people at risk, controlling waste disposal dumps and areas, implementation of control program of rodents, and increasing the multi-sectoral collaboration at the national and subnational level with engagement of high and senior level, are all needed steps to further control rabies in Jordan.

3.1.11. Assessment summary

The risk assessment outcomes were as follows: Likelihood is high; impact is moderate with moderate level of uncertainty. The prohibition of killing stray dogs by inhumane methods resulted in increasing number of feral dogs in the western and northern governorates as well as all other governorates, in light of insufficient other control measures. In addition, there is an increase in number of wild animals crossing the western borders with lack of vaccination campaigns for these animals, also extended the waste dumps that may become a collection point for the stray dogs looking for feed and mating. The impact of the disease is moderate because the virus transmitted only by animal bite and the number of mortalities would not be expected to be very high, although one human infection is always of concern. The level of uncertainty is moderate due to existence of some gaps in data available from the ministries regarding the surveillance and collection areas of wild animals with feral dogs. This requires a review and adjustment of mitigation measures in place by relevant sectors to increase the control measures including surveillance programs, laboratory diagnosis, vaccination, building capacities, awareness, and the multi-sectoral collaboration at the national and subnational level.

3.1.12. Risk pathways diagram for rabies in Jordan

Risk pathways diagram was drawn by participants and can be found in Fig. 2.

3.1.13. Risk management and communication options

Providing vaccines and immunoglobulin for human health sector, control of wild animals and stray dogs, conducting workshops for health

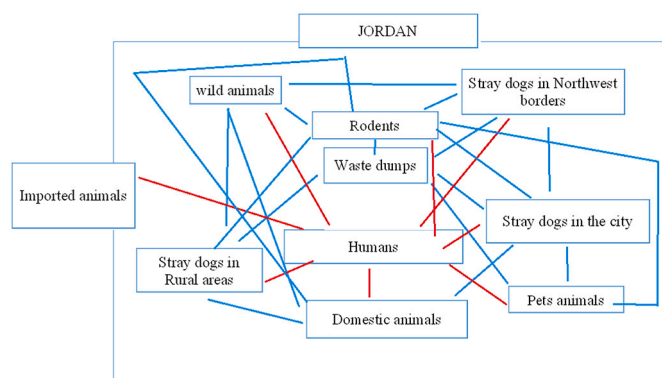


Fig. 2. Risk pathways diagram for rabies in Jordan.

providers, raising the awareness of community through messages by mass media and social media to take care when moving in risk areas, carrying out joint work between animal health sector and environment and royal society for conservation of nature to collect real data on collection areas of wild animals and feral dogs, and conducting vaccination campaign for wild animals and feral dogs using oral vaccine. Risk communication options include conducting quarterly national and subnational multi-sectoral meeting, and activating the electronic notification system and sharing data between relevant sectors.

### 3.2. Summarized JRA for AI as an event in Jordan

#### 3.2.1. A brief summary of the event or hazard being assessed (AI H5N1 in Jordan)

Avian influenza is a highly contagious and zoonotic viral disease affecting several animal species, as well as humans. AI virus strains are classified into low (LPAI) and highly (HPAI) pathogenic strains. LPAI cause few or no clinical signs in poultry, and highly pathogenic strains can cause severe clinical signs and high mortalities in poultry. Wild birds are natural hosts and reservoirs for all types of AI viruses in which evolution, maintenance, and spread of these viruses occur. AI outbreaks have serious consequences on international trade in many countries. Monitoring and controlling avian influenza in poultry is essential to decrease the virus load in the environment, and implementation of biosecurity measures, is a key to securing the production sector and trade, and limiting the risk of AI infection in humans [7].

#### 3.2.2. AI risk framing

**Hazard:** H5N1 AI Virus.

**Scope:** While there are no cases recorded in the country before but possible transmission of H5N1 AI due to infection occurrence among domestic and wild birds in neighboring countries during the period from July to December 2022.

**Purpose:** to support the mitigation of risks associated with AI on human and animals in Jordan.

**Objectives:** To increase the readiness of relevant sectors to mitigate the risk of AI incase it happens.

#### 3.2.3. Key assumptions underlying AI JRA

The time of HPAI (H5N1) infections occurrence in humans corresponds to the seasonality of HPAI Asian H5N1 virus outbreaks in poultry. Outbreaks in poultry occur mainly during the cooler months periods of the year. The surveillance system at the MOH is efficient and sufficient to detect positive cases with subtyping capabilities of the virus. The reporting between MOA and MOH in case of positive cases in zoonotic disease is effective and rapid.

**Documents:** annual reports of AI MOH and MOA in Jordan, maps, and literature review and search.

#### 3.2.4. Risk assessment question assessed

What is the likelihood and impact of at least one consumer being exposed to avian influenza (H5N1) in the live bird market in the whole country in the next six month (July–December 2022)?

#### 3.2.5. Likelihood estimate of question assessed and rationale

The likelihood estimate of the question assessed is low. The situation described in the risk assessment question is unlikely to occur. The rationale for likelihood estimate is justified by the strict measures that were taken by MOA and MOH in case of reporting H5NI in the neighboring country. In addition, import ban from the infected country, enhance surveillance measures, enhance awareness, the available national action plan, low risk of local birds exposure to wild birds, absence of the diseases in Jordan for the last 15 years despite occurrence in neighboring countries, efficient reporting system and sharing information on the disease between MOA and MOH, and the rapid response team availability and readiness, were all taken into consideration to justify the likelihood estimate.

#### 3.2.6. Uncertainty level for likelihood estimate and rationale

The uncertainty level for likelihood estimate is moderate. The rationale for uncertainty level associated with likelihood estimate is justified by the fact that the surveillance capacity for other respiratory diseases has been directed to COVID19 in recent years, the unavailability of continuous surveillance system during the six months from September to March due to shortage in budget (MOA), and the fact that the time of HPAI (H5N1) infections occurrence in humans corresponds to the seasonality of HPAI Asian H5N1 virus outbreaks in poultry. In addition, outbreaks in poultry occur mainly during the cooler months periods of the year.

#### 3.2.7. Impact estimate and rationale

The impact estimate is moderate. The rationale for impact estimate is supported by a low potential to become a pandemic among human population (risk from H5N1 is low for most people), high mortality rate in humans and animals, rapid spread among animals, threat mainly to national and international trade for certain products. In case of occurrence, needed measures may exceed the capacity of quarantine, laboratory materials for testing, and surveillance at the national level, and diagnosing of a single case means the possibility of presence of other cases among humans and birds.

#### 3.2.8. Uncertainty level for impact estimate and rationale

The uncertainty level for impact estimate is low. This is supported by the fact that human cases occur mainly in small areas and at-risk groups, in neighboring countries, and no reported cases among birds (localized, imported), since 2006.

#### 3.2.9. Risk matrix for risk assessment question

The risk matrix is illustrated in Fig. 3.

#### 3.2.10. Technical interpretation of risk assessment question

There are many measures taken by MOA and MOH in case of reporting H5NI in a neighboring country. These include ban importation from the affected country, enhancement of surveillance measures, and raising awareness. Also the national action plan (MOH, MOA, other Stakeholders) and a rapid response team and reporting systems and sharing of information of zoonotic diseases between MOA and MOH, in addition to the surveillance capacity for other respiratory diseases at MOH, are all important factors in controlling the disease. However, during the last 15 years, there were many reported cases of Avian influenza in the neighboring countries, without reporting any case in Jordan.

On the other hand, there are many challenges facing the veterinary services at MOA, and these include the low level of biosafety and biosecurity measures in the live birds market, and the absences of



<b>Likelihood</b>	High				
	Moderate				
	Low			●	
	Negligible				
		Negligible	Minor	Moderate	Severe
		<b>Impact</b>			

**Fig. 3.** Risk matrix of the likelihood and impact of at least one consumer being exposed to avian influenza (H5N1) in the live bird market in the next six month (July–December 2022).

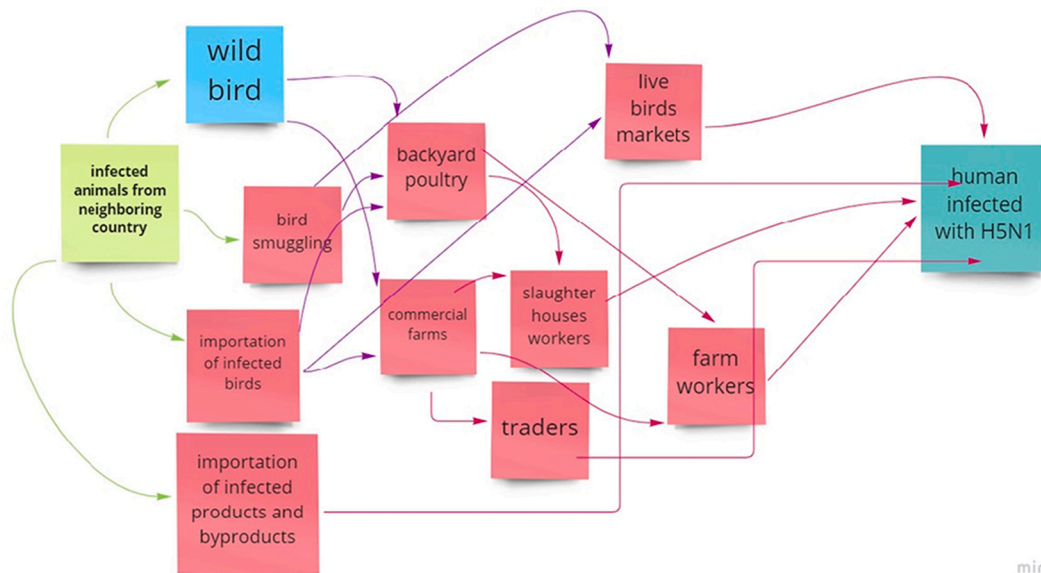
continuous surveillance system during the six months from September to March due to budget cut reasons at the MOA.

**3.2.11. Assessment summary**

The risk assessment outcomes were as follows: Likelihood estimate is low and uncertainty level for likelihood estimate is moderate. The impact estimate is moderate with a low level of uncertainty. These results were based on the risk questions assessment answers and according to the surveillance system at both MOH and MOA and the reporting system and sharing information on the disease between MOA and MOH. On the other hand, the measures are taken by MOA in case of reporting H5N1 or any HPAI and LPAI in a neighboring country. However, the low biosafety and biosecurity measures in bird market increase the risk of H5N1 infection.

**3.2.12. Risk pathways diagram for rabies in Jordan**

Risk pathways diagram was drawn by participants and can be found in Fig. 4.



**Fig. 4.** Risk pathways diagram for avian influenza (H5N1) in Jordan.

**3.2.13. Risk management and communication options**

Increase the budget for active surveillance at MOA, law enforcement for biosecurity and biosafety measures implementation in live bird markets, and conduction of quarterly national and subnational multi-sectoral meetings as regular meetings and monthly meetings during the seasonal activity of HPAI.

**4. Conclusion**

The tripartite JRA OT bring together information from all relevant sectors as well as expertise to jointly assess risks from zoonotic diseases and this contributes to the combating of mutual threats at the human–animal–environment interface. Findings of JRA results in implementation of relevant actions according to event likelihood and impact evaluations and this enables authorities to implement science-based measures and align messages and communication among sectors.

**Availability of data and materials**

The database generated and analyzed during the current study is available with the corresponding author.

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**Author statement**

The authors have read and approved the revised version submitted.

**Authors' contributions**

Sameeh M. Abutarbush: designing the study, methods, and writing the original draft. Alaa Hamdallah, Majid Hawawsheh, Lora Alsawalha, Nour Abuelez, Rachel Dodeen, Mohammad N. Alhawarat, Ekhlas Hailat, Ayman Bani Mousa, Heba Mahrous: formal analysis, visualization, and review and editing the manuscript. All authors have approved the

content, fulfill the authors' criteria, and have contributed significantly to work. All authors presented substantial contributions to this study and participated in the submitted version's correction and final approval.

#### Declaration of Competing Interest

The authors declare that they have no financial and/or competing interests.

#### Data availability

No data was used for the research described in the article.

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