



Highly pathogenic avian influenza (H5N1 HPAI) spread in the Middle East: risk assessment

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Summary

This risk assessment provides an estimate of the likelihood of introduction of H5N1 HPAI from recently infected countries (Lebanon and Iraq) to other countries in the Middle East region and neighbouring territories as a result of the movement of live poultry (both legal and illegal), poultry-related products and the migration of wild birds.

The preliminary assessment based on the available information and uncertainties associated indicate that the risk of introduction of H5N1 HPAI for each of the nine regional and neighbouring countries or territories varies and is as follows:

- High: Iran (Islamic Republic of), Israel, Jordan, the Syrian Arab Republic and Turkey
- Medium: Gaza Strip, Kuwait, Saudi Arabia and The West Bank

- Low: Armenia, Azerbaijan and Georgia
- Negligible: Cyprus

The situation in the region is of concern given the existing poultry populations at risk and the potential for spread between countries. Given the presence of civil unrest and active civil war in some countries of the region, investment in agriculture and livestock is reduced, including limitations to public veterinary services. Underreporting of animal disease events is a significant challenge given the lack of reporting systems in those areas with ongoing conflict. It is therefore possible that, in addition to Iraq and Lebanon, the disease is already present in the Syrian Arab Republic. The cause of the recent incursions into the region is currently unknown but a combination of wild birds seeding infection¹ and trade with neighbouring countries is likely. Poultry and poultry-related trade and movements play an important role in national and cross-border spread. The overall risk for the region in terms of potential spread to uninfected countries ranges from negligible to high depending on the country with Iran (Islamic Republic of), Israel, Jordan, the Syrian Arab Republic and Turkey being at highest risk of incursion. The current H5N1 HPAI epizootic is expected to have a potential impact on food security, human health and poultry-dependent livelihoods in a region which is already suffering from political unrest and deteriorated public and animal health services.

Introduction

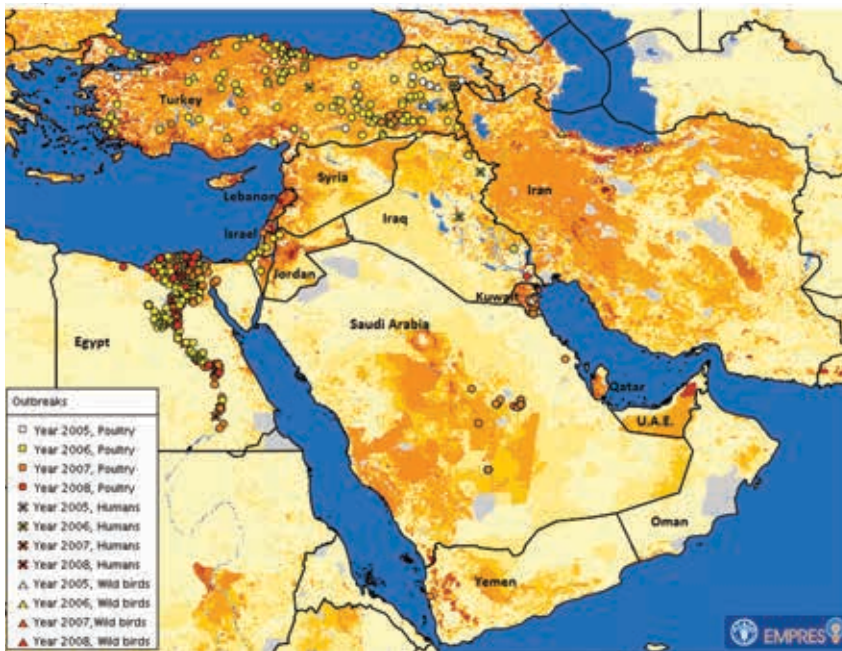
H5N1 HPAI is a highly infectious viral disease of domestic poultry that can affect a wide range of bird species, including wild, migratory birds. Avian influenza viruses that

¹ That is, reservoir species for H5N1 virus that migrate from the Siberian breeding sites to the Iraqi wetlands during the autumn and then to the opposite direction in spring.

cause HPAI are highly virulent and mortality rates in infected domestic flocks often approach 90–100 percent. Several HPAI virus strains are zoonotic, including some H5N1 strains, with fatal outcomes. For most of the human cases an epidemiological link such as direct contact with live, infected poultry has been reported.

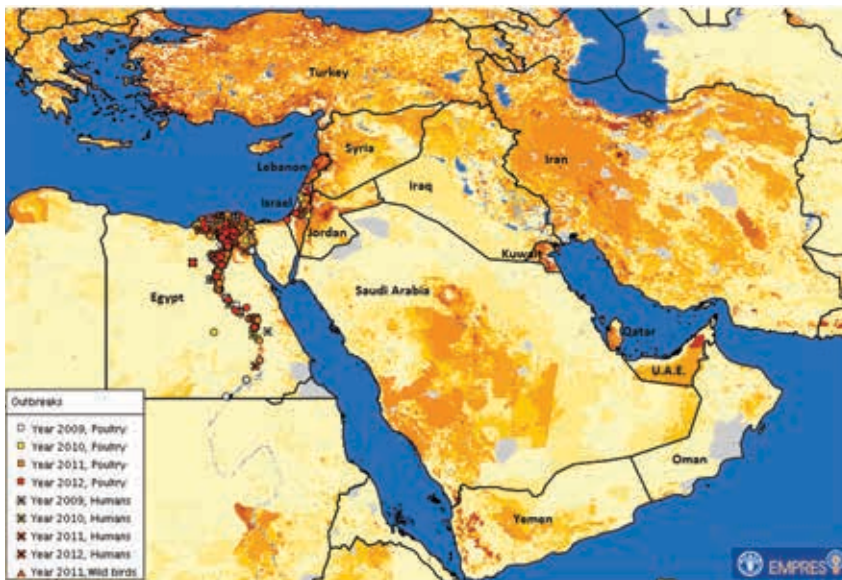
The H5N1 HPAI virus is endemic in areas of South and Southeast Asia (mixture of clades 2.1.1, 2.3.1 and 2.3.2.1a and c) and Egypt (clades 2.2.1 and 2.2.1.2), and is currently circulating in West Africa (clade 2.3.2.1c) after reintroduction in December 2014. Recent (early 2015) incursions of clade 2.3.2.1c have occurred in Europe (Bulgaria, Romania and Turkey) in both wild birds and poultry (Food and Agriculture Organization of the United Nations (FAO), 2015) (see Figure 1d for H5N1 HPAI outbreak distribution by country during the 2015/16 season). The virus has occurred sporadically in countries in the Middle East since 2006 and within the last year was reported either officially or unofficially in both poultry and wild birds. Since 2006, incursions of H5N1 HPAI were observed at different times in Gaza Strip, Iran (Islamic Republic of), Israel, Jordan, Kuwait, Saudi Arabia, Turkey, The West Bank and Yemen (see Figures 1a and b). Thus far, the Syrian Arab Republic has not officially reported the occurrence of H5N1 HPAI. In 2015, H5N1 HPAI viruses clustering with those circulating in Egypt (clade 2.2.1) were isolated from outbreaks reported in Gaza Strip, Israel and The West Bank. Incursions of H5N1 were also detected in Turkey and Iran (Islamic Republic of) in 2015. France reported H5N1 HPAI outbreaks between October 2015 and April 2016 in the southwest of the country; however, genetic characterization of the virus revealed that it was a reassortant of European avian influenza

Figure 1a. HN15 HPAI events reported in humans, poultry and wild birds in the Middle East from 2005 to 2008, overlaid on poultry population density



Source: EMPRES-i, 2016

Figure 1b. HN15 HPAI events reported in humans, poultry and wild birds in the Middle East from 2009 to 2012, overlaid on poultry population density



Source: EMPRES-i, 2016

strains and was not related to the Asian-origin viruses previously mentioned.

The current situation involves the confirmation of H5N1 HPAI in Iraq and Lebanon. **Iraq** officially reported six outbreaks to the World Organisation for Animal Health (OIE) in commercial and backyard flocks located in five governorates across the country

between December 2015 and February 2016. The first two outbreaks (16–17 December 2015) were detected in two governorates located in the Kurdistan region of northern Iraq. On the index farm – a commercial poultry farm – about 65 000 out of 685 975 susceptible birds were affected. The index farm is located in Sumel (Dahuk Governorate), approximately

60 km from the Iraqi border with Turkey. The second outbreak affected 124 backyard birds in Sangasar (Al Sulaymaniah Governorate), located approximately 40 km from the Iranian border and 250 km southeast from the index farm in Sumel, Iraq. Subsequent outbreaks were detected on 25 January 2016 (39 days after the first detection) in two commercial poultry farms located in Al-Badiar (Al Qadiyiah Governorate), approximately 500 km south from the index cases. Thereafter, the presence of the virus was confirmed on 2 April and on 7 April 2016 in two commercial farms (200 km north in Tarmiyah) located in Baghdad Governorate and in Jadid Al-Shatt, Dyala Governorate. Observed mortality rates ranged from 9.4 percent to over 80 percent. The last series of 11 reported outbreaks occurred in Alwahda, Baghdad between 15 June and 13 July 2016 with reported mortality of 100 percent. Genetic characterization of the virus circulating in Iraq has not been performed to date.

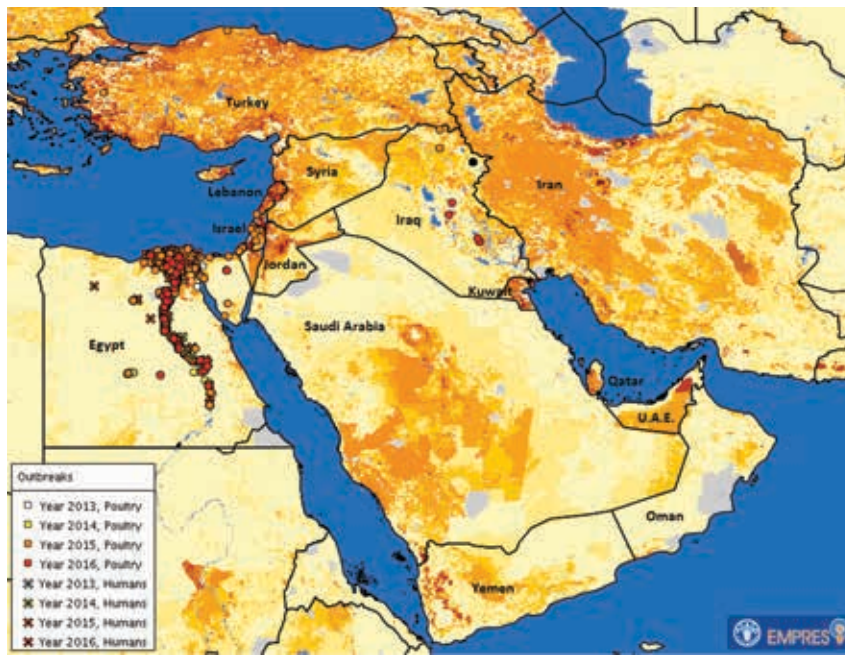
Lebanon confirmed the first incursion of H5N1 HPAI on 22 April 2016 on several chicken farms in a village located in the Bekaa region, in the east of the country. The disease was reported as the result of observed increased mortality (20 000 deaths out of a population of 80 000 birds). Epidemiological investigations pointed to illegal movement of animals as the possible source of incursion (the affected village is very close to the Syrian Arab Republic border in areas where Syrian refugees are settled). Sequencing of the haemagglutinin (HA) gene shows that the Lebanese H5N1 HPAI virus falls within the genetic clade 2.3.2.1c and presents highest similarity with the H5N1 HPAI viruses isolated between January and March 2015 in wild and domestic birds in Bulgaria, Romania and Turkey. Viruses from this clade have also caused poultry outbreaks during 2015–2016 in Cambodia, China, Viet Nam and West Africa. Lebanon has since declared the outbreak as contained (OIE, 2016).

Thus far, no human cases have been reported in the two recently affected countries. In 2006, Iraq reported the occurrence of two human cases in the Kurdistan region in addition to outbreaks in the backyard poultry system.

Last year the Iraqi media also reported rumours related to avian influenza circulation in the country, but these were never officially confirmed. The reports indicated the possible presence of H5N1 HPAI in northern Iraq including the Kurdistan region (FluTrackers, 2015). Sequences from nine virus isolates reportedly collected around the time of the alleged outbreaks (April and May 2015) are currently available in GenBank and genetic characterization confirmed the virus to also be of clade 2.3.2.1c (Genbank, 2016).

Given previous H5N1 HPAI outbreaks in the region and the high poultry production areas in countries bordering Iraq, there

Figure 1c. H5N1 HPAI events reported in humans, poultry and wild birds in the Middle East from 2013 to 2016, overlaid on poultry population density



The black dot in Iraq indicates an H5N1 HPAI suspected event in poultry in May 2016
 Source: EMPRES-i, 2016

(Lebanon and Iraq) into currently 'non-infected' countries of the Middle Eastern Region (Gaza Strip, Iran (Islamic Republic of), Israel, Jordan, Kuwait, Saudi Arabia, the Syrian Arab Republic, Turkey and The West Bank) and extra-regional countries (Armenia, Azerbaijan and Georgia) via cross-border trade and movements involving live birds, people and fomites, and wild bird migration?

2. What would be the consequences of H5N1 HPAI introduction and spread in each of the listed countries?

Hazard identification

The hazard is identified as the H5N1 HPAI virus recently reported in the Middle East in Lebanon and Iraq during late 2015 and early 2016.

Risk assessment

The confirmation of outbreaks of H5N1 HPAI in the Middle East means that neighbouring countries in the region and beyond are potentially at risk of introduction through multiple risk pathways. A qualitative risk assessment and a risk factor analyses were undertaken. A rapid qualitative risk assessment was conducted following the OIE framework (OIE, 2004). To assess the risk of introduction the following risk pathways were considered:

- imports of live poultry (both legal and illegal, associated with movement of refugees);
- imports of poultry-related products, including transport (contaminated fomites/vehicles across borders);
- wild bird migration;
- hunting of wild birds and illegal trade.

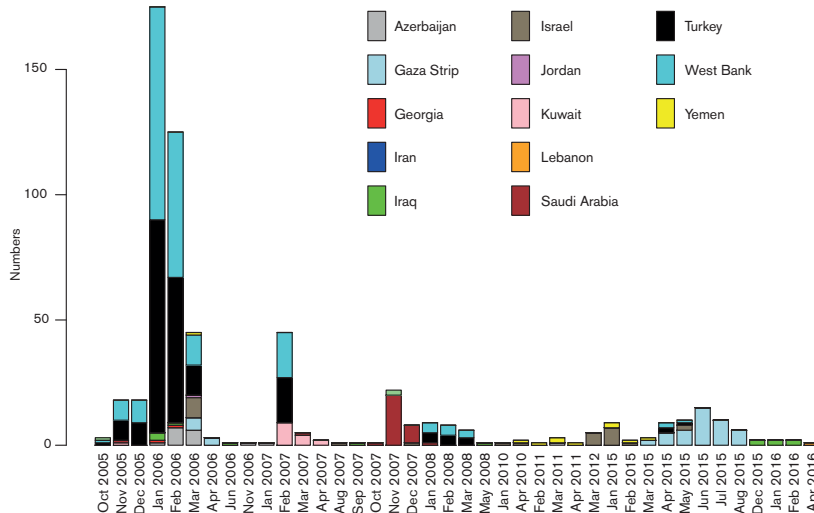
Pathways through which HPAI could be released from Lebanon and Iraq to non-infected countries (Gaza Strip, Iran (Islamic Republic of), Israel, Jordan, Kuwait, Saudi Arabia, the Syrian Arab Republic, Turkey and The West Bank) in the region and extra-regionally (Armenia, Azerbaijan and Georgia) were developed. Probability categories were estimated for each step of the risk pathways.² Definitions used for risk categories ranged from negligible to very high.

In addition to the rapid risk assessment, a regional-level analysis of H5N1 HPAI risk factors was undertaken to identify and map areas where H5N1 HPAI could be, given the historical presence of HPAI as well as the presence of known risk factors. Factors considered for the analysis included backyard and commercial chicken densities, as well as the presence of lakes and wetlands (as a proxy for water bird presence).

Consequence assessment considered the potential impact of the introduction of HPAI H5N1 into the non-affected countries at national and farm levels.

² GLEWS@fao.org can be contacted for additional information on the assessment.

Figure 1d. Bar chart of HPAI outbreaks in the Middle East (2006–2016)



Source: FAO

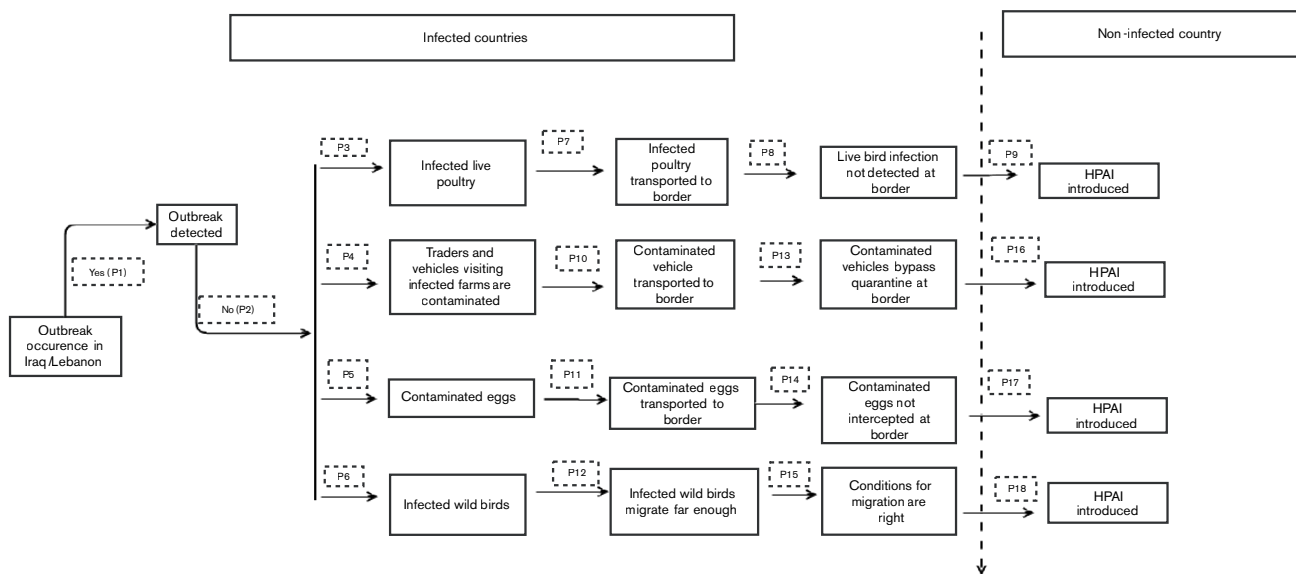
is potential for continuous incursions, establishment and spread of H5N1 HPAI in the region. A risk assessment (RA) was conducted to assess the risk of introduction from infected countries and spread within the region as well as the consequences of the infection on the poultry sector and public health.

Risk questions

This RA will focus on assessing the risk of H5N1 HPAI introduction to countries in the Middle East region and extra-regional countries in 2016 via the movement of live poultry, poultry products or wild birds. The risk questions guiding this RA are therefore:

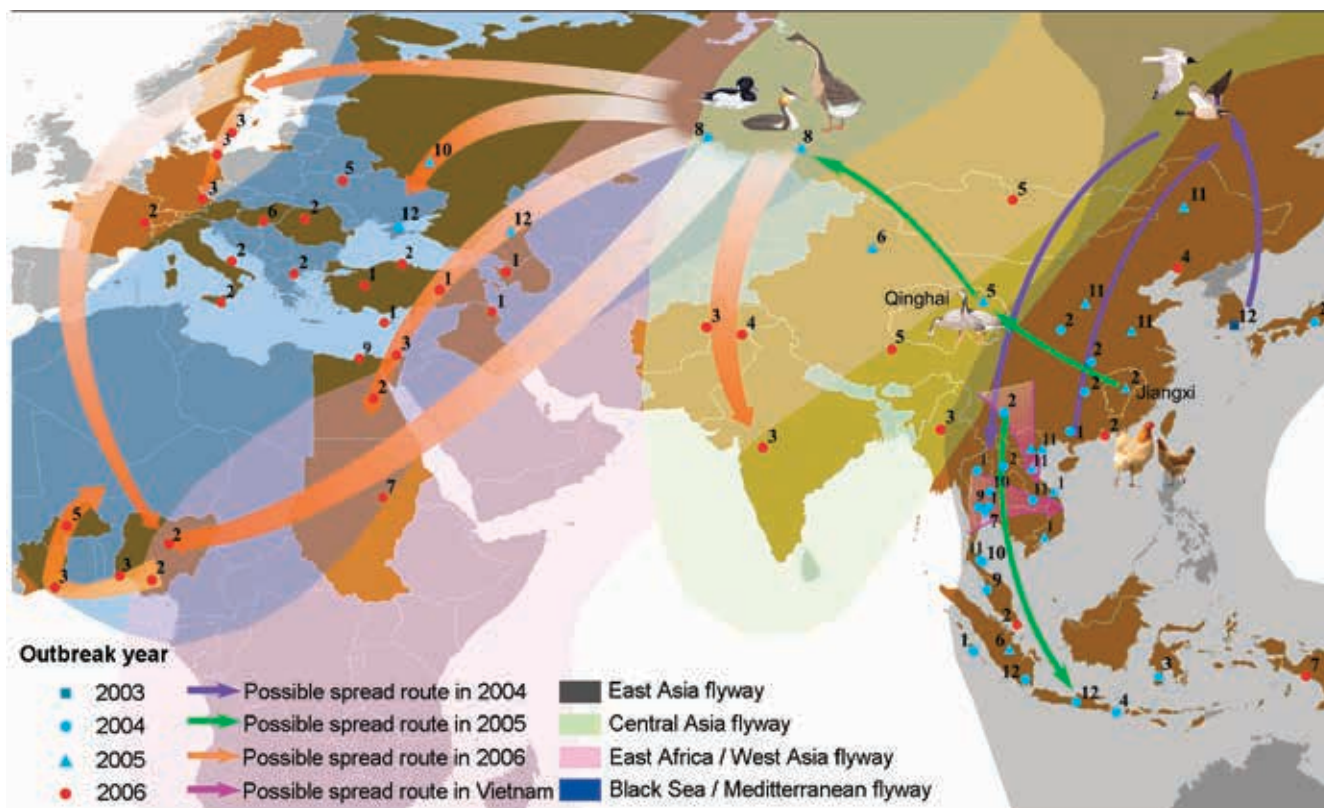
1. What is the risk of introduction of HPAI from currently infected countries

Figure 2. Pathway for introduction of HPAI from currently infected countries to uninfected countries in the Middle East



Source: FAO

Figure 3. Waterfowl flyways, H5N1 HPAI outbreaks and possible spread routes in 2004–2006



Source: Liang et al., 2010

Figure 4a. Birds' wintering areas (green polygons), including Lake Urmia, Iran (Islamic Republic of) where about 2 000 wild birds died in October 2015

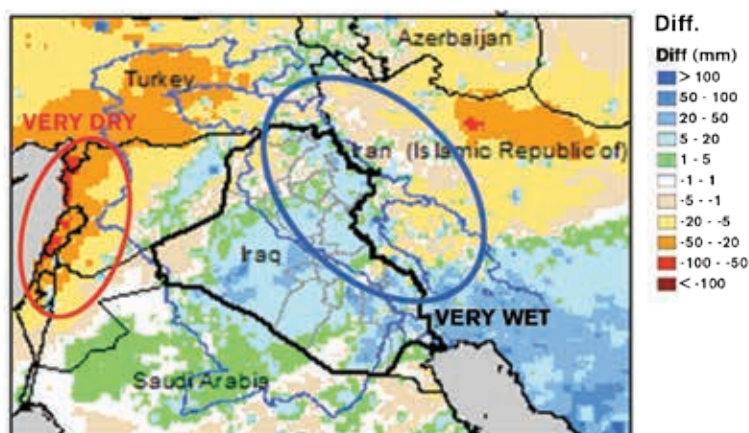
(a)



The cause of this die-off remains unknown, though avian influenza was not confirmed
Source: BirdLife International, 2016a.

Figure 4b. Precipitation anomalies in the Middle East (21–31 December 2015), showing drier-than-average conditions in the Mediterranean coastal area (including Lebanon) and wetter-than-average conditions in eastern/southern Iraq

(b)



Source: United States Geological Survey (USGS)/Earth Resources Observation and Science (EROS)

Factors contributing to the introduction and spread of the virus in the region

A number of factors in the region may have had an impact on the probability of the virus introduction as well as the relative role of each pathway in each country.

1. Political regional instability:

The civil war in the Syrian Arab Republic has resulted in large uncontrolled displacement of people and animals across the region with [Iraq](#), Jordan,

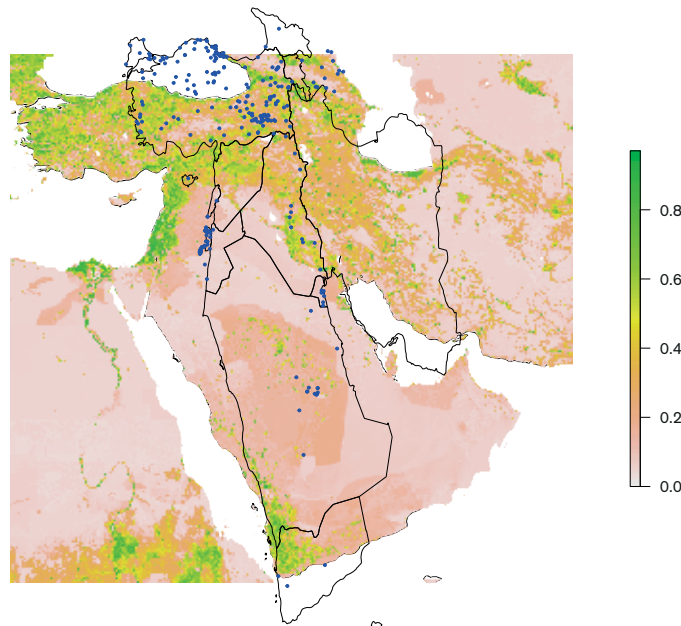
Lebanon and [Turkey](#) being the main destinations. The majority (85 percent) of the refugees are settled in rural areas where agriculture is the mainstay. Outward migration from the Syrian Arab Republic is estimated at more than 5 000 000. In 2015, 21.3 percent of all citizens of the Syrian Arab Republic lived abroad (International Organization for Migration (IOM), 2016). Iraq also experienced an internal displacement crisis, with 2.1 million Iraqis displaced by internal armed conflict in 2014 alone.

Farmers have mainly lost cross-border trade since there is no access to farmland along the border due to the continuing violence (FluTrackers, 2015).

2. Wild bird migration and climate:

- Iraq and Lebanon are a concentration point for migratory birds of the Western Siberian-Mediterranean-East Africa flyway, on their way from breeding areas in Eastern Europe and Western/Central Siberia to wintering areas in the Middle East. This includes the river systems of the Arabian Peninsula, the Nile system in Egypt, Ethiopia, Israel and the Sudan across the southeastern Mediterranean countries along the Rift Valley/Red Sea flyway and the Caspian Sea (FAO, 2015; FluTrackers, 2015) (Figure 3).
- Lebanon hosts important bird areas for breeding, wintering and passage birds, and is considered a major stopover point along the flyway route. Infected birds migrate long distance, possibly carrying the virus (Genbank, 2016; IOM, 2016). Due to its particular narrow position, Lebanon is one of the most concentrated countries on the Rift Valley/Red Sea flyway including three flyways, all parallel to the Mediterranean Sea. The first flyway extends along the shoreline and is mainly used by shorebirds, sea birds and waders. The second flyway stretches along the Bekaa Valley (where the infected farms were reported) and is the main migration route of the Red Valley/Red Sea flyway. The third flyway extends along the Anti-Lebanon mountain range and is mainly used by soaring birds during spring migration.
- A recent study showed that H5N1 could spread from central Siberia to Egypt and the Sudan along the East Africa-West Asia flyway via the Russia Federation, Iran (Islamic Republic of), Iraq, Lebanon, Israel, The West Bank and Gaza Strip (Figure 3) (FluTrackers, 2015). Analysis of the precipitation patterns shows the coastal areas including Israel, Lebanon and southeastern Turkey were drier than average for autumn 2015, while northeastern Iraq and eastern Iran (Islamic Republic of) were wetter than average (Figure 4b). Given that precipitation anomalies influence phenology and forage availability for wildlife, affect migration routes, wintering areas and departure timing for the migratory species (IOM, 2016; Iverson *et al.*, 2011; Liang, 2010), it is feasible to hypothesize that the very dry

Figure 5. Predicted probability of HPAI presence based on H5N1 HPAI occurrence data (2006–2016) and risk factors (extensive and intensive poultry density, and lakes and wetland areas)



The point location of H5N1 HPAI outbreaks (2006–2016) are indicated in blue
 Source: FAO

Syrian Arab Republic. Prior to the current crises, the Syrian Arab Republic was an important poultry producer in the region, was self-sufficient and exported to Jordan and Lebanon. Both legal and illegal trade occurs though very little documentation exists for the latter. Anecdotal evidence supports the existence of trade along the borders of northern Iraq and Turkey as well as Iran (Islamic Republic of) in the mainly Kurdish areas. Restrictive policies for trade between Iraq and the Kurdish region may have resulted in a surplus of poultry/poultry commodities and illegal movements of such commodities into adjacent regions. In terms of legal trade, most poultry is imported into the region from Europe (France, the Netherlands and the United Kingdom of Great Britain and Northern Ireland). Furthermore, there is evidence for imports from countries in the region; Iraq and Lebanon imported from Qatar in 2010 and Kuwait imported from Egypt in 2013. In regard to the competency of the veterinary services, Lebanon reacted promptly to contain the current outbreaks as per FAO communications at regional level. As for Iraq, it is noted that differences in policies for live animal trade and related commodities between central and southern Iraq and the Kurdish region may have contributed to further national spread of the disease. As discussed above, veterinary services in the Syrian Arab Republic are considered weak owing to the ongoing civil unrest and lack of investment.

Annex 1. Risk estimates.

Risk level	Explanation
Negligible	Extremely rare; it does not merit to be considered
Very low	Very rare, but cannot be excluded
Low	Rare, but does occur
Medium	Occurs regularly
High	Occurs often
Very high	Events occur almost certainly

conditions in the Mediterranean coastal area (including Lebanon) could have directed migratory and sedentary birds towards the wetter areas in Kurdistan and Iraq in search of food and water. This would imply a higher congregation of species at the critical bird resting areas in Iraq with increased risk of virus transmission among the animals, if, in fact, birds were infected. This hypothesis, however, would need to be validated through field investigations.

d. Migratory bird hunting is also an important socio-economic activity across the region, involving hundreds of thousands of people, particularly in rural areas in Lebanon (Birdlife International, 2016b). Where there are infected wild birds, hunting

could represent a risk for direct transmission of avian influenza virus to humans (Keawcharoen, 2008) or the introduction of the virus by humans to poultry populations. It could also potentially result in non-natural dispersal of flight patterns through flushing of bird populations.

3. Poultry production, movement, competency of the veterinary authority and trade: Overall, an increase in production since 2004 was observed across the region with countries such as Israel, Saudi Arabia, Turkey and Yemen being important producers (Birdlife International, 2016b). Eggs are generally imported to Lebanon from Iran (Islamic Republic of), Saudi Arabia, Turkey and Ukraine but evidence exists for illegal imports from Romania and the

4. Wild bird informal trade: Wildbirds, particularly waterfowl, are traded informally in small markets mainly for local consumption in central and south Iraq, where existing legislation is seldom enforced and the socio-economic situation is unstable. In Kurdistan, northern Iraq, hunting is also an important activity, but informal trade is curtailed through government control. It is recognized that certain bird species are smuggled for populating local zoos and to be used as birds of prey for falconry. Large and rare birds like swans are sent out of the country, mainly to Kuwait, to be sold at higher prices than those obtained in Iraq (Birdlife International, 2016b).

Conclusions

Based on the qualitative assessment, the overall risk of H5N1 HPAI introduction into the unaffected countries of this region via the selected risk pathways ranged from low to high, with moderate to high levels of uncertainty. The overall risk for spread in the Middle East region was medium, with medium uncertainty. The introduction

of H5N1 HPAI would have important consequences for the commercial sector and small poultry holders as well as for food security in each country assessed (results not shown). Since H5N1 HPAI is a zoonotic virus and therefore constitutes a public health threat, communication among ministries and enhanced surveillance are as important as prompt reporting.

The regional risk map (Figure 5) based on risk factors such as extensive and intensive poultry density, lakes, rivers, estuaries and wetlands highlighted differences in HPAI risk within and between countries in the region. Areas within Israel, Lebanon, The West Bank and Gaza Strip, and western and northern parts of the Syrian Arab Republic are at high risk for H5N1 HPAI presence if the disease is introduced (i.e. greater than 80 percent). Areas with lower to medium risk probabilities were distributed across Azerbaijan, Georgia, Iran (Islamic Republic of), Iraq, Jordan, Kuwait and Saudi Arabia. Risk probabilities were driven primarily by extensive poultry density (greater than 80 percent) rather than the presence of lakes or wetlands (0 percent).

In conclusion, based on both the risk assessment and the risk factor analyses, countries at high risk include Turkey and the Syrian Arab Republic (particularly areas near the Kurdistan region and the western area near the border with Lebanon) and Iran (Islamic Republic of). Given the presence of high poultry production areas and low

biosecurity along the Syrian Arab Republic border with Iraq and no information on the HPAI situation in the Syrian Arab Republic due to non-functional veterinary infrastructure, it is likely that H5N1 HPAI virus has already been introduced in poultry populations there, though they have not been reported to date. Iran (Islamic Republic of) is at similar risk judging from anecdotal evidence of informal trade at the Kurdish border with Iran (Islamic Republic of), but unlike the Syrian Arab Republic, the veterinary systems for detection and response are operational. Jordan shares borders with the Syrian Arab Republic and Iraq, and the movement of livestock, including live poultry across borders from the Syrian Arab Republic, is ongoing and is associated with refugee movements.

Countries at medium risk of incursion of H5N1 HPAI include Gaza Strip, Israel, Kuwait, Saudi Arabia and The West Bank. For Gaza Strip, Israel and The West Bank, there is no evidence of substantive trade, either legal or illegal from the affected countries. Additionally, incursions may be mitigated by high security concerns implemented at borders. Kuwait and Saudi Arabia share borders with Iraq and given that the extent of spread in Iraq is not fully discerned, movement of infected live poultry is possible.

Armenia, Azerbaijan and Georgia are located along spring migration pathways for wild birds travelling northwards but the risk of wild birds becoming infected and

subsequently seeding viruses to these countries is considered low. The role of live poultry trade is considered low to negligible. The overall risk of introduction of H5N1 into the poultry population is low.

Cyprus is considered at negligible risk of incursion from the two infected countries given its geographic location (separated by sea), lack of poultry trade and the fact that it is not on the wild bird migratory route.

The overall risk of HPAI spreading to non-infected countries in the region is considered medium to high. This is based on the number of countries at risk of incursion, the previous incursion patterns of the disease in the region as well as consideration of poultry production, poultry and poultry commodities trade, wild bird migration routes, and sharing of borders between affected and unaffected countries, which may facilitate smuggling or informal trade of poultry and wild birds. Disease control measures implemented in Iraq and Lebanon and their effectiveness to contain H5N1 HPAI outbreaks would also have an impact on the potential spread of this virus within those countries and in at-risk neighbouring countries. There is a high uncertainty on the reliability of available data related to trade, poultry value/marketing chains, poultry production systems, interactions between wild birds and poultry production systems, and local wild water bird species distribution patterns.

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