



A new One Health Framework in Qatar for future emerging and re-emerging zoonotic diseases preparedness and response

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ABSTRACT

One Health is increasingly recognized as an optimal approach to address the global risk of health threats originating at the human, animal, and ecosystem interface, and their impact. Qatar has successfully practiced One Health approach for investigation and surveillance of zoonotic diseases such as MERS-CoV, and other health threats. However, the current gaps at institution and policy level hinder the sustainment of One Health. In this paper, we have assessed the potential for implementation of One Health Framework to reinforce and sustain One Health capacities in Qatar for 2022–2027. To implement One Health Framework in the country, Qatar Joint External Evaluation (JEE) report, lessons learnt during One Health experiences on zoonotic, vector-borne, and food borne diseases were used to present an outline for multisectoral coordination. In addition, technical capacities of One Health and factors that are required to operationalize it in the country were also assessed in series of meetings and workshops held at Ministry of Public Health on March 2022. Present health care infrastructure and resources were found to be conducive for effective management and response to shared health threats as evident during MERS-CoV, despite being more event based. Regardless, the need for more sustainable capacity development was unanimously emphasized. The consensus between all relevant stakeholders and partners was that there is a need for better communication channels, policies and protocols for data sharing, and the need to invest more resources for better sustainability. The proposed framework is expected to strengthen and facilitate multilateral coordination, enhanced laboratory capacity and network, improve active surveillance and response, risk communication, community engagement, maximize applied research, and build One Health technical work

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force. This would enable advancement and sustainment of One Health activities to prevent and control health threats shared between humans-animals-ecosystem interface.

1. Introduction

Emerging and reemerging zoonotic diseases, remain a significant threat to global health, economy, and food security and safety [1–3]. Recent examples of these threats include severe acute respiratory syndrome (SARS), Highly Pathogenic Avian Influenza (H5N1 and H7N9), Pandemic H1N1, Ebola virus, Middle East Respiratory Syndrome Coronavirus (MERS-CoV), and the currently persisting; coronavirus disease 2019 (COVID-19) [3,4]. Moreover, zoonotic diseases such as rabies, bovine tuberculosis, brucellosis, and vector borne diseases also continue to contribute to persistent disease and economic burden, affecting public health and livelihood, in addition to their adverse impact on agricultural production and ecosystems [2]. Furthermore, the increasing complexity of food chains and food production, along with evolving agricultural practices is contributing to rise in foodborne zoonosis, such as *Salmonella*, *Campylobacter* and *Escherichia coli* infections [2,5]. In response, antibiotics are being increasingly used to mitigate these zoonoses and meet the growing demand of animal products, thus increasing antimicrobial resistance (AMR) [6]. This issue is compounded by increase in travel and urbanization, along with climate change [2,3,5].

Managing these complex health challenges warrants a comprehensive, multisectoral, and transdisciplinary approach: namely One Health, to enable better understanding of disease drivers, and to help in developing appropriate risk management strategies to effectively address health threats at the human-animal-ecosystem interface. One Health is an integrated and unifying approach that balances health of people, animals, and ecosystem and provides a sustainable solution to global health and food security, and therefore paves the way for attaining the Sustainable Development Goals [7]. Qatar recently utilized One Health approach in coordinating surveillance and investigation activities for MERS-CoV and Rabies [8,9]. Now the country is also planning to utilize a One Health approach to tackle AMR under the recently developed National Health Strategy 2018–2022 [10], and National Action Plan (NAP) for tackling AMR, as well as extend to managing multitude of healthcare issues [11].

Advocating for One Health implementation across the complete spectrum of public health system in Qatar would consolidate majority of the resources under a single banner to create a holistic public health care system. The experience of Qatar in One Health approach may be inspiring for other countries in preventing and mitigating emerging and zoonotic diseases and antimicrobial resistance, and other public health issues. Given the country's previous experiences with One Health and subsequent lessons learnt from its initial utilization, the aim of this article is to illustrate the history and experience from One Health approach in Qatar. In addition, the article will explain the future requisites to strengthen the One Health framework to ensure the sustainable development in Qatar.

2. The One Health activities in Qatar

2.1. Initial One Health investigation for emerging zoonotic diseases

Qatar National Outbreak Control Task Force (OCT) was formulated in 2005 as a joint outbreak investigation team composed of public and animal health experts from national and international level. Using One Health approach, the OCT provided a fundamental service for surveillance and response to severe acute respiratory syndrome (SARS), highly pathogenic avian influenza (HPAI), and others zoonosis in 2006–2007.

2.2. Development of One Health framework

The OCT was reactivated upon emergence of MERS-CoV in the Middle East, including Qatar. When the zoonotic origin of MERS-CoV became evident in 2014, the Supreme Council of Health (Currently the Ministry of Public Health, MoPH) established a multidisciplinary team and a plan for joint investigations of MERS-CoV cases in the country and associated risks from camels. One Health conference was held in 2015 with participants from the Centers for Disease Control and Prevention of the United States (CDC), Erasmus Medical Centre in the Netherlands (EMC), Public Health England (PHE), Food and Agriculture Organization of the United Nations (FAO), World Health Organization (WHO), World Organization for Animal Health (OIE), and regional (Gulf Cooperation Council) experts. Following the conference outcome, findings of the International Health Regulation's Joint External Evaluation (IHR-JEE) reports, and opinion from the subject matter experts in One Health, zoonotic diseases, public health, academia, and animal health sector in the State of Qatar [12], a comprehensive One Health roadmap was delivered. The roadmap aimed to coordinate surveillance and investigation, conduct epidemiological studies, and increase laboratory diagnostic capacity [13,14]. Additionally, the One Health investigation for rabies in 2018–19 provided an added value and benefits of One Health as an optimum approach to solve health challenges at the human-animal-ecosystem interface [9].

Although the MERS-CoV and rabies emergency has brought the human and animal health sectors to work together and practice One Health approach, the sustainability of One Health activities still remains to be implemented. To permit continuous collaboration and coordination, the related sectors needed a progressive strengthening of multi-lateral channels between them. These channels would encompass policies and strategies, and structures that reinforce them to promote intersectoral collaboration on all fronts to attain more effective and comprehensive surveillance and control of priority zoonotic diseases. Then, the One Health framework (OHF) was developed in 2019 following FAO consultation based on Qatar's previous experience with SARS, HPAI, MERS-CoV, and rabies.

2.3. Foodborne and vector-borne diseases and antimicrobial resistance

Vector-borne and foodborne diseases of public health importance were investigated using retrospective data as well as use of longitudinal and snapshot studies that gauged their prevalence and potential for species to proliferate. The situation of antimicrobial resistance in Qatar was assessed using available literature and internal data [10]. All these assessments were collaborated and corroborated during the external WHO expert consultant mission in Qatar between 2017 and 2019 to devise strategies to address and mitigate their impact.

2.4. Joint Risk Assessment in 2022

After the subsequent completion of the One Health Framework draft and JEE report, MoPH initiated the required activities needed to complement the different areas of One Health strategy in keeping with contextual relevance for Qatar. This involved planning and hosting an international workshop bringing together members of WHO Regional office for the Eastern Mediterranean (WHO-EMRO), FAO, OIE, and local ministries to train subject experts on different aspects of One Health, specifically *Joint Risk Assessment (JRA)* [15]. A multisectoral JRA workshop was conducted in May 2022 in the MoPH for risk assessment of avian influenza, brucellosis, Rift Valley Fever, and MERS-CoV.

3. Outcome of One Health activities

3.1. Joint external evaluation report

The main findings of JEE report stressed the importance of having a multisectoral collaboration at a legislative level that outlined a structured approach between different actors involved with their well-defined roles and responsibilities. It also recommended development of new electronic tools for active surveillance within the country for possible health threats. Qatar’s health institutions proposed a permanent unified multisectoral coordination structure, which was further updated and adjusted based on national requirements. The Interministerial Coordination Committee (IMCC) was structured at the Director level from relevant ministries such as the MoPH and the Ministry of Municipality and Environment (MOE) (currently it is Ministry of Municipality, MoM and Minister of Environment and Climate Change, MOECC) (Fig. 1). Further, this group was extended by choosing members from private sectors, research institutions, and academia, such as Qatar University (QU), Qatar National Research Fund of Qatar Foundation (QNRF), Hamad Medical Corporation (HMC), and other relevant national entities. The final list was agreed by the previous intersectoral committees. The IMCC supervises six Thematic Working Groups (TWGs) with an objective of identifying and addressing the most important One Health issues in the country. TWGs are multidisciplinary teams comprised of technical staff from relevant ministries including researchers, scientists, and other technical personnel. They provide a platform for membership interaction and the exchange of experiences around their respective areas of work and take responsibility for developing joint programs of work and supporting their implementation by relevant sectors. TWGs will also on regular basis perform assessments to check for existing or newly identified gaps and address them to

maintain program efficiency and functionality.

Lastly, the MoPH has also established the Surveillance & Vaccine Electronic System (SAVES) to fulfill the requirement to have an active surveillance tool for emerging and re-emerging disease, and to monitor disease trend in general. This system allows the various public and private healthcare institutions in the country to jointly survey for potential outbreaks. It is now moving forward with extended work, including surveillance of zoonotic animal diseases.

3.2. One Health Framework

The One Health framework increased multisectoral coordination and collaboration with clearly defined roles and responsibilities for each entity, creation of technical working group, enhancing laboratory preparedness, preparation and response for disease outbreaks, risk communication and strengthening partnerships, and conducting cross-sectoral risk assessment and applied research [16].

The joint efforts helped in detection of MERS-CoV cases through routine investigations, community-level contact tracing, and provided the first molecular evidence that camels are a potential source for MERS-CoV [13,14]. It managed to demonstrate to the policymakers the added value and benefits of One Health as an optimum approach to solve health challenges at the human-animal-ecosystem interface [14]. The joint work also revealed the rabies virus (RABV) strains from human cluster with RABV sequences previously identified in Nepal. In contrast, the animal RABV sequences from Qatar are part of another clade and cluster with sequences from the Arabic Peninsula, which is in line with epidemiological information and exposure history [9].

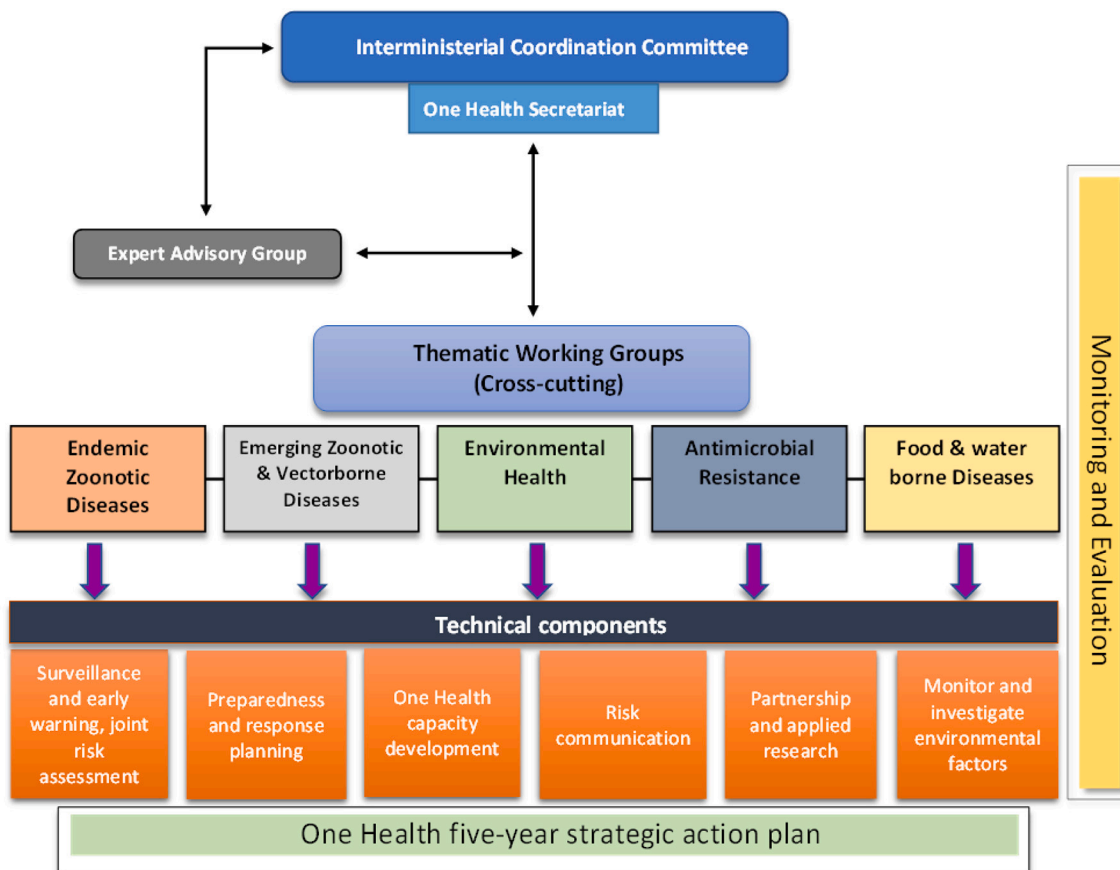


Fig. 1. Proposed structure of the One Health Framework.

3.3. One Health surveillance and early warning

The outbreak of MERS-CoV in Qatar provided a viable opportunity to utilize One Health approach. MoPH collaborated with HMC and MOM, along with other partners, to have an integrated surveillance system to identify and respond to possible MERS-CoV cases [17–22]. This permitted the One Health team to successfully detect cases early on, which was significant in mitigation of MERS-CoV [22]. Moreover, this setup for such a surveillance system is currently being used for AMR in Qatar in a limited capacity. As of now, this unified system is more applicable to human cases as opposed to identifying animal cases.

3.4. Cross sectorial risk assessment

Multisectoral risk assessment (MRA) with the participation of all the relevant sectors involved in the surveillance of a given zoonotic disease event or threat is critical to enhancing cross sectoral collaboration and improving data collection and data-sharing from and across different sectors [16]. OHF facilitated in capacity development for undertaking MRA when a zoonotic disease event or threat is identified [16,23–27]. An assessment of the epidemiological relationship between positive human cases and positive livestock cases in different livestock species must include both people and animals simultaneously, with a focus on identifying the animal species and wildlife acting as reservoirs for the zoonotic pathogens.

3.5. Collective evaluation and outcome of AMR, Foodborne and Vector-borne diseases in Qatar

The NAP for AMR has made significant gains in human health such as establishment of antimicrobial stewardship (AMS). Programs across all major inpatient and primary healthcare facilities were taken to establish National Infection Prevention and Control (IPC) Program and implemented across all healthcare facilities in Qatar. National AMR Surveillance System was established, and the data from which is reported to WHO's Global Surveillance System for AMC (GLASS-AMR). Moreover, food security is another top priority for Qatar on the developmental level and constitutes a key part of the country's security and economic development in terms of securing the needs of future Qatari generations. In line with the principles of the Qatar National Vision 2030 [28] and the second National Development Strategy (NDS-2) (2018–2022) [29], MoM launched several initiatives and projects to increase local food production and ensure the food security of the country. Foodborne pathogens have been identified as one of the major limitations to the global advancement of animal health and its importance to Qatar has been emphasized in the Qatar National Food Security Master Plan as one of the high priority issues [25].

The rural areas are most vulnerable to changes in animal and environmental health, and as such warrant community engagement. One Health Framework complements and builds upon the National Vision involving community representatives to inform policy development. This would monitor the animal owners and handlers, along with other sectors involved in animal husbandry and food production, and support in establishment of measures against zoonotic disease transmission and risk mitigation.

Using One Health Framework, environmental sectors would see improved collaboration across relevant sectors to enhance public health via enhancing quality control measures for food and water, waste management, air quality, and minimizing negative impact of climate change and pollutants and other contaminants that can be detrimental to health of humans and animals [25].

In Qatar, using One Health approach several reservoirs and vectors such as fox (*Vulpes vulpes*), commensal rodents (*Mus musculus*, *Rattus norvegicus*, and *Rattus rattus*) and mosquitoes (*Culex quinquefasciatus*, *Cx. perexiguus*, *Anopheles stephensi*, and *Aedes caspius*), were detected which can be a potential risk for local transmission of Rabies, Leishmaniosis,

Hymenolepiasis, Rickettsial diseases, West Nile virus, Rift valley fever, Malaria, and Dengue [9,26,27–32]. Interestingly, *Culiseta longiareolata* was detected for the first time in Qatar. In addition, a machine learning technique was implemented to compute the probability distribution of the species of mosquitoes as well as analyze the dependency of ambient conditions (ambient temperature and humidity) on the species distribution in Qatar. The findings show that higher temperatures and lesser humidity enhance the probability of both the *Anopheles* and *Aedes* species, while the risk of an *Aedes* mosquito increases as the humidity decreases, but only to a certain point and then drops. Temperatures between 35 and 40 °C and relative humidity levels between 35% and 45% are ideal for *Aedes* mosquitoes (Unpublished data). Adopting One Health Framework would strengthen intra- and intersectoral network and develop a national public health pesticide management policy to tackle weaknesses in pesticide use or management and to avoid and solve potential problems of impact on human health and non-target organisms [16]. Environmental sector and national laboratories would also support investigation of potential vector borne threats, and capacity building for entomology and epidemiology at organizational level for VBD risk assessment and management.

3.6. Outcome of joint risk assessment workshops

JRA workshop provided a collaborative exercise on how to conduct a multisectoral risk assessment for avian influenza, brucellosis, Rift Valley Fever, and MERS-CoV. This proved to be a crucial step forward in providing the baseline upon which to strengthen intersectoral affiliations and synergize national capacities toward One Health goal. Following the JEE report and the ensuring development of Qatar One Health Strategic Framework, MoPH hosted the first Joint Risk Assessment in collaboration with WHO EMRO, FAO, OIE, and other national partners to train local experts on how to conduct cross-sectoral risk assessment as recommended by OHF and JEE findings. The most relevant One Health issues of mutual concern for human, animal, and ecological health sectors, requiring intensified intersectoral collaboration to help target One Health actions and interventions for measurable outcomes are shown in Table 1. These interventions will be regularly assessed and serve as indicators to gauge their efficacy. Specific interventions for each disease or condition are prioritized based on the needs and the resources available. For example, for brucellosis the most urgent actions include a sero-surveillance of the infection to detect the prevalence in animal populations and provide data for developing an informed strategy for effective control of the disease in animals and humans [33,34]. This will be underpinned by strengthening intersectoral collaboration for monitoring disease in humans, information sharing, and increasing community awareness about the risk of brucellosis transmission to humans through consumption of unpasteurized dairy products.

The MRA will initiate cross-sectoral collaboration, using certain high priority zoonotic diseases (i.e., MERS-CoV, Brucellosis, Avian Influenza, and Rift Valley Fever) as basis for its facilitation. As a result, many organizations agreed to collaborate under the One Health umbrella toward a common goal for a sustainable future.

4. Way forward

4.1. One Health capacity development

The OHF functions to establish a sufficient and competent workforce that is trained to prevent, detect, control, and respond to zoonotic diseases and other health threats at the human-animal-ecosystem interface. An important aspect of capacity development is conducting assessment of existing capacities to identify any shortcomings, and subsequently develop specific actions to address them. While standard assessment protocols and tools, such as the WHO/JEE and the OIE/ Performance of Veterinary Services (PVS) conducted by Qatar have identified existing

Table 1
Topics for One Health intersectoral collaboration and major actions.

Topic	Diseases	Humans cases	Animal cases	Priority One Health action/intervention
		2010–2019	2010–2019	
Endemic zoonotic diseases	Brucellosis	822	n/a	<ul style="list-style-type: none"> • Conduct benchmark surveillance studies for brucellosis in animals. • Targeted surveys to identify the burden of bovine TB in animal populations. • Targeted surveys to determine the burden of ZTB in humans and identify high-risk populations. • Improved information sharing between public health and veterinary services. • Strengthening community awareness about the risk of transmission from animal to humans using knowledge dissemination through social media and official publishing. • Coordinated cross-sectoral response for maximum effect. • Enhanced laboratory services to provide full spectrum of tests and produce results with efficiency. • Improve active surveillance of infections/ viruses of concern (i.e., SAR-CoV2, MERS-CoV, Avian Influenza) using enhanced and transparent sharing of information/ data/ research between public health and veterinary services as well as environmental health sector. • Implementing planned action response coordinated between human, animal, and environmental health sector to address SARS-CoV, MERS-CoV, and Avian Influenza via formation of Task Force. • Strengthening community awareness about the risk of transmission from animal to humans using knowledge dissemination through social media and official publishing. • Coordinated cross-sectoral response for maximum effect. • Enhanced laboratory services to provide full spectrum of tests and produce results with efficiency. • Improved coordination with environmental sector to monitor and respond to VBDs. • Enhanced laboratory services to provide full spectrum of tests and produce results with efficiency. • Active monitoring and surveillance of diseases of concern (i.e., Campylobacter, Salmonella) via collaboration between human, animal, and environmental sector using latest data and research and coordinated planning and implementation of interventions. • Coordinated cross-sectoral response for maximum effect. • Enhanced laboratory services to provide full spectrum of tests and produce results with efficiency. • Launch national AMR surveillance plan. Allocate more resources (i.e., financial and technology) to respond at appropriate scale to resistant organisms. • Enhanced laboratory services to provide full spectrum of tests and produce results with efficiency. • Improved coordination between all relevant entities to minimize pollution and adverse climate impact, as well as addressing (i.e., carbon neutral approach) • Ensuring food, water, and air quality across the country, as well as improved waste management. • Enhanced laboratory services to provide full spectrum of tests and produce results with efficiency.
	Zoonotic tuberculosis - Limited (cattle)	n/a	n/a	
	Leishmaniosis (not reported)	84	n/a	
	Rabies (not reported in dogs)	2	2	
Emerging and re-emerging zoonotic diseases	SARS-CoV2	23,8165	n/a	
	MERS-CoV (domestic camels)	28		
	Avian Influenza (not reported)			
Vector borne diseases	Malaria	5469	n/a	
	Dengue fever	163		
	Schistosomiasis	38		
Food and water borne diseases	Campylobacter	883	n/a	
	Salmonella	3843		
AMR	n/a	n/a	n/a	
Environment contaminations	n/a	n/a	n/a	

gaps to be addressed for intersectoral collaboration. Capacity building and assessment tools, utilizing latest technological tools (e.g., SAVES) adopted by MoPH and procedures can be promptly designed and implemented in the interim to maintain minimum core One Health capacities in the country while planning for more permanent application (Table 2). The identified gaps can be addressed through continual cross-sectoral training of professionals from human, animal, and environment sectors in all aspects of One Health such as surveillance, laboratory diagnostic, risk assessment, risk reduction, and response and communication. The One Health capacity development programme can be implemented across the four thematic areas of the Framework using partnership resources at national, regional, and international levels. Nationally, Qatar University can play an active role in One Health education and training programme. FAO, OIE and WHO as well as recognized centers can also be solicited as needed for specific assessment and capacity building activities.

4.2. Preparedness and response planning

The development of One Health preparedness and response plans for priority zoonotic diseases include disease control and eradication programs on top of prevention and control measures, and rapid response team (RRT) capacity development [7,16,35]. Existing plans (e.g., MERS-CoV) should be reviewed and harmonized across the relevant sectors

with clear roles and responsibilities for coordinated actions. Multi-sectoral preparedness and response plans for priority diseases such as zoonotic influenza, brucellosis, rabies, and rift valley fever, as well as for priority food borne diseases such as salmonellosis should be jointly developed and validated by all relevant sectors, while plans for other diseases can be prepared after the fact as needed. Institution of such plans can help in mitigation of zoonotic diseases and eventually their eradication altogether.

Sharing resources across the sectors for effective response to zoonotic emergencies should be explored to avoid unnecessary duplication. This might include a single diagnostic laboratory facility for the zoonosis in question, or at least the sharing of diagnostic reagents and of expertise between government veterinary and medical laboratories, common cold-chain facilities for vaccines, joint field missions and joint public awareness and public relations campaigns.

The framework proposes mechanisms for exchange of emergency disease reports and other key epidemiological information between the relevant sectors, particularly the line ministries for human health, animal health and the environment. This is vital to enable a rapid response to new disease incidents and extensions of the outbreak, whether they are first manifested in humans or animals.

Another important aspect of the OHF is to integrate multisectoral simulation exercises after action reviews into One Health programming to test, practice, and improve contingency plans, emergency systems and

Table 2
Examples of capacity development and assessment tools for national One Health multisectoral collaboration.

Capacity building and assessment initiatives	Resource material and tools	Description	References
Disease ranking and prioritization	US-CDC One Health Zoonotic Disease Prioritization workshop	Prioritize zoonotic diseases of greatest concern for multisectoral, One Health collaboration in the country Conduct national risk assessment for a zoonotic disease or other health issue at the human-animal-environment with participation of all relevant sectors Map the core competencies from the IHR JEE and PVS evaluations and identify opportunities and actions to enhance and operationalize multisectoral collaboration	[1]
Joint risk assessment	FAO/OIE/WHO joint risk assessment tool	Evaluate animal diseases surveillance systems, and develop action plan to better track diseases that affect both animals and people Assess and define targets to improve national AMR surveillance systems in the food and agriculture sectors. Conduct a progressive approach that enables specific sectors to make step-by-step improvements toward the sustainable use of antimicrobials and management of AMR	[2]
Mapping multisectoral collaboration at the systems level	OIE/WHO IHR/PVS National Bridging Workshop		[3]
Evaluation of national surveillance systems	FAO Sero-surveillance Evaluation Tool (SET)		[4]
Assessment of Laboratories and AMR Surveillance Systems	FAO Assessment Tool for Laboratories and AMR Surveillance Systems (ATLASS)		[5]
Support National Action Plan for Antimicrobial Resistance	FAO Progressive Management Pathway for Antimicrobial Resistance (PMP-AMR) tool		[6]

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procedures, and response mechanisms and equipment [7,16,35]. These exercises can be in the form of tabletop or field operations depending on the nature of the zoonotic event and the resources available for these activities. It is equally important to plan multisectoral post-action reviews to assess the actions undertaken at each phase of managing a zoonotic event or emergency and to identify and document best practices and challenges encountered during the response. It is suggested to begin with a post-action review of MERS-CoV and zoonotic influenza events to identify actions that were most effective and those that were least effective, subsequently identifying corrective measures.

4.3. Risk communication

Multisectoral risk communication targeting all stakeholders, irrespective of an emergency event, is an essential component of One Health [16,36]. A Crisis and Emergency Risk Communication framework was developed to manage MERS-CoV outbreaks in the country. This initiative, along with the risk communication developed for AMR in the National Action Plan, can be used as basis to develop an overarching One Health risk communication strategy. Specifically, the strategy should emphasize the need for:

1. Effective advocacy and public education campaigns targeted at high-risk groups to ensure awareness of current threats among the public and mitigate high risk behaviour.
2. Establishment of risk communication mechanism that incorporate biological principles and social practices to address at risk groups.
3. Engaging communities through consultation and participation in the response to risk reduction efforts for a zoonotic disease by considering local social, cultural, political, and economic contexts.
4. Jointly developing key One Health messages to ensure consistency across the sectors and building an effective communication with media.

4.4. Partnerships and applied research

OHF will seek to promote and encourage applied and strategic research across the sectors to provide robust scientific evidence-base for a better understanding of risk management approaches to zoonotic diseases and other health threats in the country. Advancing research would inform and influence One Health policy and practice, and strongly drive cross-sectoral collaborations.

Research can be promoted in the form of scientific cooperation with academic institutions such as Qatar University, HMC, and other institutions at national, regional, and international levels. Research and scientific cooperation initiatives already exist between the public health and veterinary services and Qatar University and other institutions on topics such as brucellosis, rabies, AMR, MERS-CoV and vector borne diseases. These initiatives should be encouraged and extended to other scientific topics in line with national priorities, but most importantly, coordinated and planned with tangible outcomes under the Framework.

Research and partnerships can also be integrated in the form of developing multisectoral One Health research proposals for funding either through government channels or development partners such as the Qatar National Research Fund of Qatar Foundation. Nevertheless, the initiatives have already been put forward through these funding channels and can be further developed through strategic and sustainable research partnerships.

4.5. Integrated plan

The One Health approach will significantly expand the scope of several gains and help to establish AMR and AMC surveillance in the veterinary sector and allow for cross sector collaboration in achieving national goals in combating AMR.

One Health Framework needs a multilateral and cross-sectoral

integration to achieve optimum and efficient operationalization. Its implementation is based on an incremental approach with the following steps and basic activities: i) institutionalizing the framework by establishing the IMCC, the One Health Secretariat and associated technical and advisory groups and allocating responsibility; ii) developing a situation analysis of the burden of zoonotic diseases and other health threats shared by humans, animals and the ecosystem; iii) assessing strengths and needs of relevant stakeholders; iv) planning and resourcing for sustained funding and implementation; and v) evaluating and monitoring implementation and outcomes.

The IMCC and the TWGs would be entrusted with the task to lead and develop a 5-year action plan for implementation of the framework under its broad umbrella considering the existing One Health capacity in the country and the available resources. It is of utmost importance to institute a feasible plan and consolidate all ongoing and planned multi-sectoral projects and initiatives within the action plan. For instance, launching a multi-sectoral project to address a priority zoonotic disease such as brucellosis and advancing a coordinated approach to tackle AMR under the umbrella of the AMR action plan could be leading forces to set the foundation for effective One Health and multi-sectoral collaboration. In addition, strengthening biosecurity measures to improve food safety and security would vastly improve the food industry economic status by cutting losses and augmenting cost to benefit ratio via efficacious interventions. Sustainable veterinary services that can effectively prevent and control animal diseases including those of public health importance are the keys to achieve the NDS-2 (2018–2022) [28,29]. The eventual outcome goal is to expand upon this interlinked system to allow for surveillance of multiple health threats, with focus on zoonotic diseases.

For improved early warning and surveillance to complement One Health framework, it is recommended to integrate mechanisms and strategies that yield faster sample collection and the provision of data through common resources that all sectors can access during a zoonotic emergency or for implementation of zoonotic disease programmes. This would require a certain level of integration at: i) policy and institutional level to facilitate harmonization of activities and programmes, leading to a more efficient use of resources; ii) data collection and analysis level to facilitate intersectoral coordination and planning. This would require interoperability mechanisms including integrated data collection tools and database exchange to facilitate joint analysis among surveillance sectors and translation of policy into plans for specific actions; iii) dissemination level using joint results dissemination mechanisms such as bulletins, reports, papers, media reports, websites, etc.

One Health strategy would extend and apply to control and monitoring of vectors and vector-borne diseases. This gap is currently being addressed with continuing reformations to the integrated surveillance network to allow for seamless identification of possible cases from humans, animals, and the environment.

5. Conclusion

Qatar's experience with MERS-CoV, rabies, West Nile Fever, Rift Valley Fever, and vector-borne diseases prompted the use of One Health at regional and international levels, and it has also been prominently incorporated within the National Action Plan for AMR. However, there are several gaps in sustaining One Health and multi-sectoral coordination practice to effectively tackle existing and emerging zoonotic diseases and other health threats at the human-animal-ecosystem interface. This is primarily due to the lack of institutional and policy frameworks to advance and promote One Health practices across the sectors.

The proposed OHF is expected to consolidate available resources and actors and orient them under One Health within the country. It will provide strategic guidance to integrate institutional mechanisms to strengthen multi-sectoral engagement, conduct monitoring and evaluation for progress, continually identify potential gaps, enhance communication and coordination, and contribute to prevention and management, and in some cases eradication of health threats shared

between humans, animals, and their shared ecosystem in Qatar. Establishing and instituting One Health Framework at a legislative level would provide the infrastructural foundation to operationalize One Health in State of Qatar for foreseeable future.

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Conceptualization: DB, AEI and EAB; Writing – original draft: DB, SJ, and AEI; Writing –subsequent drafts, review and editing: NAA, MH, WAA, ER, DH, MIH, MMI, KE, MN, PVC, AAM, AAA, NMY, HMY, AAA, FD, MK, HM, MT, MA, MAH, RB, MAA, AAK, HEA, SMA, AEI, and EAF. All authors reviewed the article, contributed to interpretation, and approved the final version.

Declaration of Competing Interest

The authors declare there is no conflict of interest.

Data availability

Data will be made available on request.

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