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Interagency Coordination, Communication, and Collaboration, and Capacity Building for One Health in the Eastern Mediterranean and North Africa Region

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An abstract of
A thesis submitted to the Faculty of the
Rollins School of Public Health of Emory University
in partial fulfillment of the requirements for the degree of
Master of Public Health
in Executive Master of Public Health, 2022.

Abstract

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Background

The World Health Organization, Food and Agricultural Organization, World Organization for Animal Health, and United Nations Environment Program (jointly referred to as the Quadripartite) came together to collaborate on the global shift to a One Health approach to global health threats. As emerging infectious diseases like COVID-19 have demonstrated, pathogen spillover between animal health, ecosystem health, and human health changed global health as we know it. To respond effectively, the world needed to meet global health threats at the interface of animal health, ecosystem health, and human health. Sub-national, national, and regional interagency collaboration, communication, coordination, and capacity building (CCCC) were essential to implementing One Health and improving the health of all aspects of life. This was particularly important for the Eastern Mediterranean and North Africa Region (EMR) because of challenges in the region, but little was known about the EMR's current landscape.

Methods

To understand the current landscape of interagency One Health activities and CCCC in the EMR, a survey on One Health CCCC among agencies related to the three One Health interfaces was administered by the Eastern Mediterranean Public Health Network and Emory University. Employees of government, international governmental organizations, academic institutions, and non-governmental organizations across the 21 countries of the EMR were surveyed. The survey investigated the association between the availability of transdisciplinary training for employees at One Health-related agencies and the presence of One Health coordination.

Findings

Of 374 recipients, 35 (9.4%) completed the survey. Based on data collected, the association between the availability of transdisciplinary training for employees at One Health-related agencies and the presence of One Health coordination was not statistically significant.

Interpretation

Equitable, interagency CCCC is essential to implement and utilize One Health. Our findings from the cross-sectional survey indicated that EMR agencies need to improve their interagency One Health CCCC, but there was awareness of the concept. The data collected showed the need for greater intersectoral training among One Health interfaces including greater representation from the ecosystem interface. The time is imminent to support countries' implementation of One Health and to do that, further research should be conducted to understand the successes and challenges to interagency activities across the One Health interfaces.

Funding

No funding was provided for this research. It was conducted on a volunteer basis.

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2022

Acknowledgements

Thank you to
Dr. Scott McNabb, Dr. Mirwais Amiri.
Tammie and Terry Corrigan.
Jacob McMurray

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Acronyms

AMR	antimicrobial resistance
CCCC	collaboration, communication, coordination, and capacity-building
EMR	Eastern Mediterranean and North Africa Region
EMRO	WHO Regional Office for the Eastern Mediterranean
FAO	Food and Agricultural Organization
FELTP	Field Epidemiology and Laboratory Training Program
GF-TAD	Global Framework for the Progressive Control of Transboundary Animal Diseases
GHC	Global health community
GHD|EMPHNET	Global Health Development | the Eastern Mediterranean Public Health Network
GPH	Global public health
ICRAF	World Agroforestry Centre
MCM	multisectoral coordination mechanisms
MoU	Ministry of Health
MPH	Master in Public Health
MS	member states
NARC	National Agricultural Research Center
NEOH	Network for Evaluation of One Health
NGO	non-governmental organization
NTD	Neglected tropical disease
OHHLEP	One Health High Level Expert Panel
OH JPA	One Health Joint Plan of Action
OIE	World Organization for Animal Health
SARS	severe acute respiratory disease
SDGs	Sustainable Development Goals
UNEP	United Nations Environmental Program
U.S. CDC	United States Centers for Disease Control and Prevention
WHO	World Health Organization

Chapter 1: Background Literature Review

One Health

As the world has seen during the COVID-19 pandemic, global public health (GPH) threats have become increasingly *complex, transboundary, multifactorial, and across species, and if approached from a purely medical, veterinary, or ecological standpoint, it is unlikely that sustainable mitigation strategies will be produced.*[1] To anticipate and holistically address complex GPH threats, the global health community (GHC) – including players from many sectors and fields – conceptualized One Health.

In *The One Health Approach—Why Is It So Important?,* the authors note that while there is no universally agreed upon definition of One Health, a common definition is '*a collaborative, multisectoral, and transdisciplinary approach—working at the local, regional, national, and global levels—with the goal of achieving optimal health outcomes recognizing the interconnection between people, animals, plants, and their shared environment'* as defined by the U.S. Centers for Disease Control and Prevention (U.S. CDC) and the One Health Commission.[1]

A newer definition developed by the One Health High Level Expert Panel (OHHLEP) states that it *is an integrated, unifying approach that aims to sustainably balance and optimize the health of people, animals and ecosystems. It recognizes the health of humans, domestic and wild animals, plants, and the wider environment (including ecosystems) are closely linked and interdependent. The approach mobilizes multiple sectors, disciplines and communities at varying levels of society to work together to foster well-being and tackle threats to health and ecosystems, while addressing the*

collective need for clean water, energy and air, safe and nutritious food, taking action on climate change, and contributing to sustainable development.[2]

Although many definitions, the sentiment is universal: with the emergence of diseases like severe acute respiratory disease (SARS) and COVID-19, there is *the realization that a previously unknown pathogen could emerge from a wildlife source at any time and in any place and, without warning, [and] threaten the health, well-being, and economies of all societies*.[1] Citing other examples – such as the H1N1 Influenza Pandemic of 2009 – the authors note these types of human health emergencies bring about clarity on the need for every country to have response systems that can identify, react, and share information about new diseases and outbreaks of existing diseases.[1] For the world to effectively respond to an epidemic or pandemic, it would take *global cooperation and global participation using the basic principles enshrined in One Health*.[1]

Global cooperation and participation mean stakeholders approach GPH threats at the interfaces of animal, ecosystem, and human health rather than as siloed sectors. This takes cross-sector, transdisciplinary collaboration, communication, coordination, and capacity-building (CCCC) at the international, regional, national, and sub-national levels (Appendix B, Figure A).[2] Great strides have catalyzed a conscious shift realizing the One Health concept must focus on interagency cooperation that supports improved prevention, detection, and response to disease outbreaks and pathogen spillover. But there remain gaps in agencies' adoption of transdisciplinary and cross-sector CCCC, thwarting the successful shift to using One Health.[2]

Real-life scenarios like COVID-19 demonstrate the reality of the interconnectedness of animal, human, and ecosystem health. The Food and Agriculture Organization (FAO) of the United Nations (UN) cite *the SARS-CoV-2 virus spillover, and links to wildlife, livestock, food value chains and markets …* as a severe example of the *need for countries and partners to intensify their efforts in implementing the One Health approach, to effectively prevent the next pandemic.*[3]

Further, a regional statement by 16 countries in Africa acknowledged that great strides have been made toward setting the stage for One Health, but little has been done for its use in reducing the risk of pathogen spillover at the *human-livestock-wildlife-environment interfaces*.[3] This is particularly worrisome as more evidence shows that One Health was required to reduce pathogen spillover that led to COVID-19.[3] Therefore countries call for improved One Health governance (e.g., mainstreaming One Health policies, implementing One Health concepts, and capacity building) and are showing immense appetite for shifting to this new approach.[3] However, more research and education is needed to garner political will, investments, and equitable interagency cooperation, particularly with an emphasis on including the ecosystem interface.

The human and animal health interface benefits from the majority of the focus. Even when *ministries in charge of forestry, environment or natural resources are part of the One Health platforms or steering committees*, they lack equal voice in plans and policies.[3] As a result, the 16 African stakeholders agree in the statement to focus on ecosystem health dimensions as drivers of disease emergence and the urgent need to embolden the role of all areas of ecosystem in One Health activities.[3] Their statement

highlights overarching gaps that remain in One Health implementation, hampering the world's ability to protect people, animals and the environment.

Gaps in One Health

As with all issues that require people and governments to invest and prioritize, an initial challenge for One Health is putting it into measurable terms such as how not investing would impact the world and an individual country and how investing could change the outcome of disease outbreaks, epidemics, and pandemics. In a review of quantitative metrics, a research article sought to standardize the measurement of One Health benefits.[4] The authors' methods consisted of a review of the scientific and grey literature using search terms such as *['One health' OR ecohealth] AND [effective* OR efficient* OR useful* OR beneficial*...* excluding any article that didn't include One Health as a concept and/or didn't discuss a benefit.[4] Additionally, they performed a Google search using similar terms to identify pages that discussed benefits and measures of One Health.[4]

From this, they found benefits that range from economic to social to information with the majority falling within *more effective disease control and/or biosecurity measures (often related to infectious disease) and improvements in both animal and human health and well-being, as well as economic benefits.*[4] In a table of benefits, they include specific metrics such as a 15% cost savings for countries through sharing resources to more broad metrics such as ecosystem resilience.[4] The outcome of their research included three recommendations for how to improve measurements of One Health benefits, including …

- development of protocols to capture ongoing change.

- integration of available disciplinary metrics.
- data collection that captures One Health inputs and outcomes.[4]

Additionally, authors convened a workshop of public health and zoonotic disease experts to discuss the framework needed to capture a more thorough report of beneficial One Health metrics. Continuing their search for metrics, they established an *international, interdisciplinary* Network for Evaluation of One Health (NEOH) that *aims to enable future quantitative evaluations of One Health activities, and to further the evidence base by developing and applying a science-based evaluation protocol in a community of experts…*[4]

However both at the workshop and through NEOH, one of three key sectors of One Health was missing: the environmental sector. This emphasized the lack of focus in existing research and literature on incorporating the environmental sector as much as the human and animal health sectors.

While greater focus on One Health was due to the uptick of infectious agents threatening the wellbeing of people, equal efforts had not been given to integrating the three sectors. Looking back at implementing One Health since its inception more than a decade ago, *The One Health Concept: 10 Years Old and a Long Road Ahead* describes the importance of incorporating *ecological, evolutionary, and environmental sciences* to effectively use One Health responding to the (re)emergence of infectious diseases and combatting antimicrobial resistance.[5] The article provides a *list of barriers that need removing* and concludes the necessity of *breaking down the interdisciplinary barriers that still separate human and veterinary medicine from ecological, evolutionary, and environmental sciences*.[5]

In their review, the authors point out that the lack of understanding between the three interfaces of One Health and therefore lack of communication; a key barrier to effectively implementing One Health.[5] The authors recommend that *from a training point of view, it is essential to include ecology and evolution in any medical, veterinary, and agronomic training.*[5] This signals the need for greater interdisciplinary training for professionals working in these interfaces as one way to break down existing barriers. The review recommends that further evidence is needed on the added value of One Health for all stakeholders so that the interdisciplinary barriers that *still separate ecological, environmental, and evolutionary sciences from human and animal medicine…* can be removed.[5]

Collaboration, Communication, Coordination, and Capacity Building

In May 2022, the Quadripartite made up of the World Health Organization (WHO), FAO, the World Organization for Animal Health (OIE), and the United Nations Environmental Program (UNEP) were tasked to lead international agencies on One Health. Through efforts to align strategies and programs across the four sectors, the Quadripartite collaborates with member states (MS), non-governmental organizations, companies, and educational institutions to ensure implementation of One Health. Formerly made up of the WHO, FAO, and OIE, these international agencies came together in 2010 to form the Tripartite because they realized the multi-sectoral and multi-institutional efforts needed to address the complexity of preventing, responding to, and managing global health risks of zoonoses and other diseases.[6]

In a 2010 concept note, they outlined their coordination and collaboration for a *world capable of preventing, detecting, containing, eliminating, and responding to animal and*

public health risks attributable to zoonoses and animal diseases with an impact on food security through multi-sectoral cooperation and strong partnerships.[6] Eight years later, they updated their formal agreement on their longstanding cooperation, importance of collaboration and considering the *growing health threats at the animal-human-ecosystem interface*.[7]

In February 2021, the Tripartite invited UNEP to join them to strengthen the presence and reinforce the importance of the ecosystem interface within One Health.[8] One year later at the 75th World Health Assembly in May 2022, the WHO Director-General issued a statement outlining the new agreed upon interagency CCCC among the four agencies creating the Quadripartite One Health collaboration body.[8] Under the Quadripartite, the four agencies are drafting a One Health Joint Plan of Action (OH JPA) (2022-2026) that seeks to use *a One Health approach to strengthen collaboration, communication, coordination, and capacity building equally across all sectors responsible for addressing health concerns at the human-animal-plant-environment interface.*[8]

As the leading agencies on One Health, the websites of the four agencies were reviewed for current literature on interagency CCCC at the international and national levels, including frameworks, strategies, policies, surveys, and reports. This review provides a high-level snapshot of the current information on interagency cooperation and what, if any, regional- or country-specific research or guidance has been developed. While there was evidence of research and/or focus on addressing CCCC, particularly with a focus on the Quadripartite's work across the four agencies, recent information (within the last five years) or research looking at global interagency

collaboration or even regional collaboration that analyzed integration between all three of the One Health interfaces was limited.

By May 2022 (the cutoff date for this literature review), the draft OH JPA is the most recent publication across the four agencies focusing on CCCC through six action tracks each with specific activities, deliverables, and a timeline to be implemented upon approval of the OH JPA. The draft plan acknowledges the immense investment and global mobilization around One Health since the concept's growing popularity, but one of the key challenges to implementing One Health in practice is *professional segregation with limited cross-sectoral working, inadequate representation of some sectors…absence of multisectoral coordination mechanisms, siloed budgets and decision-making processes…particularly at regional, national, and sub-national levels.*[9]

The proposed theory of change presented in the draft plan outlines three pathways to change. Pathway 2 specifically addresses CCCC across the three One Health interfaces that lead to medium-term outcomes of alignment on One Health activities and CCCC building efforts; and *organizations that collaborate and synergize effectively*.[9] The theory of change also outlines a number of barriers such as the *limited standardization around One Health curricula* and miscommunication or lack of communication because of language and cultural barriers.[9] However, these barriers were very high level and generic. They needed further investigation to see where current CCCC exists and are succeeding or not in the regional, national, and sub-national contexts.

The plan did note that it builds on existing global and regional One Health and coordination initiatives but remained at the international, global perspective and did not

go into detail on individual regions and countries' interagency efforts.[9] While this was not within the scope of the high-level action plan, some of the next steps outlined in the plan included reviewing current funding and financing capacity at global, regional, and country level but does not suggest reviewing current One Health activities at the regional or country level to see where practices can be improved, utilized, or replicated for this plan.[9]

Another joint publication found on all four sites was the 2021 Annual Report of the OHHLEP. Formed by the Quadripartite with support from the Governments of France and Germany in 2021, the OHHLEP seeks to *enhance coordination and collaboration among sectors and agencies, nationally and internationally* in response to the lack thereof during the COVID-19 pandemic.[2] Additionally, the OHHLEP seeks to support countries in developing national One Health frameworks. As one of their first deliverables, the OHHLEP developed an improved and standardized definition of One Health, including a definition visual (Figure A) which centers around CCCC as a foundation for One Health.[2] The report outlines the OHHLEP's workplan based on the gaps identified by the four agencies in their previous research. Some of the relevant areas of need include *knowledge gaps on the state of One Health implementation around the world;* lack of resources for One Health implementation; and mapping of existing examples of success and capacities for One Health research.[2]

The second deliverable of the OHHLEP is an inventory of One Health resources. Starting with the four agencies and the members of the panel subsequently, an inventory of the relevant initiatives and activities were collected. Keywords such as *collaboration*, *multisectoral*, and *transdisciplinary* were used for the search and a

particular focus was put on ecosystem-related resources.[2] The results of the inventory thus far are not published in this report. However, there are plans for the inventory to be shared as an open-access international database, but whether or not this database would include national and sub-national level information was unclear.

The report emphasized the importance of the role that CCCC play in One Health implementation and reaffirms the gaps that exist in the literature on the One Health concept, providing a guiding way forward for the global community from the international leaders on One Health. However, one area of weakness for the panel and its report is that there still seems to be a lack of representation and participation from the ecosystem sector.[10] In review of the biographies of the 26 experts on the OHHLEP, none seemed to hold a current job focused solely on environment or ecosystem, including wildlife, forestry, water, or natural resources.[10] Many experts were involved in One Health which includes elements of the ecosystem sector and some had previous jobs, research experience, or education in the ecosystem sector, but none were currently focused on environment and the majority of the experts were based in the human health sector.[10] This continues to demonstrate the challenges of equitable interagency participation and cooperation with the ecosystem sector being the least represented on matters of One Health.

In further review of each of the agencies' sites on topics of CCCC for One Health implementation, many had a section or page dedicated to One Health. The OIE's One Health page outlined the history of the Tripartite and Quadripartite partnership linking to the various frameworks, memorandums, and plans published by the agencies to date on the formulation of the partnership including the ones mentioned above.[11] When

searching the OIE's publication database, One Health-related publications covering CCCC included strategies such as the Global Framework for the Progressive Control of Transboundary Animal Diseases (GF-TADs) for 2021-2025.[12]

This strategy discussed the purpose of the GF-TADs coordination mechanism to ensure successful control of transboundary animal diseases.[12] As one of the objectives of the mechanism and framework, Output 3.1 highlighted strengthening multidisciplinary communication and collaboration for strong partnerships with stakeholders.[12] However, this was the extent of how CCCC were covered in this publication and One Health was not mentioned.[12]

Other relevant OIE publications included a report on two questionnaires conducted by the Tripartite in the Asia and Pacific Region among its member states and by the OIE Regional Commission for Asia, the Far East and Oceania region among its member states about their current multisectoral coordination mechanisms (MCMs).[13] These mechanisms provide a method for intentional collaboration across areas of work and organizations to integrate necessary aspects of each sector.[13]

The questionnaires and subsequent report identified *the structure and functional characteristics of the Members' current MCMs between animal and public health professionals for the control of zoonosis and food safety issues and to explore any gaps.*[13] The report noted *the importance of One Health and multisector collaboration, adding that an MCM is regarded as the formalized group that acts to strengthen or develop collaboration, communication and coordination across several sectors in charge of addressing zoonosis and food safety issues at the human-animal-*

environmental interface which is why mechanisms were chosen as a representation of multisectoral integration efforts.[13]

The questionnaires' focused on …

- establishment of an MCM.
- governance of MCMs and other operationalization aspects of MCMs.
- key achievements in MCMs.
- key challenges faced in multisectoral collaboration.
- key priority activities to further strengthen multisectoral collaboration.[13]

While more than 80% of MS that responded indicated that there is a MCM established in their national government, barely half of those mechanisms included a strategy or focus on One Health.[13] Some other challenges to establishing and maintaining effective collaboration methods at the national government level identified were lack of resources and infrastructure, inadequate resource mapping, agreements on governance and upkeep of governance elements over time, and infrequency of mechanism meetings.[13]

An additional issue not noted in the report was that despite being questionnaires that looked at the animal-human-ecosystem interface and majority of responses being multi-sector, some MS only had participation from the animal or public health sectors. This alone shows a lack of collaborative coordination, but it also brings into question whether or not the ecosystem interface was adequately incorporated. The author mentioned the animal and public health sectors by name, but failed to acknowledge the agricultural and environmental sectors. Admittedly, this could be due to the fact that the report

focused on zoonosis and food safety. The questionnaires and the report did not look at amount of representation from each interface in the mechanisms.

On the FAO site, there was a One Health section, identifying FAO's role.[14] Their publications on One Health and CCCC ranged from country-specific frameworks outlining cooperative partnerships between the FAO and countries to reports on sector integration at the country-level that seek to drive policy effectiveness.[14] For example, the FAO published a report called *Implementing Agenda 2030 in Food and Agriculture: Accelerating Policy Impact through Cross-Sectoral Coordination at the Country Level.*[15] This report sought to fill a gap in literature on approaches to national and sub-national cross-sector integration for implementation of policies and strategies to respond to the complexities of global challenges.[15] Ideally, it was a resource for *national and international actors who recognize the benefits of using cross-sectoral approaches to achieve common strategic development goals at the country level*.[15]

Built around the Sustainable Development Goals (SDGs), the authors outlined 12 case studies from 10 countries selected by the FAO and the World Agroforestry Centre (ICRAF) as examples of the benefits of cross-sectoral collaborations.[15] The criteria for the case study interviews were based on the ICRAF's Stakeholder Approach to Risk-informed and Evidence-based Decision-making Hub.[15]

One of the case studies looks at the cross-sectoral platforms to foster resources for forest- and farm-based enterprises in Nepal.[15] Learnings from this case study highlighted the need for a champion to catalyze efforts which were often fueled by personal relationships and adequate time to build strong interpersonal relationships.[15]

Conversely, a beneficial step was ensuring a common vision statement was agreed upon by all partners in the cross-sectoral platform.[15]

The Agriculture and Natural Resources Platform in the Gambia started out as a cross-sectoral platform for establishing viable agricultural and natural resource production systems that would support the well-being of the Gambian people while promoting forest landscape management.[15] Bringing together the government, private, civil society organizations, and intergovernmental organizations, the platform has become an established coordination mechanism.[15] The Gambia's case demonstrated that existing infrastructure and culture provided a nurturing foundation for cross-sectoral coordination and collaboration. Furthermore, concerted efforts to base actions on evidence and literature from previous research helped all partners in cross-sectoral efforts increase dialogue and decision-making.[15]

Throughout the Central American region, the Mesoamerican Agroenvironmental Program (MAP) strengthens the capacity of this region to address problems created by climate change.[15] Coordinating actions across multiple sectors, the program aims to reduce forest degradation and deforestation and achieve water, energy, nutritional and food security.[15] This case study highlighted that introducing new, wider-range of stakeholders allowed for greater problem solving, improved transparency in governance arrangements, and resulted in decisions that better addressed the needs of the target population.[15]

Collating the findings from and conditions of the various case studies, the report establishes keys findings and next steps in a conceptual framework for future cross-sectoral collaboration at the national and sub-national levels.[15] These findings included

next steps such as investing in capacity development for government representatives and partners to implement cross-sectoral collaboration and decision making.[15] However, the authors note that this is only an initial resource and further study is needed.[15]

Another publication from the FAO in 2010 on the National Medium-Term Priority Framework for 2010 – 2015 between the Government of Malawi and the FAO looked at a country-specific example of interagency collaboration.[16] This report focused on the framework of priorities for FAO technical cooperation in Malawi to ensure that the partnership and collaboration between the international agency and the government is effective across seven areas of implementation such as food security and nutrition, sustainable agricultural land and water management, and institutional strengthening and capacity building.[16] The authors noted that this framework also serves as a planning and implementation management tool to keep efforts focused and both parties accountable in their collaboration, communication, and coordination.[16]

This type of partnership with the FAO is particularly relevant to a country like Malawi because of the significant role agriculture plays in their economy as a leading sector of employment. The framework did cover high-level aspects for each of the three interface of One Health, including public health issues such as HIV mitigation, animal health such as livestock consumption and accessibility, and environmental health in terms of agriculture and crops.[16]

The report also provides a table of each priority output, explaining the responsible governmental ministry or department for that priority area, resources committed, and resources needed.[16] In this table, each interface of One Health at the government-level was represented as a key partner in implementation.[16] However, One Health itself was

not mentioned nor outlined as a core principle for this framework. The authors concluded that the framework is a living document that should be updated throughout the five-year timeline, key performance indicators need to be developed in alignment with the priority areas outlined in the framework to monitor and evaluate progress on implementation of this cooperative partnership, and ultimately this framework is only as useful as the level of interagency coordination put into the priority areas at the national level.[16]

On the WHO site, One Health was a prominent concept with an extensive One Health section. It housed the OHHLEP information mentioned above as well as the *2022 - 2026 OH JPA*.[17] The WHO One Health Initiative microsite was the secretariat for the OHHLEP and also the acting secretariat for the Quadripartite.[18]

In addition to the OHHLEP and *OH JPA*, the WHO's database included frameworks and reports on disease- and issue-specific topics using a One Health approach such as the *2021 Annual Report from the Antimicrobial Resistance Multi-Partner Trust Fund* which is a report on the Quadripartite initiative to advance One Health response to antimicrobial resistance (AMR) at the country and global levels.[19]

This publication utilizes the One Health approach and demonstrates how efforts to improve CCCC across agencies and sectors are progressing to address AMR.[19] It is an example of how the Quadripartite is working with countries to change processes to implement One Health strategies for a specific threat. In addition to this overarching report, the WHO database houses a number of country-specific, national One Health strategies for the control of AMR.[17]

Another example is the WHO's *Ending the Neglect to Attain the Sustainable Development Goals; One Health: Approach for Action Against Neglected Tropical Diseases (NTDs) 2021-2030* which outlines a plan for national NTD programs to shift towards a One Health approach.[20] The publication highlights the need for CCCC in response to NTDs through a One Health approach and outlines transdisciplinary and multisector actions needed to improve NTD control and elimination.[20] Unlike the AMR report, this was not jointly published by the Quadripartite but did acknowledge support from the other three agencies.[20] Overall, based on this review, the WHO site hosted an overview of the One Health concept with a number of high-level publications that point to the roles of CCCC and some country-specific resources that support the implementation of One Health and the improvement of CCCC.

As the newest member of the Quadripartite, the UNEP site did not have a page or section dedicated to One Health. When searching for One Health and CCCC in its publication database, the common publications of the Quadripartite materials such as the MoU and the AMR report are listed.[21, 22] Beyond the materials cross-referenced on the other three agencies' sites, there was little to no mention of One Health in UNEP-specific reports and little language around CCCC used. This emphasized the nascent stage One Health is at within the UNEP and ecosystem sector in general and signals the overall gaps in representation among the Quadripartite agencies.

Applying One Health in the Eastern Mediterranean Region

At the regional level, the Eastern Mediterranean and North Africa Region (EMR), with 21 countries and the occupied Palestinian territory, sought to strengthen its countries' capabilities to prevent health emergencies and threats through a One Health approach.

In a WHO-led framework called *One Health Operational Framework for Action for the Eastern Mediterranean Region, focusing on zoonotic diseases*, regional leaders noted that adopting a One Health strategy was particularly significant for this region because of the challenges caused by *lack of resources, poor health systems, and political factors* faced by countries in the region.[23] This framework was one of the main guidelines found in this literature review that outlines a roadmap for achieving One Health in the region despite focusing on zoonotic diseases. Developed out of a series of meetings including the WHO Regional Office for the Eastern Mediterranean (EMRO), FAO, OIE, Ministries of Health and Agriculture from multiple countries in the region, academic institutions, and other regional partners, this framework paves the way forward for coordination across the three One Health interfaces.[23]

The framework outlines seven components including governance and management, networks and partnerships, One Health workforce development, surveillance preparedness and response, communication and advocacy, applied research, and monitoring and evaluation.[23] Within these components, many of the priority activities proposed emphasize a need to understand and identify CCCC between stakeholders such as mapping out the current level of contributions from stakeholders, codifying existing and missing coordination mechanisms and standard operating procedures for cross-sectoral collaboration, and analyzing human resources skills across sectors.[23]

Looking at a country-level example of interagency CCCC for One Health, a workshop summary conducted in collaboration with the U.S. CDC and Pakistan's National Institute of Health in 2017 summarizes the top zoonotic diseases for Pakistan and the One Health processes outlined through multisectoral efforts to address them.[24] This summary

called *One Health Zoonotic Disease Prioritization & One Health Systems Mapping and Analysis Resource Toolkit™ for Multisectoral Engagement in Pakistan* reported the activities of a three-day workshop in Islamabad, including activities that identifies gaps in multi-agency collaboration and steps to improve them to prevent and control the prioritized list of zoonotic diseases.[24] Participants who included Pakistani national and subnational agencies from each of the three One Health interfaces, the Tripartite and U.S. agencies discussed current communication and coordination between sectors.[24]

It was confirmed that although there was a national level One Health Hub, no formal One Health coordination mechanism for fostering CCCC sub-nationally existed.[24] The outcome recommendation was that the Hub house a mechanism of this sort in collaboration with the provinces.[24] Additionally, action items were solidified for each participating agency, many of whom are contributing to the formalization of a National One Health Platform for Pakistan.[24] While this workshop seemed to utilize collaborative methods across all three interfaces of One Health to outline clear next steps to improve Pakistan's One Health approach to zoonotic diseases, the workshop did not include non-governmental organizations and educational institutions.[24]

Adding to the Existing Literature

Based on gaps in existing literature and acting on proposed activities outlined in literature like the EMRO Operational Framework for Action, the Global Health Development | the Eastern Mediterranean Public Health Network (GHD|EMPHNET) and Emory University sought to support regional operationalization of the One Health approach in the EMR.

As a first step, we sought to understand the current landscape of national and regional CCCC among agencies across the three interfaces of One Health. Therefore, we conducted a survey of the relevant ministries within the 20+ MS and territories of the EMRO region to map current contributions to One Health, existing interagency and transdisciplinary efforts, and human resource capabilities to achieve alignment across the three interfaces of One Health. This survey aimed to describe a baseline of successes and barriers that exist for interagency CCCC to inform further training and educational materials for workforces within necessary agencies. The survey could provide a baseline for future monitoring and evaluation of interagency activities to ensure progress and that activities moving forward are effective in implementing the One Health approach in the region.

Student's Contributions

This paper was the collaborative effort of Master in Public Health (MPH) candidate Gabrielle Corrigan, Thesis Committee Chair Dr. Scott McNabb, and Field Advisor Dr. Mirwais Amiri. The literature review research was conducted and written by the MPH candidate and reviewed by the Committee Chair and Field Advisor. For the data collection, the MPH candidate crafted the survey questions, formatted the survey, and drafted marketing materials including email invite and social media posts for distributing the survey. The survey was translated into Arabic by the Field Advisor's colleague Dr. Ekhlas Hailat. The survey was distributed by the Field Advisor's organization GHD|EMPHNET.

For analysis and transforming the research into a written journal article, the MPH candidate wrote all sections of the thesis and journal article with review and edits from the Committee Chair and Field Advisor. All data analyses were completed by the MPH

candidate and all tables and graphs developed from the data were created by the MPH candidate. Results were translated into a written format by the MPH candidate and interpreted by the student. Interpretation of results were drafted by the MPH candidate with edits from the Committee Chair and Field Advisor. The Lancet Global Health is the intended journal for which this paper is written.

Chapter 2: Journal Article

Summary

Background

The World Health Organization, Food and Agricultural Organization, World Organization for Animal Health, and United Nations Environment Program (jointly referred to as the Quadripartite) came together to collaborate on the global shift to a One Health approach to global health threats. As emerging infectious diseases like COVID-19 have demonstrated, pathogen spillover between animal health, ecosystem health, and human health changed global health as we know it. To respond effectively, the world needed to meet global health threats at the interface of animal health, ecosystem health, and human health. Sub-national, national, and regional interagency collaboration, communication, coordination, and capacity building (CCCC) were essential to implementing One Health and improving the health of all aspects of life. This was particularly important for the Eastern Mediterranean and North Africa Region (EMR) because of challenges in the region, but little was known about the EMR's current landscape.

Methods

To understand the current landscape of interagency One Health activities and CCCC in the EMR, a survey on One Health CCCC among agencies related to the three One Health interfaces was administered by the Eastern Mediterranean Public Health Network and Emory University. Employees of government, international governmental organizations, academic institutions, and non-governmental organizations across the 21 countries of the EMR were surveyed. The survey investigated the association between the availability of transdisciplinary training for employees at One Health-related agencies and the presence of One Health coordination.

Findings

Of 374 recipients, 35 (9.4%) completed the survey. Based on data collected, the association between the availability of transdisciplinary training for employees at One Health-related agencies and the presence of One Health coordination was not statistically significant.

Interpretation

Equitable, interagency CCCC is essential to implement and utilize One Health. Our findings from the cross-sectional survey indicated that EMR agencies need to improve their interagency One Health CCCC, but there was awareness of the concept. The data collected showed the need for greater intersectoral training among One Health interfaces including greater representation from the ecosystem interface. The time is imminent to support countries' implementation of One Health and to do that, further research should be conducted to understand the successes and challenges to interagency activities across the One Health interfaces.

Funding

No funding was provided for this research. It was conducted on a volunteer basis.
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Background

One Health

As the world has seen during the COVID-19 pandemic, GPH threats have become increasingly *complex, transboundary, multifactorial, and across species, and if approached from a purely medical, veterinary, or ecological standpoint, it is unlikely that sustainable mitigation strategies will be produced.*[1] To anticipate and holistically address complex GPH threats, the GHC (including players from many sectors and fields) conceptualized One Health. In *The One Health Approach—Why Is It So Important?,* the authors note that while there is no universally agreed upon definition of One Health, a common definition is '*a collaborative, multisectoral, and transdisciplinary approach—working at the local, regional, national, and global levels—with the goal of achieving optimal health outcomes recognizing the interconnection between people, animals, plants, and their shared environment'* as defined by the U.S. Centers for Disease Control and Prevention (U.S. CDC) and the One Health Commission.[1]

A newer definition developed by the One Health High Level Expert Panel's (OHHLEP) states that it *is an integrated, unifying approach that aims to sustainably balance and optimize the health of people, animals and ecosystems. It recognizes the health of humans, domestic and wild animals, plants, and the wider environment (including ecosystems) are closely linked and interdependent. The approach mobilizes multiple sectors, disciplines and communities at varying levels of society to work together to foster well-being and tackle threats to health and ecosystems, while addressing the*

collective need for clean water, energy and air, safe and nutritious food, taking action on climate change, and contributing to sustainable development.[2]

Although many definitions, the sentiment is universal: with the emergence of diseases like severe acute respiratory disease (SARS) and COVID-19, there is *the realization that a previously unknown pathogen could emerge from a wildlife source at any time and in any place and, without warning, [and] threaten the health, well-being, and economies of all societies*.[1] Citing other examples – such as the H1N1 Influenza Pandemic of 2009 – the authors note these types of human health emergencies bring about clarity on the need for every country to have response systems that can identify, react, and share information about new diseases and outbreaks of existing diseases.[1] For the world to effectively respond to an epidemic or pandemic, it would take *global cooperation and global participation using the basic principles enshrined in One Health*.[1]

Global cooperation and participation mean stakeholders approach global public health threats at the interfaces of animal, ecosystem, and human health rather than siloed sectors. This takes cross-sector, transdisciplinary CCCC at the international, regional, national, and sub-national levels (Figure A).[2] Great strides catalyzed a shift towards realizing the One Health concept thanks to a focus on interagency cooperation that supports improved prevention and response to disease outbreaks and pathogen spillover. But there remain gaps in agencies' adoption of transdisciplinary and cross-sector CCCC, thwarting the successful shift to using One Health.[2]

Gaps in One Health

As with all issues that require people and governments to invest and prioritize, an initial challenge for One Health is putting it into measurable terms such as how not investing would impact the world and an individual country and how investing could change the outcome of disease outbreaks, epidemics, and pandemics. In a review of quantitative metrics, a research article sought to standardize the measurement of One Health benefits.[4] The authors' methods consisted of a review of the scientific and grey literature using search terms such as *['One health' OR ecohealth] AND [effective* OR efficient* OR useful* OR beneficial*...* excluding any article that didn't include One Health as a concept and/or didn't discuss a benefit.[4] Additionally, they performed a Google search using similar terms to identify pages that discussed benefits and measures of One Health.[4]

From this, they found benefits that ranged from economic to social to information with the majority falling within *more effective disease control and/or biosecurity measures (often related to infectious disease) and improvements in both animal and human health and well-being, as well as economic benefits.*[4] In a table of benefits, they include specific metrics such as a 15% cost savings for countries through sharing resources to more broad metrics such as ecosystem resilience.[4] The outcome of their research included three recommendations for how to improve measurements of One Health benefits, including …

- development of protocols to capture ongoing change.
- integration of available disciplinary metrics.
- data collection that captures One Health inputs and outcomes.[4]

Additionally, authors convened a workshop of public health and zoonotic disease experts to discuss the framework needed to capture a more thorough report of beneficial One Health metrics. Continuing their search for metrics, they established an *international, interdisciplinary* Network for Evaluation of One Health (NEOH) that *aims to enable future quantitative evaluations of One Health activities, and to further the evidence base by developing and applying a science-based evaluation protocol in a community of experts…*[4] However both at the workshop and through NEOH, one of three key sectors of One Health was missing: the environmental sector. This emphasized the lack of focus in existing research and literature on incorporating the environmental sector as much as the human and animal health sectors.

Collaboration, Communication, Coordination, and Capacity Building

By May 2022, the Quadripartite made up of the World Health Organization (WHO), FAO, the World Organization for Animal Health (OIE), and the United Nations Environmental Program (UNEP) were tasked with leading international agencies on One Health. Through efforts to align strategies and programs across the four sectors, the Quadripartite collaborates with member states (MS), non-governmental organizations, companies, and educational institutions to ensure implementation of One Health. Formerly made up of the WHO, FAO, and OIE, these international agencies came together in 2010 to form the Tripartite because they realized the multi-sectoral and multi-institutional efforts needed to address the complexity of preventing, responding to, and managing global health risks of zoonoses and other diseases.[6]

In February 2021, the Tripartite invited UNEP to join them to strengthen the presence and reinforce the importance of the ecosystem interface within One Health.[8] One year

later at the 75th World Health Assembly in May 2022, the WHO Director-General issued a statement outlining the new agreed upon interagency CCCC among the four agencies creating the Quadripartite One Health collaboration body.[8] Under the Quadripartite, the four agencies are drafting a One Health Joint Plan of Action (OH JPA) (2022-2026) that seeks to use *a One Health approach to strengthen collaboration, communication, coordination, and capacity building equally across all sectors responsible for addressing health concerns at the human-animal-plant-environment interface.*[8]

As the leading agencies on One Health, the websites of the four agencies were reviewed for current literature on interagency CCCC at the international and national level, including frameworks, strategies, policies, surveys, and reports. This review provides a high-level snapshot of the current information on interagency cooperation and what, if any, regional- or country-specific research or guidance has been developed. While there was evidence of research and/or focus on addressing CCCC, particularly with a focus on the Quadripartite's work across the four agencies, recent information (within the last five years) or research looking at global interagency collaboration or even regional collaboration that analyzed integration between all three of the One Health interfaces was limited.

As of May 2022 (the cutoff date for this literature review), the draft OH JPA is the most recent publication across the four agencies focusing on CCCC through six action tracks each with specific activities, deliverables, and a timeline to be implemented upon approval of the OH JPA.[9] The proposed theory of change presented in the draft plan outlines three pathways to change. Pathway 2 specifically addresses CCCC across the three One Health interfaces that lead to medium-term outcomes of alignment on One

Health activities and CCCC building efforts; and *organizations that collaborate and synergize effectively*.[9] The theory of change also outlines a number of barriers such as the *limited standardization around One Health curricula* and miscommunication or lack of communication because of language and cultural barriers.[9]

However, these barriers were very high level and generic. They needed further investigation to see where current CCCC exists and are succeeding or not in the regional, national, and sub-national contexts. The plan did note that it builds on existing global and regional One Health and coordination initiatives but remains at the international, global perspective and does not go into detail on individual regions and countries' interagency efforts.[9] While this was not within the scope of the high-level action plan, some of the next steps outlined in the plan included reviewing current funding and financing capacity at global, regional, and country level but does not suggest reviewing current One Health activities at the regional or country level to see where practices can be improved, utilized, or replicated for this plan.[9]

Another joint publication found on all four sites was the 2021 Annual Report of the OHHLEP. Formed by the Quadripartite with support from the Governments of France and Germany in 2021, the OHHLEP seeks to *enhance coordination and collaboration among sectors and agencies, nationally and internationally* in response to the lack thereof during the COVID-19 pandemic.[2] Additionally, the OHHLEP seeks to support countries in developing national One Health frameworks. As one of their first deliverables, the OHHLEP developed an improved and standardized definition of One Health, including a definition visual (Figure A) which centers around CCCC as a foundation for One Health.[2] The report outlines the OHHLEP's workplan based on the

gaps identified by the four agencies in their previous research. Some of the relevant areas of need include *knowledge gaps on the state of One Health implementation around the world;* lack of resources for One Health implementation; and mapping of existing examples of success and capacities for One Health research.[2] The second deliverable of the OHHLEP is an inventory of One Health resources. Starting with the four agencies and the members of the panel subsequently, an inventory of the relevant initiatives and activities were collected. Keywords such as *collaboration*, *multisectoral*, and *transdisciplinary* were used for the search and a particular focus was put on ecosystem-related resources.[2] The results of the inventory thus far are not published in this report. However, there are plans for the inventory to be shared as an open-access international database, but whether or not this database would include national and sub-national level information was unclear.

The report emphasized the importance of the role that CCCC play in One Health implementation and reaffirms the gaps that exist in the literature on the One Health concept, providing a guiding way forward for the global community from the international leaders on One Health. However, one area of weakness for the panel and its report is that there still seems to be a lack of representation and participation from the ecosystem sector.[10] In review of the biographies of the 26 experts on the OHHLEP, none seemed to hold a current job focused solely on environment or ecosystem, including wildlife, forestry, water, or natural resources.[10] Many experts were involved in One Health which includes elements of the ecosystem sector and some had previous jobs, research experience, or education in the ecosystem sector, but none were currently focused on environment and the majority of the experts were based in the human health sector.[10]

This continued to demonstrate the challenges of equitable interagency participation and cooperation with the ecosystem sector being the least represented on matters of One Health.

In further review of each of the agencies' sites on topics of CCCC for One Health implementation, many had a section or page dedicated to One Health. The OIE's One Health page outlined the history of the Tripartite and Quadripartite partnership linking to the various frameworks, memorandums, and plans published by the agencies to date on the formulation of the partnership including the ones mentioned above.[11] When searching the OIE's publication database, One Health-related publications covering CCCC included strategies such as the Global Framework for the Progressive Control of Transboundary Animal Diseases (GF-TADs) for 2021-2025.[12]

This strategy discussed the purpose of the GF-TADs coordination mechanism to ensure successful control of transboundary animal diseases. As one of the objectives of the mechanism and framework, Output 3.1 highlighted strengthening multidisciplinary communication and collaboration for strong partnerships with stakeholders.[12] However, this was the extent of how CCCC were covered in this publication and One Health was not mentioned.[12]

On the FAO site, there was a One Health section, identifying FAO's role. Their publications on One Health and CCCC ranged from country-specific frameworks outlining cooperative partnerships between the FAO and countries to reports on sector integration at the country-level that seek to drive policy effectiveness.[14] For example, the FAO published a report called *Implementing Agenda 2030 in Food and Agriculture: Accelerating Policy Impact through Cross-Sectoral Coordination at the Country Level.*[15]

This report sought to fill a gap in literature on approaches to national and sub-national cross-sector integration for implementation of policies and strategies to respond to the complexities of global challenges.[15] Ideally, it was a resource for *national and international actors who recognize the benefits of using cross-sectoral approaches to achieve common strategic development goals at the country level*.[15]

Built around the Sustainable Development Goals (SDGs), the authors outlined 12 case studies from 10 countries selected by the FAO and the World Agroforestry Centre (ICRAF) as examples of the benefits of cross-sectoral collaborations.[15] The criteria for the case study interviews were based on the ICRAF's Stakeholder Approach to Risk-informed and Evidence-based Decision-making Hub.[15] One of the case studies looks at the cross-sectoral platforms to foster resources for forest- and farm-based enterprises in Nepal.[15] Learnings from this case study highlighted the need for a champion to catalyze efforts which were often fueled by personal relationships and adequate time to build strong interpersonal relationships.[15] Conversely, a beneficial step was ensuring a common vision statement was agreed upon by all partners in the cross-sectoral platform.[15]

On the WHO site, One Health was a prominent concept with an extensive One Health section. It housed the OHHLEP information mentioned above as well as the *2022 - 2026 OH JPA*.[17] The WHO One Health Initiative microsite was the secretariat for the OHHLEP and also the acting secretariat for the Quadripartite.[18] In addition to the OHHLEP and *OH JPA*, the WHO's database included frameworks and reports on disease- and issue-specific topics using a One Health approach such as the *2021 Annual Report from the Antimicrobial Resistance Multi-Partner Trust Fund* which is a

report on the Quadripartite initiative to advance One Health response to antimicrobial resistance (AMR) at the country and global levels.[19]

This publication utilizes the One Health approach and demonstrated how efforts to improve CCCC across agencies and sectors are progressing to address AMR.[19] It is an example of how the Quadripartite is working with countries to change processes to implement One Health strategies for a specific threat. In addition to this overarching report, the WHO database houses a number of country-specific, national One Health strategies for the control of AMR.[17]

As the newest member of the Quadripartite, the UNEP site did not have a page or section dedicated to One Health. When searching for One Health and CCCC in its publication database, the common publications of the Quadripartite materials such as the MoU and the AMR report are listed.[21, 22] Beyond the materials cross-referenced on the other three agencies' sites, there was little to no mention of One Health in UNEP-specific reports and little language around CCCC used. This emphasized the nascent stage One Health is at within the UNEP and ecosystem sector in general and signals the overall gaps in representation among the Quadripartite agencies.

Adding to the Existing Literature

Based on the gaps in existing literature and acting on proposed activities outlined in literature, the Global Health Development | the Eastern Mediterranean Public Health Network (GHD|EMPHNET) and Emory University sought to support regional operationalization of the One Health approach among the 21 countries of the Eastern Mediterranean and North Africa Region (EMR). As a first step, the partners sought to understand the current landscape of national and regional CCCC between agencies

across the three interfaces of One Health. Therefore, we conducted a survey of the relevant ministries within the 21 countries and territories of the EMR to map out current contributions to One Health approaches, existing interagency and transdisciplinary efforts, and human resource capabilities to achieve alignment across the three interfaces of One Health.

This survey aimed to describe a baseline of successes and barriers that exist for interagency CCCC to inform further training and educational materials for workforces within necessary agencies. The survey also provided a baseline for future monitoring and evaluation of interagency activities to ensure progress and that activities moving forward are effective in implementing the One Health approach in the region.

Methods

In this cross-sectional study, representatives from ministries of health, agriculture, education, and environment/forestry/natural resources, academic institutions, and non-governmental agencies focused on One Health interfaces in the WHO's EMR were surveyed via an online platform. Questions were developed out of a focus group tasked with assessing system readiness to operationalize the One Health approach in the EMR convened by GHD|EMPHNET. The focus group was made up of One Health, interagency, health system, and health emergency experts. The survey included 31 questions on inter-agency interaction such as frequency of communication with agencies and ministries in different facets of the One Health interfaces: human, animal, and environment health. The survey was split into three sections – Understanding and Implementation of One Health; Current Implementers of One Health; and New

Implementers of One Health. The questions addressed areas of engagement, interdisciplinary education and training, and needs. The survey was administered via Google Forms and offered in English and Arabic.

The recipient list was developed by the focus group based on the GHD|EMPHNET organization contact list with additional contacts added by partners connected to the relevant agencies identified in the literature review and by stakeholders in the region. Survey respondents were given the opportunity to share contacts of other representatives from related organizations at the end of the survey. In total, the survey was sent to 374 individuals representing the 21 countries in EMR as well as regional and intergovernmental agencies. This included a One Health WhatsApp group utilized in the EMR. Sent via email, the survey was open for 20 days. Reminder emails were sent at 11 days and 18 days after the initial email was sent to ensure as many responses as possible were captured. The responses were submitted and saved in a private Google Drive folder only shared with study managers. The survey did not capture identifying information as this is a systematic analysis. Emails used were removed upon analysis and only visible to study advisors.

A brief explanation for the purpose of this data collection project was provided at the beginning of the survey. The introduction also included definitions for some key terms. These terms included the following and their definitions:

- One Health – A multisectoral and collaborative approach to address complex health issues at the animal-human-environmental interface that recognizes the linkages and interdependence of the health of humans, animals, and the environment.[25]

- Human health interface – Ministry, Department, or Technical Agency responsible for human health, including public health, human focused programs/policy, and food safety.[25]
- Animal health interface – Ministry, Department, or Technical Agency responsible for animal health, including terrestrial and aquatic animal programs/policy, surveillance, biosecurity, and veterinary public health.[25]
- Environment interface – Ministry, Department, or Technical Agency responsible for the environment, including environmental sciences, waste management, pollution control, climate change, land use planning, natural resource management, biodiversity and ecosystem management, wildlife health, and wildlife management and conservation.[25]
- One Health Coordination Mechanism – Any means by which Ministries, Departments or Technical Agencies have organized themselves to be able to collaborate across sectors within their country or territory with an aim in addressing health threats (not limited to zoonoses, antimicrobial resistance, and food safety). The mechanism can be represented as a steering committee, technical working group, or any other means of organization.[25]

The survey was made up of 31 multiple-choice responses; select one response and free response questions. The survey questions covered three overarching sections. The first three questions covered general characteristics such as country/region, ministry/department/agency and One Health interface represented.

The second section looked at *Understanding and Implementation of One Health*, including questions on the agency's familiarity and experience with One Health and current engagement nationally and regionally across a number of areas of activities within One Health interfaces.

The third section covered *Current Implementers of One Health*. This included questions on general One Health coordination, presence of a One Health Coordination Mechanism, any mechanisms' legal recognition and frequency of One Health stakeholder meetings. The fourth section covered *New Implementers of One Health* which included questions such as areas that could improve and foster greater One Health CCCC and sources of communication of One Health information.

Upon closure, data were cleaned, and all Arabic responses were translated into English. During the cleaning process, duplicate submissions, test submissions or incomplete responses were identified and removed to ensure that there was only one submission per individual and unusual discrepancies were addressed. Using SAS Studio, a descriptive analysis was completed on the survey responses to map the frequency and trends in responses to relevant questions. To address the research question of if availability of transdisciplinary training in agencies was associated with One Health coordination among agencies both nationally and regionally, we used the Fisher's exact test of independence to test the hypothesis that availability of transdisciplinary training for employees at One Health-related agencies is associated with presence of One Health coordination nationally and regionally. Fisher's exact test of independence was chosen over chi-square test because the sample size was small and the expected values for each category of our predictor and outcome were smaller than five.

Findings

Between May and June 2022, the survey was shared with 374 representatives associated with the One Health interfaces identified by regional networks and respondents. The sample population represented a variety of agencies including ministries of public health, ministries of food security, country, and regional offices for FAO, WHO, CDC, and UNICEF, GHD|EMPHNET, independent consulting, academia, research organizations, and non-governmental organizations. Of the 374, 35 (9.4%) responded representing 10 countries, regional perspectives. Afghanistan and Jordan were most represented with 40% and 25.7% respectively (Appendix A, Table 1).

To create a binary variable for awareness of One Health, we combined responses that indicated *very good understanding of One Health and that it was well established* and *good understanding of One Health and that it has been integrated to some degree* to create a response for *good awareness.* Once combined, 51.4% indicated good awareness. The responses for *some basic understanding of One Health but the approach not well established* and *no understanding of One Health and that it has not been integrated* were combined to create a response for *none to some awareness*. Once combined, 48.6% indicated none to some awareness (Table 1). The results indicated that each of the One Health interfaces (animal, ecosystem, and human health) were evenly spread across this binary variable of awareness of One Health (Table 1).

Respondents indicated their agencies' regular and occasional areas of collaboration across the three One Health interfaces. For regular collaboration, human health was indicated as the most common area of collaboration and livestock and animal health

was the second most common area of collaboration with 65.7% of respondents and 45.7% total respondents respectively. Other areas or none of the sectors were indicated by a small percentage of respondents at 11.4% and 5.7% of total respondents respectively (Appendix B, Figure 1).

Education was another area of high regular collaboration at 31.4% of total respondents (Figure 1). For occasional collaboration, agencies most commonly collaborate with 40% of respondents indicating occasional collaboration with environment and natural resource activities (Figure 1). Livestock and animal health at 34.3% of total respondents and food safety at 28.6% of total respondents indicating their agencies' occasional collaboration in these areas (Figure 1). No respondents indicated that they did not collaborate occasionally with any of the listed areas.

Alternatively, respondents indicated their agencies' formal and informal collaboration regionally across areas of the three One Health interfaces. For formal collaboration, human health activities were the lead area of collaboration at 68.6% of total respondents (Appendix B, Figure 2). The rest of the areas of activities were lower with areas such as livestock and animal health at 31.4% of total respondents and food safety at 22.9% of total respondents (Figure 2). Out of the total respondents, 14.3% indicated that there was no formal engagement with any of the sectors listed (Figure 2). For informal collaboration regionally, human health activities remained the lead area of collaboration with 57.1% of total respondents indicating informal engagement (Figure 2). Livestock and animal health and food safety had more informal collaboration at 34.3% and 31.4% of total respondents, respectively, indicating engagement (Figure 2). The

other areas listed had lower percentages of responses with 11.4% of total respondents indicating that there was no informal collaboration with any of the areas listed.

One Health Coordination Mechanism

In the second section of the survey, respondents considered their agency's One Health coordination nationally and regionally. Knowledge of general activities of One Health coordination at the regional level were mostly unknown with 40% of total respondents indicating they did not know if there was One Health coordination regionally. This was highest among representatives of agencies with none to some awareness of One Health (Appendix A, Table 2). Among representatives of agencies with good awareness of One Health, 47.1% were aware of general One Health coordination and 29.4% were not aware of general One Health coordination, and 23.5% did not know (Table 2). Among representatives of agencies with none to some awareness of One Health, 58.8% of them did not know about general One Health coordination, 29.4% indicated that there was none, and 11.8% knew of general One Health coordination (Table 2). One respondent did not respond to this question.

Similarly, respondents reported on the existence of a One Health coordination mechanisms regionally or nationally. Most respondents (38.2%) indicated that there was a national coordination mechanism. Among representatives of agencies with good awareness of One Health, 52.9% said they were aware of a national mechanism followed by 35.3% who said there was both a national and regional mechanism (Appendix A, Table 3). No respondent among those with good awareness of One Health indicated they did not know of a One Health coordination mechanism while 11.8% indicated that there were no regional or national mechanisms (Table 3). Among

representatives of agencies with none to some awareness of One Health, 50% indicated there was no regional or national mechanism followed by 25% indicating there was at least a national One Health coordination mechanism (Table 3). Two respondents did not respond to this question. None of the respondents who did respond indicated awareness of only a regional mechanism.

When asked how any of these One Health coordination mechanisms were legally recognized, 27.3% indicated this type of mechanism was recognized by ministerial endorsement from participant ministries. Another 27.3% of the total respondents indicated that this type of mechanism was not recognized by any formal or legal agreement (Appendix B, Figure 3). Most respondents did not know and others indicated verbal and contractual agreements (Figure 3). Considering available resources for these types of mechanisms, 37.1% indicated there were no dedicated resources to facilitate One Health coordination, surveillance, or other One Health activities. Conversely, 22.9% indicated that there were dedicated resources for these activities, but the majority of total respondents at 40% did not know. Furthermore, in response to where resources did come from, international aid was indicated the most with government and non-governmental organizations (NGO) closely providing the next most (Appendix B, Figure 4). Many were unsure from where resources, if any, were coming (Figure 4). One respondent did not respond to this question. However, a large majority of respondents indicated that sources from the human health sector funded One Health activities the most out of the three One Health interfaces and the education sector (Appendix B, Figure 5).

One Health Coordination and Cross-sector Training, Education, and Communication of Information

For training on One Health and to support transdisciplinary collaboration, communication, and coordination respondents reported on whether their agency offered transdisciplinary training to assist with coordination between interfaces. Among representatives of agencies with good awareness of One Health, 50% indicated that their agency provides training to assist with cross-sectoral coordination (Appendix A, Table 6). Among representatives of agencies with none to some awareness of One Health, 53% indicated that their agency provides no training to assist with cross-sectoral coordination (Table 6). For both stratified groups, 16.7% and 23.5%, respectively, of respondents reported they did not know (Table 6).

From an individual perspective, the respondents reported on One Health in their academic training. Of the 35 respondents, 57.1% indicated that they did not learn about One Health in their academic training and education whereas 37.1% indicated that they did learn about One Health in their academic training and education. Additionally, this was stratified by the binary variable of awareness. Among representatives of agencies with good awareness of One Health, 50% indicated they learned about One Health in their academic training and education (Appendix A, Table 4). Similarly, 44.4% of those representatives indicated they did not learn about One Health in their academic training and education (Table 4). Among representatives of agencies with none to some awareness of One Health, 23.5% indicated they learned about One Health compared with 70.6% who indicated they did not learn about it (Table 4). One respondent from each group did not know.

In addition to past academic training and the existence of transdisciplinary training by the agency, respondents reported on the primary source for the communication of One Health information. Respondents indicated the Quadripartite as the most common primary source of One Health information with 74.3% of the 35 respondents selecting the Quadripartite as one of their answers (Appendix B, Figure 6). Conferences were indicated as the second most common source with 57.1% of respondents also including conferences as a source of communicating One Health information (Figure 6). Government and social media were the least common sources of communication of One Health information.

When testing the hypothesis that availability of transdisciplinary training for employees at One Health-related agencies is associated with presence of One Health coordination nationally and regionally, we found that there was not enough statistical significance at a *p*-value 0.3 to reject the null hypothesis and find an association between the two variables within a 95% confidence interval (Appendix A, Table 7). However, a challenge to running this type of statistical test was the small sample size and expected cell counts that were less than 5, resulting in a chi-square test not being valid. Additionally, many respondents selected “did not know” with high frequency. However, looking at the pure frequency of responses to whether there is One Health coordination generally by the exposure to transdisciplinary training, 14.3% indicated that their agency offered transdisciplinary training and that there was One Health coordination. Similarly, 14.3% also indicated their agency offered transdisciplinary training but that there was no One Health coordination (Appendix A, Table 8). Comparatively, 11.4% indicated their agency did not offer transdisciplinary training and there was no One Health coordination

and 8.6% did not offer transdisciplinary training but that there was One Health coordination (Table 8).

Interpretation

Equitable, interagency CCCC is essential to implementing and utilizing a One Health approach that will protect all life from health threats. We conducted a cross-sectional survey to assess EMR agencies' current understanding and awareness of One Health and their activities on CCCC. Our findings indicated that EMR agencies including government, international agencies, non-governmental organizations, and academia need greater interagency One Health activities, but there was familiarity and experience with the concept. More than half of respondents indicated that their agency had good awareness of One Health, but this was matched by the other half of the respondents indicating that their agencies had none to some awareness with the concept. Across the three interfaces of One Health that respondents represented, no one interface seemed to indicate a difference in awareness of One Health, highlighting a basic need for greater education and awareness building of the One Health concept throughout the region. Findings from the survey demonstrated low participation from the ecosystem interface. Particularly, respondents indicated they represented the ecosystem interface less than the other interfaces with approximately 11% representation. This low participation was reflected in the types of agencies respondents represented. While there was one response from an agency of water safety, no agencies of agriculture, environment, natural resources, or climate change participated in the survey. However, respondents that indicated ecosystem as their represented interface were from agencies

of public health, supporting evidence of One Health efforts within the human health interface.

These observations were consistent with assessments from other literature, studies, and working groups. As noted in the *One Health operational framework for action for the Eastern Mediterranean Region, focusing on zoonotic diseases*, progress from past and current efforts was stalled from all interfaces by a lack of transdisciplinary collaboration and national operational plans.[23] Additionally, the *Strategic Framework for Collaboration on Antimicrobial Resistance* developed by the Quadripartite highlighted the gaps in support and representation from the ecosystem interface as a basis for the need for the strategic framework to improve One Health approaches to issues such as antimicrobial resistance.[22] The need for continuing to fold in the ecosystem interface from policies, collaboration with related agencies to training of the workforce is a priority to ensure One Health approaches are holistically implemented and successful. The antimicrobial sector was a good example of how stakeholders worked to ensure equal representation and participation across all three interfaces for more effective solutions.[22]

When investigating the coordination activities, awareness of a regional or national One Health Coordination Mechanism trended more predictably across familiarity and experience of One Health. Regionally, 40% of respondents did not know if there is One Health coordination, but nationally, approximately 38% of respondents indicated there is a national One Health Coordination Mechanism. Respondents from agencies that have very good or good familiarity and experience with One Health are mostly aware of regional and national coordination. Approximately 47% of this stratified group were aware of regional One Health coordination and 53% indicated that there is a

national One Health Coordination Mechanism. Similarly, respondents from agencies with some or no familiarity and experience with One Health, were mostly unaware or indicated that there was not general coordination or any mechanism. Approximately, 59% did not know and 30% indicated there was no regional One Health coordination among this stratified group. For awareness of a One Health Coordination Mechanism, 50% of this stratified group indicated that there was neither national nor regional mechanism. While there were regional and country specific frameworks that exist and some level of informal or formal regional and national coordination as the survey findings indicated, the literature on current activities remained consistent with the survey findings that the way forward included further development of multisectoral collaboration and coordination mechanisms in the EMR across the interfaces of One Health.[23]

With a response rate of only 9.4% of the target population, the results were limited and could only provide a narrow understanding of the situation. While there was not enough evidence to identify a significant association between transdisciplinary training and presence of One Health coordination at a 95% confidence interval (*p*-value = 0.3), this research demonstrated a need for better understanding of interagency CCCC for One Health in EMR. In addition to the quantitative data, free response answers also provided valuable insights on the gaps and challenges to implementing One Health in the region. The free responses led to additional literature research and insight into areas where further research was needed.

Free Response on One Health Activities and Cross-sectoral Coordination

In a free response section of the survey, respondents shared their expectations of regional leaders like the Quadripartite and GHD|EMPHNET to support cross-sectoral cooperation. One respondent noted Pakistan's need for multidisciplinary training for One Health and support from these leaders on country-based projects. Another respondent from Pakistan noted that Pakistan has a One Health document that was being revamped to include more animal health agencies from the previous one that was included and more environmental agencies which had not been included at all. These comments highlighted the common gap of supporting multidisciplinary training and inclusion of each interface of One Health throughout the region both among national interagency efforts and in regional support from regional and international leaders.

For example, GHD|EMPHNET collaborated with Pakistan's human health interface to strengthen disease control, emergency management and field epidemiology training, and workforce development through the Pakistan Field Epidemiology and Laboratory Training Program (FELTP) housed at Pakistan's National Institute of Health.[26] Pakistan's FELTP focused on One Health in its training efforts and developed a collaborative cooperative agreement between the human and animal health interfaces and the National Agricultural Research Center (NARC).[27] Eleven veterinarians had enrolled in FELTP courses based on the latest published numbers on their website as of May 2022.[27] As the regional network supporting Pakistan's FELTP, GHD|EMPHNET supported these multidisciplinary trainings but to what extent is unknown. Support from the Quadripartite on these efforts are unmentioned and unknown as well. In another example, GHD|EMPHNET provided project-based support for the ecosystem interface in Pakistan on surveillance of brucellosis, an infectious disease that spreads from

animals to people, through the Pakistan Agricultural Research Council and NARC.[27] In addition, the regional public health network spurred communication with the Pakistan Ministry of Health to operationalize sub-national routine immunization efforts, demonstrating theirs and other regional and international leaders' capacity and potential to act as a catalyst for national and sub-national activities.[27]

Searching across the four Quadripartite global and regional websites, the agencies' multidisciplinary training resources and activities in the region seemed to be limited. In 2011-12, the WHO EMRO collaborated with the Oman Ministry of Health on an outbreak management course that was *designed to improve practical skills of multidisciplinary and multisectoral teams at local, regional and national levels.*[28] From this research, it could not be identified whether this training course was continued and adapted for other countries in the region. Similarly, in 2015, Sudan's Federal Ministry of Health collaborated with the WHO EMRO and Egyptian Society of Epidemiology to coordinate the first sub-regional training workshop for the national rapid response teams on Ebola virus disease.[29] The training sought to cover the functions of multidisciplinary outbreak response teams and how they work together for Ebola outbreak response.[29] However, it was unclear whether animal and ecosystem disciplines were included in facilitating and participating in the training and whether this training was replicated for other outbreaks and new cohorts.

Collaborative efforts like these regional and sub-regional trainings across disciplines are a step in the right direction, however, as another survey respondent from Sudan emphasized their agency looks to regional One Health leaders like the Quadripartite and GHD|EMPHNET to strengthen capacity building and coordination across relevant

agencies to prepare for and respond to epidemics, particularly of animal origin. This is reinforced by survey findings on the main source of communication of One Health information. Approximately, 74% of all respondents indicated the Quadripartite as one of their agency's primary sources of communication of One Health information. No other source listed was this commonly chosen, emphasizing the role the Quadripartite plays in supporting national and regional One Health activities and fostering cross-sectoral coordination and collaboration. The Tripartite's 2019 guide *Taking a Multisectoral, One Health Approach: A Tripartite Guide to Addressing Zoonotic Diseases in Countries* spoke to their role as a leading communication source of One Health information noting that having many sources can lead to misinformation, but they acknowledge the need for training and identifying spokespeople from all sectors of each interface who can maintain effective communication across all agencies.[25] The Quadripartite is a necessary global coalition for fostering the shift to a One Health approach, but it cannot remain a sole source of communication of information if countries are going to build capacity to implement an effective One Health strategy.

Limitations

Putting this research into context of the above background literature review, this research was a start to understanding current practices and gaps in interagency CCCC in the EMR where current national, regional, and international literature leaves gaps both when reviewing the Quadripartite databases for publications, Google Scholar, PubMed and the Eastern Mediterranean Journal of Health on CCCC and the terms of multisectoral, multidisciplinary, One Health, and cross-sectoral. However, this research was not extensive enough in terms of representation from countries in the region and number of respondents who shared perspectives, particularly from the ecosystem

interface who only had three representatives. The low total number of respondents and country and interface representation was the main limitation to this study and requires further research. However, this research could act as a template and sought to encourage and advocate for further research in this region around One Health. Other limitations include survey design and inadequate sectoral representation in development of questions, self-reporting and recall bias as the data is based on respondents' perspectives and recall of their agency's activities and awareness of One Health. Additionally, respondents were given the freedom to interpret many of the ratings and terms such as *informal* vs. *formal* coordination, so each response could mean very different things to each respondent.

Data Sharing Statement

The raw data and data dictionary are available with deidentified data upon request from GHD|EMPHNET. The survey in English and Arabic will also be available. These materials will be available upon publication of this article. Please email Dr. Mirwais Amiri at mamiri@globalhealthdev.org with the purpose of desired access to the data and for access. Data will be shared upon review of a proposal that furthers the research of this study and at the discretion of GHD|EMPHNET. Before data is shared, an access agreement form will be signed to ensure data is not shared with unapproved parties.

Funding

No funding was provided for this research. It was conducted on a volunteer basis.

Chapter 3: Future Directions and Public Health Implications

Even with its limitations, this research's outcomes indicated that more education and awareness-building led by individual EMR agencies is needed around One Health to spur greater urgency for the implementation of One Health approaches and interagency CCCC. Greater interest and communication of One Health activities is needed from many of the countries in EMR, particularly from the ecosystem interface within these countries as demonstrated from their low response rate. Transdisciplinary and multi-sectoral training is needed within individual agencies across the region to ensure professionals have the tools and skills to be able to conduct interagency CCCC. As next steps, further research in these areas and incorporation of CCCC and One Health in animal, ecosystem, and human health workforce training are essential to ensure that all countries shift to a One Health approach that will address the health conditions and threats impacting our animal, ecosystem, and human health.

As the world continues to address the COVID-19 pandemic going on its third year as of 2022 and environmental experts are sounding the alarm about the consequences of immense climate change, we are in a rare window of opportunity when governments and society are focused on health, both public and ecosystem.[3] It is a time when we can look at real world experiences of predicting, preventing, and responding to pathogen spillover from animal to human and responding to a novel disease. Though as other challenges arise and take the spotlight, we are losing the opportunity to galvanize political will and global unity to address ongoing and emerging health threats. Therefore,

the health sectors of each of the three One Health interfaces must act now to build support and spur the shift to the One Health approach. Strong interagency alignment built on communication, coordination, collaboration, and capacity building to foster the One Health approach will create a world that can predict, prevent, quickly detect, and effectively respond to health threats, no matter their origin, to safeguard the health of humans, animals, and our ecosystem.[3]

Experts are indicating and warning that emerging infectious diseases are on the rise, pointing to climate change as a significant catalyst.[30] As the emergence of COVID-19 demonstrated, the world currently is not well prepared for any, no less an increase in, emerging diseases. Great collaborative efforts have been made to address the gaps in preparedness even since the start of the COVID-19 pandemic in 2020, especially in the area of One Health and shifting practices towards this approach, but as most of the literature and this research suggests we have more to learn about what is needed for countries to effectively implement a One Health approach. In a bibliometric analysis of nearly 13,000 articles on One Health research priorities, the authors found that One Health research is currently trending globally with a particular focus on natural sciences such as zoonotic diseases and antimicrobial resistance.[31] Yet the literature severely lacks in the social science space of One Health such as capacity building and communication.[31] Based on this, the authors recommended that greater research be done on interdisciplinary and intersectoral activities and collaboration.[31] The time is now to support countries' implementation of One Health and in order to do that we need to conduct further research to understand the successes and challenges to interagency activities across the One Health interfaces.

Appendices

Appendix A. Tables

Table 1. Awareness of One Health among Agencies in the Eastern Mediterranean and North Africa Region, by Country and One Health Sector, 2022

	None to Some N (%)	Good N (%)
Country		
Afghanistan	11 (64.7)	3 (16.7)
Jordan	0	9 (50)
Pakistan	2 (11.8)	1 (5.6)
Other	2 (11.8)	0
Egypt	0	2 (11.1)
Morocco	1 (5.9)	0
Yemen	1 (5.9)	0
Qatar	0	1 (5.6)
Sudan	0	1 (5.6)
Regional	0	1 (5.6)
One Health Sector[1]		
Animal	6	8
Health	13	1
Ecosystem	2	2
Responses	17 (48.6)	18 (51.4)

1. Responses are not mutually exclusive.

Table 2. Awareness of One Health among Agencies in the Eastern Mediterranean and North Africa Region, by Having General One Health Coordination Among Agencies, 2022

	None to Some N (%)	Good N (%)
Yes	**2 (11.8)**	**8 (47.1)**
No	**5 (29.4)**	**5 (29.4)**
Do not know	**10 (58.8)**	**4 (23.5)**
Total [1]	**17**	**17**

1. Missing 1 response.

Table 3. Awareness of One Health among Agencies in the Eastern Mediterranean and North Africa Region, by Presence of National or Regional One Health Coordination Mechanism, 2022

	None to Some N (%)	Good N (%)
Both regional and national	**2 (12.5)**	**6 (35.5)**
Regional	**0**	**0**
National	**4 (25)**	**9 (52.9)**
None	**8 (50)**	**2 (11.8)**
Do not know	**2 (12.5)**	**0**
Total [1]	**16**	**17**

1. Missing 2 responses

Table 4. Awareness of One Health among Agencies in the Eastern Mediterranean and North Africa Region, by Academic Training in One Health, 2022

	None to Some N (%)	Good N (%)
Yes	**4 (23.53)**	**9 (50)**
No	**12 (70.59)**	**8 (44.44)**
Do not know	**1 (5.88)**	**1 (5.56)**
Total	**17**	**18**

Table 6. Awareness of One Health among Agencies in the Eastern Mediterranean and North Africa Region by Agencies' Transdisciplinary Training, 2022

	None to Some N (%)	Good N (%)
Yes	**4 (23.5)**	**9 (50)**
No	**9 (53)**	**6 (33.33)**
Do not know	**4 (23.5)**	**3 (16.67)**
Total	**17**	**18**

Table 7. Statistical Significance of Association between Presence of One Health Coordination among Agencies in the Eastern Mediterranean and North Africa Region and Agencies' Transdisciplinary Training, 2022

Coordination	No Training N (%)	Training N (%)	Do not know N (%)	Total
Yes	3 (8.57)	5 (14.29)	2 (5.71)	10 (28.57)
No	4 (11.43)	5 (14.29)	1 (2.86)	10 (28.57)
Do not know	8 (22.86)	2 (5.71)	4 (11.43)	14 (40)
Total	15 (42.86)	13 (37.14)	7 (20)	35

Statistic	Prob.	P-value
Fisher's exact test[1]	0.0006	0.3064

1. 83% of the cells have expected counts less than 5. Chi-square may not be a valid test.

Table 8. Transdisciplinary Training among Agencies in the Eastern Mediterranean and North Africa Region by Presence of One Health Coordination, 2022

Training provided	Presence of Coordination N (%)	No Coordination N (%)	Do not know[1] N (%)	Total
Yes	**5 (14.29)**	**5 (14.29)**	**2 (5.71)**	**13**
No	**3 (8.57)**	**4 (11.43)**	**8 (22.86)**	**15**
Do not know	**2 (5.71)**	**1 (2.86)**	**4 (11.43)**	**7**
Total [1]	**10**	**10**	**14**	**35**

1. Missing 1 response.

Appendix B. Figures

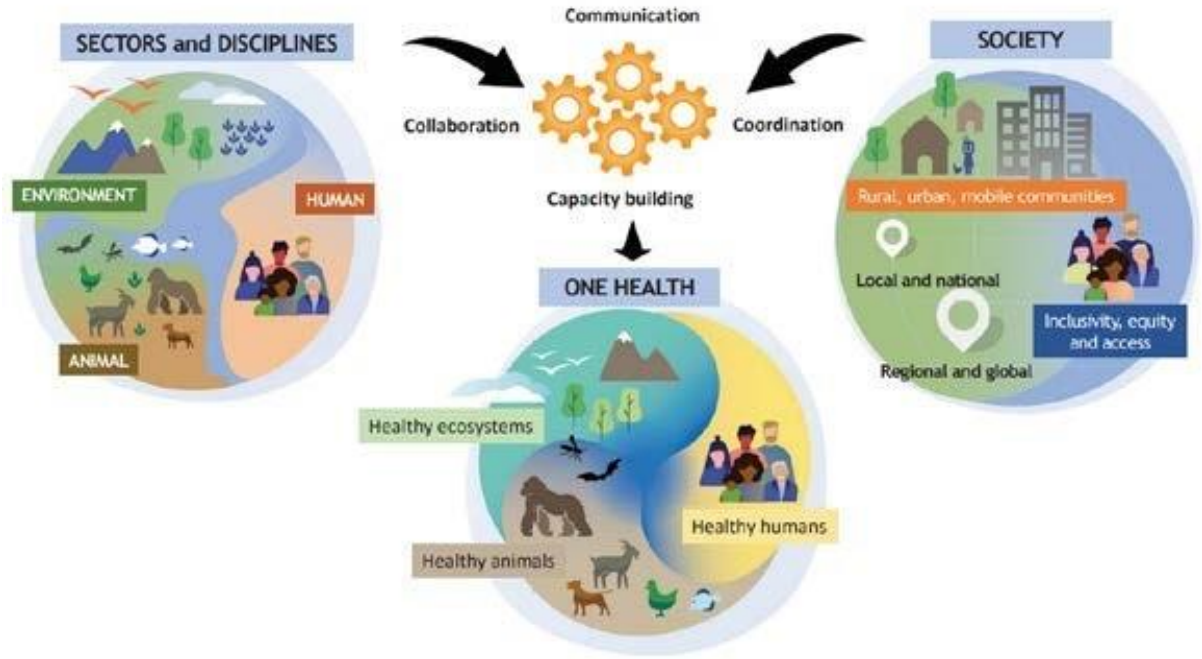


Figure A: One Health High Level Expert Panel's (OHHLEP) One Health Definition, 2022.[2]

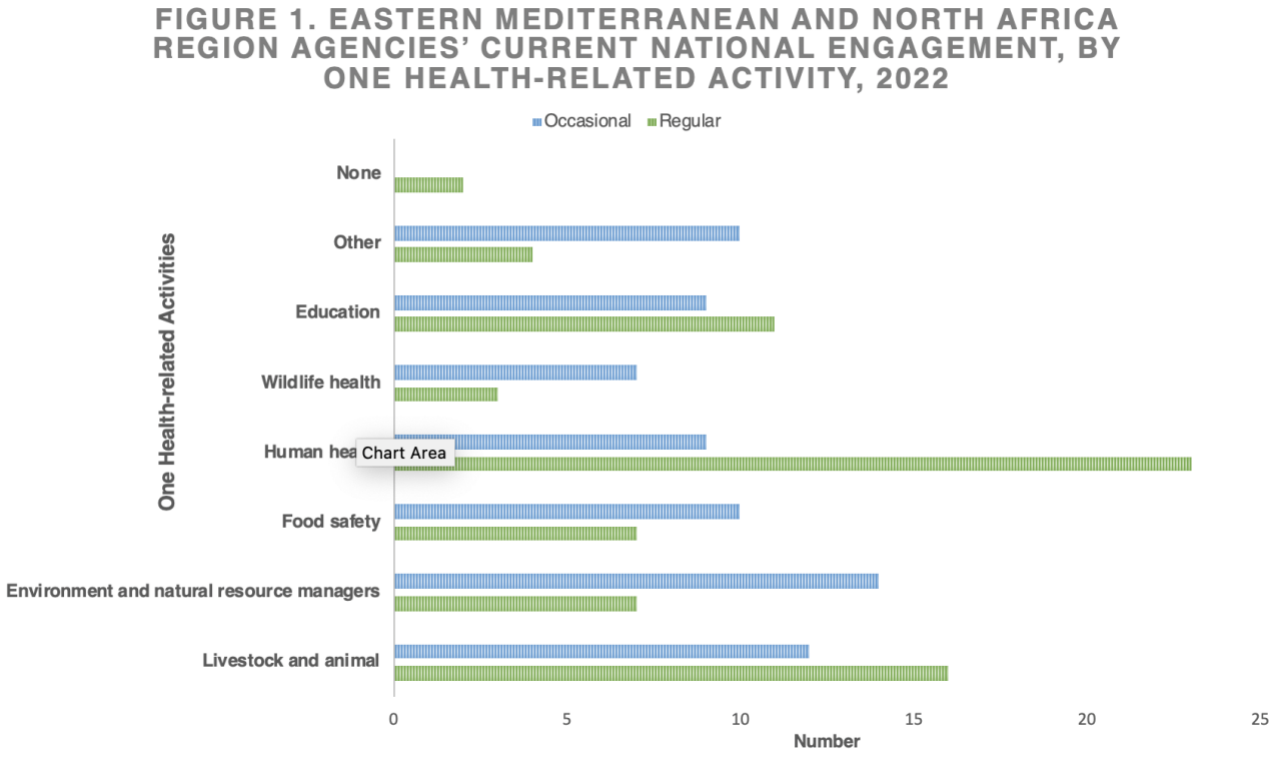


FIGURE 2. EASTERN MEDITERRANEAN AND NORTH AFRICA REGION AGENCIES' CURRENT REGIONAL ENGAGEMENT BY ONE HEALTH-RELATED ACTIVITIES, 2022

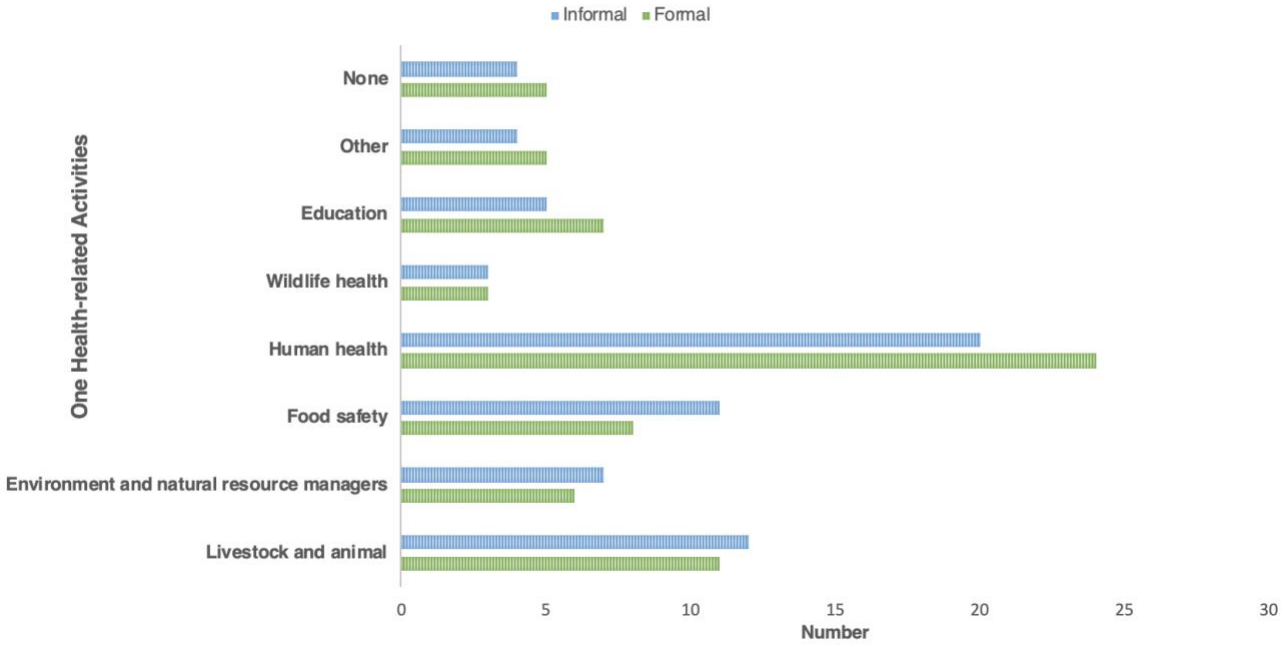


FIGURE 3. TYPE OF LEGAL RECOGNITION OF ONE HEALTH COORDINATION MECHANISM AMONG EASTERN MEDITERRANEAN AND NORTH AFRICA REGION AGENCIES, 2022

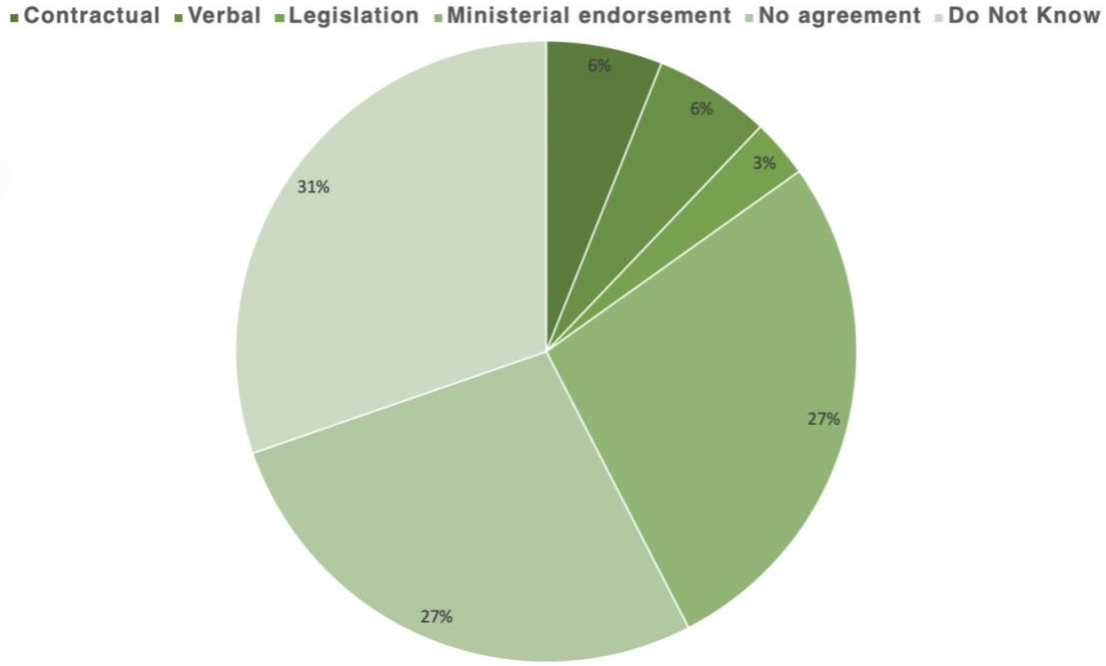


FIGURE 4. SOURCE OF RESOURCES FOR EASTERN MEDITERRANEAN AND NORTH AFRICA REGION ONE HEALTH COORDINATION MECHANISM BY TYPE OF AGENCY, 2022

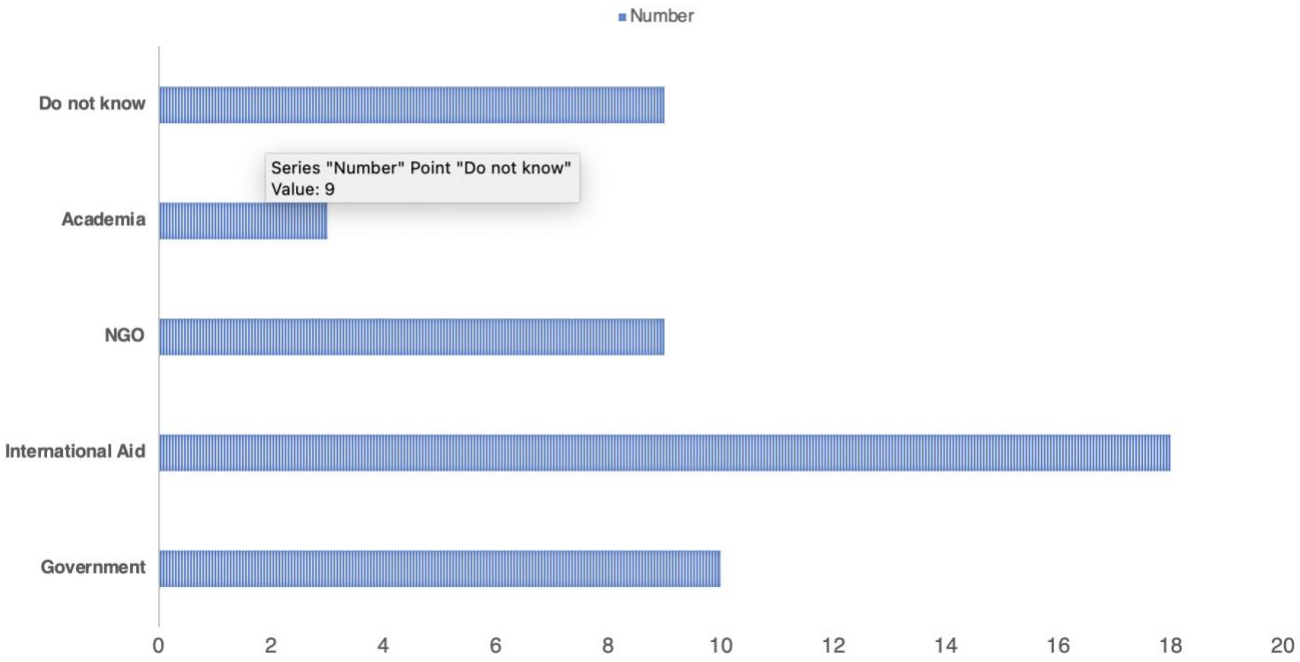


FIGURE 5. SOURCE OF FUNDING FOR EASTERN MEDITERRANEAN AND NORTH AFRICA REGION AGENCIES' ONE HEALTH ACTIVITIES BY ONE HEALTH INTERFACES AND EDUCATION, 2022

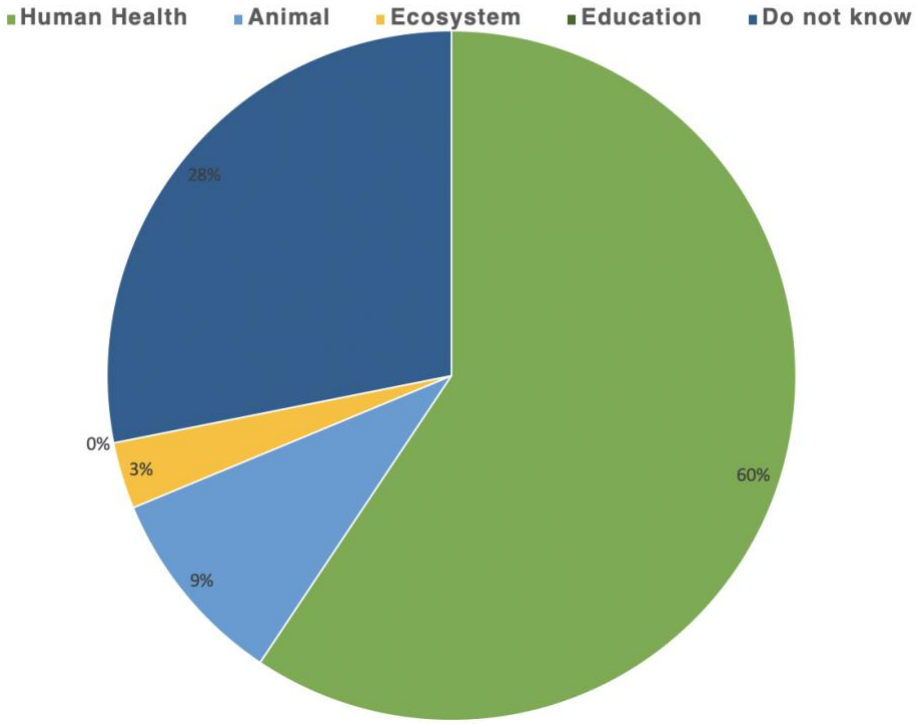
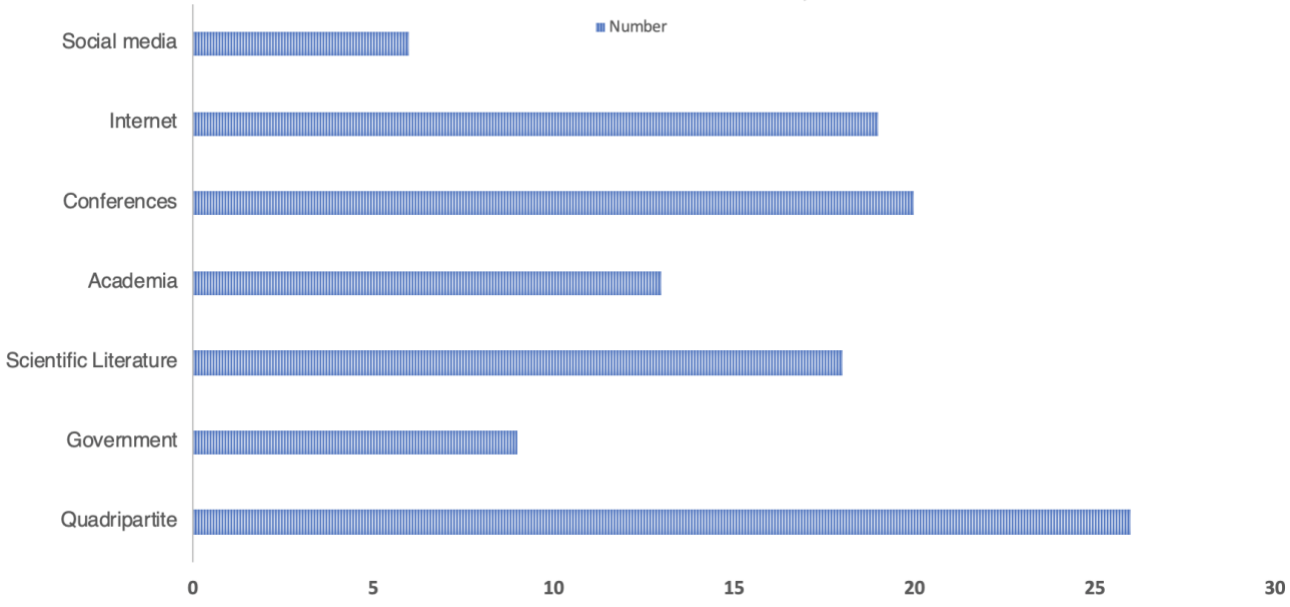


FIGURE 6. EASTERN MEDITERRANEAN AND NORTH AFRICA REGION AGENCIES' PRIMARY SOURCE FOR COMMUNICATION OF ONE HEALTH INFORMATION, 2022



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