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The One Health framework and its implementation in global health governance through public-private partnerships.

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Abstract

Antimicrobial Resistance (AMR) is one of the biggest public health challenges of our time, causing several hundred thousand deaths every year. The One Health framework has been developed to highlight that AMR is a trans-sectorial health issue, involving the human-animal-environment interface, and that it should be addressed as such, coordinating the efforts of scientists, policy-makers and other stakeholders. However, One Health lacks a 'practical' dimension, meaning that it is rarely adopted to address public health crises, mainly because it has not been internalised in society as a new paradigm able to drive human behaviour and legislation.

Non-traditional health actors, among which public-private partnerships (PPPs) like the Global Antibiotic Research and Development Partnership (GARDP), have been recognised within the One Health framework as possible coordinators of global health governance with the aim to advance global health. A governance analysis of GARDP, however, reveals that although it adopts a vision and objectives aligned with those of One Health, it alone cannot provide a comprehensive response to severe and omnipresent public health issues like AMR. More partnerships like GARDP are needed to transform One Health into a governance practice and to coordinate the efforts of researchers, educators, policy-makers, entrepreneurs and citizens towards solid and efficacious solutions to public health challenges.

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Introduction

Antimicrobial Resistance (AMR) is one of the biggest public health challenges of our time, causing 700 thousand deaths yearly (GARDP, c2020). It occurs when microorganisms - bacteria, viruses, fungi and parasites - become genetically resistant to antimicrobial drugs, a phenomenon which increases the persistence and spread of infections. This is amplified by the incorrect use of antibiotics in humans, as well as in agriculture, farming and aquaculture, and by unsuitable drug disposal mechanisms. Consequently, AMR is a health issue that involves humans, animals and the environment, and therefore very complex to tackle. While AMR is recognised as a threat to humanity having the same urgency as climate change within the scientific community, weak efforts have been made to respond to it comprehensively, as highlighted in UK former Chief Medical Officer Sally Davies' report *The Drugs Don't Work* (2013).

The One Health framework highlights that AMR is a trans-sectorial health issue, involving the "human-animal-environment interface" (Schneider et al., 2019, p. 1), and that it should be addressed as such, coordinating the efforts of scientists, policy-makers and other stakeholders. "Non-traditional health actors" (Clark et al., 2010 in Okello et al., 2015, p.370), among which public-private partnerships (PPPs), have been recognised as possible coordinators of global health governance with the aim to advance global health, but it is argued that they foster private interests and are driven by market- and big pharma-factors.

This dissertation attempts to provide a critical outlook on One Health and analyse how PPPs adopt this framework and integrate it within the global health agenda. After a thorough literature review of articles published in the peer-reviewed journal *The Lancet,* and of the books *Partnerships and Foundations in Global Health Governance* (Simon and Williams, 2011) and *Global Health and International Relations* (McInnes and Lee, 2012), three interviews were carried out with experts: Professor Ilaria Capua, director of the One Health

Centre of Excellence at the University of Florida, interviewed thanks to Professor Carlo Giaquinto from the University of Padua; Doctor Owain Williams, researcher in Global Health at the University of Leeds and Professor Garrett Brown, chair in Global Health Policy at the University of Leeds. All interviews were recorded with their written and oral consent, transcribed by the researcher (myself) and safely stored in the university's M drive. Excerpts from the interviews are included in Appendices A, B, C, respectively.

The final section provides the governance analysis of the Global Antibiotic Research and Development Partnership (GARDP), referring to the book *Governance Analysis: Critical Enquiry at the Intersection of Politics, Policy and Society* (Carmel, 2019). By reviewing in-house publications and mission statements and locating them within the One Health literature and discourse, it has been possible to conclude that GARDP's work combines the capabilities of its members with a vision aligned with that of One Health, but alone it cannot provide a comprehensive response to widespread public health issues like AMR. More partnerships like GARDP are needed to transform One Health into a governance practice and coordinate the efforts of researchers, educators, policy-makers, entrepreneurs and citizens towards efficacious solutions to these challenges.

Literature Review

Antimicrobial Resistance is gaining significant momentum in the global health governance agenda. People are becoming more and more resistant to antibiotics and, in a not-so-distant future, may become vulnerable to death by simply catching a cold, England's former Chief Medical Officer Sally Davies explains (Davies et al., 2013). While this phenomenon can lead to catastrophic effects, on the same level as climate change, the efforts made by the international community to address it do not seem good enough (Davies et al., 2013; Lee and Brumme, 2013; Hermsen et al.,2014; Okello et al., 2015; Chaudhary, 2016; Van Katwyk et al., 2016; European Commission, 2017; Morel et al., 2017). The UN General Assembly's 2016 High-Level Meeting focused on the threats of AMR and urged world leaders to promote sustainable action to fight it, but it has been difficult to find an effective action framework (Labonté and Gagnon, 2010; Rochford, 2018). Framing AMR only as a healthcare or development or innovation or security issue has proven to be limiting and not fully encompassing the complexity of the phenomenon (Gopinathan et al., 2015; Wernli et al., 2017; Schneider et al., 2019). Therefore, many academics have turned to the One Health framework as an adequate means to conceptualise and address AMR. This approach underpins coordination and collaboration among multiple disciplines to attain optimal health for humans, animals and the environment equally (Wernli et al. 2017). This holistic view dominates the literature on AMR and is praised as the best tool to achieve substantial advancements in global health (Jinks et al, 2016; Larsson et al., 2018; Ogawa et al. 2018; Van Hengel and Marin, 2018; Hernando-Amado et al., 2019).

One Health has gained prominence only recently, so the amount of research available is still growing but is already substantial. What this review reports on, in line with the dissertation's objective, is the link between One Health and AMR, and how new actors, especially public-private partnerships (PPPs), have become involved in the global health governance system.

Antimicrobial Resistance is a threat to human life. While antibiotics treat infections, they also reduce the amount of healthy bacteria in our body. Furthermore, as malign bacteria develop new ways of sharing their genetic material, drug-resistant strains spread more easily and quickly, to the extent that existing drugs become ineffective (Davies et al., 2013). International travel, misuse of antimicrobials at home and in health care, lack of new drugs and inadequate sanitation facilitate the spread of resistant bacteria (Kickbusch and Quick, 1998; Davies et al., 2013; Robinson et al., 2016; Ogawa et al., 2018; Schneider et al., 2019). Due to AMR's ubiquitous presence, various global health frames have been adopted to deal with it but One Health is gaining support as the most complete one. It identifies the determinants of AMR within and between the human, animal and environment spheres. It is worth highlighting, however, that already in the 1950s veterinary professionals, when assessing the transmission of diseases like rabies, coined the term 'one medicine' to acknowledge the systemic interaction between humans and animals. This approach was then used for the first time to develop cross-species treatments and vaccines, sometimes through experiments in animals, which would benefit human health (Schneider et al., 2019).

Nowadays antibiotics are frequently used in farming to stimulate animal weight and growth, and in agriculture to strengthen crops (Ventola, 2015a; Larsson et al., 2018; FAO, 2017 in Schneider et al., 2019; Hernando-Amado et al., 2019), thus contributing to the development of AMR. AMR also spreads in the environment due to the contamination of wastewater and waste in general (Monnier et al., 2018), and much more research is needed to understand this aspect of One Health, Larsson et al. (2018) explain. In view of the above, the One Health framework does not focus specifically on healthcare or development or innovation or security as independent spheres of action and intervention concerning AMR, rather it looks at them as part of the same system.

The identification of the “human-animal-environment interface” (Schneider et al., 2019, p. 1) and of the multidirectional correlation among these spheres are the key themes in the One Health literature, which also advances proposals on how to coordinate efforts. Experts call for a joint action of specialists in various disciplines to promote surveillance, stewardship and research and development programmes (Hermsen et al., 2014; Chaudhary, 2016; Jinks et al., 2016; Ogawa et al.,2018; Monnier et al., 2018; Van Hengel and Marin, 2018; Ardal et al., 2019; Hernando-Amado et al., 2019). They point to the need for a new economic model and an effective global health governance architecture. The former should promote incentives for pharmaceutical companies to develop new drugs and prevention and detection technologies. In fact, the current economic model for drugs depends on the volume of sales, so producers do not invest in the development of new antimicrobials, being aware that when any antimicrobial drug enters the market and is sold and used resistance develops, quickly making it ineffective. As the use of drugs needs to be restricted to minimise the risk of resistance development, this model causes a market failure for antimicrobials (Ventola, 2015b; European Commission, 2017; Van Hengel and Marin, 2018). Different incentives have been identified as potential tools to promote sustainable drug marketization and R&D: pipeline coordinators, such as governmental and nongovernmental organisations (Van Hengel and Marin, 2018; Ogawa et al., 2018); grants or market entry rewards to antibiotic developers (Ardal et al., 2019; Morel et al., 2017); delinked payments to create predictable long-term supply (Monnier et al., 2018).

In this perspective, the role of multisector stakeholders is important to enhance data sharing, research and development coordination and funding (Kickbusch and Quick, 1998; Ventola, 2015b; Ardal et al., 2019; Schneider et al., 2019). “Non-traditional health actors” (Clark et al., 2010 in Okello et al., 2015, p.370) have gained prominence in the context of global health governance in the late 20th century, when the World Health Organization (WHO) sought the

help of new contributors to strengthen its position (Okello et al., 2015). These include non-governmental organisations, civil society organisations, public and private bodies and philanthropic foundations that set up partnerships with the goal of improving global health (Kickbusch and Quick, 1998; Labonté and Gagnon, 2010; Rochford et al., 2018). The Bill & Melinda Gates Foundation, the Innovative Medicines Initiative (IMI) and the Drugs for Neglected Diseases initiative (DNDi) are examples of how third actors can help monitor AMR and sustain progress in this regard (Rochford et al. 2018).

The available literature on the partnerships established to fight AMR within governance mechanisms, however, lacks an analysis of their approach towards One Health. Only academics dealing broadly with global health governance challenges identify issues linked to the possible neoliberal drifts of partnerships, which entail the prioritization of specific diseases based on corporate interests and the increased power of third-party actors in decision-making processes (McGregor, 2001; Miraftab, 2004; Ruckert and Labonté, 2014; Marstein and Babich, c2018). That is why deeper understanding of the involvement of PPPs within One Health is needed.

Additionally, the gaps in the One Health approach are rarely analysed. Issues identified by a handful of experts relate to the definitional ambiguity of the concept and to the absence of a coordinating body, which, according to some, lead to resource allocation based on ad hoc criteria, such as attractiveness to donors or foreign or economic policy priorities (Lee and Brumme, 2013). While on the one hand the breadth of the concept allows One Health to serve as an umbrella for innovative partnerships (Leboeuf, 2011), on the other it increases complexity in the landscape of governance for an issue, namely AMR, which is in itself very complex. The risks in the pursuit of One Health goals are therefore fragmentation and reductionism (Lee and Brumme, 2013).

Thus, the concept's definitional gaps regarding applicability and its partnerships' potential neoliberal derives have been overlooked: this dissertation aims to provide a critical outlook on the comprehensiveness of the One Health approach and an analysis on how public-private partnerships tend to adopt it.

Theoretical Approach: One Health

The view of health as 'one' has been developed to point out the inseparability and mutual influence of the human, animal and environmental spheres of life, thus proposing an extension of the conventional view according to which humans are the only beneficiaries of health (Capua, 2019). This approach is relevant regarding AMR, a phenomenon that involves the mutual transmission of drug-resistant strains of microbes – bacteria, viruses, fungi and parasites - across humans, animals and the environment. The trilateral interconnectedness at the basis of this framework can also be used to understand more comprehensively other diseases, such as avian influenza, Ebola (EVD), HIV/AIDS, and, most recently, COVID-19 (Sars-CoV-2) (Moraca, 2020). In fact, the initial spread of such diseases involves an interaction between animals and humans, and is facilitated by the surrounding environment.

Starting from the awareness of the interconnectedness of the "human-animal-environment interface" (Schneider et al., 2019, p. 1), the One Health approach also establishes the need to design and implement programmes, policies, legislation and research in which multiple sectors communicate and work together to achieve better public health outcomes (WHO, 2017). For instance, One Health highlights the need for researchers across countries and fields to collaborate on the development of new and sustainable drugs, for medics to administer antimicrobials sensibly and only to treat specific types of bacterial infections, for patients to be aware of what is being prescribed to them, for farmers and traders not to use fertilisers and supplements that can harm humans and the environment, for governments to set regulations on the use and disposal of medicines, to incentivise R&D and ensure access to medicines to all citizens, for leaders to work together and coordinate international efforts. This approach therefore calls for a system-wide transformation in which the 'one health' of all living things is a common goal and at the same time a common asset.

Ilaria Capua, director of the One Health Centre of Excellence for Research and Training at the University of Florida and a renowned virologist, reiterates that this framework is comprehensive but puts forward interesting considerations regarding the conceptualisation and success of One Health (see Appendix A). While the theory is based on the idea that a trilateral relationship exists among humans, animals and the ecosystem, “today One Health is mainly viewed as the overlapping of animal and human health” Capua (2020) argues, as the role of the environment has not been valued and investigated enough. Garret Brown, professor of Global Health Policy at the University of Leeds, agrees on this point and adds that One Health is still weak in practice (see Appendix B). So, AMR remains a largely undebated health issue (Galaz et al., 2015). One Health is argued to be comprehensive only in its theoretical formulation, while in empirical studies it is seldom adopted to explain the composition of the determinants of transmissive diseases, AMR and emerging pathogens. This in turn hinders the actual application of the framework and justifies the current trends of interventions and behaviours regarding human health that are believed not to impact the sustainability and health of the world’s biomes.

According to both experts, people need to understand the interconnectedness of a globalised world and become aware of the consequences of their behaviour on the health of the planet and of its inhabitants (Brown, 2020; Capua, 2020). Assuming that health is a universal good, One Health needs a “movement from the bottom” (Capua, 2020) similar to the one triggered by the climate crisis in order to bring about a systemic change and reconceptualization of health. With regard to AMR and other health issues, Capua (2020) comments that “what is being done is fragmented”: a more solid and organised interaction between different sectors of the society is required in order to share sustainable practices to prevent the spread of diseases. In her book (2019), she refers to ‘big data’ and artificial

intelligence as key facilitators in gathering valuable information, in sharing knowledge within the global scientific community and across other fields, like agriculture, trade and politics, in finding affordable paths to solve health issues. Open access to information and transparency are very important in the One Health paradigm to effectively enable research, policy-making and coordination (Rüegg et al., 2018).

One Health envisions 'non-conventional' actors as necessary third parties when it comes to sharing knowledge, fostering research and development, and finding new solutions to AMR interdisciplinarily and inter-sectorally. These actors are usually private, academic and philanthropic foundations or public-private partnerships, which are non-profit organisations that involve different funding sources to develop drugs, vaccines and other health tools (Lin, 2014). Within the One Health approach, PPPs are also assigned the role of implementers and coordinators expected to align human behaviour, research and information, and to horizontalise governance, as "the coordination aspect for the approach is for now mostly ad hoc and responsive, not proactive, and symptom based" Brown (2020) comments.

Owain Williams, Senior Research Fellow on Global Health at the University of Leeds, digs deep into the implications of the involvement of product development (PDPs) and public-private partnerships in global health governance (see Appendix C). "Most of the PDPs in the world are about developing medicines, they are not about AMR stewardship and responses to the underlying problems that One Health is really focussing on" (Williams, 2020), like lack of access to medicines, of regulations regarding patent rights and prescription, of pipelines of drugs or market incentives. Although partnerships take a different shape compared to traditional health actors, they still tend to bolster the corporate, neoliberal agenda that has been so deleterious to health outcomes across the globe in the past (Barnes and Brown, 2011; Faubion et al., 2011). In fact, instead of making efforts to achieve health as a global

public good, they too often focus on remuneration and are driven by a hierarchical system where big pharmaceutical companies dictate the rules (Williams, 2012). Moreover, the World Health Organisation and other international or state actors tend to offshore their responsibilities to private actors, which are often perceived as more efficient providers of innovation and services but set a “clean linear hierarchy of control and command” (Brown, 2020) that does not operate in line with a vision of health as a public asset. Although the One Health approach identifies these new actors as important links in the chain of comprehensive health governance, it is often unclear how they actually implement and adopt its theoretical foundations in their initiatives.

Governance Analysis of GARDP: One Health and PPPs

To better understand the role of public-private partnerships within the One Health paradigm and assess the extent to which its theoretical underpinnings are implemented, a case study has been selected. As Professor Brown (2020) states, PPPs come into the operational end of One Health, which calls for the implementation and coordination of efforts towards the cohesive resolution of AMR and other health issues. The Global Antibiotic Research and Development Partnership (GARDP), based in Geneva, is a suitable and innovative example. Although launched only recently, in 2016, by the WHO and the Drugs for Neglected Diseases Initiatives (DNDi), GARDP represents a new different 'hybrid' actor which - like DNDi, as Williams (2020) suggests - has good prospects of developing new drugs without the involvement of pharmaceutical companies. It establishes partnerships and launches collaboration and coordination projects to develop and deliver new or improved antibiotics with stakeholders across the world (Piddock, 2018). These are government representatives, like the UK Department for Health and Social Care and the German Ministries of Education and Health, private funds or philanthropic foundations, such as the Bill & Melinda Gates Foundation and Wellcome Trust, and non-governmental organisations, like Médecins Sans Frontières (GARDP, c2020).

At first sight, GARDP's mission seems limited to what Williams (2012) criticised as being the only sphere of action of PPPs today, mainly the production and marketization of new medicines. However, the analysis of the partnerships' agenda and mission statements clearly shows that it has a broader scope. Firstly, "GARDP's efforts focus on global public health priorities and indications less likely to be developed by others" (Piddock, 2019, p.1), meaning that its research and development decisions are not driven by market forces. In fact, the *5by25* report (GARDP, 2019a) highlights how GARDP is committed to transparently leveraging the best of both the public and private sectors for the achievement of a mutually

beneficial objective, recognising that a market-driven approach cannot deliver enough innovative antibacterial treatments. The public sector sets public health priorities and shapes the incentives for private actors, which in turn bring in significant expertise and innovation. Partnerships within GARDP are based on the synergy of the respective actors' capabilities and on risk distribution, and are actualised through a portfolio approach to create long-term commitments to projects (Piddock, 2019).

GARDP (2018, 2019a, c2020) also sets and discloses the criteria to assess partner suitability and the processes determining the setup of its board of directors and committees, membership conditions and the composition of its income and expenditure decisions. Most of the economic contributions it receives come from national ministries and its board members and observers are scientific experts or government research councils' representatives, which shows how GARDP's initiatives are driven by the aim to improve global public health. Considering that some European countries, like Switzerland, France and Germany, are its main financial contributors, the question arises as to which populations are the main beneficiaries of its efforts, given that stakeholders from the Global South are not involved, except the South African Medical Research Council. This doubt is resolved by looking at the diseases GARDP's clinical development programmes focus on, and by acknowledging that, as Professor Capua (2020) highlights, in order to defeat AMR "everyone needs to contribute in the fight against it in whichever way they can": European countries are the most resourceful economically and technologically for investing in research and development. In addition, GARDP's agenda includes projects related to access and stewardship: it is committed to working with governments, civil society and academic partners to define and implement pre- and post-registration activities for new antibiotics that promote responsible and sustainable access, especially in low- and middle-income

countries, which are worst affected by limited treatments and high mortality rates (GARDP, 2019b).

GARDP aims to tackle priority pathogens identified by the WHO and the gaps in treatment of infectious diseases in key populations (Piddock, 2019) by collaborating with universities as well as scientific and academic communities worldwide, for instance with the University of Verona, Institut Pasteur Korea and University of London (GARDP, 2019c). Its clinical development programmes focus on sexually transmitted infections, neonatal sepsis, and paediatric infections. Additionally, GARDP pursues the Antimicrobial Memory Recovery and Exploratory Programme (AMREP) with the goal to identify undeveloped or forgotten antibiotics that could be turned into new treatments, connect researchers, trainers and educators through the open access website REVIVE, and build a portfolio of novel chemical entities or drugs to support its clinical programmes. Therefore, GARDP has the ability to enter at any point of the drug development pipeline, from early exploratory studies to patient access, ensuring good antimicrobial stewardship throughout (Piddock, 2018, 2019). This multilateral approach proves to be best fit for a complex issue like AMR and leads GARDP to commit to the sustainable development of drugs and especially to the building of an interconnected scientific and learning community, which, according to Capua (2019), are key elements for a transparent AMR resolution.

Thus, the Partnership's mission does not just revolve around incentivising and actualising research and development but also includes sharing knowledge with the scientific community and the society through the REVIVE platform and ensuring the developed medicines are accessible and used sustainably worldwide. GARDP does this by connecting the private, public and third sectors inter-regionally. Based on its organisational and structural setup, GARDP does not propose a vertical, market-oriented approach to the development of medicines, rather it aims at the convergence of disparate sectors'

capabilities to “develop new treatments for unmet clinical needs” and “ensure everyone, everywhere in the world has access to the treatment they need in a responsible and sustainable manner” (Balasegaram, 2019 in GARDP, 2019a, p. 40). Based on these features, GARDP integrates core elements of the One Health framework within its agenda, showing awareness of the importance of interdisciplinary cooperation for the wellbeing of humanity. Its spheres of action do focus mainly on human health and the eradication of specific diseases but are contextualised within long-term sustainable development.

In fact, in the *5by25* report’s (GARDP, 2019a) mission statement, the organisation recognises that its efforts to eradicate AMR will allow big steps to be made towards the achievement of the Sustainable Development Goals (SDGs), which have been designed to reflect the human, animal and environmental interconnectedness more than the Millennium Development Goals did. All SGDs are intended to be crosscutting and the inter-linkages and networks within them are as important as the individual goals themselves (Queenan et al., 2017). The awareness that deep systemic changes are needed in order to develop new paradigms based on the integration of environmental, economic and societal drivers and on inter-sectoral collaboration is rooted into the One Health paradigm and GARDP can be its global enabler.

On the other hand, although aligned with the premises and objectives of the One Health literature, GARDP is still in its start-up phase (GARDP, 2019a). Only in the next five to ten years, it will be possible to evaluate its leadership and maturation in terms of reach and sustainability of developed medicines and practices. Even if its features render it an important ‘link’ in the chain of initiatives put in place to eradicate AMR and adopt a vision of health as a public good, GARDP alone cannot make One Health a globally shared reality, and consequently a comprehensive response to AMR, which is the ultimate goal of the One Health framework, is still missing. As to the scientific community, the DNDi network, to which

GARDP belongs, is moving in this direction, but such hybrid actors are few. Furthermore, there is still global unevenness in medical practices and, more widely, in national and international policy agendas responding to public health crises.

Governments respond to health issues reactively, without focussing on the importance of planning and coordination for the achievement of sustainable results in the long run. The lack of practical recognition, in terms of policy and education, of the interrelation of animal, human and environmental health and human dependence on the health of the ecosystem leads to sectoralised, instead of integrated and preventive, measures. For example, Capua (2020) refers to the fact that in the U.S. Food and Drug Administration (FDA) website there is no mention to medicine recycling, an issue that has severe repercussions on the health of the environment and causes the pollution of waterways. Many countries still allow for the extensive use of antimicrobials in farming, which is a key outlet of AMR in humans (Williams, 2020). Moreover, governments respond based on their national capabilities, so low-income countries that do not even have a stable public health system can neither comply with international health regulations nor adopt legislation on the correct use of antibiotics. Culture also has a way to shape society and political opinions that makes it increasingly difficult for governments to cohere to the same framework, One Health, and to educate citizens providing relevant scientific knowledge and suggesting practices that safeguard their health (Capua, 2020).

This has become evident with regard to the current COVID-19 outbreak. Its origin and spread clearly exemplify the inseparability of the human, animal and environment spheres, which emerged as a paradigm within the scientific community since the 1950s. The virus was originally transmitted to humans through the ingestion of an infected wild animal and its global spread was facilitated by international travel and trade. Studies also show that the areas mostly hit by the virus are characterised by very high levels of pollution, which is

presumed to be a key enabler of the spread (Ogen, 2020). In addition, the existence of open markets of wild animals in densely populated, polluted and industrialised cities in China is an exemplification of the risks brought about by the modification of biodiversity and ecosystems (Moraca, 2020). Such dynamics in disease spread had already been identified and predicted by the scientific community, considering that HIV/AIDS and Ebola outbreaks originated from some form of human-animal contact, too. However, global health and socio-economic policy efforts have always been reactive, with limited scope, and unable to reshape the system around the tripartite connection defined by the One Health paradigm.

National governments are dealing with the issue differently, implementing laws on social distancing and economic activity restrictions according to individual plans. Within the European Union, countries closed their borders and set their own regulations at different times, acting towards containment of the numbers of infections instead of towards overall prevention, and setting talks for coordinated action only after the pandemic severely hit Italy and Spain (BSG, 2020). On a global level, the WHO's 24 April initiative of global collaboration to accelerate new health technologies has come a little too late, further undermining trust in this institution. The initiative has been adopted by few countries, unclearly endorsed by several private actors, and it is, once again, reactive in its agenda. As of now, it does not include post-pandemic projects focussed on preventing further outbreaks and emphasising how medical, social and economic practices should be reshaped (WHO, 2020). The sharing of data and information is also uneven and non-transparent, for example it is being argued that China did not disclose the real figures on infections and deaths (Manson and Yu, 2020), which alters global forecasts on the strength and spread of the virus.

The experience with COVID-19 casts large doubts on the current global health governance system and highlights how cohesive action is limited by faults in communication and

coordination, as well as in conceptualisations on global and human health. Actors such as GARDP, which connect private and public bodies to achieve goals that go beyond medicine development aiming at long-term sustainable advancements, play an important part in the operationalisation of One Health, but cannot work alone. The fact that there are few similar hybrid actors and that they still are weakly connected nuclei, together with the few social and political efforts being made to revolutionise and reconceptualise health, leave the practicability of One Health unsure.

Conclusion

The dissertation's aim was to provide a critical analysis of One Health and to investigate how public-private partnerships integrate this framework in their activities. Thanks to the contribution of Professors Ilaria Capua, Garrett Brown and Owain Williams, it has been possible to define One Health and highlight the need to evaluate the health of humans, animals and the environment comprehensively and interdisciplinarily. The framework is theoretically sound and innovative, while at the same time providing a new scientific redefinition of health designed to be operationalised in medical, societal and political decision-making practices through the coordination of various actors and stakeholders.

However, One Health seems to be lacking this very 'practical' dimension, meaning that it has rarely been adopted to address public health crises like AMR, mainly because it is not internalised in society as a new paradigm able to drive human behaviour and legislation. Unfortunately, in fact, One Health has not yet been able to trigger systemic changes as, instead, the climate change movement is beginning to do thanks to the massive support it is enjoying worldwide. This aspect has often been overlooked in One Health studies, which often tend to focus on the framework itself rather than on its actual effectiveness and feasibility.

Owing to their increased role in global health governance and their hybrid composition involving a variety of actors, public-private partnerships like the Global Antibiotic Research and Development Partnership have been identified as possible enablers and coordinators of One Health, as they tend not to be driven by neoliberal approaches and to direct their efforts towards long-term stewardship and sustainability of health. The governance analysis reveals that it does integrate some aspects of the framework satisfactorily. The capabilities and funding resources of non-state, public and private health actors are combined in pursuing sustainable research and development in the field of medicines for public health

needs. The sharing of relevant knowledge with society and the wider scientific community, and the advisory support provided to developing countries on how to manage drug accessibility are included in its post-drug development projects.

Although GARDP is a significant actor at the operational end of the One Health framework, it cannot implement this paradigm practically and obtain a comprehensive response to public health crises like AMR without the involvement of other such actors and the collective awareness of a new 'one' health vision. This governance analysis therefore confirms the doubts that emerged in the literature review and theoretical analysis concerning the limited application of One Health, but reiterates the importance of such a framework for the purpose of making health interventions and practices sustainable, while also revealing how new hybrid actors could lead to the cohesion of global efforts in this direction. The example of COVID-19 confirms how humans, animals and the environment are interconnected, and how consistent policies aimed at protecting the world's biomes should be proactively implemented in lieu of reactive and fragmented responses with short-term goals.

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Appendices

Appendix A

Interview with Prof. [redacted], 29 January 2020.

The One Health Centre, which I direct, wants to propose a more modern version of One Health. Meaning that the current vision of One Health is focussed on emerging pathogens, like Coronavirus, other transmissive diseases from animals to humans, and AMR. In my opinion, these issues certainly are part of One Health, but the concept today needs to be developed into something more. This is the reason why I have conceptualised the idea of 'Circular Health' that goes beyond One Health. Today One Health is mainly viewed as the overlapping of animal and human health. Actually, we should lean towards the convergence of the animal, human, plant and environment health, because AMR is one of those mechanisms through which in order to save or protect one side, say the human level, we damage another one.

There are numerous medical practices (…) that have been taught to us that actually are completely wrong. We were thought it was necessary to give antibiotics to animals to make them grow better, however today we have come to realise that things and practices that were mainstream in the 70s, 80s and 90s are actually very damaging. I would also like to add that unfortunately in some parts of the world, which are more than we think, antibiotics are used in plants too. This is very alarming, because this alters the earth and water's microbiome, and so on. The AMR problem cannot be solved vertically, but has to be dealt with in a spherical way. It is an issue that has many drivers and we need to intervene on them.

Now, on the GARDP website, I see the image with two hands, with some pills in them. This leads me to add another problem, that in developing countries antibiotics are used widely and excessively. It is therefore obvious that AMR is an extremely complex issue, but

everyone needs to contribute to the fight against it in whichever way they can. Therefore, Europe, which can afford to invest in research and development and in adequate recycling for medicines, needs to act accordingly. Here in the USA, medicine recycling is not a thing. For example, batteries and medicines are thrown out in the same bin. Therefore, it is clear that the issue is very complex and involves the whole world, and with globalisation, for example, a resistant bacteria from the Philippines can be easily detected in an Italian hospital the next day. This is the real issue. Therefore, initiatives like GARDP are necessary, but I personally do not know much about it so I will not go into it now. I however believe that public-private partnerships are one of the ways to interpret and solve this problem in the future.

In addition to this, in my opinion, the key determinant in the AMR resolution is patient engagement. What we need to do as a community, for many reasons, is avoid people getting sick. We need to shift everything on prevention because we can no longer afford the current demographic situation we are in. […] To do this, we need an active engagement of the patient: say all medics and vets do their job properly, if the collaboration of the patient lacks, and say he/she takes three pills instead of six, we cannot achieve anything. In my opinion there needs to be more engagement, of citizens in general more than patients, in order for initiatives like GARDP to be successful.

My centre deals with finding new pathways that help “co-advance” the health status of humans, animals, plants and environment. It is not therefore One Health because humans get sick, but One Health as a circular concept because if you do not monitor the whole system, humans get sick. How do we study and approach this? With big data and artificial intelligence. We collect a range of very diverse data, which we collect from control units, hospitals, clinics, on a lot of things, and we look to channel this clout of data in platforms aimed at solving specific problems in sustainable manners. […] We need to look at the

problem in its entirety, which involves all forms of life, even the inanimate component. If you dispose of toxic waste in the sand, how is that going to affect the environment and how will that decompose? We need to be brave and also transparent, which is still difficult to achieve. Change is always complicated, people are always attached to their roots, professional path and to what they can do. Therefore, finding new instruments and adopting them is always difficult when people are used to doing things in a certain manner to embrace new solutions.

One of the reasons why I though One Health needed to be updated as a definition is that if it remains linked to the human-animal interface, we will lose many opportunities to deal more broadly with the same issues. One Health is way bigger and what is being done is fragmented and overlooks Low and Middle Income Countries, and in my opinion there could be better answers and results if we dealt with issues in a true interdisciplinary manner. […] Depending on cultural phenomena is not feasible. With big data we can try and overcome this, to acknowledge culture but also spread scientific knowledge necessary for the health of populations. This is what I mean by saying that there are so many more drivers to health issues that limiting One Health to the human-animal interface is necessary, but not sufficient to solve AMR. We live in complex systems, but we can overcome them and connect the dots of complex networks thanks to artificial intelligence.

[…] We need to start a movement from the bottom, to involve farmers who use pesticides, citizens and the various stakeholders.

[…] My vision is that of saying: isn't it time to stop thinking that humans are the final depositories of health, and that there is someone or something else that needs and deserves it? The key here is that humans are in charge for this.

[…]

Appendix B

Interview with Prof. [redacted]*. 11 February 2020.*

[…]

I guess my fear with PPPs is to avoid monopolistic behaviour, and my worry is fragmentation and overlap.

Technically, they are supposed to be the oversight, the organisation that coordinates all of the stuff. And they do play that role. One Health is one of these supposed organisational concepts that with the global security health agenda is supposed to work tightly on in it. The G7 and the G20 have initiatives on AMR, working groups, information sharing and all these kinds of stuff. How all that fits together? I don't know. I do global health governance and I can't tell you how its done! So that's one level, the global level. Then you have multilateral agreements, where the European Union, or a collection of states, forms a partnership with a private entity. And then you have bilateral PPPs where you have national governments. But what's not clear to me is how are these joined up. What the WHO does is give a sort of steers and guidelines, but they are pretty loose: there are protocols that are supposed to be followed, but how these are followed in practice, I don't know. This is what worries me.

I'm not sure One Health is as holistic and encompassing as we think. I know it includes animals, and some agriculture, but what about water for example. AMR is something that cuts across so many areas, like public health, patient and doctor behaviour, communication, R&D, pharmaceutical, soil, water, animals- so it is huge. When you look at One Health, it is a first nice attempt to say: all these things are interrelated and we kind of have to approach them together, as a bundle. If we don't do this, we are going to miss something and we are never going to rectify the problem, which represents the coordination issue. But I'm not sure if it really does it, or what teeth it has. And again not only there are multilateral and bilateral

activities, but then you add private partners into that and you start to think- how is this being coordinated in a way that is actually joining things up?

It has to be holistic and, like I said, behaviour is massively important. People not following on their antibiotics properly is a big problem, resistant fish, all this stuff is coming up and AMR is a very complex thing and you need to educate people on it. You encounter some immovable objects that are difficult to deal with: 28% of the people who get a prescription don't go pick it up, and then another percentage of people who do, don't properly take the prescription. That is a behavioural change, a cultural change that really needs to be deep. So there needs to be joining up with education. And at the end of the day it involves agriculture, water, education, farming, practitioner behaviour, procurement in R&D. So, One Health should really be like that, not just the interface between snakes and marketplaces.

[…]

To me One Health is okay, a little narrow and can be broadened, but it is just a conceptualisation and about getting the right map of what needs to be coordinated. Getting coordination and motivation for people to do all that, that is the thing and where PPPs come in. They are supposed to be the implementers and the coordination mechanisms. So, if you fragment that, you are 'screwed'. I think it needs a bit more uniformity, seriousness, potentially securitisation to raise up the policy landscape and be high policy, and implementation. So: reconceptualization, motivation and coordination. PPPs I think only come in at the end. they may be part of the solution, but can also be part of the problem. That coordination aspect of the approach needs to be thought out, for now it is mostly ad hoc, and responsive, not proactive and symptom based, not on the baseline problems that cause the symptoms in the first place, like farming and agriculture. […]

Appendix C

Interview with Dr. [redacted]. 7 February 2020.

[…] One Health describes in a way the zoonotic interface, the relationship between animals and human health. There are two ways of breaking down how that interface works, for me. The first is with regards to the interaction between wild animals, mainly bats, and humans. It also clearly, as in Coronavirus and HIV, is the case when humans eat wild animals. (…) In it there are obviously cultural, socio-economic drivers for why people choose to do that, but we know that that is one source of zoonotic infection. Other than that it, can be it arising in the wild, but that is rare. […]

The other side is the interface between intensive animal husbandry and antibiotic use. So, for example, the Chinese every year use tons of antibiotics, half of that consumption is going into animals, chickens and pigs (Refers to an article found on the Guardian website). So, the upshot of that is you are getting antimicrobial resistance through what you eat, again. It is not much better is America. There has been a long debate, better belief, that antibiotics would not only protect animals as prophylaxis against bacterial infections, but they also lead animals to gain weight, which is the main driver, really the name of the game. So, One Health is on one hand those sets of consumptive behaviour, but it also is more widely the human-animal interface, and it is about developing a holistic agenda for that.

That is one driver for AMR, which is our interface with the animal world. In terms of what you are doing, the problem with most of the AMR initiatives is that they are responding to the other end of the problem- that is the classic biomedical response. If you talk about the rational use of medicine, that is not overprescribing, getting patients to understand they need to finish their course, having the right antibiotics in place so that you are not using second and third line treatments. Most of the Product Developing Partnerships (PDPs) in the world are about developing medicines, they are not about AMR stewardship and responses to the

underlying problems that One Health really is focusing on. So, they are at two different ends of the spectrum. So, in a way, how does this fit into the One Health discourse? Well, if you are looking at AMR just in terms of medicines development, it does not fit with it at all; it is just a different way of responding to it. If you look at how it fits into AMR more broadly, when you are looking at the rational use of antibiotics in animals- that is a different thing. The PDPs are only just about developing medicines, but other aspects and ways of AMR responses are not considered. So, in a way, their work does not fit with One Health at all. One Health is more about prevention, or understanding different vectors of AMR.

[…]

How can we expect adequate national standards for the sale and prescription of antibiotics if countries do not have a functioning health system? In lots of health facilities in the least developed countries, you are lucky if you have running water and electricity, let alone clinical guidelines for prescription, you might not even have the drugs. [...]

The real problem that PDPs are responding to is a different type of market failure, which is the fact that - which I have grappled with over time - there are only two firms in the world making vaccines and the reason is that markets are high in volume, but low in value. So the MMR vaccine is 5 or 6 cents of a US $ a dose. Volumes are huge: so firms make profits, but at very low margins. […]

Other problematic issues are on the role of who makes the money off it (drug development), and what are the rights to it when the product is made. And what are the arrangements, if any, for equitable access. So, if you look at these debates, they constantly involve these partnerships. […] Pharmaceutical companies have a very good business model of cherry-picking publicly funded research, so is this another instance of it? Now, this is a very critical view, but it is still a very profound question to be asking about PDPs.

[…]

There are alternatives being suggested (to PDPs). Should we be doing this nationally, in terms of serious investment in public sector organisations? Not just in university, but organisations that do this for universities. […] Should we be doing it by public sector organising what currently things like CEPI (Coalition for Epidemic Preparedness Innovations) are doing? Is it complicated to just do it in one country? Maybe. You can do it in US, UK, Germany, Switzerland. Other than that, it gets smaller and difficult to do anywhere else. Are we then looking at global coalitions, public sector organisations- pooled money, pooled capacity, pooled global public goods for health? Well, how hard is that to do? Quite. If you look at DNDi, that's precisely what they have done. They have carved out firms and done it, and they are starting to do it very well.

[…]