Resistant bacteria in society

VALORISATION

Societal relevance is an important component of scientific research, and Maastricht University encourages explicit reflection upon this aspect in a separate chapter of a PhD thesis. Therefore, here I will outline how my journey through different AMR practices has contributed and will contribute to the development of practical and analytical tools for understanding and communicating this phenomenon. I will reflect upon new opportunities for research and policymaking that can be opened up by transdisciplinary collaborations, and I will describe how the results of this thesis have been disseminated among health professionals and laypeople.

New opportunities for transdisciplinary understanding of AMR

In the arena of health policy, AMR has often been understood as a biological fact, the solution for which can be found in laboratories that produce new technologies for AMR screening and new medications for the treatment of infections (O'Neill, 2016; WHO, 2015). In this context, human practices of antibiotic use have been problematised as something that needs to be fixed through awareness campaigns and behavioural control programmes (Rodrigues, 2020; Will, 2019). We can see such conceptualisations of AMR in the *Global Action Plan on AMR* by the WHO, OIE and FAO (2015), in the *European One Health Action Plan against AMR* (2017), and in the influential report on AMR by the British economist Jim O'Neill (2016). However, as I have shown throughout this thesis, such approaches to AMR have been widely criticised by scholars in the biomedical and social sciences (Chandler, 2019; Larsson, 2014; Will, 2018). One of the major points of this criticism is that AMR is not only a biological but also a social phenomenon, which is shaped through various social, economic and political processes (Chandler, 2019). In addition, neither the biological nor the social nature of AMR can be understood as a fixed fact because knowledge about bacteria and their social embeddedness is constantly changing. Therefore, scholars in both the biomedical and social sciences have argued for more nuanced approaches to AMR that reflect the social context and the biological uncertainties of this phenomenon (Chandler et al., 2016; Collignon et al., 2018; Smith, 2015).

Following the traditions of STS that suggest analysing knowledge as constructed through different practices (Latour & Woolgar, 1986), this thesis unpacked several systemic and infrastructural nuances that have influenced AMR practices and shaped AMR in different settings. This approach did not dismiss the biological nature of AMR, but it engaged with bacteria as a social phenomenon that influences and is influenced by policymaking practices, the organisation of healthcare delivery and epistemic practices. Analysing AMR knowledge as

constructed, this thesis also tried to bring together biological and social constructions of bacteria.

The analysis of the *social life* of AMR opens up opportunities for alternative research and policymaking, where AMR is conceptualised as a biosocial phenomenon that can be addressed through transdisciplinary collaborations. Transdisciplinarity is often understood as an ambitious project for systemic integration of knowledge that 'transcends the scope of disciplinary worldviews' (Klein, 2017). This integration allows the development of more comprehensive, holistic understandings formed by a diversity of languages, methods and epistemic practices (Hackett et al., 2017). The importance of transdisciplinarity in AMR research and policymaking is emphasised by the urgent need for transformation of the current practices, policies and economic organisations that are not able to respond to the growing concern about AMR. AMR is a complex issue, and different specialist approaches are not able to resolve it on their own. Transdisciplinary approaches and the integration of biosocial perspectives to address the biosocial phenomenon of AMR are crucial steps that require the transformation of research infrastructures and policy choices that present AMR as static and universal in every social context.

Studies in microbiology have shown that AMR refers to various microorganisms and various mechanisms of resistance, which can be natural or acquired (Cox & Wright, 2013; Reygaert, 2008). Studies in social sciences have demonstrated how various social and political processes shape different antibiotic practices, including antibiotic use, distribution and waste management (Collignon et al., 2018; Lambert et al., 2019; Willis & Chandler, 2019). However, the insights from these two very different disciplines have rarely been put into a dialogue with each other, which hinders the production of adequate explanations of AMR (Smith, 2015). The lack of such dialogue can be seen in policy approaches to AMR that neither fully engage with the biology of bacteria nor with its diverse social practices. Namely, environmental aspects of AMR are largely outside the political scope as are economic and social inequalities that hinder access to antibiotics. Instead, national awareness campaigns, as well as international policy regulations, narrow their approaches to AMR as something technical that can be solved by the production of new antibiotics and changes in antibiotic use by implementing guidelines and protocols (Hinchliffe & Ward, 2014; O'Neill, 2016; Will, 2019).

Engaging with the biosocial diversity of AMR, rather than focusing on its selective features, is a necessary shift for the development of comprehensive and meaningful approaches to resistant bacteria. To allow this shift, biomedical and social sciences should be engaged in a closer transdisciplinary dialogue to exchange and question each other's epistemic practices of

knowledge production, including the use of scientific language, methods and theoretical instruments. This questioning of epistemic practices will provide a basis for 'co-contamination' of these practices – introducing the insights of the social science world into the world of the laboratory and vice versa. Although the concept of co-contamination may go against the methods of different disciplines that have their established vocabulary and conventions of dealing with research topics, it opens the window for innovation and alternative approaches that may be impossible within the frames of one discipline.

The current disciplinary separation of biological and social studies of AMR hinders the potential integration of knowledge produced in these disciplines. By studying the biology of bacteria, microbiologists also learn about the biological dynamics of social worlds from where these bacteria came from and what practices they were a part of. In a similar way, by studying social practices and the processes related to health and hygiene, social scientists learn how bacteria become part of social, political and economic processes. The biological and the social nature of AMR is manifested in the bacteria themselves; however, the epistemic practices that produce knowledge about the biosocial nature of bacteria are currently separated.

To open up the opportunity for transdisciplinary research between the biological and social aspects of AMR, we need to revisit the epistemic distinction of knowledge production practices. The work of the STS scholar Latour (1983) may serve as a helpful guide here. Reflecting on the transformative capacity of a laboratory, Latour (1983) rephrased the famous Archimedean expression into the following: 'Give me a laboratory and I will raise the world'. By rephrasing a famous Greek motto, he aimed to address a crucial distinction between the micro and macro level of social studies of science, where the former refers to the analysis of the interpersonal relationships between people or social groups, and the latter refers to the analysis of social institutions. To show the meaninglessness of this distinction, Latour (1983) refers to his analysis of the laboratory work of Louis Pasteur and his development of the anthrax vaccine.

Following the work of Pasteur, Latour shows that the introduction of the vaccine was not a clear and linear process from the laboratory to society. Rather, Latour (1983) argues, Pasteur first had to convince farmers, veterinarians and hygienists that anthrax was caused by bacteria – he had to make this bacteria visible for others in his laboratory. He then had to convince them that there was a cure that could tackle this bacteria – he did experiments in his laboratory showing the vaccine worked. Then he had to convince them once more that the vaccine worked not only in his laboratory but also on farms, if farmers followed his instructions. Given this example, Latour (1983) argues that by studying the work of one laboratory of Pasteur – a study

that would usually be referred to as micro-level – a researcher can see the social (or macro) transformations of society. Latour shows how, by convincing different actors in society (e.g. veterinarians, farmers and hygienists), Pasteur introduced the *Bacillus anthracis* as a new actor in this society, which he could control. But to establish this control, Pasteur did not just release the vaccine to society for free use, he turned society into his laboratory by setting the conditions under which this vaccine would work. That's the motivation for the Latour's alteration of the Archimedean motto – for Pasteur to introduce an anthrax vaccine, he had to turn the world into his laboratory and make the *Bacillus anthracis* a part of this world.

The reason I introduced the work of Latour (1983) here is to highlight once again that the laboratory and society do not exist in two parallel worlds, where the scientific facts from a laboratory are simply transferred to society. Rather, these two worlds co-create each other. A laboratory can raise the world by turning it into a laboratory and introducing new inhabitants to it. But the world can be turned differently, depending on what laboratory it is. Pasteur turned the world into a microbiological laboratory, introducing microorganisms with their biological mechanisms as the new inhabitants. These biological microorganisms, according to Pasteur, could be conquered with his vaccine. However, the laboratory world that Pasteur introduced did not incorporate the socio-economic divisions and inequalities that can be shaped by these microorganisms via access to vaccines. Establishing transdisciplinary laboratories and allowing the co-contamination of biological and social sciences may result in the creation of a different world where micro-organisms and their biological mechanisms have to co-exist with macro-organisms and their social practices. This is a necessary step for understanding bacteria and their socialisation processes.

Communicating antimicrobial resistance

Throughout my research, I organised several events to communicate my findings on AMR to professionals and laypeople. One of these events was Antibiotic Awareness Day, which took place at the Siberian State Medical University on 21 March 2018. Organising this event, I invited professionals from three different disciplines: medicine, microbiology and philosophy. Such disciplinary diversity enabled discussion of AMR as a biosocial phenomenon, highlighting different nuances from every discipline. The event took place at the building of a

medical university, which attracted many medical students who often did not work with non-biomedical dimensions of AMR. In total, about 50 people participated in the event.

Following Antibiotic Awareness Day, in collaboration with a medical doctor from the Siberian State Medical University, I organised two social science student research projects on AMR. Both projects aimed to understand antibiotic practices of patients and medical doctors in Tomsk, Russia. Throughout these projects, I provided students with several workshops on qualitative methods and transdisciplinary approaches to AMR. The major aim of these projects was to introduce students to the importance of knowledge diversity in understanding and addressing such phenomena as AMR.

Poster from the Antibiotic Awareness Day at Siberian State Medical University on 21 March 2018, Tomsk.

Apart from education projects in Russia, I developed a case study on AMR for one of the learning activities within the Philosophy in Action course at Maastricht University. This course was taught in the health sciences bachelor's programme, and it invited students to reflect on different biomedical topics by applying the theories of ethics. In addition, I developed two case studies for the course Communicable and Non-communicable Disease in the EU and WHO European Region for the European public health bachelor's programme at Maastricht University. These case studies aimed to show students the importance of transdisciplinary communication and collaboration in addressing such phenomena as AMR. Bringing together the insights from both biological and social sciences, I showed students the various angles that different knowledge practices can bring into their future professional practice.

The insights from my research have also been communicated to different professionals in the field of microbiology. I was invited to participate in the research day of the Microbiology Department of Maastricht University where I presented the results of the project that was described in Chapter 2. This engagement stimulated some important conversations on how we can bridge different types of knowledge that have been produced in various disciplines.

Assembling a biosocial puzzle of knowledge practices

Within the last decade transdisciplinarity has increasingly become an important component of much research and one of the requirements for funding (Hessels et al., 2010; Mattsson, 2015). Transdisciplinarity was also at the core of my research in that I collaborated with microbiologists and public health professionals. Many studies that aim to combine different types of knowledge run the risk of co-existing on the same project without co-producing results (Parker, 2010). To address this risk, one of the aims of my research was to build a coherent collaboration with professionals working with the biological side of AMR. The methodology of stool and stories that was presented in chapter five is a result of this collaboration where I aimed to bring microbiological and social science knowledge into a dialogue with each other.

Picture from a transdisciplinary symposium on the cross-border movements of microorganisms, 22 November 2018, Maastricht.

To stimulate the development of transdisciplinary knowledge production practices, I co-organised a symposium on the cross-border movements of microorganisms. The symposium took place in Maastricht on 22 November 2018, and it brought together professionals from anthropology, microbiology, art, infectious diseases and sociology. As a result of this symposium, together with six other participants, I applied and received the Mingler scholarship to conduct a collaborative research project that will combine insights from microbiology, epidemiology, sociology and art. Following the insights from my thesis work, this research project will develop an understanding of the cross-border movements of microbes and propose alternative epidemiological mappings of these movements.

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