The Post-Antibiotic Era
Cultural perspectives on antibiotic resistance

Adam Brenthel and Kristofer Hansson

This report presents and analyzes discourses that describe the growing antibiotic resistance that may cause humanity to enter into a time which the WHO has dubbed "the post-antibiotic era." It is an era that could appear if no new antibiotics are found while the existing antibiotics become more ineffective as bacteria develop resistance to the active substances used today. The idea that we are entering this era seems to have its beginnings in the 1990s. It is then that we find the first articles which conclude that prevailing developments involving increasing resistance and a lack of new antibiotics could come to shape an upcoming period in human history. The aim is to evoke a sense of emergency.
Keywords: post-antibiotic era, antibiotics, bacteria, antibiotic resistance, One Health, risk communication

Den postantibiotiska eran. Kulturella perspektiv på antibiotikaresistens: Rapporten redogör för och analyserar diskurser som beskriver den tilltagande antibiotikaresistens som kan leda till att mänskligheten går in i en tid som av Världshälsoorganisationen kallas för den "postantibiotisk eran". Det är en era som skulle infinna sig om inga nya antibiotika hittas samtidigt som den befintliga antibiotikan blir allt mer verkningslös på grund av att bakterierna utvecklar resistens mot idag verksamma substanser. Idén om att vi är på väg in i denna era tycks ha sin början på 1990-talet. Då finner vi de första artiklarna som drar slutsatserna att rådande utveckling med ökande resistens och utebliven ny antibiotika skulle kunna prägla en kommande tid i mänsklighetens historia. Syftet är frammana en känsla av akutläge.
Nyckelord: postantibiotisk era, antibiotika, bakterier, antibiotikaresistens, One Health, riskkommunikation

Adam Brenthel & Kristofer Hansson: "The Post-Antibiotic Era: Cultural Perspectives on Antibiotic Resistance," *Working Papers in Medical Humanities*, Vol. 3, No. 1, 2017: 1-43. Published by Lund University Libraries: http://journals.lub.lu.se/index.php/medhum/index

TABLE OF CONTENTS

FOREWORD

Today we are facing completely new societal challenges, as one of the foremost medicines of the 20th century – antibiotics – are at risk of becoming ineffective and obsolete. More and more frequently, increased antibiotic resistance is presented as a threat – one that has already claimed many thousands of lives in Europe and the rest of the world. Considerable efforts are also underway to both slow this negative development and to find new and effective medicines. Yet to solve these societal challenges, both medical and humanities research is needed; indeed, the latter is growing ever more important.

Above all, this is because today's societal challenges are so complex that no single science alone can solve them. In this report, we present cultural scientific theories and methods that can shine a spotlight on current developments and promote our understanding of what is occurring. We hope that the report can highlight other issues and perspectives than those we commonly encounter in news reporting on antibiotic resistance.

The report is the first scientific publication from our research project, which is funded by the Crafoord Foundation. We are very grateful to the foundation for its support!

The research project has been conducted by the project manager Kristofer Hansson, an associate professor of Ethnology, and the researcher Adam Brenthel, a PhD in Visual Studies. Both are active in the Medical Humanities Research Node at Lund University's Department of Arts and Cultural Sciences.

Kristofer Hansson, Lund December 2017

INTRODUCTION

This report describes and analyzes depictions of the increasing antibiotic resistance which may cause humanity to enter into a time that has come to be known as the "post-antibiotic era." It is a concept that defines a potential, near-future era in which no new antibiotics have been discovered, while the existing antibiotics become increasingly ineffective – perhaps completely obsolete – because the bacteria have developed resistances to the active substances. This development has been caused by the human use of antibiotics. The idea that we are entering this era seems to have its beginnings in the 1990s. It is then that we find the first articles which conclude that prevailing developments involving increasing resistance and a lack of new antibiotics could come to shape an upcoming period in human history. Today, the situation is different than it was in the early 1990s. Many governments and their agencies now work both nationally and globally to reduce the social efficiency rates of a future antibiotic resistance. Much has happened in 25 years, and awareness of this issue has increased. A clear sign of this trend are the many global reports that have been published in recent years. We use these reports as a starting point and discuss how the problem is defined scientifically and how the challenges are communicated. In order to provide a broader picture and understand how this issue is perceived, reference is also made to magazine articles, documentaries and debate books. From a cultural perspective, we analyze the cultural meanings that have come to be ascribed to the "post-antibiotic era" when we imagine our planet's future, and life with bacteria. Our interpretation is based on a Swedish context. Sweden may have a good starting position in comparison with most other countries, but in a globalized world, no country is an island.

In the early 1990s, the American disease control doctor Mitchell L. Cohen sketched a picture of the potential implications of a future increase in antimicrobial resistance (Cohen 1992). Cohen contrasts situation of hospitals in the early 1980s, where modern medical care was offered to patients, with how a hospital facility in the 1930s might have looked. In those days, people died of syphilis, pneumonia, typhoid, and other bacterial infections – maladies which modern medicine has been able to treat and cure. Millions of people have been saved from premature death or disability. Compared to the bright and optimistic decades of the 1950s until the 1980s, the period before the discovery of antibiotics appears to have been a dark age. Cohen is thus not only the first person to present what a post-antibiotic era may mean; he is also one of the many who allow notions of a dark history to be projected onto an impending, dystopian future.

We do not address the question of whether those who lived during the pre-antibiotic era actually found it to be as dark as we do. Our focus is on how we perceive that period today. In this report, we are interested in our contemporary images and perceptions of history and the impact they have on us today, as

conveyed through news reporting, popular science documentaries on TV, or in books. The dark history becomes a visual for how the future may look, and in our analysis, we examine how this temporalization of "before" and "after" the current, enlightened period is a constantly recurring illustration. Of course, using historical experiences and facts to understand or explain the future is nothing new. With this report, we hope to contribute a critical perspective that examines how such depictions affect the contemporary image of antibiotic resistance.

How is the Situation Described?

We will initially present the most widespread but also most extensively analyzed example. In 2014 the British Prime Minister David Cameron painted a dark picture of what the development of resistance could mean, claiming that: "[i]f we fail to act, we are looking at an almost unthinkable scenario where antibiotics no longer work, and we are cast back into the Dark Ages of medicine" (BBC 2014). Although this statement was made in a political context primarily intended to capture the public's attention, in particular, it presents the picture of a future post-antibiotic era that threatens to become a new Middle Ages for health care and medical science. This sort of proclamation is intended to spur political change, but at the same time, such allegations also conjure up apocalyptic images of a world that is transforming into something dangerous. One has to wonder whether this approach encourages engagement, or if it is more likely to lead to resignation.

Other international reports, as well as Swedish reports, present similarly apocalyptic prognoses for the future (MSB 2013, WHO 2014, WHO 2015, AMR Review 2016). One can of course argue that these visions of the future are reasonable and scientifically substantiated, and that they therefore are not apocalyptic, but rather a sobering forecast to which society must react. We see no reason to question such a stance – quite the contrary. Given that the reports present reasonable conclusions about the future, they reinforce the reasons to actually understand how this information can be interpreted and understood by the public or the politicians who are the intended recipients of the message. The same year as Cameron's report, the World Health Organization (hereinafter referred to as WHO) determined that humanity has been in a "discovery void" since 1987 – essentially, no completely new antibiotics have been introduced since that year. The products that had been marketed as new drugs after 1987 had instead been variants or combinations of previously discovered substances (WHO 2014). This finding contributes to the apocalyptic vision of a world in which humanity has painted itself into a corner and stands on the precipice of an existence in which antibiotics have become completely ineffective. Other dystopian images in the form of metaphors are used to illustrate the contemporary situation and where current developments may lead. For example, in a "MOOC" lecture at Uppsala University a metaphor was used in which antibiotic resistance was referred to as

"the silent tsunami" (Alvring & Tängdén 2017). The course description notes that more and more bacterial strains are developing resistance to our medications, at the same time as "the pipeline of new antibiotics is now almost dry" (ibid). The world is flooded with dangerous bacteria, while new medicines are conspicuously absent; two metaphors – the tidal wave and the trickle – are presented in stark contrast to each other. When the American infection doctor Martin Blaser discusses how increased vulnerability due to decreased diversity in gut flora interacts with increasing resistance, he illustrates just how bad the trajectory of the world is by writing that in a "more interconnected world, [the loss of diversity] constitutes an impending deluge which grows with each passing day" (Blaser 2016:275). In a broad sense, these initial examples of images are illuminating. Both the vision of a return to the Middle Ages and the flood images are used to illustrate mankind's plight and to simultaneously encourage a commitment to change. It is a metaphor-heavy form of imagery in comparison with the recommendations about which there seems to be great consensus if one is to believe what one has read in the recent reports.

The recommendations regarding global actions that recur in most of the reports are almost always the same. According to the report ordered by Cameron, "Tackling Drug-Resistant Infections Globally: Final Report and Recommendations" from 2016, the recommendations can be summarized in the themes: knowledge dissemination, improved hygiene, the reduced use of antibiotics in the meat industry, the mapping of resistance, better and faster diagnostics to prevent incorrect use, the promotion of vaccination, improved working conditions for health professionals, funding for the development of new antibiotics, and increased global cooperation (AMR Review 2016). This report has been widely disseminated and is a key text for those seeking to describe the global situation in the mid-2010s.

All the recommendations mentioned here are highly dependent on policy characterized by global solidarity. All the above points involve complex challenges. For example, the improvement of hygiene in parts of the world where the population does not have access to clean water and sanitation, probably necessitates not only technology, knowledge dissemination and aid, but also trade and human mobility. The creation of better diagnostics and the prevention of misuse demand that many people and care systems cease to see antibiotics as a "magic bullet," despite the fact that for the most part they remain highly effective. Our point is that the images, metaphors and tropes that are used to disseminate knowledge and increase engagement which differ from the actual policy needed to address the challenges at hand.

Sweden is often described as a leading country in this effort – both in terms of its politicians and its scientists. In international comparisons as well, Sweden is portrayed as a good example of a place where the population's knowledge is high

and prescribers are conservative (Pinder et al. 2015:26-7&41). On the Swedish Government's website addressing how work against antibiotic resistance should be conducted, Gabriel Wikström (the former Minister for Public Health, Healthcare and Sports), a Social Democrat who served from 2014-2017, writes that "Sweden has had great success in the fight against antibiotic resistance, but we cannot afford to let our guard down. This is a battle we cannot win alone — in an age when bacteria spread all over the world, we must also find common solutions" (Wikström 2016). The Government's current strategy (2017) is largely in line with international reports and recommendations that highlight the need to "continuously collect data about, e.g., the incidence of resistant bacteria and the use of antibiotics" (The Government Offices of Sweden 2016:7). A major reason that this strategy is so crucial is that it allows one to see which actions lead to results, in order to establish a cost-effective approach.

There have also been numerous studies regarding the public's understanding of issues related to antibiotics, resistance and bacteria (The Public Health Agency of Sweden 2016b). According to these studies, the understanding of antibiotics and the problem of antibiotic resistance has been communicated to Swedes through information campaigns, as well as by prescribers, who discuss the pros and cons of antibiotics in health care situations. However, the picture is not clear-cut. *Svenska Dagbladet* reported on a 2016 Sifo survey study which demonstrated that "men are the most ignorant," wherein 42% of male respondents stated that they believed or were unsure whether antibiotics help to combat colds. Among women, 33% gave the same response (Bengtsson 2016). We believe that the question of the public's knowledge (or lack thereof) is not the crucial issue in understanding attitudes and behaviors. The use of antibiotics involves numerous inherent conflicts of interest, and these may interact negatively with the way antibiotics are portrayed in the media. We will address this issue later in our report.

A starting point for this report is therefore to problematize and critically examine these types of national and international reports on antibiotic resistance and the picture presented in the different types of statistical surveys on the public's approach to antibiotics and antibiotic resistance. The starting point is that the emerging antibiotic resistance is such a complex social problem that it requires a multidisciplinary approach in order to understand, explain and hopefully solve the challenges entailed. This report contributes what can be defined as a medical humanities perspective, one that attempts to understand, explain and critically examine social problems on the basis of culture, scientific theories and methods (Bernhardsson & Hansson 2016). Such a perspective can complement and highlight issues that are not directly related to the natural sciences (for example), and thus also offers different and complementary responses.

Materials and Analytical Tools

The materials presented in this report consist of text-based material as well as various forms of visual material. An important part of the background information is derived from international reports.[1] Much of the material is contemporary, but it also includes flashbacks which can illustrate changes over time. The main method for the collection of material has been searches in Retriever Research (formerly Mediaarkivet), Google Scholar, the interpretation of the research situation through the reading of existing reports, and other background material in the form of research articles. We have also closely followed the national media reporting on this subject from September 2016 to April 2017, in order to capture the media image of antibiotics and resistance problems in Sweden. The newspapers we monitored include the daily newspapers *Svenska Dagbladet*, *Dagens Nyheter*, and *Sydsvenska Dagbladet*, as well as trade journals such as *Läkartidningen* och *Dagens Medicin*. Sveriges Television (SVT) and Sveriges Radio have also reported extensively on the subject, and have also broadcast documentaries and scientific features on antibiotic resistance, which have been followed more sporadically.

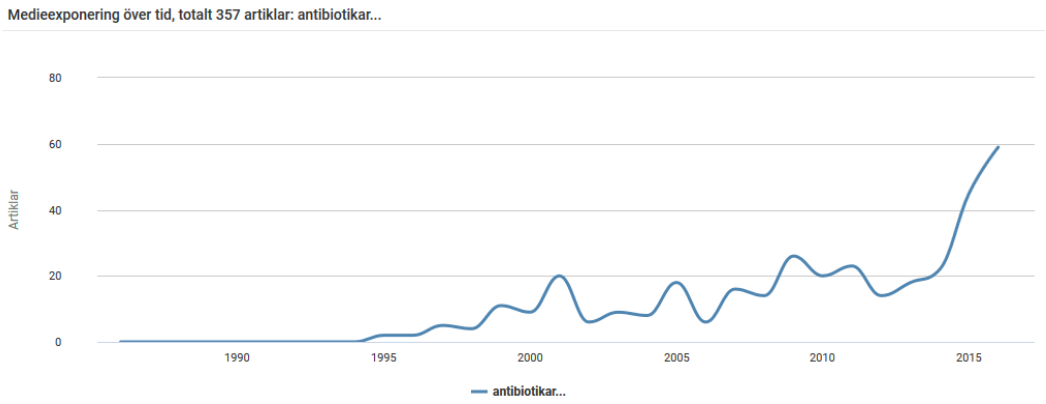
To illustrate how interest in the issue has grown, one need only examine the number of hits in Retriever Research for the phrase "antibiotic resistance" for the years 1986 to 2016, i.e., the period during which no new antibiotics have been produced (see Figure I). These numbers tell us nothing about the content of the articles that include the phrase "antibiotic resistance," but nevertheless they allow us to map how the issue has come to the forefront. The term is used more and more frequently in the daily news reports. At the same time, one can compare this phrase with others that have previously been used in relation to bacterial resistance. One such concept is that of "killer bacteria," the use of which peaked in the early 2000s and began to slump around 2010. "MRSA" (Methicillin-resistant staphylococci) is another such term. In both cases, the incidence of usage decreases as resistance to antibiotics increases, but the latter term much more frequently employed overall. Nevertheless, the decrease in the number of occurrences of a particular phrase tells us little about its usage and development in various texts. Closer reading and interpretation of the context in which the words are used is needed.

This report employs discourse analysis to interpret and provide understanding of the texts and visual material analyzed herein. By "discourse," we mean a collection of assertions that collectively structure how a phenomenon is perceived,

[1] WHO: *Antimicrobial Resistance Global Report on Surveillance* (2014), The Review on Antimicrobial Resistance: Antimicrobial Resistance: *Tackling a Crisis for the Health and Wealth of Nations* (2014), WHO: *Global Action Plan on Antimicrobial Resistance* (2015), AMR Review 2016: *Tackling Drug-Resistant Infections Globally: Final Report and Recommendations* (2016).

but a discourse can also mean that the things included in a certain context constitute the basis of these assertions (Foucault 1993). Discourse can thus be considered that which is created when actors – journalists, scholars, politicians and so forth – speak and write in a certain way about a given phenomenon. At the same time as it arises through how actors speak and write, it is also influenced by how these actors speak and write about something. Discourse is also in a state of constant change, even as it secures our common understanding of a phenomenon.

Our method is not appropriate for determining whether the discursive statements are true or false, but rather allows us to analyze which cultural values and norms they are associated with. By extension, these discourses create different types of regulatory systems in which certain knowledge is legitimized, but other knowledge is not (Bergström & Boréus 2005). For example, this is demonstrated by the fact that certain authority figures may express themselves before others and that it is the statements of these authorities that will prevail in a particular historical context. Our analysis is not so extensive that we are endeavor to investigate which authority figures are central to the field of antibiotic resistance and how these actors might change over time. Rather, our focus is on analyzing the statements that we have found in the material we present in this report.



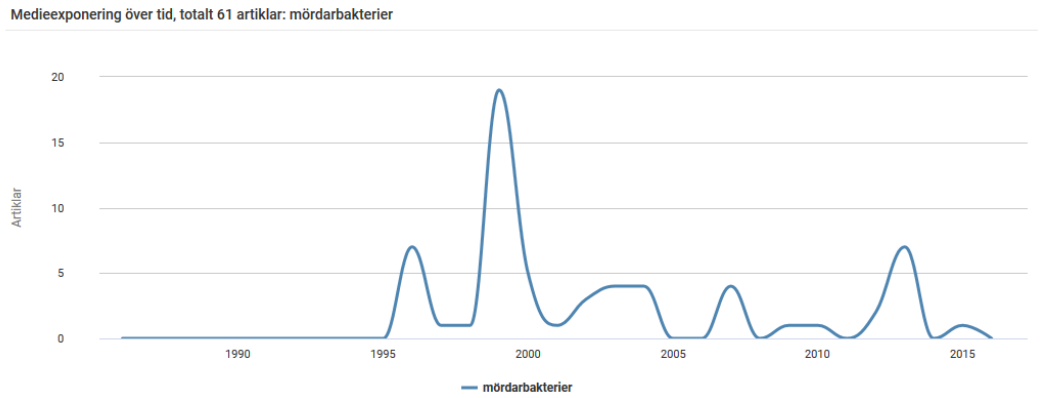


Figure I. Searches on Retriever Research has been made between the years of 1986 to 2016 for the keywords "antibiotic resistance" and "killer bacteria." As illustrated in the graphs, the term "antibiotic resistance" came to be used more frequently in daily news reporting, which indicates the increased timeliness of the issue in question. In contrast, "killer bacteria" peaks in 1999 and has since been used less frequently.

Report Outline

The chapter "The Post-Antibiotic Era" presents and discusses the concept of the post.antibiotic era and the ideas that bacterial resistance will come to shape our impending future, rather than merely being a problem of the current age. The term encapsulates what is said to be a new era into which humanity is now entering, and which also promises new challenges. The chapter discusses the question of whether and how this era can be classified as a new age. The chapter concludes with a presentation of the concept of "One Health," a perspective that aims to approach these societal challenges in new ways.

"A Cultural Studies Perspective on Bacteria" presents further theoretical reasoning regarding how to one can apply cultural scientific theories to our understanding of the new relationships with bacteria that the post-antibiotic era is perceived to create. Previous perspectives have focused on how the medical community's relationship to infectious bacteria has been altered through effective antibiotics, but one might ask whether the relationship between humans and bacteria shifts when the role of medicine changes. The chapter includes a discussion of whether the relationships between humans and bacteria, as well as the social relationships between people, could become more problematic. When infections once again becomes a threat to life and health, will this necessitate a discussion and examination of fragile human relationships? The chapter concludes with a discussion of these changes from a temporal perspective, in order to explain why this new state of affairs may come to define an era.

"The Many Faces of the Post-Antibiotic Era" presents and outlines the many different discourses which are already found in the different media materials on this issue. Here we highlight what we call "the ethics of antibiotics" and analyze

how it colors the way we talk and act in relation to antibiotics and the risks of resistant bacteria. The chapter also investigates the purportedly rational use of antibiotics and how a global perspective is likely to alter our view of this rationality.

The report concludes with the chapter "The Inevitable Trend towards Increased Uncertainty despite Increased Knowledge," wherein the communication about the rational use of antibiotics and the future risks of the post-antibiotic era are discussed and problematized. There are some similarities (but of course also differences) with how current climate change is reported. Not least, there is an inherent danger in the fact that the looming risks appear to be more complex and difficult for the public to understand. In an era in which there is a risk of wavering public confidence in numerous social institutions, it is important to describe how such challenges can be studied and addressed. This is noted as a task for future research in the field.

THE POST-ANTIBIOTIC ERA

Semantics are not unimportant, and a conceptual historical understanding can facilitate the understanding of how "the post-antibiotic era" appears in the discourse. It seems that one of the first instances of the idea that bacterial resistance will shape our imminent future, rather than being a minor ongoing problem, was a publication in 1992 by Mitchell L. Cohen (the physician mentioned in the introduction above), an infectious disease doctor and Director of the American Swedish Institute for Infectious Disease Control (CDC). In his article "Epidemiology of Drug Resistance: Implications of a Post-Antimicrobial Era," Cohen asks what the consequences might be if we are indeed entering a post-antimicrobial era (Cohen 1992). There are a number of additional articles from the 1990s that discuss the problem of resistance based on the idea that this era is either already here or just around the corner. One such text is J.M. T. Hamilton-Miller's article "Living in the 'Post-Antibiotic Era'," published in 1997, in which he argues that like the Greek god Janus, we must look both forward and backward in time in order to understand this problem. The pre-antibiotic era becomes a necessary mirror through which to view the future, not just to understand how it will hold, but also to embrace a more probiotic approach – the incorporation of live bacteria into the diet is considered to be beneficial to health. The idea of the necessity of a probiotic approach is one which has been analyzed from an anthropological perspective by Heather Paxson (2013). We will return to this subject in "A Cultural Studies Perspective on Bacteria." We note that as a subject of discourse, the post-antibiotic era is not isolated, and must be regarded in a broader perspective if we are to understand it and believe that the challenge is not merely a medical one. We argue that antibiotics must be addressed in a broader manner in order to preserve their availability and usability as medicine in the future, and thus connect our assertions to the One Health approach that emphasizes the importance of a cross-sectoral, interspecies, and multidisciplinary approach. One Health has become the dominant research approach for funding research on antibiotics, both nationally in Sweden, in the EU and when the UN recommends which research should be carried out in the area. We will return to the broader implications of this perspective in the next chapter, because it is also an expression of how perceptions of antibiotics change – from being a taken-for-granted part of modern health care to becoming an issue of human survival as we are catapulted into a rapidly changing world. This altered way of seeing things can be described as a shift from a pharmacological perspective to a phenomenological perspective on the lifeworlds of humans and animals.

The 2014 WHO report "Antimicrobial Resistance: Global Report on Surveillance," sparked new media interest in the idea of a "post-antibiotic era." Searches in Retriever Research make this clear; following the publication of the report, there is a spike in the number of hits for the term. The report states that

antibiotic resistance is an issue that is likely to threaten modern medicine: "[a] problem so serious that it threatens the achievements of modern medicine" (WHO 2014: IX).

Internationally, antimicrobial resistance (AMR) is discussed more frequently than antibiotic resistance (ABR), yet the term "post-antibiotic" is used more frequently than "post-antimicrobial" when it comes to representing an impending era. In the Swedish context, the narrower concept of antibiotic resistance is used almost exclusively. There may well be historical reasons for this. During the 1980s and 1990s, it was primarily antibiotic resistance that was perceived as a problem. The focus was on the ability of bacteria to evolve and tolerate antibiotics. It was only during the 2000s that the increased resistance of fungal diseases and viruses to antimicrobial agents was highlighted as a healthcare problem. In Sweden, nationally organized work to counteract resistance has been ongoing since 1995, when Strama (an acronym for "Strategigruppen för rationell antibiotikaanvändning och minskad antibiotikaresistens," the Strategy Group for Rational Antibiotic Use and Reduced Resistance to Antibiotics) was formed. At the time, the narrower concept of antibiotic resistance was used to a greater extent than that of antimicrobial resistance.

In the foreword to its 2014 report, WHO writes that the post-antibiotic era will be characterized by the fact that common infections will threaten to kill people. WHO posits that this is far from an apocalyptic fantasy, but rather a phenomenon that is becoming a reality. Deputy Director-General Dr. Keiji Fukuda writes that this is "a very real possibility for the 21st century" (WHO 2014:IX). When Fukuda points out that this forecast future is not an "apocalyptic fantasy," we interpret his meaning to be that this can indeed become a reality, despite the fact that to most people, it sounds like the plot of a disaster movie.

This catastrophic portrayal recurs in many reports, both nationally and internationally. In the introduction to the final report "Antimicrobial Resistance: Tackling Drug-Resistant Infections Globally" (AMR Review 2016), the authors write that: "[t]he magnitude of the problem is now accepted" (p. 4) and they predict that in 2050, 10 million people will die of infections that cannot be treated because of resistance, resulting in an estimated cost of 100 trillion dollars.

We do not question the conclusions of these reports, but one might wonder what it means to describe the future in this way. How does this threat of catapulted into the apocalypse affect our perceptions of ourselves and the world around us? How does such a perspective affect the way these conclusions are formulated when they are communicated to the public? How does it affect the recipients' – the public's as well as medical professionals' – perception of the message? There are many different ways to communicate, and in a complex and rapidly changing world, it can be difficult to determine the nature of the links between message and behavior.

The post antibiotic era is portrayed by many as a return to an earlier stage that is often compared to the Middle Ages, and as we pointed out in our introduction, it seems that the former British Prime Minister David Cameron contributed to the popularization of this comparison. When Cameron presented the report "Antimicrobial Resistance: Tackling a Crisis for the Health and Wealth of Nations" (AMR Review 2014), he asserted that humanity is in danger of being flung back into the Dark Ages: "If we fail to act, we are looking at an almost unthinkable scenario where antibiotics no longer work and we are cast back into the Dark Ages of medicine" (BBC 2014). This quote is interesting because many people have picked up on it or criticized it for being apocalyptic (Brown & Nettleton 2016).[2] Given the vision we have of the Dark Ages, it obviously is an apocalyptic message. In this instance, our perception has nothing to do with how life actually was in the "Middle Ages," but rather merely with how we imagine things to have been. The "Middle Ages" are a contemporary concept; the idea exists in its own present and has nothing to do with the actual reality of that historical period. Brown & Nettleton find references to "Dark Ages" in numerous sources, and believe that the thought of an impending era of darkness fits well with the idea that humanity is at war with bacteria. As early as 2005, the *Alliance for the Prudent Use of Antibiotics* spoke of a "shadow epidemic" and argued that the world may return to "the Dark Ages of medicine" (Brown & Nettleton 2016:502). The conclusions drawn by Brown & Nettleton are based on critical economic analysis, through which they determine that the war against bacteria and the threat of a future catastrophe constitute an engine for growth in a contemporary market-liberal economy. Talk of the future is really talk of the present. To quote a 1947 text by the German sociologist of religion Jacob Taubes, "(a)pocalyptic prophecy thus focuses on the future and yet is fully set in the present" (Taubes 2009:10). Taubes's book *Occidental Eschatology* is a history of the Western World's recurring apocalyptic beliefs, and he posits that the idea that the world will one day perish has a major impact on how we act as people. This eschatological thinking about the Christian Judgment Day is on a different timescale than that on which the antibiotic era unfolds. In the latter instance, we are talking about a speedy process that begins in the Golden Age of the 1940s with the rapidly growing availability of antibiotics to cure all infections. 70 years later, it appears that the effects of antibiotics are ebbing while bacterial resistance is increasing sharply. Exactly when the still-ongoing antibiotic era will end cannot be determined until after it has actually happened, and we believe that we should be skeptical of any visions of a definitive end. Alexander Fleming's accidental discovery at the start of the last century and the knowledge it produced about how the relationship between humans and bacteria can be handled will not disappear

[2] Among other sources, this is pointed out in an article in the University of Gothenburg's *Science Faculty Magazine* (Eliasson 2015).

unless mankind disappears. On the other hand, one might argue that in certain places in the world, some people already live in a post-antibiotic situation. There is reason to consider whether we should change the image of an upcoming catastrophic era in human history and take note of the fact that there are places that already offer catastrophically bad conditions for human existence when it comes to access to basic health care, sanitation, clean water and food.

We wonder if the scenario of an impending, predicted post-antibiotic era is really that hard to imagine. Cameron asserts that it is an "almost unthinkable scenario" (BBC 2014), but given our culture is clearly awash in disaster images, news features, and documentaries on the subject. As Taubes argues, the idea of this impending doom is culturally built into our thinking. On the superficial level, one can also argue that pop culture loves disasters and exploits the tingling pleasure of witnessing them from the distant comfort of one's living room. Thus, we find that Cameron's assertion that a post-antibiotic era would be "almost impossible to imagine" is inaccurate. His statement was presumably intended to strengthen the scientific picture of trends over time, but for us the question is not if it is realistic, but rather whether people can easily imagine and assimilate it in a way that leads them to adapt their actions. There are certainly plenty of movies about epidemics and outbreaks that are based on real events or future threats. These include *Outbreak* (1995), *I Am Legend* (2007), *Contagion* (2011), and *Pandemic* (2016), to name just a few. These apocalyptic or post-apocalyptic films are set in a near future in which an infection has changed everything and thrown society into chaos.

In terms of how it is used as an attention-grabbing scare tactic, the concept of the post-antibiotic era is employed as a kind of historical mirror of the future. In the University of Gothenburg's *GU Science Magazine*, researchers write that: "without effective antibiotics on which we can rely in the future, the situation would be disastrous. Neither an operation nor even the delivery of a baby could be conducted without major risks. Practically speaking, we would be back in the Middle Ages" (Eliasson 2015). Visions of "the olden days" are used to describe how things will be when we go enter the post-antibiotic era. This alarmism is analyzed by the British professor Birgitte Nerlich (among others), who identifies a vision of a post-antibiotic apocalypse that has similarities to how we face current societal challenges such as climate change and terrorism (Nerlich 2009). An accelerating discourse of fear will be used to communicate scientific news about antibiotics. Nerlich argues that scientists are contributing to the alarmism. When we study the reports, news stories and articles included in our material, this discourse is strongly present.

Some scientists also see similarities between a post-antibiotic era and climate change. In his book *Maktlös Medicin* (English title *Missing Microbes*), the American infectious disease doctor Martin Blaser writes that there are "many

parallels between changes in climate and changes in the body's resident microorganisms" (Blaser 2016:273). For Blaser, it is not a question of a rhetorical or discursive similarity such as that described by Nerlich, but rather a systemic similarity. Blaser believes that allergies, asthma and certain other "modern pestilences" are a superficial symptom of internal changes in the body, in the same way that local storms and other extreme weather events are superficial signs of a deeper internal change in the global climate system which is only visible through its symptoms. Blaser writes that we are headed for an antibiotic winter, and he does not primarily mean that antibiotics will cease to exist but rather that the diversity of microorganisms in our bodies is on the verge of collapse. The antibiotic winter is coming, and it is an inverted variant of the post-antibiotic era. As a reader, perhaps you recognize this language from a time when nuclear war threatened to result in a nuclear winter in which the world would become virtually uninhabitable. However, it appears that the antibiotic winter of which Blaser warns has other references and that it is not a question of "powerless medicine" ("maktlös medicin"), as the Swedish title of the book would suggest. The book's English title is *Missing Microbes*, with the subtitle *How the Overuse of Antibiotics is Fueling our Modern Plagues*. Its message is that the absence of bacteria is a problem (Blaser 2014). In the Swedish translation, emphasis is instead placed on powerlessness and the threat to our survival; *Maktlös medicin: antibiotikaresistens och vår hotade överlevnad* translates to *Powerless Medicine: Antibiotic Resistance and Our Threatened Survival*. The load-bearing element of the book's argument is that the future may be like the past – that we may "return" to a time in which our loved ones, especially our children, died of infections.

An impending post-antibiotic era can only be conceptualized if we perceive the present as an ongoing era that may come to an end. At the same time, it is difficult to find depictions which provide a sense of the present as merely a passing era, and which stress that is therefore necessary to look both backwards and forwards. Although it is the period with which we are most familiar, the antibiotic present seems to slip out of our grasp and resists incorporation into our portrayals. It seems that in order to make visible that which may be lost, one must depict something frightening. The problem with this is that the alarmism can amplify problematic behaviors in the here and now, and may accelerate the very development that we wish to avoid.

Cross-Border Research

While the post-antibiotic era is portrayed in very grim and apocalyptic terms, other parts of the discourse are imbued with a more action-oriented perspective. In May 2016, the Swedish Government adopted a new strategy for preventing antibiotic resistance. The approach advocated in Svensk Strategi för arbetet mot antibiotikaresistens" (the "Swedish Strategy for Work to Prevent Antibiotic

Resistance") has been dubbed the "One Health perspective," and this is used to emphasize the fact that bacteria move between humans, animals, food and environments, completely regardless of whether or not they are resistant. This choice of perspective is justified by the fact that "the problem is so complex, [that] it demands that our entire society work together" (The Government Offices of Sweden 2016:3). Sweden is far from alone in this perspective. The UN highlights the perspective and writes that the "One Health approach emphasizes that this requires coherent, comprehensive and integrated multisectoral action, as human, animal and environmental health are interconnected" (WHO 2016) and contributes to the discourse on an interconnected complex world that requires that boundaries between countries, sectors and disciplines be crossed in order to resolve our common problems. The declaration points out that antibiotics "are not like other medicines" and that the development "is the greatest and most urgent global risk" and therefore requires that one raises awareness and works with consensus at all levels. The work must be directed towards efforts in all sectors, and funding should go to multidisciplinary research with a perspective that captures the local, national and global situation. The UN also notes that: "social and behavioral sciences, as appropriate, are needed in order to better understand antimicrobial resistance." The EU Commission also recommends this approach, in its strategy "A European One Health Action Plan against Antimicrobial Resistance (AMR)" from the same year. When the Swedish research bill for 2017-2020, "Kunskap i samverkan – för samhällets utmaningar och stärkt konkurrenskraft" ("Knowledge in Cooperation – for Society's Challenges and Competitiveness") (Government Bill 2016/17:50) was presented, it included a ten-year research funding program for antibiotic resistance. It highlights the same perspective as the UN strategy and writes that: "the transboundary nature of the issue requires a global perspective and international cooperation" (p. 90). In this context, Sweden is hailed as a pioneer. The concept of One Health can be seen as a sign of the times, even if the concept has not yet become an explicit part of such discourse in magazines, documentaries and news reports at the time of the writing of this report. At the same time, the idea of the risks and challenges of an interconnected complex global world is often found in discussions, including in the online forums we studied. Thus, despite the fact that the concept of One Health is not used, this understanding of the world is present. The research for which politicians now advocate will involve crossing borders between species, countries, sectors of society and scientific fields, and it will make the complex interconnected world in which we live a bit more knowable. For many people, the globalized world has proven challenging to embrace, and the dissolution of boundaries also entails risks, because identities must be renegotiated. One Health is thus imbued with an inherent tension, because it aims to instigate change on many levels. At the same time, the problem is ascribed such a vast scope that it

can seem both unquantifiable and overwhelming for a single actor, or, for that matter, a single prescriber or user of antibiotics. A cultural perspective on this understanding will be presented in the next chapter.

Summary

In this chapter, we have aimed to highlight the concept of the post-antibiotic era and how it is discussed and presented in various contexts, primarily in international documents. From the cultural analytical perspectives into which we have delved, it is clear that the term is used to portray a bleak future, one in which experts posit that in 2050, as many as 10 million people will die of infections that cannot be treated because of resistance. One might ask how this apocalyptic description affects how we perceive and relate to the future. How do we act in the face of the threats which are woven into the descriptions of this coming era? Not infrequently, the post-antibiotic era is also described as a return to an earlier stage in history that is compared with the Middle Ages. Perhaps these images are used because the potential scenarios are so difficult to imagine. We therefore posit that the post-antibiotic era may give rise to a discourse of fear. However, there are also alternative perspectives that are more action-oriented. One such perspective is that of One Health, which is founded in the idea that antibiotic resistance must be approached at the local, global, human and animal level, employing a strategy that takes on issues of education economy, aid and research.

A CULTURAL STUDIES PERSPECTIVE ON BACTERIA

We live with the bacteria that inhabit us, at the same time as we humans inhabit a world that is in many ways dominated by microbiotas. This is a biological relationship, but in a period in which mankind's position in the world is in flux, it also has existential dimensions that entail cultural studies perspectives. The cultural notions surrounding man and microbiotas have a long history and highlight the different relationships between bacteria and the body. In her 1995 book *Flexible Bodies*, the anthropologist Emily Martin argues that as a result of the scientific achievements of the 1950s and 1960s, the cultural conceptions of bacteria came to frame them in opposition to the human body. Martin points out that bacteria were domesticated as both useful and dangerous to mankind, and this evolution occurred largely through the medical advances made in the post-war period.

In the Nordic region, this development was closely linked to the expansion of the welfare state (Alver et al. 2013). The dangerous bacteria became something that medicine should manage and control in order to ensure the population's good health. This evolution in thinking is rooted in the 19th century's altered views regarding the responsibilities that government authorities had begun to take on in order to guarantee the well-being of their people. This perspective was further reinforced in the post-war period, which has been called "the golden age of medicine." However, Martin also stresses that this view was altered by modern bacterial research (Martin 1995), and today we find ourselves in a situation in which man's symbiosis with good bacteria (in particular) has come to the fore. Instead of regarding the body as a stronghold that is to be protected from dangerous bacteria, the idea of a flexible body – a body that needs good bacteria – has emerged. Medicine keeps dangerous bacteria under control through the use of effective antibiotics. Faced with a potential post-antibiotic era, we might ask ourselves whether we can expect new displacements in this dichotomous mode of thinking.

In her book 2013 *The Life of Cheese: Crafting Food and Value in America*, the American anthropologist Heather Paxson calls the people who embrace bacteria "post-Pasteurians." The world has undergone a pasteurization; clinical purity is seen as desirable and, in many cases, a standard that people are expected to follow. Is there a risk that this attitude will lead people to avoid human contact so to avoid being exposed to bacteria that threaten our health and our bodies? Or can a handshake with a stranger be an expression of affirmation of bacterial multiculturalism? Paxson describes how those who she calls post-Pasteurians select foods with the aim of developing a relationship that leans toward an active association with good bacteria. There are clear parallels here with how probiotics are now highlighted as essential to the prevention of illness and the promotion of health. The question of whether and how to boost one's immune system may

become increasingly important as a myriad of post-antibiotic concerns are expressed in popular culture and scientific communication. We see that discussions on antibiotic resistance and its societal implications are popping up in many different media and pop cultural contexts.

Bacterial resistance to antibiotics is often perceived as a contemporary social problem and many people have opinions on the subject and wish to discuss and debate it – especially in the media, but also in political and scientific circles.[3] Thus, terms such as "antibiotic resistance" and "bacteria" are considered keywords that allow us to methodologically understand how community is created and negotiated in different contexts (Williams 1988). In particular, these terms relationships make visible the relationships between our own human bodies and our microbial enemies – or friendly bacteria; it all depends on how we perceive the issue and where the bacteria are located. The cultural conceptions of bacteria may become discourses categorized as "good bacteria" and "the ones that harm us," contrasting the bacteria that are an important part of our health and those who are perceived as a threat to our health. In discussion, we often lose sight of the fact that it is largely the individual body's status or where the bacteria are in one's body that determines whether a given bacterium is beneficial or detrimental to an individual's health.

In a text on "Immunization and Violence" the Italian philosopher Roberto Esposito writes about the inherent contradiction that exists between immunity and community (Esposito 2012). Etymologically speaking, "immunity" means that an individual is protected from community-related threats. Esposito finds a dialectic between "immunity" and "community," which are connected by their common root, *munus*, which means "gift" or "obligation." "Community" is an affirmative obligation, whereas "immunity" is an exemption from compliance with the inherent obligations of all things communal. Esposito presents vaccination as a related comparison, and in this instance the dialectic should be understood as not only cultural, but also biological (but can also be likened to the legal immunity that diplomats and heads of state may enjoy when they are in a foreign country but are not subject to the laws of the land). It is the tension between communal obligations and individual liberation that defines the immunity concept highlighted by Esposito. For example, immunity is achieved because an individual part of the community – one becomes immune through exposure to common infections, which in turn leads to the development of an immune system. But if an individual instead chooses to exist outside the community, there is a risk that he/she may not develop immunity, and this results in a clash with the very

[3] We have therefore entered this debate in order to highlight the cultural studies perspectives on this social problem. See: Brenthel 2016b, 2017 and Brenthel & Hansson 2017a & b.

community he/she has rejected. This argument can also be used to explain the conflict between the individual's interest in gaining access to antibiotics in order to recover faster and how this relates to the common interest in preserving the effectiveness of antibiotics for future patients in need of life-saving treatment. However, Esposito's reasoning can also illuminate other conflicts. He writes that a strong defense against what is perceived as a dangerous enemy is likely to also destroy the (social) body that seeks to protect itself: "[t]he negative protection of life, strengthened so much that it is reversed into its opposite, will wind up destroying not only the enemy outside it but also its own body" (Esposito p 2012: 11). In this case, Esposito likens our social protection mechanisms against everything that seems foreign to an excessive defensive response that may well trigger an autoimmune reaction that affects society rather than protecting it (cf. Arvidson 2016). When the community is perceived as limited to Swedish citizens in Sweden, for example, and if many countries operate according to similar beliefs, then the development of excessive defense mechanisms in the form of restrictions on the movement of people, trade, education and knowledge risk weakening global efforts to combat antibiotic resistance. This will likely be detrimental to both the common interest in preserving the effectiveness of antibiotics and the interdependence of individual countries in our interconnecting world. Dependence and conflicts of interest can be found at many levels of the antibiotics issue.

Fragile Relationships

To illustrate and extend this reasoning, we shall start with the Belgian documentary film *Resistance*, which premiered in 2015 and was directed by Michael Graziano. The documentary adopts a historical perspective and begins with a researcher recounting the story of the first patient treated with penicillin. The scientist states that the patient was a police officer enjoyed working in his garden in his spare time. He pricked himself on a rose thorn and contracted Staphylucuccos Aurelius. This bacterium developed in an unfortunate manner and the policeman nearly died of blood poisoning, but was saved by the first penicillin regimen, which he received. The documentary's message to today's viewers is summarized in the voice-over: "[s]omeone can just be scratched on the cheek by a rose thorn and nearly die from it, and we are going right back to that situation, where that happens and you need a ten thousand dollar antibiotic to treat that person." Through this everyday event related to the new situation with antibiotic resistance, the documentary seems to point out for us viewers that "we" have misunderstood our relationship to bacteria and the potential downsides of antibiotics. Antibiotics became a miracle drug that could save people and animals from life-threatening bacterial infections, and now our abuse of antibiotics threatens to put us in a situation in which antibiotics become ineffective. One of

the messages of the documentary is that the relationship between humans and bacteria is fragile, and that we must cherish what we have.

According to the documentary, because this relationship is fragile we cannot assume that we are at war with the evil bacteria that seek to do us harm. One of the researchers in the documentary emphasizes this point, saying "The notion that we are at war with them (bacteria) is hilarious – if we were at war with them, we'd be toast!" The number of bacteria in our bodies alone is 10 times greater than the number of human cells of which the body is composed. When it comes to bacteria in the world at large, their cumulative weight is 100 million times more than the total weight of every human on the planet put together. The documentary's message can be understood as follows: Antibiotics were the first miracle medicine that could save us from life-threatening bacterial infections, but our "bellicose" relationship to bacteria contributes to the misuse of antibiotics, because we have misunderstood our relationship to them. It is time to find another relationship in which we can coexist.

This theme is repeated in other documentaries, such as the Danish-Swedish documentary *När antibiotikan slutar verka* (*When the Antibiotics Stop Working*), which was broadcast on SVT in 2016. That film is about how healthcare (and particularly maternity care) has become more risky as a result of the growing incidence of multidrug-resistant bacteria. One particular bacterium found in pigs has crossed the species barrier and now infects humans, including premature babies. The documentary opens with a scene in which two new Swedish parents describe an incident in which they received the news that their premature baby may have been infected by a multidrug-resistant bacteria. To prevent the spread of infection, the child was quarantined. The situation was very critical and the documentary uses the parents' experiences to highlight the constant anxiety that parents feel and how it impacts both their daily lives and the reactions of those around them. In the documentary, a step-grandfather whose immune system has been compromised as the result of cancer treatment says that he scarcely dares to spend time with the newborn because of the risk and fear of becoming infected. If that were to happen, the baby's close relative is convinced that he will die. The new parents also testify that it feels as if their friends avoid them, and that parenthood has ended up being a very isolating experience.

Through the concerns of the parents and images of the newborn's tiny body, the documentary illustrates human frailty and the way that social relationships can break down in the face of the fear that one will fall victim to resistant bacteria. This life story and the parents' trauma also creates a framework for the documentary, which seeks to highlight the unwillingness of Danish politician to examine the actual incidence of resistant bacteria in Danish pig herds, especially when it comes to the breeders, who are at "the top of the genetic heap." The

documentary argues despite the clear recommendations of researchers, the issue has not been addressed because of financial interests.

We also follow a Danish pig farmer who has become socially isolated on his farm, because he is a carrier of resistant bacteria. As long as the farmer continues to keep pig stocks, the healthcare system can provide little treatment. If he is treated and cured, he will get infected again as soon as he enters a stall. This has caused the pig farmer to lose many of his former friends, who no longer dare to visit him because of the resistant bacteria of which he is a carrier. The same fractured relationships can be found in the healthcare system, where the infected farmer is banned from entering the traditional healthcare spaces due to the fear that he will carry resistant bacteria into the care environment. When the Antibiotics Stop Working is a story that is about mankind's cohabitation with bacteria in a relationship that cannot be broken up, but in which we have made bacteria our enemies by using antibiotics in an irresponsible way. The categorization of bad and good bacteria in the documentary has its counterpart in society, where some groups cause resistances while others suffer from them. The documentary itself is an illustration of the discourse that we have previously discussed in this report, namely that society now seems to have reached a point in history where treatment options are running out and that this causes the resulting concerns to take on existential dimensions. The documentary repeats a common theme in the story of antibiotic resistance, but what makes this documentary unique is that it also discusses and illustrates the fact that human social relationships are perhaps the first thing to break down.

Yet in the discussion of the emerging antibiotic resistance, not everyone highlights the delicate relationships. A different but parallel narrative revolves around mankind's relationship to microbiotas – the overall diversity of bacteria and other microorganisms that surround us and with which we evolved in tandem. In his book *Maktlös medicin* (2016; English title *Missing Microbes*) the American physician and. infectious disease researcher Martin Blaser writes about how the bacteria that lived in our intestines until the introduction of antibiotics are related to the bacteria that had begun to coexist with mankind as early as 200,000 years ago. Blaser emphasizes that humans and these bacteria have evolved in tandem over the course of our common history – and we have benefited from each other and become dependent on each other. For example, Blaser argues that the good and diverse bacteria which are passed from the mother's womb to a newborn, are a foundation of lifelong good health. This inheritance also entails a microbiological link from generation to generation, at least until recently. Blaser therefore believes that many chronic human illnesses may be caused by the fact that the bacteria on which we depended has been replaced by other bacteria, or a dearth of bacteria. The antibiotic, posits Blaser, broke the line of good diversity sometime in the mid 1900s, but it did not eliminate our need for microbiotas. Blaser believes that

modern plagues (diabetes, allergy, asthma, etc.) have replaced the old bacterial scourges that previously caused death and illness. Such a perspective illustrates not only different viewpoints about the relationship between humans and bacteria – and how relationships between people are affected by the resistant bacteria – but also makes it clear that we are creating a new approach to the relationship between humans and bacteria.

Temporality

It has long been known that resistance develops quickly if antibiotics are used in the wrong way – for example, as early as 1945 Alexander Fleming pointed this out in his Nobel lecture, in which he also emphasized the individual responsibility involved in the use of antibiotics (Fleming 1945). This may occur when medication is used for a short time or in a small dosage. However, we must not forget that resistance can also arise when antibiotics are used properly. The bacterial strain that adapts to an environment that is toxic to other bacterial strains gains an evolutionary advantage. It is possible to regard the development of new antibiotics and the development of resistance by bacteria as an ongoing struggle. Such an organic understanding of the fact that resistance is always the result of use contributes to strengthening the joint argument for restricting the use of antibiotics in order to benefit those patients who truly need them. This also helps to encourage understanding that antibiotics should be seen as a form of "environmental toxins" with very special effects that differ from how we usually understand environmental toxins. The environmental impact can occur wherever bacteria exist, and may result in some strains doing better than others – i.e., resistant bacteria.

All biological life has evolved by adapting to changing environments, but this process is much more rapid for microorganisms than it is for higher lifeforms, because they have a very short generation time. This ability to adapt is captured visually in a video made by Kishony Lab at Harvard Medical School, which illustrates just how quickly the development of resistance may occur.[4] Figure II shows a still from the film illustrating the growth of non-resistant bacteria on a very large agar plate[5] (120 cm x 60 cm), the creators of which call it the MEGA dish (Microbial Evolution and Growth Arena) (Baym et al. 2016). The MEGA dish consists of a shallow basin that is filled with growth medium for bacteria and

[4] The film can be viewed on YouTube under the name *The Evolution of Bacteria on a "Mega-Plate" Petri Dish* (Kishony Lab):
https://www.youtube.com/watch?v=plVk4NVIUh8 (2017-12-06).

[5] On Wikipedia, an agar plate is defined as follows: "an agar plate is a petri dish that contains a growth medium (typically agar plus nutrients) that is used to cultivate microorganisms [...]." https://sv.wikipedia.org/wiki/Agarplatta (12-06-2017).

antibiotics with an increasing level of concentration near the middle of the plate. The growth medium is transparent, but the bottom of the basin is painted black to achieve a contrast effect that makes the growing bacteria visible.

The lines drawn from point-to-point across the image and show the branches in the family tree created by the evolution of the bacteria, from their inception and through the various concentrations of antibiotics over the course of just 11 days. Each point is a bacterial strain that differs from the other strains at the genetic level. Figure II shows the final stage of the experiment, which begins with two bacterial strains on each side of the MEGA dish. This visualization illustrates the importance of understanding bacteria from a time perspective in which they are constantly evolving and changing.

The visualization of this form of temporality – bacterial strain variability – will be an essential discourse in the post-antibiotic era. Many of the biological processes that are occurring (and which can be said to be an expression of that era) are not necessarily visible to the eye. Rather, it is only through science's ability to aggregate and visualize data that these changes become something to which man can relate (Brenthel 2016a).

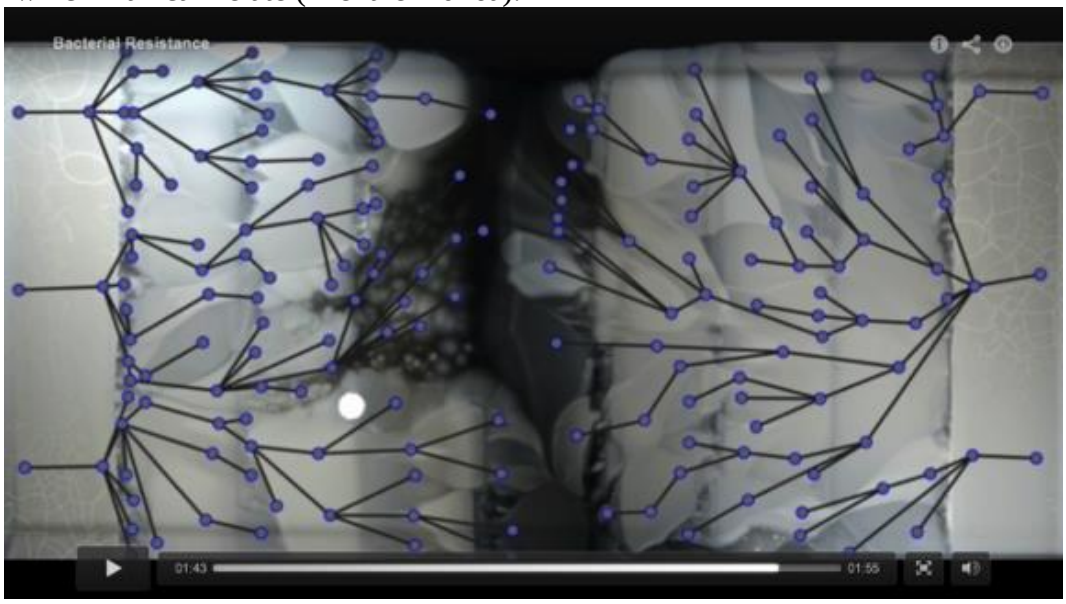


Figure II: In a YouTube clip from Kishony Lab at Harvard Medical School, we get a snapshot of their MEGA dish (Microbial Evolution and Growth Arena), in which the rapid adaptation of bacteria is visualized and temporalized.

Summary

Cultural studies perspectives on the post-antibiotic era also demand that we develop new theoretical perspectives on how we can understand bacteria. This chapter makes a first attempt to present some of the theoretical reasoning that has been central to our analytical work. One such theme are the cultural beliefs

surrounding relationships between humans and bacteria. In many historical representations, they become "the dangerous bacteria," something that medicine should manage and control in order to ensure the population's good health. Medicine had maintained control over the dangerous bacteria through the use of effective antibiotics. Can we expect new displacements in this dichotomous mode of thinking in the post-antibiotic era? Not least because our abuse of antibiotics has landed us in a situation in which bacteria are becoming resistant. Yet perhaps we should not view ourselves as being "at war" with the "evil" bacteria? A parallel narrative often frames man's relationship to bacteria as something good and something that creates a strong relationship between humans and bacteria. One point is that the bacteria found in our intestines have a long history and have probably been there since the very beginning of humanity. In order to understand resistance problems, we must also understand how resistance is accelerating in the post-antibiotic era – we would argue that it is crucial to establish a temporal dimension.

THE MANY FACES OF THE POST-ANTIBIOTIC ERA

The concept of "the post-antibiotic era" evokes the sense of a far-off boundary for the era in which we are currently living. By this we mean that the prefix "post" conjures up images of a future in which antibiotics no longer exist, while at the same time establishing our current, modern age as "the antibiotic era." There are surprisingly few concrete images or illustrations of this forthcoming era; rather, verbal descriptions create clear notions of how the future may look. For the lack of images does not mean that we have a hard time imagining it.

Former British Prime Minister David Cameron's choice words, (presented earlier) are frequently quoted, and exemplify how our imaginations can work. When the report from the AMR Review (2014) was to be presented, Cameron argued that immediate action was necessary to prevent mankind from being catapulted back into "the Dark Ages of medicine." The words evoke our collective vision of the Middle Ages, which we then project onto the future. Little does it matter that none of us experienced the Middle Ages first-hand, or that nobody knows what the future will bring. The images are still clear. We have strong associations with the Middle Age – an era when plague, bloodletting and drugs so toxic that the patient died of the treatments were part of many people's daily lives. At the same time, there are people who remember a time before antibiotics were available to cure infections whose successful and easy treatment we now take for granted. However, these notions do not seem to evoke such strong fears. Thus, these visions also create a temporality that revolves around the fact that the period in which we are currently living is temporal and the future will look completely different.

Yet although the Middle Ages are the primary temporal reference point to which bacteria are linked in the report's postulations, there has long been another form of temporality in science. Even before penicillin became available to the vast majority of patients, scientists were aware that bacteria can become resistant to antibiotics. As we have previously highlighted, in his Nobel lecture Alexander Fleming himself described not only how resistance is likely to occur in the healthcare setting but also the responsibilities of those who have access to penicillin treatment (Fleming 1945). Towards the end of his speech, Fleming raises the specter of what may happen when "the ignorant man" can buy penicillin, and the risks this would entail. Forebodingly, he writes that the day may come when penicillin can be purchased by anyone over the counter, i.e., exactly what is now possible in certain countries. As early as 1945, Fleming clearly saw the risks associated with such availability, and said that should penicillin become too widely accessible, there was a risk that the "ignorant man" might accidentally under-dose himself and thus expose his microbes to non-lethal concentrations of the medicine, thereby causing them to become resistant. The current situation in

Sweden is better than the one Fleming describes; antibiotics can only be purchased with a prescription.

In Sweden, many different actors work together in a structured manner to promote the rational use of antibiotics. In the foreword to The Public Health Agency of Sweden's report, "Svenskt arbete mot antibiotikaresistens" ("Swedish Efforts to Combat Antibiotic Resistance") (The Public Health Agency of Sweden 2014), the authors write that "Sweden is a small country with a relatively low antibiotic consumption, and, from an international perspective, a favorable resistance situation." The agency thus conveys a certain sense of security, while also creating an image of a threat that is largely external. From a strictly geographical perspective, this description may very well be accurate. Nonetheless, resistance develops wherever antibiotics are used; it is only the speed with which this occurs that varies from place to place. In "Svensk Strategi för arbetet mot antibiotikaresistens" (the "Swedish Strategy for Work to Prevent Antibiotic Resistance") (The Government Offices of Sweden 2016), the Government uses speed as a metaphor, writing that our relatively good resistance situation does not mean that we can rest on our laurels, because "resistance is also increasing here, though more slowly than in other places" (p. 8). Threats and speed are two variables that are used to provide a picture of what is happening in the world at large. As readers, we must understand that in some of the world's higher-risk locations, the speed with which the increase of resistant bacteria differs from the somewhat slower prevailing speed in Sweden.

The Ethics of Antibiotics

Antibiotic use has always been associated with a form of ethics, which has revealed a moral lesson: the incorrect use of antibiotics can reduce the effects of the medicine, because bacteria have gained a new edge. To borrow a weapon-related metaphor from the contemporary discussion, antibiotics have proven to be a double-edged sword. With access to antibiotics comes a responsibility which is now becoming clear, even if it should come as no surprise. The moral message has been that it is the user who must take responsibility for how and when she or he uses the medication, but that it should of course be used according the physician's prescription. As has already been mentioned, Alexander Fleming addressed this issue. Let us now return to the Nobel lecture from 1945, in which Fleming illustrates how those who have access to penicillin should exercise their responsibility. In his lecture, Fleming presented the following scenario:

> Mr. X. has a sore throat. He buys some penicillin and gives himself, not enough to kill the streptococci but enough to educate them to resist penicillin. He then infects his wife. Mrs. X gets pneumonia and is treated with penicillin. As the

> streptococci are now resistant to penicillin the treatment fails. Mrs. X dies. Who is primarily responsible for Mrs. X's death?
> (Fleming 1945)

Fleming believes that individuals are responsible to those in the surrounding area for those around them, those to whom one is likely to pass on an infection if one does not use penicillin wisely. "Wise" usage means that the individual follows the doctor's instructions. Fleming's question about who is responsible for Mrs. X's death illustrates the responsibility inherently entailed by access to antibiotics. Yet where does the ethical responsibility lie when unwise decisions are made as a result of ignorance? Could it be that Mr X was not sufficiently informed by the prescribing physician, or by the pharmacist who gave him the medicine?

When we transfer this moral reasoning to the present day, it is evident that we are living in a more global world than the one Fleming knew. It is in everyone's interest to maintain the effectiveness of antibiotics in the future, but how do we share the responsibility for disseminating this moral? Both contamination and resistance problems are now present worldwide, and they are not limited to individual relationships or places. Moreover, from a global perspective antibiotics are more accessible than ever. It is also more difficult to demand that someone take responsibility, because it is unclear that any single person is to blame.

The link from the individual to the communal is also expressed by the bacteria that we share, and that is why most recommendations on how to address antibiotic resistance also include contamination, sanitation and vaccination programs. After having established that this issue concerns everyone, from people to animals, WHO's most important point is that infection must be prevented: "[e]very infection prevented is one that needs no treatment" (WHO 2015, p. 5, our translation).

In addition to the responsibility shouldered by anyone treated with antibiotics, there is an individual responsibility to avoid infection to begin with. Yet there is another dimension to this question, and that is the responsibility for one's own health and one's own immune system. This responsibility is described in different ways, but in summary, it is a question of the individual's responsibility for his/her own body and her/his own health (Alftberg & Hansson 2012). Advocates argue that if the individual accepts this responsibility, the risk that he/she will be negatively affected by multidrug-resistant bacteria also diminishes. In the long run, this also means that individuals take on a collective responsibility. For example, as an illustration of this approach, the debater Peter Rothschild writes in Dagens Medicin that "it may also involve strengthening our resistance by consuming more minerals, vitamins and probiotics. Sleep, exercise and stress reduction also boost the immune system" (Rothschild 2016). In Rothschild's debate, responsibility thus has to do with more than just following the doctor's

recommendations; it is a responsibility that is much larger and which affects numerous parts of our everyday lives. As the text puts it, the goal is good general health. At the same time, in this example good health depends on the ability to act as a consumer and demand "minerals, vitamins and probiotics" (ibid.). There are therefore many similarities between this reasoning and the reasoning related to, e.g., lifestyle diseases, where the discourse supposes that the individual is personally responsible for staying healthy. Diet and exercise are frequently highlighted, along with stress reduction and establishing good habits to keep illness at bay. Moreover, if one falls ill, this discourse preaches that one must embrace the role of a sick person and do everything one can to get well again and thus return to society. We believe that an ongoing negotiation (or perhaps several different negotiations) underlies the visible expressions of the discourse – a negotiation in which the relationship between the individual and society has changed. Several shifts are involved, but the greater individual freedom to choose – both lifestyle and healthcare providers – is one clear trend. Freedom can also lead to choices that fall outside the socially accepted range of options, such as purchasing antibiotics online without a prescription or listening to advice that is not supported by science and proven experience.

In the Public Health Agency of Sweden's 2016 report "Antibiotikaanvändning och antibiotikaresistens"("Antibiotic Use and Antibiotic Resistance"), which is based on a relatively extensive quantitative study of the attitudes and knowledge of the Swedish population, virtually all of those surveyed disapprove of the behaviors that one might call unethical when it comes to the use of antibiotics. For example, 80-90% of the surveyed group disagree with the assertion that it is good to purchase antibiotics online or buy antibiotics abroad without a prescription. 50-60% reject the idea that antibiotics "should kill all the bacteria in the body" (p. 24), but at the same time, a majority of those with a lower level of knowledge believed the opposite – that the intention is to kill all the bacteria in the body. Based on these figures, it can be said that the population in Sweden is well-informed and has good knowledge of the use of antibiotics. However, there are also variations between different groups.

Based on this study, one can still argue that the Swedes' knowledge level is good and that there are good conditions for attitudes that promote the wise use of antibiotics. In the discussion, the authors write that "the study shows that there seems to be a positive correlation between the level of knowledge regarding the effects of antibiotics and antibiotic resistance and confidence in doctors' decisions regarding antibiotics" (The Public Health Agency of Sweden 2016b, p. 28). This discourse is also central to today's moralizing, which involves not only the acceptance of individual responsibility for one's treatment, but also the active prevention of illnesses, keeping healthy, and maintaining a healthy lifestyle.

Despite the development that has been outlined, we believe that there is still a strong ethics of antibiotics to which most people claim to subscribe when they are interviewed in various forms of surveys and studies. However, there is a threat that this ethical attitude may be undermined because new challenge loom and antibiotic resistance is a multifaceted problem. In the preface to the Swedish Government's strategy for work to prevent antibiotic resistance, Ministers Gabriel Wikström, Sven-Erik Bucht and Helene Hellmark Knutsson emphasize precisely this point: "antibiotic resistance is a multi-faceted problem" (The Government Offices of Sweden 2016: 3).

Rational Use?

In Sweden, Strama (described earlier in this report), has been engaged in the fight against antibiotic resistance since 1995, and "the rational use of antibiotics" is an important catchphrase in their activities. Strama's message is that antibiotics should only be used when it is genuinely beneficial to do so, and that prescriptions must be followed so that the patient does not contribute to the development of resistance by under-dosing. For Strama, prescribing doctors have been (and still are) the most important players when it comes to disseminating information and ensuring that people to use antibiotics in a rational manner. Moreover, they play a crucial role in informing their patients about how and when antibiotics can and should be used. When explaining why Strama has been successful in Sweden, the organization explains that "a crucial concept in Strama's strategy has been that personal meeting and dialogue are a prerequisite for achieving changes in attitude and behavior among doctors" (STRAMA 2017: 8).

Furthermore, the interested reader now has excellent access to information about antibiotic resistance and the challenges associated with resistance. On the internet, there are many educationally oriented websites that present texts and illustrations aimed at target groups with different levels of previous knowledge.[6] In a synoptic comparison of the various sites, it appears that the recurrent message is essentially the same. In other words, there is a high degree of consensus. Moreover, all these websites present antibiotic resistance with a focus on healthcare situations.

[6] www.strama.se, www.antibiotikasmart.se, www.smittsäkra.se, www.antibiotikaellerinte.se, www.1177.se, and the website of the Västerbotten County Council offers information aimed at parents, in 14 different languages. www.vll.se/startsida/halsa-och-vard/smittskydd/infektioner-hos-barn. It is worth noting that there are also websites which are operated by companies and which present messages similar to government public service announcements. See for example www.antibiotikaresistens.se, which is BioGlan's website for their products (all available pages 12-15-2017).

In the example of the Public Health Agency of Sweden's information campaign *Skydda antibiotikan* (*Protecting Antibiotics*), three pieces of advice are highlighted: (1) talk to your doctor or veterinarian about when antibiotics are beneficial, (2) do not use leftover antibiotics; instead, hand them in at the pharmacy, (3) prevent infections and contagion when possible, for example by washing your hands and follow vaccination programs.[7] The information is also addressed to animal owners, but only care situations are addressed.

The successful work carried out by Strama in Sweden also focuses on care situations. The information available via the websites of Strama and the Public Health Agency of Sweden is attractive to those who are interested in statistics on the sale of antibiotics and a great deal of other data. Knowledge is very good in Sweden – both the knowledge of which antibiotics are prescribed and in what quantities, but also relatively good popular knowledge about the resistance problem associated with the careless use of antibiotics.

Yet with increasing knowledge among Swedes about how antibiotics are used around the world, there is a risk that the Swedish ethics of antibiotics will be undermined. One need not move very far beyond the Swedish borders to find examples of things that in Sweden would be seen as the careless use of antibiotics. This fact could spark upset and indignant emotions, because others are not taking responsibility for their actions. Moreover, a recurrent argument in the general debate is that the danger beyond the borders of Sweden.

In *Sydsvenskan Dagbladet*'s reader text "Stoppa missbruket av antibiotika – vi behöver antibiotikan" ("Stop the Abuse of Antibiotics – We Need Antibiotics"), we read that there is "strong evidence that pig farmers, veterinarians, and scientists have long hidden the truth!" and the writer refers to the 2016 Swedish-Danish documentary *När antibiotikan slutar verka* (*When the Antibiotics Stop Working*) (2016 Kalmström). The author of the piece believes that Danish antibiotics use is reprehensible, but reminds his readers that the chicken industry also has problems with the presence of multidrug-resistant bacteria. What is most thought-provoking about this piece is the author's indignation over the "abuse" that leads to resistance. We believe that this is a moral outrage that must be understood in light of Sweden's image as a country that has the situation under control. The film sets up an "us versus them" situation in which the Other does not have control, and its actions instead cause everyone harm.

Little does it matter whether Sweden is a pioneer in this respect; rather, we are interested in how this presentation affects the ethics of antibiotics. If "the Others" do not respect the ethics of antibiotics, it may well prove difficult to motivate both prescribers and infected individuals to understand the importance of refraining from using antibiotics. In the long term, indignation over behavior that runs contrary to the established ethics of antibiotics may wane. The motivation to be

[7] www.folkhalsomyndigheten.se/skyddaantibiotikan/ (2017-12-15).

compassionate and make sacrifices for the benefit of others is based on a sense of reciprocity.

In the Swedish Government's "Svensk strategi för arbetet mot antibiotikaresistens" (the "Swedish Strategy for Work to Prevent Antibiotic Resistance"), the word "rational" is not used at all. Rather, the authors (Ministers Wikström, Bucht and Knutmark) state in the foreword that "it is of the highest priority that the plan of action be put into practice so that all countries will take on the responsibility of combating the resistance problem" (The Government Offices of Sweden 2016). The Swedish approach represents a shift from a national perspective to an externally oriented outlook on a world in which people believe that the problem currently exists. Yet this is not a sudden turn of events, the trend toward a global perspective has been gradual. Otto Cars, who is one of the founders of Strama and sets the tone of the debate on resistance, posits that "the perception of antibiotic resistance as an ecological problem existed early in veterinary medicine and in 1986 resulted in legislation on the use of antibiotics in animal feed" (The Public Health Agency of Sweden 2014, p. 54).

From our discourse perspective, one can still argue that overall, the problem has been addressed as a challenge in the care situation and that it may have been worsened by the legislation that frames it as a minor issue for animal husbandry in Sweden. The issue may have received less attention in the debate for the very reason that legislation did exist. In a Festschrift commemorating Strama's 10th anniversary, the authors write that at the time (1995) "many lived in the belief that it was enough to look after one's own house, but now we know better. Bacteria travel without passports or visas, and even the sharpest terrorism surveillance is unhelpful" (STRAMA 2005). In the Festschrift, one of the invited authors, Sigvard Mölstad, writes that "the most important factor governing the occurrence of resistant bacteria in humans is the consumption of antibiotics by humans" (p. 10), and this has been the message for many years. The focus has been on the consumption of medicine, and this is still largely the case. The website www.antibiotikaellerinte.se, which is run by Strama, states that "[in] Sweden, we use the Penicillin model, which means that doctors are advised to favor the use of 'narrow' antibiotics" (12-06-2017). This is typical of what we perceive to be the Swedish ethics of antibiotics – doctors should not prescribe antibiotics before it is determined that the patient has a bacterial infection and the bacterium in question has been identified. The infected patient must await the test results. The entire approach is based on an acceptance that the individual must sacrifice his/her time for the sake of the collective interest, but the care-seeker does not just sacrifice time; he/she also endures nuisance and discomfort. As long as "the collective" can be described as all future care-seekers, a situation in which everyone is part of the same community of solidarity, and as long as the rules apply to all care-seekers,

ethics can be upheld. Yet the question remains – what happens to this acceptance when the boundaries of this collective broaden?

A Global Perspective

Increasing resistance to antibiotics will probably primarily affect those who are already least likely to be able to handle the problem. This is one of the reasons why issues related to antibiotics and justice also become a matter of the medical humanities. Many aspects of justice are involved in the use of and access to antibiotics. The most important aspect raised by WHO is the prevention of contagion in the first place. In its *Global Action Plan*, WHO writes that the way forward is first and foremost the prevention of contagion "[e]very infection prevented is one that needs no treatment" (WHO 2015). Most important are good sanitary conditions, clean drinking water and proper sewage systems so that the population does not suffer from diseases, and it is among these people that the effects of increased resistance will be most visible.

Many of the industries that produce antibiotics in bulk are located in Indian Patancheru; it is there that the active substances are manufactured and then sold to various pharmaceutical companies. Studies have shown that the treated effluent in Patancheru contained toxic concentrations of antibiotics (Larsson 2014). The concentration of certain substances is higher than that of the blood of patients who have consumed the same medicine. In other words, conditions are perfect for the development of resistant bacteria. The sewage contains both various concentrations of antibiotics and a mix of bacteria from both animals and humans which exchange resistance genes with each other. In some parts of the world, the production of the medication is a dirty industry (ibid., Liu & Lundin 2016). In the places where industrial sewage or waste is allowed to enter the environment, the concentration of medication is often so high that it is toxic to the organisms living there. Medications are designed to have biological effects, and in the wrong place, they do harm rather than good. In the case of antibiotics, the harm is not only toxic but also mutagenic. The medicine emitted in industrial sewage or waste has not passed through a few patients. This means that it usually has not been broken down. In contrast with municipal sewage systems where a few people have consumed medicine and broken down the medicine to some extent, the concentrations in industrial wastewater can be much higher. Certain drugs do not break down inside the patient or reemerge in an altered form. Wastewater treatment plants are not always capable of extracting these broken-down products from the water. In other words, it is not just important to know where antibiotics are emitted, also whether they have passed through a human or animal body first.

Summary
The post-antibiotic era cannot be easily summed up in a single narrative. It is a complex and ambiguous story, and to understand it one must approach in from many angles. Perhaps what unites these stories is the prefix "post," which easily conjures visions of a future devoid of effective antibiotics. Yet this is not quite the whole truth. As we have highlighted in this chapter, many different actors work both nationally and internationally to promote the rational use of antibiotics, and are thus creating a different view of the future, one that is not wholly dystopian. An interesting perspective that we have identified in the analyzed material is a form of ethics of antibiotics in which the user must take responsibility for how and when she or he uses a medication. This ethical approach is linked to the threats that will arise should antibiotics cease to work. At the same time, there are trends that challenge the rational use of antibiotics, especially if we adopt a global perspective on development. Crucially, increasing resistance to antibiotics will probably primarily affect those who are already least likely to be able to handle the problem.

CLOSING COMMENTARY: THE INEVITABLE TREND TOWARDS INCREASED UNCERTAINTY DESPITE MORE KNOWLEDGE

Science communication directed at citizens is often based on a communication model in which knowledge is transferred from those who possess it to those who do not, i.e., from scientists or other experts to the public. This model is often referred to as a transmission model or a transmitter-receiver model, and its objective is the transfer of knowledge (Brenthel 2016a). When the communication seemingly fails in its goal, the blame is often placed on the recipient, who is perceived to be either noncommittal or merely a scientific ignoramus. This applies to climate communication (ibid.) and other research communication, but in the scientific literature, comparisons between the communication of information about antibiotic resistance and climate change have been made by, inter alia, Birgitte Nerlich (Nerlich 2009) and others. On Swedish soil, the Swedish Civil Contingencies Agency (Myndigheten för Samhällsskydd och Beredskap, MSB) draws this connection in its report on antibiotic resistance, stating that "antibiotic resistance is a threat of insidious nature which can be said to have some similarities with climate change" (MSB 2013:37), and adds that combating antibiotic resistance will be costly.

We believe that the pedagogical communication challenge is similar. It involves a threat that is increasing but whose causes are invisible on one plane and highly visible on another, and the development is dependent on political decisions, together with the individual choices we make in our everyday lives. There is also a similar conflict between individual and societal interests, although there are noteworthy differences. These aspects take up a modest amount of space in the recommendations that have been developed in different contexts. When it comes to communication, there is a tendency to focus on knowledge gaps, but although many studies (The Public Health Agency of Sweden 2014) indicate a link between knowledge about antibiotics and the amount of antibiotics used by a given group, the picture is unclear. An evaluation of the EU Commission's earlier action plan from 2011 notes that 84% of European citizens say that they know that the unnecessary use of antibiotics causes the medication to become ineffective, but only 56% know that antibiotics do not help combat colds and influenza (EU 2016b: 29). In other words, the public seems to possess good knowledge in some areas, but that there are knowledge gaps in other areas.

From an international perspective, larger organizations (WHO, the AMR Review, the EU) raise the issue of the need for knowledge dissemination. In the WHO global action plan from 2015, the primary aim is to "[i]mprove awareness and understanding of antimicrobial resistance through effective communication, education and training" (WHO 2015:8). A similar example is the final report from the AMR Review, which urges that the first and foremost effort should be a "global public awareness campaign" (AMR Review 2016:19), while the European

Commission's "Road Map" ranks what it calls "[c]ommunication, education and training" 12th in its list of priority measures to counteract growing resistance to antibiotics (EU 2016a). Other research calls on both scientists and the media to take responsibility for presenting a balanced picture of the challenges (Pruden et al. 2013). The researchers in this study believe that there is a risk that certain individuals may be confused by conflicting messages and may not take prescribed antibiotics because they have distorted the message about being careful with antibiotics. We note that all communication messages are always dependent on the person receiving the message. Successful communication uses several channels and ways of expression to capture the attention of many groups, but it also adapts its message as the problem description changes, in order to stay in pace with the times and achieve its discourse production. One Health may lead the communication to adapt its message in order to keep up with the antibiotic trend, as antibiotics shift from being a health challenge to becoming a global environmental problem.

Similarities with Climate Change?

The ongoing discussion about climate change can provide us with knowledge about the dissemination of information regarding antibiotics. One can draw upon both positive and negative experiences. Not least, there are similarities when it comes to the problems of conveying knowledge when signs such as changes in climate or bacteria are not directly visible to the individual. Both issues have to do with the mediation of risks that have been exposed through science (Beck 2000).

In a similar way as with climate change or the spread of chemical substances, it is everyone's common consumption of antibiotics that is contributing to the problem of resistance. The problem is not limited to individual emissions, and at the same time, it is difficult to say that any individual's consumption of antibiotics will lead to the post-antibiotic era. Nonetheless, every individual user helps to push the system towards its breaking point. This increasing antibiotic resistance is described by the World Health Organization in its *Global Action Plan on Antimicrobial Resistance*, in which WHO warns that: "[w]ithout harmonized and immediate action on a global scale, the world is heading towards a post-antibiotic era in which common infections could once again kill" (WHO 2015). But there are also differences between climate change and antibiotic resistance, and these can affect how communication should be drawn up when the aim is to transform the behavior of a target group. One of these differences is that antibiotics always act locally, even though their impact may ultimately be global. In a communication perspective, the patient's body should therefore be described as an environment, which is also what it becomes when recommendations are administered about how a drug should be used and how large a dosage is necessary to actually kill the bacteria that have infected a patient.

It is important to point out that no matter where they end up, antibiotics affect their local environment. Whether they wind up in an animal's body, a human body, a watercourse or a sewer system, antibiotics will affect the composition of the bacteria there. Here there is a difference compared to climate impact, which can also affect how communication should be designed in order to be most effective. The reasoning is that unlike climate gases, which more or less affect the atmosphere as a whole, antibiotics always have a local when they reach certain concentrations. Precisely where antibiotics are emitted into the environment is therefore of importance, and it is thus possible to point to particular individuals, companies or businesses that are responsible for addressing their problems. The effects of climate change, on the other hand, are not related to exactly where climate gases are released; it is the total amount in the atmosphere which matters. Then there is another fact – the effects are most dramatic in certain locations. Currently, the most dramatic signs of climate change are visible in the polar regions, but virtually no emissions come from these locations. Desert-adjacent areas will be majorly affected by climate change, but the current emissions from these areas are minor. This lack of geographical links between emissions and consequence means that there are fewer built-in incentives to use when formulating climate communication. Instead, solidarity with vulnerable countries and future generations is used to create incentives that will appeal to citizens in Sweden, for example. Climate communication seems to constantly grapple with this lack of connection between emissions and their long-term effects, which will primarily affect others. In the case of antibiotics, on the other hand, there are many individual and local connections between cause and effect that ought to constitute a good foundation for communication strategists in their work to prevent or mitigate the post-antibiotic era.

REFERENCES

Literature

Alftberg, Åsa & Hansson, Kristofer (2012): Introduction: Self- care Translated into Practice, *Culture Unbound. Journal of Current Cultural Research*, Vol. 4, pp. 415-424.

Alver, Bente Gullveig, Ryymin, Teemu & Fjell, Tove Ingebjørg (2013): *Vitenskap og varme hender: Den medisinske markedsplassen i Norge fra 1800 til i dag*. Oslo: Scandinavian Academic Press.

Alvring, Saga & Tängdén, Thomas (2017): Antibiotic Resistance: The Silent Tsunami, FutureLearn, MOOC, April 24th 2017. Uppsala: Uppsala University. https://www.mooc-list.com/course/antibiotic-resistance-silent-tsunami-futurelearn (12-20-2017).

AMR Review (2014): Antimicrobial Resistance: Tackling a crisis for the health and wealth of nations. London: The Review on Antimicrobial Resistance. https://amr-review.org/sites/default/files/AMR%20Review%20Paper%20-%20Tackling%20a%20crisis%20for%20the%20health%20and%20wealth%20of%20nations_1.pdf (12-20-2017).

AMR Review (2016): Antimicrobial Resistance: Tackling drug-resistant infections globally. London: The Review on Antimicrobial Resistance. https://amr-review.org/sites/default/files/160518_Final%20paper_with%20cover.pdf (12-20-2017).

Arvidson, Mats (2016): Det autoimmuna jaget: Om att sätta gränser, *Socialmedicinsk tidskrift*, Vol. 93, No. 3, pp. 280-287.

Baym, M., Lieberman, T. D., Kelsic, E. D., Chait, R., Gross, R., Yelin, I. & Kishony, R. (2016): Spatiotemporal microbial evolution on antibiotic landscapes. *Science*, (80-) 353, 1147 LP – 1151.

Beck, Ulrich (2000): *Risksamhället: På väg mot en annan modernitet*. Gothenburg: Daidalos.

Bengtsson, Ninna (2016): Många svenskar tror fel om antibiotika: ”Oroväckande”, *Svenska Dagbladet*, 11-17-2016.

Bergström, Göran & Boréus, Kristina (2005): *Textens mening och makt: Metodbok i samhällsvetenskaplig textanalys*. Lund: Student literature.

B, Katarina & Hansson, Christopher (2016): Theme: Tio fallstudier i medicinsk humaniora, *Socialmedicinsk tidskrift*, Vol. 93, No. 3, pp. 229-233.

Blaser, Martin J. (2014): *Missing Microbes: How the Overuse of Antibiotics is Fueling our Modern Plagues*. New York: Henry Holt and Company.

Blaser, Martin J. (2016); *Maktlös medicin: Antibiotikaresistens och vår hotade överlevnad*. Lidingö: Fri tanke.

Brenthel, Adam (2016a): *The Drowning World: The visual culture of climate change*. Lund: Lund Studies in Arts and Cultural Sciences.
Brenthel, Adam (2016b): Diversity must be embraced – even in bacterial community, *Sydsvenska Dagbladet*, 11-18-2016.
Brenthel, Adam (2017): Surgeon X: antibiotikaupplysning mot en mörk fond, *Vetenskap & Allmänhet*, 02-15-2017.
Brenthel, Adam & Hansson, Kristofer (2017a): Sluta med antibiotikaresistens i apokalyptisk dräkt, *Dagens Medicin*, 01-04-2017.
Brenthel, Adam & Hansson, Kristofer (2017b): Krigsmetaforer gör inte saken bättre, *Dagens Medicin*, 01-17-2017.
Brown, Nik & Nettleton, Sarah (2016): There is worse to come: The biopolitics of traumatism in Antimicrobial Resistance (AMR), *The Sociological Review*, Vol. 65, Issue 3, pp. 493-508.
Cohen, Mitchell L. (1992): Epidemiology of drug resistance: implications for a post-antimicrobial era, *Science (Washington)*, 257(5073), pp. 1050-1055.
Eliasson, Carina (2015): Antibiotikaresistens – ett hot mot mänskligheten , *Science Faculty Magazine*. http://sciencefacultymagazine.se/halsa/antibiotikaresistens-ett-hot-mot-manskligheten/ (12-21-2017).
Esposito, Roberto (2012): Immunization and Violence. I: Esposito, Roberto, Welch, Rhiannon Noel & Limb, Vanessa (ed): *Terms of the political: community, immunity, biopolitics*. New York: Fordham University Press.
EU (2016a): Action Plan Against the rising threats from Antimicrobial Resistance: Road Map. Brussels: European Commission. www.ec.europa.eu/health/antimicrobial_resistance/docs/roadmap_amr_en.pdf (12-20-2017).
EU (2016b): Evaluation of the Action Plan against the rising threats from antimicrobial resistance. Brussels: European Commission. www.ec.europa.eu/dgs/health_food-safety/amr/docs/amr_evaluation_2011-16_evaluation-action-plan.pdf (12-20-2017).
Fleming, Alexander (1945): Penicillin. Nobel Lecture, December 11, 1945. https://www.nobelprize.org/nobel_prizes/medicine/laureates/1945/fleming-lecture.pdf (12-22-2017).
The Public Health Agency of Sweden (2014): Svenskt arbete mot antibiotikaresistens. Stockholm: The Public Health Agency of Sweden.
The Public Health Agency of Sweden (2016a): Antibiotikaanvändning och antibiotikaresistens: Attityder och kunskaper hos ett slumpmässigt urval ur Sveriges befolkning mellan 18 och 74 år. Stockholm: The Public Health Agency of Sweden.

The Public Health Agency of Sweden (2016b): Analys av förutsättningar för att testa en ny ersättningsmodell för antibiotika. Stockholm: The Public Health Agency of Sweden.
Foucault, Michel (1993): *Diskursens ordning: Installationsföreläsning vid Collège de France den 2 december 1970*. Stockholm: B. Östlings bokförlag Symposion.
Hamilton-Miller, J.M.T. (1997): Living in the "post-antibiotic era": Could the use of probiotics be an effective strategy? *Clinical Microbiology and Infection*, Vol. 3, Iss. (1, pp. 2–4.
Kalmström, Peter (2016): Stoppa missbruket av antibiotika - vi behöver antibiotikan, *Sydsvenska Dagbladet*, 12-05-2016.
Larsson, Joakim (2014): Pollution from drug manufacturing: review and perspectives. *Philosophical Transactions B*, Vol. 369, Iss. 1656.
Liu, Rui & Lundin, Susanne (2016): Falsified Medicines: Literature review, *Working Papers in Medical Humanities*, Vol. 2, No. 1.
Martin, Emily (1994): *Flexible bodies: Tracking immunity in American culture from the days of polio to the age of AIDS*. Boston: Beacon Press.
MSB (2013): Antibiotikaresistens ur ett säkerhetsperspektiv. Stockholm: MSB. https://www.msb.se/RibData/Filer/pdf/27259.pdf (12-21-2017).
Nerlich, Birgitte (2009): The post-antibiotic apocalypse and the war on superbugs: catastrophe discourse in microbiology, its rhetorical form and political function, *Public Understanding of Science*, Vol. 18, No. 5, pp. 574-590.
Paxson, Heather (2013): *The Life of Cheese: Crafting Food and Value in America* (California Studies in Food and Culture) [Electronic resource]. California: University of California Press.
Pinder, Richard, Sallis, Anna, Berry, Dan & Chadborn, Tim (2017): Behaviour change and antibiotic prescribing in healthcare settings: Literature review and behavioural analysis. London: Public Health England. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/405031/Behaviour_Change_for_Antibiotic_Prescribing_-_FINAL.pdf (12-20-2017).
Pruden, Amy, Larsson, D.G. Joakim, Amézquita, Alejandro, Collignon, Peter, Brandt, Kristian K., Graham, David W., Lazorchak, James M., Suzuki, Satoru, Silley, Peter, Snape, Jason R., Topp, Edward, Zhang, Tong & Zhu, Yong-Guan (2013): Management Options for Reducing the Release of Antibiotics and Antibiotic Resistance Genes to the Environment, *Environmental Health Perspectives*, Vol. 121, No. 8, pp. 878-885.
The Government Offices of Sweden: Svensk strategi förarbetet mot antibiotikaresistens. Stockholm: Regeringskansliet. http://www.regeringen.se/4a8234/contentassets/7b70f26ea0e74e18ab6cd1cc5d3f030f/svensk-strategi-for-arbetet-mot-antibiotikaresistens.pdf (12-20-2017).

Swedish Government Bill 2016/17:50: Kunskap i samverkan – för samhällets utmaningar och stärkt konkurrenskraft. Stockholm: The Swedish Government.
Rothschild, Peter (2016): Vi måste sluta använda antibiotika i onödan, *Dagens Medicin*, 11-18-2016.
STRAMA (2005): STRAMA tio år. http://soapimg.icecube.snowfall.se/strama/STRAMA%2010%20ar.pdf (12-12-2017). Solna: STRAMA, The Swedish Institute For Infectious Disease Control.
STRAMA (2017): Framgångsfaktorer och utmaningar i lokalt arbete mot antibiotikaresistens. Solna: STRAMA, The Swedish Institute for Infectious Disease Control. http://strama.se/wp-content/uploads/2017/02/Framg%C3%A5ngsfaktorer-och-utmaningar.pdf (12-15-2017).
Taubes, Jacob (2009): *Occidental eschatology.* Stanford: Stanford University Press.
WHO 2014: Antimicrobial Resistance: Global report on surveillance. France: WHO. http://apps.who.int/iris/bitstream/10665/112642/1/9789241564748_eng.pdf (12-21-2017).
WHO (2015): *Global Action Plan on Antimicrobial Resistance*. Geneva: WHO. http://www.wpro.who.int/entity/drug_resistance/resources/global_action_plan_eng.pdf (12-23-2017).
WHO (2016): Draft political declaration of the high-level meeting of the General Assembly on antimicrobial resistance. Geneva: WHO. https://www.un.org/pga/71/wp-content/uploads/sites/40/2016/09/DGACM_GAEAD_ESCAB-AMR-Draft-Political-Declaration-1616108E.pdf (11-12-2017).
Wikström, Gabriel (2016): Ny strategi för att bekämpa antibiotikaresistens. Stockholm: The Government Offices of Sweden. 04-23-2016. http://www.regeringen.se/pressmeddelanden/2016/04/ny-strategi-for-att-bekampa-antibiotikaresistens/ (12-14-2017).
Williams, Raymond (1988): *Keywords: a vocabulary of culture and society*. London: Fontana.

Film

Contagion (2011): Directed by Steven Soderbergh. Hollywood: Warner Bros.
I Am Legend (2007): Directed by Francis Lawrence. Hollywood: Warner Bros.
När antibiotikan slutar verka (2016): SVT.
Pandemic (2016): Directed by John Suits. Hollywood: New Artists Alliance.
Resistance (2015): Directed by Michael Graziano.
Outbreak (1995): Directed by Wolfgang Petersen. Hollywood: Warner Bros.

Websites

www.antibiotikaellerinte.se, Strama Stockholm & The Swedish Association of Local Authorities and Regions (12-15-2017).

www.antibiotikaresistens.se, Bioglan AB (12-15-2017).

www.antibiotikasmart.se, Strama Stockholm & Sveriges Kommuner och Landsting (12-15-2017).

www.bbc.com/news/health-28098838, BBC, 2014, Antibiotic resistance: Cameron warns of medical 'dark ages' (12-15-2017).

www.folkhalsomyndigheten.se/skyddaantibiotikan/, The Public Health Agency of Sweden (12-15-2017).

www.smittsäkra.se, Gård & Djurhälsan and Växa Sverige in cooperation with the National Veterinary Institute. This page is funded by the Swedish Board of Agriculture (12-15-2017).

www.strama.se, Strama Program Council (12-15-2017).

www.youtube.com/watch?v=plVk4NVIUh8, The Evolution of Bacteria on a "Mega-Plate" Petri Dish (Kishony Lab). Director: Rick Groleau (12-06-2017).

www.vll.se/startsida/halsa-och-vard/smittskydd/infektioner-hos-barn, Västerbotten County Council (12-15-2017).

www.1177.se, The Swedish Association of Local Authorities and Regions (12-15-2017).