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Unpacking Rational Use of Antibiotics

Policy in Medical Practice and the Medical Debate

HEDVIG GRÖNDAL



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Abstract

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Rational use of antibiotics—using antibiotics only when needed and in the right way—is a prioritized goal in policy aimed at preventing antimicrobial resistance. A vast body of research is devoted to understanding why unnecessary antibiotics are prescribed. However, this research tends to treat the definition of rational prescribing as an unproblematic fact, which is given by evidence.

The thesis aims to sociologically unpack rational use of antibiotics as medical knowledge and a policy goal. One study examines how rational use of antibiotics in health care was established as a crucial part of AMR prevention in Sweden, and three studies, drawing on different materials, look at how rational antibiotic use for everyday infections is negotiated and performed in medical practice and the medical debate in Sweden. The thesis makes theoretic use of material semiotics and critical policy studies, which enables examination of how medical knowledge, medical objects and policy are performed in webs of relations between human and non-human actors.

The studies show that rational use of antibiotics for everyday infections is characterized by uncertainties and tensions. These cannot be reduced to medical professionals' ignorance, or to how non-medical factors influence medical practice. This implies that social factors are not enough to explain why medical professionals dismiss specific policy definitions of medically appropriate prescribing. Instead, the uncertainties and tensions characterizing rational antibiotic prescribing can be traced to the complex and contingent nature of medical knowledge and medical objects, as well as to the potentially conflicting risks that antibiotic prescribing involves. As a consequence, deviance from, or critique of, a specific definition of rational use of antibiotics may constitute a performance of rational use of antibiotics as a policy goal. In medical practice and the medical debate, rational use of antibiotics as a policy goal can draw on and work with mutable medical knowledge and objects, as well as conflicting medical risks. It is concluded that sociologists need to continue entering the seemingly pure medical sphere to critically investigate policy and policy goals that draw on medical knowledge and that, as such, appear to be neutral and undisputable.

Keywords: Antibiotics, Policy, Medical Sociology, Actor-Network Theory, Human-microbial relations, Antimicrobial Resistance, Everyday Infections, Material semiotics, Medical sociology, Medical objects, Medical technologies, Medical knowledge

Hedvig Gröndal, Department of Sociology, Box 624, Uppsala University, SE-75126 Uppsala, Sweden.

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List of Papers

This thesis is based on the following papers, which are referred to in the text by their Roman numerals.

- I Gröndal, H. (forthcoming) The emergence of antimicrobial resistance as a public matter of concern: A Swedish history of a “transformative event”. *Science in Context*.
- II Gröndal, H. (2016) Iscensättanden av halsfluss: relationella göranden av en sjukdom i medicinska praktiker. *Sociologisk forskning*, 53(3): 247-270.
- III Gröndal, H. (2018) Harmless, friendly and lethal: antibiotic misuse in relation to the unpredictable bacterium Group A streptococcus. *Sociology of Health & Illness*. Published online ahead of print.
- IV Gröndal, H. and Holmberg, T. (forthcoming) Aligning Policy and Patient Interests in the Age of Antimicrobial Resistance. *Submitted manuscript*.

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Abbreviations

ANT	Actor-Network Theory
AMR	Antimicrobial Resistance
EBM	Evidence-based medicine
GAS	Group A Streptococcus
Strama	The Swedish strategic programme against antibiotic resistance [Samverkan mot antibiotikaresistens]

1 Introduction

A few years ago, I attended a sociological seminar on ADHD. At the end of the session, one participant used the case of bacterial throat infection as a point of comparison to argue that while ADHD is a social construction, bacterial throat infection [halsfluss] is not. Unlike ADHD, the speaker claimed, diagnosis of bacterial throat infection is based on physical signs and results from a laboratory test. Therefore, the disease cannot be negotiated: its existence—and the need for treatment with antibiotics—is either confirmed or denied. After the seminar, the discussion on non-social bacterial tonsillitis condition bothered me. It made me think about what a disease is, what a laboratory test does, and what it means to say that some conditions are social constructions and others medical facts.

In one sense, the present thesis develops the discussion and my thoughts from that seminar—the studies included are concerned with the policy goal of rational use or rational prescribing of antibiotics in relation to everyday infections. The Swedish Public Health Agency writes that all prescribing of antibiotics should be rational: “antibiotics should be used only when it is needed and in the right way”.¹ Following this line of thought, using correct medical knowledge, adequate diagnosis and management of antibiotics will be carried out so as to achieve the policy goal of rational antibiotic use. Crucial to why the Swedish Public Health Agency insists that antibiotic use should be rational is the association between antibiotic consumption and development of antimicrobial resistance (AMR) on the individual and population level (cf. World Health Organization 2012). There is a broad international consensus among medical scientists, global organizations and national governments according to which prevention of AMR requires avoidance of unnecessary use of antibiotics. Medically appropriate, or rational, use of antibiotics is thus a prioritized goal in policy aimed at preventing AMR² (Laxminarayan et al. 2013, OECD 2016:4, World Health Organization 2012, 2015). In general, rational use of antibiotics is equated with management of infections in line with evidence-based guidelines (e.g., World Health

¹<https://www.folkhalsomyndigheten.se/smittskydd-beredskap/antibiotika-och-antibiotikaresistens/> Retrieved May 10, 2018. In relation to medical practice, rational use of antibiotics and rational prescribing of antibiotics are employed as synonyms both in policy discourse and in the present thesis.

² See Section 1.1 for discussion on that other terms than *rational* use sometimes are employed.

Organization 2015, Laxminarayan 2013). Through implementation of such guidelines in medical practice, the policy goal of rational use of antibiotics will be reached. Another measure promoted is use of laboratory tests in primary care, because if used in prescribed ways, they will increase diagnostic certainty (Laxminarayan et al. 2013, World Health Organization 2015). Importantly, in Sweden rational antibiotic prescribing has been a prioritized issue in health policy and politics. Forceful policy measures have been carried out, and since the 1990s, antibiotics consumption in primary care, especially for respiratory tract infections, has drastically reduced (Mölstad et al. 2017, Tyrstrup et al. 2016). In parallel, the AMR rate is low in Sweden (European Centre For Disease Control 2017a, Public Health Agency of Sweden and National Veterinary Institute 2017).

The notion of rational use of antibiotics follows the same logics as the discussion from the seminar on bacterial throat infection and ADHD. Similar to what the participant argued, a medically adequate diagnosis can be achieved by adhering to clinical criteria and using a laboratory test. However, research shows that, in medical practice, antibiotic prescribing tends to be irrational (Adriaenssens et al. 2011, Laxminarayan et al. 2013), despite available guidelines (Haeseker et al. 2012, Hawker et al. 2014, Tyrstrup et al. 2017). Studies from Sweden indicate that evidence-based guidelines for antibiotic prescribing are not fully implemented in primary care (Hedin et al. 2006, Hedin et al. 2014, Mölstad et al. 2009, Nord et al. 2013, Tyrstrup et al. 2016). An almost unlimited body of international research is devoted to understanding why unnecessary antibiotics are prescribed. Examples of determinants for irrational prescribing identified by research are medical professionals' ignorance, unjustified uncertainty or fear, time-pressure and social factors, such as the interactions between patient and doctor (cf. Broom et al. 2014, Butler et al. 1998, Cabral et al. 2015, Laxminarayan et al. 2013, Lopez-Vazquez et al. 2012, McKay et al. 2016, Stivers 2007, Tonkin-Crine et al. 2011). Moreover, a vast body of research describes the effect of different interventions on antibiotic prescribing (for overview articles, see Arnold and Straus 2005, Drekonja et al. 2015, Ranji et al. 2008). However, although these studies provide important insights into the complexities of antibiotic prescribing, they treat the definition of rational prescribing as an unproblematic fact, a fact given by evidence. This state of affairs depends on treating the character of medical objects, for example specific bacteria and infections, as medical facts too. By treating rational antibiotic prescribing and medical objects in this manner, previous research has left a crucial part of antibiotic prescription unanalysed. Instead of exploring why medical personnel deviate (or do not deviate) from medically correct prescribing, I have explored medically appropriate prescribing, or rational use of antibiotics, *per se*. My studies make theoretical use of material semiotics and critical policy studies, which enable examinations of how medical knowledge, medical objects and policy are performed in webs of relations between humans and

non-humans (developed in Chapter 4). Thus, I have investigated the policy goal of rational antibiotic prescribing as something that is produced in practices in which actors of various kinds actively participate.

1.1 Aim and research questions

This brief background illustrates how rational use of antibiotics as a policy goal draws on the notion that correct prescribing can be defined by medical evidence. Thus, rational prescribing will be achieved if medical knowledge is employed correctly, and as long as medical professionals are not ignorant or do not let non-medical factors influence their prescribing. The present thesis aims to sociologically unpack rational antibiotic prescribing as medical knowledge and a policy goal. To this end, it examines how rational antibiotic prescribing for everyday infections is performed in medical practice and the medical debate. As such, it intends to bring new insights to the understanding of rational use of antibiotics as medical knowledge and a policy goal. In particular, the thesis shows how deviations and critique from policy definitions of rational use of antibiotics can be understood as meaningful phenomena produced in practices, which are constituted by relations between human and non-human actors, for example, doctors, patients, bacteria, infections and laboratory tests. Given that most antibiotics in Sweden are being prescribed in outpatient care for respiratory tract infections, this is the focus of my studies.

The aim is specified through the following research questions:

- How and through what core processes did rational antibiotic prescribing become established as a solution for preventing AMR in Sweden?
- How do humans and non-humans take part in performing an everyday infection in the diagnostic work at a healthcare centre, and what are the consequences for definitions of rational use of antibiotics?
- How do different ways of relating to a specific bacterium influence definitions of rational antibiotic prescribing for an everyday infection?
- How are different risks and demands managed by doctors in relation to antibiotic prescribing for respiratory tract infections in everyday doctoring?

In the thesis, I employ the term *rational* use/prescribing of antibiotics, which is often used in Sweden to describe medically appropriate use or prescribing, and as the opposite of misuse, overuse, or unnecessary use of antibiotics.

However, the preferable use of antibiotics is conceptualized differently between and within contexts. For example, the World Health Organization (2015) writes that the use of antimicrobial drugs needs to be *optimized* (here, however, they also refer to rational use); in the Swedish action plan on AMR (Socialdepartementet 2016), it is stated that antibiotic use needs to be *responsible*. In English-speaking parts of the world, the term *prudent* use of antibiotics is commonly employed. In relation to antibiotic prescribing in health care, all of these terms refer to the medically correct ways in which antibiotics should be used in the context of AMR.

By *policy* I mean directives or principles that are established to guide practices and decision-making—such as strategy documents or action plans—that are implemented through, for example, guidelines and protocols. In the theory chapter, I develop my theoretical understanding of policy, and policy goals, as something that needs to be performed by local actors through specific practices.

The research questions are addressed by four separate studies. The first study is a historical investigation of the emergence of AMR as a public matter of concern in Sweden—a concern caused by unnecessary use of antibiotics. This study contextualizes Study II-IV, which focus on how rational antibiotic prescribing is performed in medical practice and the medical debate. Study II is an investigation of the diagnostic practices for throat infection at two healthcare centres and the human and non-human elements that take part in these practices. Study III examines a medical controversy concerning evidence-based guidelines for throat infection, which centres around two different ways of relating to the bacterium Group A streptococcus. Finally, Study IV analyses interviews with general practitioners about antibiotic prescribing and the different risks and demands of everyday doctoring. The data used in the studies are rich and varied: The studies use historical material (from archives, newspapers and medical journals, as well as interviews with the persons initiating AMR policy work in Sweden), ethnographically inspired data from observations in healthcare centres, interviews with nurses and doctors, evidence-based guidelines and articles from the Swedish medical journal *Läkartidningen* [*The Doctors' Journal*]. In this manner, policy for rational use of antibiotics is investigated in relation to different practices and in different arenas, in a variety of settings, and using different datasets. However, the studies do not seek to give a complete picture of rational antibiotic prescribing, but should instead be read as a set of cases offering insights into how the policy goal of rational use of antibiotics for everyday infections can be negotiated and performed.

1.2 Disposition

The thesis is organized as follows: In Chapter 2, I contextualize my studies through a description of Swedish healthcare organization and the place of policy for rational use of antibiotics within it. Here I show that rational prescribing of antibiotics is a prioritized issue in Swedish health policy. In Chapter 3, I relate my studies to previous research. I start by reviewing studies on social aspects of antibiotic prescribing. While this research presents antibiotic prescribing as a complex sociological phenomenon, it treats the actual definition of rational, or medically correct prescribing, as an unproblematic fact. Because, in contrast to this research, I have investigated rational antibiotic prescribing *per se*, I relate my studies to sociological research on external regulation of medical practice and its consequences for medical knowledge. In light of this literature, policy for rational use of antibiotics can be understood as potentially involving a turn from medical professionalism to population-based medicine. This literature makes evident that definitions of rational use of antibiotics can draw on different types of medical knowledge and prioritize different medical risks. In the next chapter, I outline the theoretical framework that allows me to study rational use of antibiotics—as a policy goal and as medical knowledge—as something that is performed in practices constituted by humans and non-humans. The theoretical framework enabling this is critical policy studies and material semiotics. A chapter on material and methods follows. Here I account for the material and methods used in the project as a whole and describe how a material semiotic approach has guided my studies. I then summarize my four studies. The introductory part of my compilation thesis ends with a concluding discussion, in which I answer the research questions and thereby the aim of the thesis. Here, I argue that uncertainties and tensions are part of—not antithetical to—rational use of antibiotics. Accordingly, they cannot be reduced to medical personnel’s ignorance of the relation between AMR and antibiotic prescribing, lack of knowledge on how prescribing should be carried out, nor to how social or other non-medical factors influence prescribing. Instead, uncertainties and tensions are consequences of the complexities of medical practice, where different medical risks, as well as mutable medical objects, need to be managed. Thus, rational use of antibiotics can be performed even when specific definitions of such use are abandoned, problematized and criticized. To conclude, I argue that rational use of antibiotics, as a policy goal, can in practice draw on and work with mutable medical knowledge and objects, as well as conflicting medical risks.

2 Swedish healthcare organization: contextualizing policy for rational use of antibiotics

In this chapter, I contextualize my studies by situating policy for rational use of antibiotics in the Swedish healthcare organization. I first briefly describe how Swedish healthcare is organized. I then describe policy for rational use of antibiotics in the Swedish healthcare organization. Here, I also put Swedish antibiotic consumption and rate of AMR in an international context. In order to assist readers with limited experience on how healthcare for everyday infections is generally carried out in Sweden, a short section on antibiotic prescription at the healthcare centres follows.

2.1 Swedish healthcare organization

Swedish healthcare has historically been characterized by its position at the core of the Swedish welfare state. As such, it has been structured around principles of universalism and equity (cf. Magnussen et al. 2009, see also Esping–Andersen 1990). These ideals have been mirrored in that healthcare is publicly run and financed through taxes (Glenngård et al. 2005). However, in the past decades, Sweden (as well as the other Nordic countries) has undertaken major changes in its welfare and healthcare systems (Magnussen et al. 2009, Martinussen and Magnussen 2009). These changes are driven by goals to reduce constantly increasing costs coupled with broader ideological changes emphasizing freedom of choice (Bergh 2015, Johansson Krafve 2015). For example, the possibility of establishing private healthcare facilities increased in Sweden in the 1990s, especially in primary care (Hagen and Vrangbæk 2009, Martinussen and Magnussen 2009). In addition, cost control through reforms influenced by New Public Management has been evident (Magnussen et al. 2009:4).

However, today the Swedish healthcare system is still mainly publicly run and financed by taxes. Twenty-one separate county councils have the mandate to raise taxes in order to finance the county's healthcare and to largely decide how healthcare should be organized in their region. Thus, on the one hand, Swedish healthcare is largely de-centralised. On the other, since the

1990s, the central government and national official bodies have become more active in formulating programmes aimed at controlling healthcare nationally. For example, programmes linked with grants have been increasingly common and are aimed at steering the healthcare carried out in the county councils in certain directions (Glenngård et al. 2005, SOU 2017:48). Thus, there are indications that the high decentralization in Sweden is being somewhat reversed (cf. Martinussen and Magnussen 2009).

On a national level, overall goals and policies as well as legal frameworks for healthcare are established, and this national level also involves coordination, education, licensing and control over healthcare (Glenngård et al. 2005, Hagen and Vrangbæk 2009). There are a number of laws regulating Swedish healthcare. The Swedish Health and Medical Services Act (2017:30) [Hälsö- och sjukvårdslagen] states that healthcare should be of good quality and accommodate patients' need for safety and continuity. The Patient Act (2014:821) [Patientlagen] contains specific regulations intended to consolidate the importance of the patient and increase the amount of participation. Here it is also stated that all treatment should be based on science and recognized, sound medical practices [beprövad erfarenhet]. Systematic patient safety efforts are further directed through the Patient Safety Act (2010:659) [Patientsäkerhetslagen], which also regulates proposed measures to be taken against caregivers and healthcare personnel if these obligations are not met. There are also a number of more specified laws, regulating specific areas and aspects of healthcare (SOU 2017:48).

On a national level, the Ministry of Health and Social Affairs [Socialdepartementet] serves to realize the political healthcare goals set by the Swedish parliament and government. This ministry deals with policy and legislation in healthcare, social welfare services and health insurance. The Ministry of Health and Social Affairs collaborates with several other government bodies. The National Board of Health and Welfare [Socialstyrelsen] manages implementation of public policy matters and legislation in healthcare and social welfare services. It follows up and evaluates healthcare services in relation to the goals laid down by the Swedish government. It is also the licencing authority for physicians and can revoke licences in cases of malpractice (SOU 2017:48). In 2013, The Health and Social Care Inspectorate [Inspektionen för vård och omsorg] was constituted as a government agency responsible for supervising healthcare, a task that previously belonged to the National Board of Health and Welfare.³

The Public Health Agency [Folkhälsomyndigheten] was founded in 2014 when the previous Swedish Institute for Infectious Disease Control [Smittskyddsinstitutet] and the National Public Health Institute [Statens folkhälsoinstitut] were merged. This agency has national-level responsibility

³ <https://www.ivo.se/om-ivo/other-languages/english/> Retrieved May 10, 2018.

for public health and disease control.⁴ Another governmental agency central to healthcare is the Medical Products Agency [Läkemedelsverket], which is responsible for regulation of, surveillance of the development of, manufacturing and sale of drugs and other medical products. The Medical Products Agency is also responsible for providing independent information on pharmaceuticals and for facilitating improved use of pharmaceuticals.⁵ Together with healthcare specialists, the agency develops and distributes treatment recommendations for different conditions (SOU 2017:48).

2.2 Rational use of antibiotics in Swedish healthcare

2.2.1 Antibiotic consumption in healthcare and AMR in Sweden: international perspective

Antibiotic use differs substantially between countries. In 2016, antibiotic consumption in the community (outside of hospitals) in Europe, estimated using DDD (defined daily doses per 1000 inhabitants per year), ranged from 10.4 in the Netherlands to 36.3 in Greece. The mean in the European Union was 22.9 DDD. Sweden had the second lowest antibiotic consumption in the European Union (together with Estonia)—12 DDD (Norway, 15.2, Denmark 15.9, Finland 16.5). Between 2012 and 2016, the trend was towards decreasing antibiotic consumption in Sweden, Norway, Finland and Luxembourg, and increasing consumption in Greece and Spain. In addition, there is also a difference between countries regarding what kinds of antibiotics are most commonly used. Penicillin, which targets a limited set of bacteria, is preferable to broad-spectrum antibiotics as concerns resistance. From an international perspective, a large proportion of prescribed antibiotics in Sweden belong to the penicillin group (European Centre for Disease Prevention and Control 2017b).

Moreover, antibiotic resistance rates vary widely across the world. The European Centre for Disease Prevention and Control produces annual reports on antibiotic resistance in Europe. In general, the resistance rate in Europe is highest in the south-eastern parts and lower in the north. Sweden has a low resistance rate from an international perspective. However, resistance rates vary across bacterial species. Additionally, the rate varies depending on the substance of antibiotics used to measure resistance. For the most common bacteria causing lower urinary tract infection, *E. coli*, the rate of resistance to the antibiotic quinolones in invasive isolates, mostly used when a urinary

⁴ <https://www.folkhalsomyndigheten.se/om-folkhalsomyndigheten/vart-uppdrag/> Retrieved May 10, 2018.

⁵ <https://lakemedelsverket.se/overgripande/Om-Lakemedelsverket/> Retrieved May 10, 2018.

tract infection affects the kidneys, varied in 2016 between 4.6% of the isolates in Iceland to 43% in Cyprus. The reported rate in Sweden was 13.7%. For *S. pneumoniae*, the main bacterial agent causing pneumonia, the rate of isolates non-susceptible to penicillin varied in Europe in 2016 from 0.4% in Belgium to 41.1% in Romania, and the reported rate in Sweden was 7.1% (European Centre for Disease Prevention and Control 2017a).

Several countries have developed and implemented national strategies to prevent AMR and unnecessary use of antibiotics. However, as shown by Bonk (2015), the effects of such strategies on antibiotic prescribing tend to be uncertain. For example, in Great Britain antibiotic consumption in humans increased despite a national action plan and structural interventions meant to optimize prescription practices. Nevertheless there are also examples where policy measures appear to have had an impact: For example, during the beginning of the 21st century, in France, prescription of antibiotics for humans was reduced by 15–20 % in the community (Bonk 2015).

2.2.2 Policy for rational use of antibiotics in Swedish health care

A report from the Swedish Public Health Agency states that the public threat posed by AMR and the importance of rational use of antibiotics were recognized and taken seriously early on in Sweden. This is, according to the report, mirrored in the past decades of forceful, strategic and successful AMR prevention that has taken place in the country (Folkhälsomyndigheten 2014). According to the Swedish strategy to combat antibiotic resistance (Socialdepartementet 2016), there is a broad political consensus in Sweden regarding the importance of AMR prevention (see also Folkhälsomyndigheten 2014). The first national action plan for AMR was published in 2000, and since 2005 there has been a national strategy for AMR prevention enacted by the Swedish government.

Several government authorities are responsible for AMR prevention through the promotion of rational use of antibiotics in Swedish healthcare. Most important are The National Board of Health and Welfare, The Public Health Agency and the Medical Products Agency. Antibiotic consumption and AMR rates are continuously monitored by the Public Health Agency (Folkhälsomyndigheten 2014:26). The National Board of Health and Welfare and the Medical Products Agency are responsible for developing and distributing evidence-based recommendations for management of infections and antibiotics in healthcare. The organization Strama—the Swedish strategic programme against antibiotic resistance [Samverkan mot antibiotika-

resistens]⁶—has been central for Swedish AMR prevention, especially for its pursuit of rational use of antibiotics in Swedish healthcare (see Study I). Strama was founded in 1995 as a voluntary network, consisting mainly of medical doctors and representatives of governmental agencies. The development and growth of Strama have paralleled a radical reduction in antibiotic consumption in outpatient care. Strama works both at the national and local level, and exchange between these levels is described by the Public Health Agency as crucial to the organization’s success (Folkhälsomyndigheten 2014, see also Mölsted et al. 2017). Strama has been active in putting the threat of AMR, as well as the goal of rational antibiotic use, on the public and political agenda. The organization has also, in cooperation with other official authorities, been central in developing treatment recommendations for infections (which are described in more detail below), and in national and local monitoring of AMR. Since 2010, Strama’s steering group (now called the Cooperation Group for Strama Issues) has been incorporated into the Swedish Institute for Communicable Disease Control (now the Public Health Agency).

Strama has local groups in all Swedish county councils. In general, medical professionals from different specialities as well as pharmacists take part in these groups. The local groups support implementation of rational antibiotic prescribing in various ways. They collect local data on AMR and antibiotic consumption and make out-reach visits to healthcare centres and hospital departments. During such visits, feedback on antibiotic prescribing and resistance is distributed to medical professionals. The local groups also circulate national guidelines for management of infections, and organize education and workshops on rational prescribing of antibiotics. At such workshops, local adjustments to national guidelines are sometimes developed. In addition, Strama has developed information and educational material about AMR and rational antibiotic prescribing to the public (Folkhälsomyndigheten 2014, Mölsted et al. 2017).

2.2.3 National treatment recommendations for infections in outpatient care

A crucial part of Swedish efforts to promote rational use of antibiotics for everyday infections is the development and distribution of evidence-based national recommendations for management and treatment of infections in outpatient care. The Medical Products Agency develops these recommendations together with Strama. The recommendations are produced during

⁶ Strama was initially the abbreviation for the strategy group for rational antibiotic prescribing and reduced antibiotic resistance [Strategigruppen för rationell antibiotikaanvändning och minskad antibiotikaresistens].

meetings with experts from different medical specialties. For example, when the recommendation for throat infection was developed, general practitioners, ear, nose and throat specialists, infection specialists, microbiologists and pharmacists took part. Before these expert meetings, the participants write evidence-based “background documents” dealing with different aspects of the condition. The expert meetings are organized to run for two days. Initially the experts present the background documentation, and then they discuss adequate and evidence-based recommendations until consensus is reached. After the meeting, the recommendations are summarized and sent out to all experts for comments.

When the recommendations are finalized, they are published by The Medical Product Agency. In parallel, and as described above, local Strama groups spread the recommendations to healthcare. The recommendations are also summarized in easy-access formats, as brochures that can be carried in healthcare professionals’ pockets. Such brochures are distributed to healthcare centres across the country by Strama, The Medical Products Agency and The Public Health Agency (Folkhälsomyndigheten 2014).

2.2.4 Prescribing antibiotics for everyday infections

In Sweden, a physician’s prescription is required in order for a patient to receive antibiotics. As stated above, outpatient care, more specifically primary healthcare, is where a majority of all antibiotics in Sweden is prescribed (Public Health Agency of Sweden and National Veterinary Institute 2017). A patient’s first healthcare contact is normally within a primary healthcare centre, where most everyday infections are managed. Here, patients meet a general practitioner (a specialist in general medicine) or sometimes, initially, a district nurse. Most visits are booked beforehand via telephone. On the phone, a nurse assesses whether the patient needs an appointment at all and if so when, or whether the patient is in need of immediate care at a hospital. At the healthcare centres, general practitioners work in group practices, mostly together with several other professionals such as district nurses, physiotherapists, psychologists, etc. The personnel at the healthcare centre are employed—private practitioners with their own clinics are unusual. From primary care, patients can be referred to specialized hospital care. In most county councils, however, individuals can also seek care directly from hospitals at emergence units (cf. Glenngård et al. 2005). In addition, the possibility of receiving web-based healthcare has recently emerged, and antibiotics can in some cases also be prescribed after diagnosis via an on-line encounter with a doctor.

To sum up, the Swedish healthcare organization has taken its present form owing to its position at the core of the Swedish welfare state. Swedish healthcare is still mainly publicly financed and run, as well as largely

decentralized. However, during recent decades, cost-control reforms, increasing centralization, and increased possibilities to establish private facilities have been evident. As for rational use of antibiotics, this is a prioritized issue in healthcare policy and politics, and the organization Strama has been important in ensuring this state of affairs. Importantly, this prioritized position appears to have had an effect on both antibiotic consumption and antibiotic resistance, which are low from an international perspective.

3 Social science perspectives on policy for rational antibiotic prescribing

In this chapter, I situate the thesis in the context of previous research. First, I describe how scholars have problematized antibiotic prescribing as a straightforward endeavour to apply medical knowledge. Although these studies handle antibiotic prescribing as a sociological phenomenon, which is complicated by social factors, they tend to treat the medical knowledge of (rational) prescribing as a given. As such, they differ from my studies, in which I investigate the medical knowledge(s) of rational use of antibiotics and how it is (they are) produced in specific practices. I therefore relate my studies to a different body of sociological literature, focusing on medical knowledge and external regulation of medical practice. According to this research, increased external regulation of medical practice has emerged together with a knowledge shift. This shift has led to epidemiology, statistics and health of populations being prioritized over medical professional's clinical experience and observations from individual patients. In light of this literature, policy for rational use of antibiotics appears to be part of a broader development, involving a focus on population health and the prioritization of specific forms of (statistic) knowledge. Importantly, this literature reveals that rational use of antibiotics may be constructed differently depending on the prioritized knowledge and risk. In the last section, I review research discussing how policy is implemented or used in medical practice. This research shows that medical practice, despite the increased external regulation, is characterized by several knowledges, demands and rationalities, which is why the effects of policy on medical practice remain uncertain. Policy has to be actively employed by medical personnel and can be employed in various ways. This research opens the door in particular to studies of the situated doings of rational use of antibiotics.

3.1 Social aspects of antibiotic prescribing

On the one hand, the sociological literature on antibiotic prescribing is small. As such, antibiotic prescribing seems to be a matter of limited sociological interest. On the other hand, there do exist studies arguing that prescription of antibiotics is complicated by social factors. Thus, in this research, social aspects are used to explain medically inappropriate prescribing. Timmermans and Oh (2010) state that antibiotics, given its characterization as a magic bullet that makes previously incurable infections curable, was crucial to the privileged position of physicians and the “golden age of medicine” (cf. Bud 2007). They further state that physicians’ position as mandatory passage points for antibiotic prescription have helped them to “maintain their authority with individual patients at a time when the public lost faith in the general professions of medicine” (Timmermans and Oh 2010:100) Along these lines, Butler et al. (1998) argue that antibiotic prescribing has a symbolic effect on the doctor-patient relation. As a consequence, in contradiction to their medical knowledge, doctors might prescribe antibiotics in order to maintain their relationship with their patients, who might expect antibiotics. Inappropriate prescription of antibiotics is thus, according to Butler et al., a *cultural* problem.

Another scholar examining antibiotic prescribing as a social endeavour is Stivers (2007:185⁷), who focuses on the interaction in the medical encounter. Stivers argues that the root of antibiotic misuse can be traced to “a micro-level problem in social interaction”. In line with Butler et al. (1998), she states that doctors generally know they are making a medical mistake when they prescribe unnecessary antibiotics to children with viral respiratory tract infections. However, Stivers shows how the social interaction between parent and doctor influences the consultation and potentially makes doctors act in opposition to their medical knowledge, with antibiotic misuse—prescriptions of antibiotics for viral infections—as a consequence. More specifically, she demonstrates how physicians tend to interpret parents’ interactional strategies as expressing a desire for antibiotics, causing doctors to prescribe antibiotics even when they are not needed. Stivers argues that, due to the structure of these interactions:

the diagnosis and treatment of upper respiratory tract infections is not simply the result of applying a clinical algorithm. Rather, the diagnosis and treatment are arrived at in and through a moment-by-moment interaction with the parents and children (Stivers 2007:185).

Misuse of antibiotics is thus the consequence of the complexities of the social interaction in the medical encounter, and therefore, according to Stivers,

⁷ See also Stivers 2002 and 2005.

it is a sociological issue. Stivers argues that interactional negotiation surrounding antibiotics, and how it might end up in misuse of antibiotics, represents a social dilemma. This social dilemma concerns how antibiotic prescribing might pit the common good—avoidance of AMR—against requests and risks connected to the individual patient. Thus, due to the risk of AMR, antibiotic prescribing might pit an individual rationality and a collective rationality against each other (Stivers 2007).

The notion of how antibiotic prescribing potentially pits the individual patient and the common good against each other has also been developed in other studies investigating the social dimensions of antibiotic prescribing. In a study of hospital doctors, Broom et al. (2014) showed that while these doctors considered AMR to be important in principle, they perceived it as of limited concern at the actual bedside, where the risks connected to the patient were instead prioritized. Broom et al. (2014) use a social explanation for the doctors' way of prioritizing. They argue that it is a consequence of the "habitus of the social world of the hospital" (2014:87) and "the game", which is "more geared toward protecting patients, managing time pressures, gaining and achieving social capital, and expressing a benevolent identity, than it is about the threat of antimicrobial resistance". In this way, Broom et al. (2014) treat medically inappropriate prescribing of antibiotics (which they term "sub-optimal") as a given and as caused by the social nature of prescribing antibiotics. In a similar fashion, Cabral et al. (2015) found that doctors tend to prioritize the risk of harm to individual children with respiratory tract infections over the risk of AMR to society. Cabral et al. (2015) trace this way of prioritizing to the social construction of children as vulnerable individuals in need of protection from adults.

Even though it is limited, this literature is important to the present thesis. The studies referred to above show that antibiotic prescribing is not a straightforward medical matter of employing a clinical guideline, but a complex endeavour that might involve several and potentially conflicting risks and demands that need to be managed—especially in the interaction between doctors and patients. I have made use of these insights in order to examine rational use of antibiotics in practice. However, when social explanations are employed in attempts to explain why antibiotic prescribing is medically inadequate, or why doctors prioritize specific risks, the medical aspects of prescribing and the definition of medically correct prescribing are treated as unproblematized facts. Departing from these studies, I expand the sociological frame to investigate how the actual definition of rational antibiotic prescribing is negotiated and produced in specific locations and practices. I therefore draw on a different body of sociological literature, which problematizes medical knowledge and shows, in particular, how policy involves prioritizing specific medical knowledge and risk.

3.2 Policy, evidence-based medicine and medical knowledge

In my studies, I examine medically appropriate—rational—antibiotic prescribing and how it is produced. As such, my studies are concerned with medical knowledge. Although the specific studies on antibiotic prescribing, described in the previous section, do treat medical knowledge about prescribing as a given, medical knowledge and medical objects have been investigated and destabilized in a large body of sociological literature (see, e.g., Foucault 1963/1993, Atkinson 1995). I, however, situate my studies in the context of a specific sociological discussion on medical knowledge and external regulation of medical practice. This literature (cf. Armstrong 2002, Harrison 1998, Lambert 2006, Timmermans and Kolker 2004) describes a shift in the medical knowledge base: *from* medical professionals' clinical experiences and observations of individual patients *to* epidemiology and statistics, which have evolved together with increasing external regulation of healthcare. The sociological discussion on this shift can bring new insights to the study of rational antibiotic prescribing.

While medical sociologists have described the medical sphere as historically relatively unregulated from the outside, they have also recognized that this state of affairs is changing (cf. Armstrong 2007, Bradby 2012, Nettleton et al. 2008, Numerato et al. 2012, Waring et al. 2016). Thus, various researchers have argued that, to an increasing extent, medical practice is being externally regulated through policy, which is implemented through guidelines, audits, and other systems for governing and monitoring medical practice (Bradby 2012, Harrison 1998, Nettleton et al. 2008, Numerato et al. 2012). Owing to this change, how medical practice should be carried out is no longer a matter for the medical profession only. Importantly, scholars suggest that a shift in how medical knowledge and risk are valued and prioritized is key to this change.

The forces behind the development towards increasing external regulation of healthcare are several and they may, or may not, harmonize (Entwistle and Matthews 2015:1145). Contributing to this change are several factors: concerns about safety and quality, the need to rein in constantly increasing costs in a context of limited resources and aging populations, the ambition to increase patient involvement coupled with a general decrease in trust in doctors and increasing involvement of market forces in medical practice (Bradby 2012). Various researchers, however, have identified the rise and spread of evidence-based medicine (EBM) as a key to this development. Today, EBM is the predominating health policy (Dobrow et al. 2004, Lambert 2006, Nettleton 2006, Zuiderent-Jerak et al. 2012). The ideal of EBM is that medical professionals' decisions concerning individual patients should be based on the current best evidence. Current best evidence is

identified through a specific way of ordering and prioritizing evidence, where randomized controlled trials are placed at the top (cf. Bohlin 2011, Burns et al. 2011, Sackett 1996). EBM is typically implemented through formalized tools such as clinical practice guidelines or protocols intended to spread proven knowledge about diagnostics and therapeutics to the level of medical practice (Timmermans and Berg 2003). EBM can potentially make medical practice more transparent, and as such it enables external involvement and regulation by actors such as managers, patients or the state (Timmermans and Berg 2003:99). Armstrong states (2007:76) that, through EBM, “clinicians could more easily be held to account for their clinical decisions”.

Proponents of EBM argue that it makes medical practice better—it will be safer, more equal, and more (cost) efficient (cf. Sackett 1996). In the context of policy for rational antibiotic prescribing, both in Sweden and internationally, evidence-based guidelines have been identified as crucial for arriving at rational prescribing (cf. Laxminarayan et al. 2013, World Health Organization 2015). However, a large body of research in medicine as well as sociology has problematized and/or criticized the claims made by proponents of EBM. Of particular interest to my studies are scholars’ ideas about how the EBM promise of making medical practice scientific actually involves particular ways of valuing medical knowledge.

Scholars have argued that EBM fails to acknowledge the uncertainties that characterize the production of science, the ordering of evidence as well as the development of evidence-based guidelines and protocols. Harrison (1998) argues that EBM draws on naïve positivism and an assumption about scientific consensus that in practice seldom exists. In a similar fashion, Goldenberg (2006) argues that what constitutes evidence, and how evidence are ordered hierarchically in EBM, is not self-apparent. Instead, evidence from controlled settings must also undergo subjective interpretations, meaning that “There is always room for scientific disputes” (Goldenberg 2006: 2630).

Moreover, researchers who have empirically examined the processes through which evidence-based guidelines are created have confirmed these arguments. For example, van Loon and Bal (2014) argue that the collective process through which evidence is valued to create an evidence-based guideline is characterized by uncertainty (cf. Knaapen 2013). Moreover, according to Timmermans and Berg (2003), in the development of evidence-based guidelines, there is seldom enough evidence to cover all parts of a guideline. Instead there tend to be blank spots or conflicting evidence, which needs to be managed, often by consensus groups that discuss and negotiate how blank spots and conflicting evidence should be managed. Researchers have also problematized what constitutes evidence in EBM, or how EBM values evidence. For example, in their article tellingly entitled “Guidelines should reflect all knowledge, not just clinical trials”, Zuiderent-Jerak et al. (2012)

argue that the randomized clinical trial is not always the preferable way to gain knowledge regarding management of health issues (cf. Harrison 1998, Lambert 2006).

Given EBM's way of ordering evidence, Tanenbaum (2005) argues that it is a form of "epistemological politics". Thus, by conceptualizing EBM in this way, Tanenbaum claims that EBM is not simply a way of identifying the best evidence, or the best knowledge. Instead, EBM is normative: It privileges specific knowledge and knowers, while excluding others. In a similar way, Berg (1997) argues that EBM relies on an illusion, namely that through facts, one can identify a single optimal intervention for a medical problem. Thus, according to Berg, EBM obscures or disregards the fact that medical practice is characterized by several coexisting rationalities and knowledges.

How then can the epistemological politics of EBM be described? Scholars have characterised EBM as involving a shift in the medical knowledge base, because it prioritizes statistics, epidemiology, population health and epidemiology over clinical experience and pathophysiology (Armstrong 2002, Harrison 1998, Lambert 2006). Timmermans and Kolker (2004:198) write, "The randomized clinical trial has replaced the autopsy as the gold standard in medicine, and it has consolidated a quantitative, population-based way of looking at medicine and illness." Thus, with the advent of EBM, quantified data from large patient populations are prioritized over other forms of knowledge. Timmermans and Kolker argue that EBM involves the establishment of a new kind of clinical gaze, drawing on new technologies and priorities, and leading to new power relationships (cf. Armstrong 2002). Several scholars claim that the way in which statistics and epidemiology are prioritized in EBM is one reason why it is so often not implemented in medical practice. For example, Harrison (1998) argues that it is unlikely that physicians will prioritize knowledge that is based on epidemiology and the collective over their own clinical experiences and patient observations (cf. Armstrong 2002). Thus, there are obvious parallels between this discussion and the tension inherent in antibiotic prescribing, identified by Stivers (2007) as a social dilemma, where the common good is pitted against the individual. However, in relation to the sociological reasoning on EBM, this social dilemma can be seen as a tension between different kinds of medical knowledge that can be prioritized in various ways.

As noted above, researchers have argued that the shift from clinical experience and observations of individual patients to epidemiology and statistics is not limited to EBM, but part of a broader change. Focusing on British primary care, Gale et al. (2017) argue that while policy for this sector previously focused on provision of healthcare in response to patients' request, it is now more focused on clinical epidemiology and public health perspectives through preventative healthcare such as immunization, screening, prevention of chronic diseases (Gale et al. 2017). Checkland (2004) describes how British primary care has become more focused on preventive healthcare through

its use of clinical guidelines and quantitative measures of performance drawing on an epidemiological logic. He writes: "within general practice there is a move away from the traditional approach of treating patients who walk through the door, towards a clinic-based approach to groups of patients" (Checkland 2004: 954). McDonald et al. (2013) makes similar observations and conceptualizes it as a turn to "population-based medicine", which they contrast with traditional medical professionalism. Thus, while medical professionalism is ideally based on the best interest of the individual patient forming the basis for the medical professional's actions, population-based medicine instead prioritizes ensuring the best health outcomes for a given population.

In the context of this literature, policy for rational use of antibiotics appears to align with a broader development. Policy for rational use of antibiotics is a matter of external medical regulation and, in addition, aims to make doctors acknowledge not only the patient who is receiving healthcare, but also future patients for whom AMR is a risk. As such, AMR prevention potentially involves a tension between individuals receiving healthcare and the future collective need for efficient antibiotics (cf. Stivers 2007, Will 2017, Wood 2016). Instead of understanding medical professionals' management of this tension as a consequence of how non-medical factors influence medical practice, the tension can mirror the ambiguities that characterize (different types of) medical knowledge. Thus, the scholarship reviewed above enables an understanding of rational antibiotic prescribing as a matter of negotiating and prioritizing specific medical knowledge, knowers and risk.

3.3 Policy and population-based medicine in medical practice

As shown in the previous section, there exists a large body of sociological literature arguing that healthcare is increasingly externally regulated, and that this regulation tends to involve prioritization of epidemiological and statistical knowledge in medicine. While scholars in medicine as well as in the social sciences initially feared that medical professionals' freedom and autonomy would radically decrease due to increasing external regulation, empirical studies have shown that the effects of external regulation on medical practice are uncertain (see Timmermans and Kolker 2004 for a discussion). Thus, research has shown that the influence of policy on actual medical practice tends to have its limitations, and that tools at hand to implement policy, such as guidelines and protocols, are seldom applied as intended (Armstrong 2002, Berg 1997, Timmermans and Kolker 2004). This implies

that the knowledge shift described above does not necessarily dominate actual medical practice.

Studies show that policy is only one of several things that health personnel take into account when performing their work. For instance, McDonald et al. (2013) argue that although British healthcare has been subjected to reforms dominated by population-based medicine, such reforms do not influence all parts of medical practice. Instead, McDonald et al. state that the logic of medical professionalism, where doctors focus on interactions with individual patients, is present in parallel with population-based medicine, which involves other priorities and types of knowledge. As a consequence, McDonald et al. suggest that several logics co-exist in, and characterise different dimensions of, medical practice. In a similar fashion, Berg (1997) states that one feature of medical practice is the ways in which several “rationalities” co-exist. Thus, policy that accounts for only one rationality might, at least partly, be put aside (Berg 1997:1084, cf. Checkland 2004, Gabbay and Le May 2011). Researchers have also shown that different policies directed at medical practice might be in tension with each other. For example, in parallel with increasing demands for evidence-medicine, policy has been developed that promotes patient-centred care. While evidence-based medicine seeks to minimize variations in medical practice, patient-centred care rather draws on an ideal of care that accounts for the specifics of the individual patient (cf. Armstrong 2007).⁸ In a study of British general practitioners, Armstrong (2002) argued that a patient-centred approach could be employed in order to justify making exceptions from evidence-based medicine.

More specifically, the divergence from guidelines in practice has been accounted for in empirical studies showing how clinical experience and knowledge of individual patients are not simply being replaced by evidence and guidelines. Instead these appear to be complementary resources that sometimes draw on each other (Timmermans and Berg 2003, Timmermans and Mauck (2005). In relation to protocols intended to direct the action of medical personnel, Berg (1997:1082) writes: “Even if medical personnel are aware of their existence and “use” them, protocols are often circumvented, tinkered with, and interpreted in many different ways”. Thus, according to this scholarship, tools intended to make medical practice evidence-based are not passively implemented, but instead actively, and selectively, employed (cf. Timmermans and Berg 2003:99).

Importantly, this literature shows that professional discretion, or medical professionalism, is not in opposition to policy and guidelines: instead they can rely on each other. For example, in a study of medical protocols, Timmermans and Berg (1997) argue that one prerequisite for protocols to

⁸ See Lydahl (2017) for a discussion on how evidence-based medicine and patient-centred care are not simply opposites.

work is that they are modified. Thus, lapses might be necessary if the protocol is to be used. Protocols are according to Timmermans and Berg (1997:298), dependent on the “non-docility of the actants which populate these practices”. Tinkering, multiplicity and diversity are often fundamental for a technology or policy to work (cf. Timmermans and Epstein 2010:81).

In relation to the literature reviewed in this section, policy for rational use of antibiotics and especially guidelines aimed at implementing this policy goal need to be studied empirically. Specifically, the reviewed literature includes the ways in which tinkering with evidence-based guidelines, intended to rationalize antibiotic use, might be necessary for the guidelines to work at all, especially because medical practice is complex and characterized by several logics or rationalities operating at the same time.

3.4 Medical knowledge and medical objects

Taken together, this review demonstrates that antibiotic prescribing is not simply a matter of employing a medical algorithm, but a complex process and a sociological problem to be investigated. The research showing this, however, tends to treat the medical definition of rational antibiotic prescribing as an unproblematic fact. In this sense, rational antibiotic prescribing, and how it is produced in medical practice, appears to be a sociological blind spot.

I have also related my studies to the sociological discussion on external regulation of medical practice and (shifting) medical knowledge. This literature does not explicitly focus on prescribing of antibiotics, or policy concerning such prescribing. However, through it, rational antibiotic prescribing can be interpreted as potentially involving a tension between population-based medicine and more traditional medical professionalism. Thus, the review makes explicit how medical knowledge about rational prescribing is not necessarily a given, but might involve tensions between clinical experience and observations of patients and codified knowledge drawing on epidemiology and statistics. The reviewed literature also shows that, in medical practice, policy (and tools intended to implement policy) is employed in various ways, and thus needs to be studied empirically. In particular, this calls for research on the ways in which medical professionals manage and negotiate different types of knowledge and risk—such as clinical experience, observations of individual patients, evidence, guidelines and concerns for populations—when prescribing antibiotics.

However, while the reviewed literature problematizes medical knowledge, it does not focus on how policy and medical knowledge are co-produced with medical objects in actual medical practice. In my studies, I have investigated how medical knowledge concerning rational prescribing

of antibiotics occurs in and through non-human objects. For example, at the healthcare centre, laboratory tests, flow charts, thermometers and even bacteria play important roles. My studies address co-production of medical knowledge, policy and medical objects, as it emerges in interactions between various elements—human and non-human. Thus, I have investigated medical knowledge, medical objects and policy as highly practical endeavours and asked questions about the ways in which medical professionals negotiate rational antibiotic prescribing, not only with patients, but also in relation to clinical skills, specific tests, bacteria and more. In the next section, I will expand on this by outlining the theoretical framework used to make sense of rational prescription of antibiotics as a situated performance of policy, knowledge and medical objects, in which humans and non-humans take part.

4 Making sense of rational use of antibiotics: critical policy studies and material semiotics

In this chapter, I map out my theoretical framework and the concepts employed in the studies. To make sense of the notion that rational antibiotic prescribing is the co-production of a policy goal, medical knowledge and medical objects, I use scholarship from critical policy studies⁹ and Science and Technology Studies, in particular material semiotics. Drawing from critical policy studies, I employ the notion of policy as something that is performed in social practices. Through this theoretical framework, policy and specific policy goals are viewed as changing depending on how they are interpreted, communicated and negotiated by local actors. My studies, however, are concerned with performances of a policy goal that draws on medical knowledge, and in practice this policy goal is dependent on various non-human elements—such as laboratory tests, clinical skills and infections—if it is to be performed. As shown in the previous chapter, sociological studies of antibiotic prescribing tend to treat medical knowledge about rational antibiotic prescribing as an unproblematic fact given by evidence. To examine the sociological blind spot in relation to rational antibiotic prescribing, I need a theoretical framework that does not restrict my analysis to the social aspects of medical practice. By making use of material semiotics, I have been able to study rational antibiotic prescribing as a situated and practical performance, in which a complex set of elements—humans and non-humans, medical and social—take part and take form. After describing the broader theoretical framework, I relate it to the central concepts employed in my studies: public issue, microbiopolitics and alignment work.

⁹ The research field that I refer to as critical policy studies is not homogenous, but include various strands of policy research, referred to not only as critical policy studies but for example interpretative policy analysis and deliberative policy analysis. In line with Fischer et al. (2015) I however use the term critical policy studies to address the entire field and I do not intend to explore the variation within it.

4.1 Policy in practice

The present thesis is concerned with rational use of antibiotics as a policy goal. By policy, I am referring to directives or principles intended to guide practices and decisions—such as strategy documents or action plans—which in turn are implemented through application of, for example, guidelines and protocols. In general, entities such as governments, official authorities or organizations develop and implement policies. Rational use of antibiotics as a policy goal is evident both in the Swedish and the international context, in a large body of strategy documents and action plans and such like. For example, as described in the introduction, the Swedish Public Health Agency states that all antibiotic prescribing should be rational.

Although I refer to policy as directives or principles intended to guide local action in certain ways, theoretically I align with an understanding according to which policy is considered highly uncertain in practice. More specifically, I employ a notion of policy as something that is performed and re-performed in practice. This notion has been put forward in the field of critical policy studies, where it can be traced to the sociologist Lipsky's scholarship (cf. Freeman et al. 2011, Yanow 2015). In the late 1970s, Lipsky (1978, 1980) formulated a critique of Weber's bureaucracy theory. While Weber understood policy as something constant that is implemented in an a-political and administrative style, Lipsky instead claimed that policy is always the subject of local interpretations of the "street-level bureaucrats" — e.g., medical professionals—implementing it (cf. Yanow 2015:402). In this manner, Lipsky argued that policy is performed; it is *done and redone* by professionals in practice (cf. Jenkins 2007, Freeman et al. 2011:130). As such, policy is contingent: It changes depending on the practice in which it is performed. Other researchers have pointed out that not only professionals, but all involved actors, take part in the policy practice. Both providers and recipients of policy are "active and knowledgeable insiders who in fact make and transform policy in their interactions with it" (Kingfisher 2013:11-12). Thus, due to negations and interactions between local actors, policy and specific policy goals change (Jenkins 2007:34).

This scholarship thus opposes understanding policy as something that can be transferred to different local sites without being changed. As a consequence, boundaries between formulation and implementation of policy are blurred, and policy is seen as open-ended (Freeman et al. 2011, Lendvai and Stubbs 2007:175, Yanow 1996). Scholars have argued in particular that, because policy is something that is performed in situated and varied practices, it may be ambiguous. As such, policy is conceptualized by several scholars not only as contingent and changing, but as potentially multiple. This means that a given policy can be different things at the same time. Hodgson and Irving (2007) state that policy "is no single thing: its boundaries are

drawn and redrawn, in flexible, historically changing and sometimes ambiguous ways”. Moreover, Yanow (2015) argues that policy is not singular—instead it is constructed through the meaning-making practices constructed in potentially multiple readings (see also Kingfisher 2013, Lendvai and Stubbs 2009, Mosse 2005, Shore and Wright, 2011:20). Thus, due to social practices like meaning-making and interpretation, policy can be performed differently and as such different performances may be in tension with each other.

The notion that policy is performed—potentially in different and incoherent ways—is central to the discussion carried out in the present thesis. With this approach, rational prescription of antibiotics is, on the one hand, a policy goal that is articulated in official policy documents. As such, it is specified in, and hopefully realized through, specific treatment guidelines or interventions performed to decrease the number of antibiotic prescriptions. However, the policy goal of rational antibiotic prescribing is also more abstract. Policy for rational use of antibiotics only exists, or is only realized, in situated performances. As such, it can be performed differently in different sites, at least in theory.

Research in the critical policy studies field generally focuses on social aspects of policy practice; on what policy *means* for various human actors, how it is *communicated* and *interpreted* (cf. Fischer 2003:215, Yanow 1993, 2007, 2015, cf. how Clarke et al. 2015 use the terms translation and assemblage). However, the policy goal of rational antibiotic prescribing cannot be reduced to a social performance between humans. First, it is a policy goal that draws on medical knowledge, and second, this medical knowledge is negotiated and performed in practices in which more than human actors are involved. Laboratory tests, bacteria, infections and statistics all influence, in particular ways, what rational antibiotic prescribing is. Thus, I need a theoretical framework that enables sociological examinations of medical knowledge and medical objects. In order to examine rational antibiotic prescribing as it is produced in practices involving both social and seemingly non-social elements, I have turned to material semiotics.

4.2 Material semiotics: examining the situated co-production of medical objects and knowledge

Material semiotics derives from Science and Technology Studies, and in particular from Actor-Network Theory (ANT). Several scholars have pointed out that neither ANT nor material semiotics is a theory in the sense of describing how the world is constituted or making general claims about the world (Latour 1999b, Law 2004, Mol 2010). Law describes ANT as “a disparate family of material-semiotic tools, sensibilities, and methods of

analysis” (Law 2009: 24). However, these disparate sensibilities all share a number of crucial traits, which have guided the studies in the present thesis.

Material semiotics aligns well with an understanding of policy as something that is performed in practice. As example, Gill et al. (2017) conceptualize policy as a “distributed practice across heterogeneous actors, relations and spaces. Hence, there is no way to distinguish policy from its implementation; policy is practice and is thereby multiple, specific, situated configurations of relations and actors”. In material semiotics, policy is a situated, uncertain, potentially multiple and ambiguous *doing*. As stated by Singleton (2005:771) in a study of the UK New Public Health Policy, policy “does not survive its practices”. In Singleton’s study, this meant that although specific official policy documents offered a new approach to public health—which transgressed traditional boundaries and categories— in the practices where the New Public Health policy was performed traditional boundaries and categories were instead stabilized. As a consequence, the progressive potential embedded in the official policy articulations was not achieved.

Scholarship in critical policy studies and material semiotics has, however, generally involved some important differences. While critical policy studies focus on policy as performed in social practices involving human actors, material semiotics turns the idea of social practice on its head. As seen in Gill et al.’s quote above, material semiotic sees practices as heterogeneous. This means that practices are made of relations between humans and non-humans and that they are simultaneously discursive and material, social and natural, epistemological and ontological (cf. Asdal 2015, Law and Singleton 2014). For material semiotics, agency is not inherently human—as the outcome of human intention or subjectivity—but a relational effect. As a consequence, both humans and non-humans—e.g., texts, things and technologies—can be actors (Callon and Law 1995, Johnson 1988, Latour 1999b). However, material semiotics does not understand any thing(s) as acting by itself (themselves). Bacteria might be actors, as might doctors, but the agency of both doctors and bacteria is created in relations between guidelines, clinical signs, healthcare centres, laboratory tests, statistics, antibiotics and more. Importantly, bacteria and doctors also take part in creating each other’s agency (cf. Callon and Law 1995, Latour 1999a).

With material semiotics, it is impossible to draw clear boundaries between medical and social aspects of medical practice. Instead medical practice is understood as heterogeneous—as being constituted in webs of relations between various human and non-human actors. This has consequences for sociological research on medicine, because it allow us to investigate the seemingly “pure” medical sphere. In a classical article, Berg (1992) argues for sociological research that treats the social aspects and medical content of medical action symmetrically. Casper and Berg (1995:403) call for sociological research on the core of medical practice: “the effectuation, materialization, and transformation of scientific medical

knowledges as enacted on human bodies within particular contexts”. Timmermans and Haas (2008) similarly make a plea for a “sociology of disease” that investigates the biological and technical aspects of health and illness and their interplay with social aspects. Mol (2002), in her ethnographic study of atherosclerosis, criticizes the distinction between disease and illness, which has been employed by sociologists to differentiate between the social and medical dimensions of health conditions. Mol argues that, through this distinction, medical knowledge and medical objects have come to be out of reach for social scientists, as matters that can be investigated and discussed in the medical sphere only. All these scholars argue that material semiotics (or ANT) is a way for social scientists to enter the medical sphere and the coproduction of medical objects and knowledge.

The keys allowing material semiotics to break down categories as social and medical are anti-essentialism and performativity. For material semiotics, everything in the natural and social world is the effect of locations in webs of heterogeneous relations. The approach makes use of the semiotic notion that words acquire their meaning in relation not to the object they represent, but through their relation to other words (cf. Law 1999, Mol 2010). In contrast to semiotics, however, material semiotics does not apply this line of thinking to language or representations only, but extends it to materiality and reality. Also, things and objects are thought to take their particular form through their relations with other elements. As such, the production of reality is a practical matter that can be investigated empirically (cf. Law and Lien 2013). Importantly, in material semiotics *knowledge of reality* and *reality* are understood as being co-produced in specific practices (Law and Singleton 2014, cf. Latour 1987). Knowledge is thus seen as performative: the bringing of certain realities into being. Mol (1999:77) explains how knowledge is co-produced with reality, or rather, realities in practice:

[Reality] is manipulated by means of various tools in the course of a diversity of practices. Here it is being cut into with a scalpel; there it is being bombarded with ultrasound; and somewhere else, a little further along the way, it is being put on scale in order to be weighed. But as a part of such different activities, the object in question varies from one stage to the next.

Medical knowledge (and medical objects) is thus approached as produced or enacted in socio-material practices (Mol 2002, Mol and Elsmann 1996). Importantly, both humans and non-humans can be actors in these practices. Thus, not only doctors and nurses, but also for example medical technologies, drugs and bacteria can potentially take part in enacting medical phenomena in specific ways (Berner and Johnson 2012, Willems 1998). In line with this reasoning, the mundane events at a healthcare centre where bacterial throat infection is diagnosed, or a controversy in a medical journal

concerning treatment guidelines, are sites where medical knowledge(s) and medical objects are coproduced.

Importantly, and as emphasized in Mol's quote above, one consequence of material semiotic reasoning is that reality is not necessarily coherent—instead it might come with tensions and even contradictions. A specific bacterium or infection might be enacted differently in different practices (cf. Law and Singleton 2014, Mol 1999, 2002). As a consequence, rational antibiotic prescription may differ. Material semiotic scholarship has called for the need for policymakers to acknowledge the mutable, situated and potentially inconsistent or even contested character of reality (Hinchliffe 2001, 2007, Law and Singleton 2014). Law and Singleton (2014:391) write, “If we think we're dealing with a single reality when we try to implement a policy, then we're simply deluding ourselves”. This scholarship argues that instead of searching for closure regarding the character of natural and medical objects, policymakers should accept and work *with* the contingency and mutability of reality.

In this line of reasoning, rational antibiotic prescribing, and its relation to AMR, is a situated, fragile and highly practical matter that can be unpacked through studies of the specific interactions in which it is performed together with, for example, specific infections and bacteria. Various human and non-human elements—such as doctors, nurses, patients, bacteria, laboratory tests, diseases, guidelines etc. —become potential actors negotiating rational antibiotic prescribing. Because rational antibiotic prescribing is formulated as a policy goal for Swedish healthcare, these practices are also situated performances or enactments of this policy goal. This is how I have approached rational antibiotic prescribing in my studies.

4.3 Public issues: the production of policy problems

For critical policy studies and material semiotics, the emergence of scientific phenomena—such as AMR—as public and political problems in need of management through policy is not a given, but the result of uncertain and complex processes. Research in the field of critical policy studies has disclosed in particular how the definition of policy problems reflects and reproduces cultural, historical and socially specific knowledge and values (cf. Fischer et al. 2015, Fischer 2003:212, Hodgson and Irving 2007:197, Jenkins 2007, Kingfisher 2013:12). Thus, this scholarship shows how the definition of policy problems and their solutions are not provided by science alone (cf. Barbehön et al. 2015:246, Lövbrand and Stripple 2015:93, Åm 2015). Moreover, research in Science and Technology Studies has insisted on the complex relation between policymaking and science (Jasanoff 1999, 2004, Lindskog and Pleijel 2011:223, Lindskog and Sundqvist 2011: 14). In line

with critical policy studies, this research problematizes the belief that science is “speaking the truth to power”, as well as that the policy process involves a straightforward practice of identifying the most efficient way to manage problems (Haas and Stevens 2011). As example, in relation to environmental policy, Lindskog and Pleijel (2011:223) state that the relationship between science and policymaking is characterized by complex and dynamic interactions.

One way to make sense of the socio-material processes in which scientific entities are articulated as matters of widespread concern is through the concept of public issue (Asdal 2015, Hird et al. 2014, Latour 2007, Marres 2005a, 2005b, 2007). Public issues refer to scientific entities—previously closed off from outside involvement by the broader publics—that are opened up for outside involvement.

The emergence of a public issue means that something is articulated as not being sufficiently dealt with by existing institutions and, thereby, as urgent and unsettled. A public issue is open for wider public involvement through, for example, attention in the media and public debates (Marres 2005a). Here, the public issue can be problematized and questioned. However, and as pointed out by Latour (2007), issues are only public for a limited period of time (cf. Hird et al. 2014). Thus, an issue may also be constituted as having been dealt with, settled and normalized, and as such, it can be closed off from outside involvement (Asdal 2015, Latour 2007, Marres 2005a). The “detour of publicisation”, however, is generally crucial to the later settlement of an issue (Marres 2005a: 91, see also Study I).

The specific public that is mobilized by an issue does not exist beforehand, but is assembled, or “sparked into being” (2005b) *together* with the issue at hand (Marres 2005a, 2007, Latour 2005:814). In line with the material semiotic framework outlined above, however, the processes through which issues are formed are not solely social or discursive. Hird et al. (2014:447) write, “Emerging publics are not only assembled around arguments, values, and interests, but out of combinations of heterogeneous materials, processes, and nonhuman things”. A public issue brings heterogeneous actors together, and as such, the material semiotic constitution of the actual issue is contingent (Marres 2005a). Thus, using the concept of public issue, it is possible to make sense of policy problems, seeing them as the results of complex and heterogeneous processes through which the actual constitution of the policy problems, as well as their solutions, changes.

4.4 Microbiopolitics: managing human-microbial relations

As stated above, material semiotics enables an analysis of how humans, in mutual relations with non-humans, take part in performing rational antibiotic prescribing. Several scholars have argued that the attention given to AMR, and other emerging and re-emerging pathogens, during recent decades has developed together with "a conceptual revolution in microbiology" (Cooper 2006:115). While previously bacteria have primarily been understood as disease-causing invaders of human bodies, this conceptual revolution means that bacteria have emerged as our potential friends. Thus, quite paradoxically, the increasing attention given to AMR has developed together with an understanding of microbes as (potentially) beneficial for, and sometimes even parts of, the human organism (cf. Brown and Nettleton 2017:495).

One way to make sense of how human-microbial relations are understood as well as handled in socio-material practices—which are constituted by specific technologies, hygienic practices, and cultural understandings—is through Paxson's (2008) concept of microbiopolitics. The concept draws on Foucault's (2008) *biopolitics*, but refers to efforts to recognize and manage the relations between humans and microorganisms. In "Pasteurian" microbiopolitics, bacteria are primarily related to as enemies that need to be controlled and ultimately eliminated through antiseptic practices, antibiotics and vaccination. Paxson argues that a foundation for Pasteurian microbiopolitics is the ambition of taming the natural world, which is perceived as dangerously unruly and in need of human control. Consequently, in this microbiopolitics, the control of microbes is essential to the creation and maintenance of a well-ordered society (Paxon 2008:22, 2014).

Even though Paxson suggests that the logic of Pasteurian microbiopolitics dominates the contemporary view of microbes (cf. Tomes 1999 and Ingram 2011), she also acknowledges the shift described above. Thus, she states that Pasteurian microbiopolitics has been challenged due to developing notions of human-microbial symbiosis.¹⁰ In post-Pasteurian microbiopolitics, the positive potentials for human-microbial relationships are stressed. Here, benign microbes are potential friends that can be allied to protect against potentially dangerous microbes (see also Helmreich 2015, Ingram 2007, Paxson and Helmreich 2014). A main threat in post-Pasteurian microbiopolitics is the absence of microbes and disturbance of ecological balance due to obsessive hygiene and the imperialist notion that bacteria are our enemies. In this way, the post-Pasteurian way of relating to bacteria as potential friends

¹⁰ Important to note, as Sangeodeyi (2014:7) points out, is that "Microbes have always been spoken of in an 'idiom of promise'". For example, Pasteur empathized that microbes were necessary for human beings. In bacteriology, however, the focus has been on pathogens (Sangeodeyi 2014:23)

aligns with concerns about bacteria being threats to humans because they can develop resistance to antibiotics.

Microbiopolitics conceptualizes how human-microbial relationships are understood and managed, in practices that are at the same time material and social. Technologies that make microbes visible are crucial to both Pasteurian and post-Pasteurian microbiopolitics. Just as laboratories, agar gel and agar plates were necessary for the Pasteurian relation created with microbes together with bacteriology (Latour 1993), genetic mapping has created new possibilities to understand microbes as living in symbiosis with humans (Nerlich and Hellsten 2009). Moreover, the material practices of killing off, or feeding, (specific) microbes are part of the performances of microbiopolitics. At the same time, microbiopolitics are crucial to how humans relate to each other and the world (cf. Paxson 2008, Sangeodeyi 2014, Tomes 1999). Regarding post-Pasteurian microbiopolitics, Paxson and Helmreich (2014:188) linked it to “a broader environmentalist vision” and Sangodeyi (2014:139) to an understanding of nature under threat, which has become predominant in cultural, medical and scientific spheres. Microbiopolitics thus illustrates the material semiotic argument that humans as well as non-humans—such as bacteria, laboratories, and antibiotics—take part in creating the social.

4.5 Alignment work: stability through instability

A consequence of understanding policy and reality as being performed in various situated practices, and thus contingent and even potentially multiple performances, is that policy, medical knowledge and objects can be performed differently. Thus, ambiguities and inconsistencies can emerge (Gill 2017, Law and Singleton 2014, Singleton 2005). This evokes questions concerning how a seemingly successful policy project, such as efforts to reduce use of antibiotics in human healthcare in Sweden, can be understood. Mosse (2005:246) states that although a policy programme might appear to be a logical, universal and coherent whole, order is actually “produced through the messiness of contingent practice”. The quote illustrates a theoretical argument made by several material semiotic scholars, namely that instability and incoherence may not stand in opposition to stability and coherence. Instead instability may nourish stability.

In an influential study of the U.K. Cervical Screening Programme (involving screening women for early stages of cervix cancer)—which was described as successful in official narratives—Singleton and Michael (1993) and Singleton (1998) elaborate on this line of reasoning. They argue that despite the stories of success, *in practice* the programme was foremost characterized by inconsistency and ambivalence: For example, general

practitioners as well as laboratory personnel problematized and criticized the programme. Despite this, Singleton and Michael (1993: 241) argue that the inconsistencies and ambivalences did not lead to “uncontrollable complexity and betrayal” of the programme (cf. Singleton 1998). Instead the incoherence, in a paradoxical way, acted in a stabilizing manner. The main point made by Singleton and Michael is that the screening programme was not one single and coherent structure; instead it was created by inconsistent and ambivalent practices. In a later study, Singleton (2012:431) states: “Stability (an organization, an object, a protocol, a rule) [...] is accordingly always an achievement of instability and multiplicity” (see also Singleton 2005). Singleton’s argument is thus that for policy to “work” in practice, it *must* be accompanied by practical instabilities.

One way to conceptualize how doctors manage tensions between different ways of performing rational antibiotic prescribing is through the concept “alignment work” (Study IV). Alignment work refers to the discursive strategies used by doctors to align possibly incoherent risks and demands related to antibiotic prescribing. Thus, alignment work conceptualizes how rational use of antibiotics as a policy goal is a situated performance, involving negotiations and management of tensions. The tensions are the consequences of how doctors manage (potentially) conflicting medical knowledge, medical risks and demands, which are related to the patients receiving healthcare as well as AMR. Alignment work conceptualize how exceptions from and problematizations—and even critique of—policy might take part in aligning with and stabilizing the policy.

In sum, the concept of public issue has been used to visualize the contingency and specificity characterizing matters that become public problems and their solution—such as AMR and rational antibiotic prescribing. The conceptual use of microbiopolitics makes it possible to analyse different ways of relating to bacteria, and the consequences for rational use of antibiotics. Finally, the concept of alignment work has been deployed in the analysis to make sense of how performances of rational use of antibiotics involve the management of different types of risks and demands.

5 Tracing rational use of antibiotics: materials and method

In this chapter, I describe the data and how they have been analysed. The data used are extensive and diverse, and to a certain extent employed in an overlapping manner. This chapter starts with an overview of the project as a whole and my position in it, and continues with a discussion on the methodology in relation to material semiotics. It then moves on to describe each study separately, the data the studies draw on, and how the data were collected and analysed.

5.1 Overview of the project

In my PhD project, I have studied how rational antibiotic prescribing is performed in several different arenas, or locations. While Study I focuses on how rational antibiotic prescribing in human healthcare became established as a solution for preventing AMR in Sweden, I, in Study II and IV, explore antibiotic prescribing in medical practice and how it is performed as something rational. In Study III, I explore a debate in a Swedish medical journal on guidelines for antibiotic prescribing for throat infection.

The material and methods used are diverse and as such the project employs a mixed study approach. The project draws on interviews with doctors and nurses, observations from medical practice, articles from a medical journal, medical guidelines and related documents. In Study I, I have performed a set of interviews and collected medical articles, newspaper articles and achieve material.

Although the empirical field was set out from the beginning, the project has grown and developed during my years as a PhD student. In 2012, I was engaged as a researcher in a project on Swedish general practitioners' management of throat infections. Although the publications from this project are not included in the present thesis, through this experience I became interested in mundane infections and aware that Swedish evidence-based guidelines for management of throat infection in outpatient care were being contested in the Swedish medical journal *Läkartidningen* [*The Doctors' journal*]. I began

studying the controversy and this was the starting point of Study III, which in a chronological sense was the first study conducted in the project.

In 2013, I was invited to take part as a researcher in a study on antibiotic prescribing for respiratory tract infections. I saw this as an opportunity to explore throat infection in medical practice. Study II and IV in the thesis draw on material collected within this larger study. The larger study was financed by the Swedish Public Health Agency and aimed at identifying factors related to prescription of antibiotics for respiratory tract infections in primary healthcare. It was performed by a team led by Professor Sigvard Mölsted of Lund University and employed a mixed-method design (see Hedin et al. 2014, Strandberg et al. 2016). A variety of data from eight different healthcare centres in Sweden were collected: interviews with professionals and managers, audits, statistics on antibiotic prescriptions, a patient survey and observations from the healthcare practice. Five researchers—two medical doctors and two social scientists (including myself)—performed the data collection and analysis in the project.¹¹

The larger study drew on the understanding that rational antibiotic prescribing is desirable and possible to identify through use of evidence-based guidelines. The publications from the study, which I have taken part in authoring, are focused on how antibiotic prescribing can be improved and particularly how increased adherence to treatment guidelines can be achieved. However, as a researcher in the project, I was given the opportunity to make use of the collected data to perform my own analyses, and these are the studies I have included in my thesis. Importantly, these analyses are different from the larger study, as they draw on an open approach to what rational antibiotic prescribing might be.

The data for Study I were collected last. Study I focuses on the emergence of AMR as a public matter of concern in Sweden, a process in which AMR was constituted as a problem in need of policies intended to reduce unnecessary use of antibiotics. The study was performed in order to contextualize policy for rational antibiotic prescribing; it differs from the other studies in that it takes a historical approach.

One of the persons interviewed for this study, Sigvard Mölsted, one of the founders of the organization Strama (see section 2.2.2), functioned as a research leader for the larger project described above. This illustrates that I have held a position as both an insider and outsider in relation to policy for rational use of antibiotics. I have been a colleague and taken part in a project where rational use of antibiotics is defined in a particular way. As such, I have found it important to differentiate between my work as a researcher in the larger project on antibiotic prescribing and my own analysis of the

¹¹ Importantly, I was employed as a researcher in this project in addition to my employment as a PhD student at the Department of Sociology, Uppsala University. Thus, this project has supplied material for two of my studies, but not financed my PhD work.

material from this project. In my own studies, I have not intended to find ways to improve antibiotic prescribing, but instead to explore rational antibiotic prescribing as such. However, the collaborative work in the larger study has inspired my own analyses of the data. For example, also in the larger project, we analysed how laboratory tests influenced antibiotic prescribing—and I have been inspired by these insights in my own analyses. In addition, although my own studies have not been driven by the aim of improving antibiotic prescribing, when finalizing the thesis I have become more interested in how my results bring new understandings to discussions on policy promoting rational antibiotic prescribing.

As a whole, my project has been driven by a combination of pragmatic considerations (such as access to interviews and observations), a theoretical fascination with medical objects and knowledge, and an explorative approach in which empirical findings have given rise to new questions. The research process has not been straightforward but organic, and the project as a whole is in one sense not coherent. However, as I will return to in the next section, there is also coherence in the project—not only because all the studies focus on policy for rational use of antibiotics—but also in the way the data have been approached.

5.2 Material semiotics as a methodological sensibility

Although material semiotics does not offer a specific method, the approach has influenced all of the studies detailed here. A particular consequence of the material semiotic framework is that the empirical data have been given a lot of space in the studies. The anti-essentialist approach, and especially the symmetric analysis of humans and non-humans, has been employed throughout the research process, and I have carefully noted the ways in which heterogeneous actors took part in my data. In particular, I have been guided by an interest in bacteria as non-human-actors (cf. Hird 2009, Paxson and Helmreich 2014). In line with material semiotics, I have avoided analysis based on “social” explanations. That is, I have not investigated how categories such as class, state power, gender, etc., explain patterns in my data.

As scholars in the field have argued again and again, there are no neutral places that offer an objective perspective on the world. Research is always situated somewhere (cf. Haraway 1988, 1997). Using a material semiotic approach, we can understand every description *of* the world as actively taking part *in* the world—descriptions are performative (cf. Asdal et al. 2007, Law and Singleton 2000:767). This research (and, in fact, all research) cannot be understood as objective in the traditional sense, but it can still make a contribution (Law 2004). Through the detailed analysis of data that are broad and varied, the performed studies offers an important account of

how policy for rational use of antibiotics is performed. As AMR emerges as a global threat, it is a phenomenon that we need to grasp in all its complexity. My studies offer new and alternative ways of understanding antibiotic prescribing and AMR prevention. In the conclusion, I specifically elaborate on how, and to what, my thesis is a contribution to previous research.

5.3 Overview of data

Data

- Study I** **Interviews about Strama’s development:**
Otto Cars (infection specialist), Sigvard Mölstad (general practitioner), Hans Fredlund (infection specialist and health officer), Rolf Asterlund (infection specialist and health officer), Gunnar Kahlmeter (microbiologist), Chistina Grekko (veterinarian), Mats Entell (infection specialist and health officer), Peet Tüll (infection specialist, former head of the Department for Disease Control at the National Board of Health and Welfare), Anders Lundqvist (infection specialist).
- Interviews/e-mail about the pneumococci outbreak**
One paediatrician, one general practitioner, one microbiologist, one health officer.
- Text material**
Articles on antibiotic resistance in *Läkartidningen*.
Articles on antibiotic resistance from scientific journals (identified via *Läkartidningen* or PubMed).
Strama’s own archive material (archived at the Public Health Agency of Sweden).
Archived minutes from health officers’ annual meetings (at the National Board of Health and Welfare).
The Swedish Medical Association’s archive on Annual General Meetings for Physicians.
Publications from Strama.
Official reports on AMR in Sweden.
- Study II** **Data collected from two healthcare centres (collected within a larger study)**
8 interviews with general practitioners (4 from each healthcare centre)
8 interviews with nurses (4 from each healthcare centre)
Observations during 2 weeks at each healthcare centre
- Study IV** National treatment guidelines for management of infections in non-institutional care, published by the Swedish Medical Products Agency in 2001, updated in 201.

Background information, published by the Swedish Medical Products Agency, containing 16 articles.
17 articles from *Läkartidningen*.

Study IV 29 interviews with general practitioners (collected within the larger study).

5.4 Data collection and methods: Study I

In Study I, I examine how AMR emerged as a public matter of concern in Sweden together with the development of the organization Strama. Because Study I is a historical investigation, it differs from the other studies in materials and method.

To trace the development of AMR as an issue in Sweden, I collected a variety of data. Following a material semiotic approach, I traced this development across seemingly divergent spheres (cf. Jasanoff 2004, Lindskog and Sundqvist 2011), acknowledging that it was dependent on human as well as non-human actors. Accordingly, I moved between medical journals, interviews with doctors from various specialities and in different positions, employees from health authorities, newspaper articles and archive material from governmental agencies. More specifically, the written material consisted of articles on antibiotic resistance in *Läkartidningen* (and additional articles from scientific journals), Strama's own archive material (archived at the Public Health Agency of Sweden), archived minutes from health officers' annual meetings (at the National Board of Health and Welfare), The Swedish Medical Association's archive on Annual General Meetings for Physicians, texts from Strama and official reports on AMR in Sweden.

In order to complement this material, I performed nine interviews with people identified as key figures, or as well informed on, the development of Strama—medical doctors from various specialities: infection specialists (two were health officers, working with disease control), microbiologists, and general practitioners, including one veterinarian. Most of these were identified via the material listed above, but the interviewees also helped me to identify further important persons. Because these interviewees were selected due to their professional roles, the interviews are not anonymized (in agreement with the interviewees). The interviews were recorded and transcribed. I also performed short interviews (or had email contact) with people with specific experience from an outbreak of antibiotic-resistant pneumococci in southern Sweden, which I found to be crucial to the described development.

The fact that some of the interviewees themselves were involved in Strama's development and in Strama today could be regarded as a strength; they contributed unique experiences, enriching my material beyond the written sources. On the other hand, this is also potentially problematic, as they were all greatly invested in their accounts. In addition, they were recounting something that had happened over 20 years ago, at a time when the Swedish approach to AMR is considered a success. Beyond these words of caution, I argue that the interviews and written sources complement each other, together comprising the multifaceted account provided in my study.

5.5 Data collection and methods: Study II

The data used in Study II consist of interviews and observations culled from the larger study described above. Together with a medical doctor, I conducted interviews and observations at two different healthcare centres, and this material is used in Study II. Accordingly, Study II draws on eight interviews with doctors and eight interviews with nurses. The interviews were semi-structured and contained open-ended questions; the interview guide was developed jointly by the research team. The topics for the interviews were: clinical diagnostic procedures in relation to different respiratory tract infections (throat infection, upper respiratory tract infection/cough, and otitis), antibiotics and AMR, guidelines for respiratory tract infections, collaboration between different professions, patient education and patient-centred consultation. Importantly, these questions draw on the assumption that rational use of antibiotics can be defined and implemented through use of evidence-based guidelines. The interviews were audio recorded and transcribed. The study conforms to the principles outlined in the Declaration of Helsinki and was approved by the Regional Ethical Review Board in Lund, Sweden (2013/679). Participation was voluntary, and interviews as well as observations (of health personnel and patients) were performed only after informed consent. All data were treated confidentially and anonymized prior to presentation.

The observations were performed during a period of one month, and I spent about two weeks at each healthcare centre. Influenced by an ethnographic tradition, aiming to observe participants' everyday routines (cf. Gobo 2011:25, Silverman 2005:174), I followed personnel in their daily work: meeting patients, giving advice over the phone, drinking coffee and attending workplace conferences. In practical terms, the observations were documented through field notes that were developed directly after the observations.

In the analysis, I focused specifically on throat infection, and reconstructed how the practices employed when taking care of patients with this

condition played out. The material semiotic approach, more specifically Mol's conceptualization of diseases as enacted, directed my attention not only to how these practices were influenced by humans, but also to how non-human elements took part in the constitution of these practices. I paid attention to how laboratory tests, guidelines, etc., influenced the diagnostic process, and how this enacted bacterial throat infection in need of antibiotic treatment in different ways. I also paid close attention to how the healthcare personnel's tacit and bodily competences (Mol 2002:152, Slack et al. 2010:227, see also Berner 2008) enabled the various elements to influence medical practices.

5.6 Data collection and methods: Study III

In Study III, I examined a medical controversy played out in the Swedish medical journal *Läkartidningen*. The controversy concerns the National treatment guidelines for management of infections in non-institutional care, published by the national authority the Swedish Medical Products Agency [Läkemedelsverket]. In addition to the articles in *Läkartidningen*, the data in the study consist of the actual guidelines, and the "Background documentation". The Background documentation is a collection of medical articles published by the Swedish Medical Products Agency and intended to serve as a summary of the up-to-date medical knowledge required to develop the guidelines.

Within the controversy, a major issue subject to conflict concerned how the bacterium GAS—Group A Streptococcus—should be identified and managed, which had consequences for how the bacterium's identity was described. All texts discussing GAS were analysed (see description of analysis below). Altogether, in addition to the guidelines published in 2001 and 2012, there were 33 articles. While most of these articles explicitly defend or criticize the guidelines, some do not engage explicitly in the controversy but have, based on their content, been categorized as supporting one side of it.

I analysed the material to discover how discursive strategies, scientific facts and specific technologies created relations between actors or entities and stabilized their identities (Callon 1984, Latour 1993). I investigated the relations produced with GAS, in particular, and microbes, in general. All the data were analysed systematically with regard to a number of aspects: 1) how GAS, infection and antibiotics are described through establishment of facts and use of specific concepts or metaphors, 2) which techniques and technologies were promoted for diagnostics when antibiotic treatment of GAS was recommended, and 3) what or who is depicted as *at risk* as well as what or who constitutes a risk. This analysis confirmed that GAS was related to and conceptualized in two different ways in the controversy. These two

ways of relating to GAS were, in turn, analysed using Paxson's (2008) concept of microbiopolitics (see Section 4.4). While the initial analysis of GAS was empirically driven, the analysis in relation to Paxson's concept was theoretically informed.

5.7 Data collection and methods: Study IV

The data in Study IV derived from the same larger research project as the data in Study I (Hedin et al. 2014), financed by The Public Health Agency [Folkhälsomyndigheten]. However, all the interviews with general practitioners performed within the larger project were used here: 29 interviews, with general practitioners from eight healthcare centres in three Swedish counties. Demographically, these represent a variety of gender, age, educational background, working experience and urban/rural location (of the healthcare centres). The same interview guide described in relation to Study II was used, and 8 of the interviews partly overlap with the data in Study II.

Study IV is co-authored with professor Tora Holmberg. The analytical process in the study was performed in several steps. The analysis was based on a broad interest in how AMR policy was managed by the general practitioners, but the actual coding was empirically driven. In this context, "AMR policy" refers to policy intentions and interventions carried out in order to reduce the prescription of unnecessary antibiotics. At the time of the study, a National Patient Safety Campaign was on-going that targeted inadequate prescribing of antibiotics using various measures. In the county councils, financial rewards to healthcare centres were tied to specific antibiotic prescription rates. Therefore, the analysis focused on how the imperative of antibiotic moderation was expressed and managed in the interviews. First, general coding of the dataset was performed. Here, codes such as "refraining from antibiotics is healthy", "refraining from antibiotics is risky for patients", "patients do not want antibiotics", etc., were developed. I carried out the coding. Second, we focused on specific instances in which AMR policy aligned with or was in friction with risks and demands related to the actual patient receiving healthcare. Finally, we analysed these instances in terms of policy and patient interests—the latter defined as risks related to both individual patients and patient satisfaction. To make sense of how "policy interest" and "patient interest" were managed by the general practitioners, we constructed the concept "alignment work" as an analytical tool. This refers to the discursive strategies used by the general practitioners to align possibly incoherent risks and demands.

6 Summary of studies

6.1 Study I: Emergence of antimicrobial resistance as a public matter of concern: A Swedish history of a “transformative event”

The study examines how AMR came to be constituted as a matter of public concern in Sweden together with the development of an inter-professional organization, Strama, the aim of which is to achieve rational consumption of antibiotics in healthcare. In an international perspective, Sweden stands out owing to its comparatively low degree of antibiotic resistance and low consumption of antibiotics. Since the 1990s, the consumption of antibiotics for humans has decreased drastically, and accordingly the Swedish approach to tackling resistance has been described as successful. The study examines how this success came about and what actors and processes made AMR a prioritized issue. The analysis shows how an outbreak of antibiotic-resistant pneumococci in southern Sweden in the mid-1990s was essential to this development. The study suggests that such occurrences, crucial to the emergence of a matter of public concern, could be conceptualized as “transformative events”. These are events that make issues and the risks related to them concrete and urgent, and therefore they are crucial to *how* something is transformed into a matter of public concern. They also make such transformations rapid. In this respect, transformative events could be understood as constituting an assembling and transformative force that creates possibilities for existing practices and infrastructures to extend and reconnect.

Importantly, the outbreak of pneumococci was formative for AMR’s trajectory as an issue in two closely related, but slightly different ways. First, through the outbreak, AMR emerged as an urgent issue, as a public threat that was not sufficiently managed. In this way, the outbreak created intensity and uncertainty; it opened up AMR for public involvement and, at the same time, a concerned and unsettled public was assembled. Second, the outbreak was crucial to another transformation in the trajectory of the AMR issue, namely its development into becoming more or less settled, normalized and taken care of by an official machinery. The transformative event emerges as a key to the status of AMR prevention and specifically to the prioritized position of policy for rational use of antibiotics in Sweden. Thus, the specific form AMR took on when it became public was necessary for the

transformation of AMR into something that must be taken care of. Transformative events can thus be understood as having the potential to transform issues into public matters of concern in different, but related, ways. They may contribute to issues emerging as urgent and insufficiently managed by existing institutions. However, because they trigger a transformation in which issues become public, they may also be crucial to an issue's settlement and normalization. The outbreak of pneumococci was critical to both of these modalities of the AMR issue. The current study calls for further discussions on transformative events, their form and function in order to better understand the complex processes and various ways in which phenomena enter the public and political spheres, and transform the agenda within these spheres.

6.2 Study II: Iscensättanden av halsfluss: Relationella göranden av en sjukdom i medicinska praktiker [Enacting tonsillitis: Relational performances in medical practices]

In this study, the diagnostic process of bacterial tonsillitis at two Swedish healthcare centres is described and analysed in relation to how this disease comes into being, or how it is *enacted*. The study starts from an overview of medical sociology and concludes that, due to this field's focus on social phenomena, throat infection, seen as an apparently purely medical phenomenon, has been a non-issue in this literature. By drawing on research from the field of science of technology studies, the sociological non-interest in everyday infections and other diseases that appear as non-social (as well as seemingly non-social aspects of diseases), is problematized. I make use in particular of Mol's (2002) concept of enactment. This concept implies that diseases are performances, that is, they are constituted in, and through, relational practices involving human and non-human elements. Mol argues that diseases are constituted differently in different practices, and thereby that they are contingent and even potentially multiple. Thinking of diseases as enacted involves a critique of the distinction between disease and illness, as this dualism implies that we can separate the social and medical aspects of diseases. Accordingly, Mol problematizes the tendency in social science to restrict itself to social dimensions of, or perspectives on, disease.

My study on enactment of throat infection is based on interviews with nurses and doctors as well as observations from the everyday work done at the healthcare centres. In the analysis, I show how different—and sometimes conflicting—enactments of bacterial sore throat appear at the healthcare centres and that these are dependent on the complex relations between

human and non-human elements. I show that while nurses at one of the healthcare centres manage throat infections more or less in line with national guidelines, the doctors' practices are different. Accordingly, I argue that "bacterial sore throat" is not a given phenomenon, but changes with the specific practice in which it is performed. In particular, the practices differ owing to the use of clinical guidelines and the related use of particular laboratory tests, which intervene in the practices and changes how bacterial sore throat is enacted.

The analysis further shows how diagnostic agency is created in the relations between both humans and non-humans. Neither guidelines, nor technologies, determine the medical practice in any straightforward manner. Accordingly, professional clinical judgement is not overruled by, but coproduced with, laboratory tests and guidelines. I conclude that the professionals' practice cannot be interpreted as "right" or "wrong". In particular, the doctors' deviance from the guidelines is a way to account for bacteria that the guidelines do not take into consideration. The diagnostic process of tonsillitis shows how the most mundane medical diagnoses involve a number of complex relations that extend beyond categories such as social and medical.

6.3 Study III: Harmless, friendly and lethal: antibiotic misuse in relation to the unpredictable bacterium Group A streptococcus.

Evidence-based treatment guidelines for managing infections in healthcare are promoted as tools to prevent unnecessary use of antibiotics. Antibiotic misuse has been examined as regards the doctor-patient relation and the social context of medical practice. Less attention has been paid to how the very conceptualization of human-microbial relations may influence understandings of antibiotic misuse. Such relations constitute a growing area of research in sociology, anthropology and Science and Technology Studies. Paxson (2008) developed the concept 'microbiopolitics' in order to theorize different ways of understanding and regulating the relation between human beings and microbes. Drawing on this scholarship, the current article examines a medical controversy concerning evidence-based guidelines that target antibiotic misuse: Swedish guidelines for the management of throat infection (tonsillitis) in outpatient care.

In this controversy, doctors from different medical specialities debate whether or not the guidelines' recommendation concerning diagnostic procedures and antibiotic treatment is correct, and especially whether the guidelines might put individual patients with throat infection at risk. The study focuses on how the controversy unfolds around two different ways of

conceptualizing and relating to a specific bacterium: Group A streptococcus (GAS). The analysis shows how two divergent microbiopolitics—involving different understandings of human-microbial relations—are created in the controversy. Defenders of the guidelines describe GAS as holding a shifting identity and as potentially harmless or even friendly. Thus, according to the defenders, circulation of the bacterium in society needs to be accepted. The critics instead relate to GAS as a constant pathogen, which is always potentially dangerous. As a consequence, its spread should be reduced. Importantly, the analysis shows how different antibiotic prescribing practices are justified in the controversy. By focusing on the bacterium GAS—which is commonly observed, but also unpredictable and potentially dangerous—the article provides new insights into the relations between bacteria, humans and policy in an age of AMR. It argues, in particular, that the definition of antibiotic misuse is instable. Consequently, policy measures aimed at reducing misuse must be related to how specific infections and bacteria are conceptualized in the actual context the policy addresses.

6.4 Study IV: Aligning policy and patient interest in the age of antimicrobial resistance

Study IV examines how policies aimed at reducing unnecessary use of antibiotics are related to patient interest in everyday doctoring. The study draws on interviews with 28 general practitioners in Sweden; it was performed during a national "Patient safety campaign". This campaign can be understood as an example of a much-described increase in the external regulation of medical practice. The campaign promoted pre-defined protocols, monitoring and reward systems, to meet quantifiable performance goals regarding antibiotic prescription rates. However, initiatives aimed at increasing patient safety typically concern the individual patient receiving healthcare, for example, by preventing medical negligence, medication error and incompetence. Through its focus on AMR, the campaign instead makes patient safety a matter that concerns future patients. In this respect, it places the risk challenging patient safety not only at the population level, but also in the distant future.

The study examines how potentially conflicting demands and risk rationalities related to antibiotic prescribing for respiratory tract infections are described and managed by the general practitioners in the interviews. It shows how the general practitioners balance and negotiate policy and patient interest through "alignment work", which involves discursive strategies used for managing risks and demands related to antibiotic resistance as well as patients receiving healthcare.

The analysis further shows how AMR policy and a “patient first” paradigm often harmonize and how AMR policy is often described as an unproblematic matter of course by general practitioners. Here, interviewees describe how refraining from antibiotics may be in the medical interest of the patient and that patients are satisfied without antibiotics. However, the present study also shows that patient and policy interests may be in tension. To make the patient satisfied without antibiotics, and to align the risk of AMR with the risks to patients receiving healthcare, work and measures are performed by the general practitioners.

Specifically, our findings show that through the “alignment work” performed, AMR policy is aligned with by the general practitioners, and seems to harmonize with their approach to doctoring, as long as it does not put specific patients at risk. Identifying and treating severely ill patients is described as the priority. However, also when describing severe cases and exceptions made from the AMR policy, the general practitioners expressed their loyalty to the AMR policy by presenting themselves as “restrictive” and “careful” with antibiotics. In this sense, we argue that our result cannot be understood in terms of adherence or non-adherence to policy. Instead, through alignment work AMR policy is aligned with, *together* with descriptions of tensions between policy and patient interest. Thus, loyalty to the policy and the restrictive approach to antibiotics seem to be created through the GPs’ reflexivity in relation to the policy and strategies used for making exceptions to it.

7 Concluding discussion

In this study, I have set out to unpack rational antibiotic prescribing as medical knowledge and a policy goal by examining how it is performed in medical practice and the medical debate. In this chapter, I answer my research questions and discuss the thesis' contribution to previous sociological research on antibiotic prescribing. I also show how my studies add new insights to the sociological literature on the relation between policy, medical knowledge and medical practice. Based on my findings, I argue that uncertainties and tensions are part of—not opposite to—rational use of antibiotics. These uncertainties and tensions cannot be reduced to medical professionals' ignorance, or to how non-medical factors influence medical practice. This implies that social factors are not enough to explain why medical professionals dismiss specific policy definitions of medically appropriate prescribing. Instead, the uncertainties and tensions characterizing rational antibiotic prescribing can be traced to the complex and contingent nature of medical knowledge and medical objects, as well as to the potentially conflicting risks that antibiotic prescribing involves. Importantly, in practice, rational use of antibiotics as a policy goal can draw on and work with mutable medical knowledge and objects, as well as conflicting medical risks. In sum, my findings imply that sociologists need to continue entering the seemingly pure medical sphere to critically investigate policy and policy goals that draw on medical knowledge and that, as such, appear to be neutral and undisputable.

7.1 Answers to the research questions

How and through what core processes did rational antibiotic prescribing become established as a solution for preventing AMR in Sweden?

This question is answered in Study I, where I examine how AMR became a public matter of concern in Sweden together with the development of the organization Strama. Throughout this process, AMR was constituted in a specific form—as a contagion threatening the public, in need of management by reducing antibiotic prescribing in healthcare. This specific process was formative for the current constitution and status of AMR in Sweden—as a prioritized issue and as a subject of intense policy interventions directed at all prescribers of antibiotics.

The study shows that this specific constitution of AMR was not the result of a straightforward process, where policymakers developed solutions for a scientifically identified problem. Instead, the emergence of AMR as a public matter of concern involved (unpredictable) relationships with heterogeneous actors, such as medical experts, penicillin resistant pneumococci, news media, public healthcare, laboratories and drug sales statistics. These different elements assembled in an outbreak of penicillin resistant pneumococci in Sweden, which I argue can be conceptualized as a “transformative event”. As a result of the transformative event, AMR was changed from a medical issue, of limited public significance, to an urgent public threat that was not being dealt with sufficiently. As this threat was framed as a matter of disease control, the transformative event was also critical to the way in which Strama mobilized the already established Swedish organization for disease control.

How do humans and non-humans take part in performing an everyday infection in the diagnostic work at a healthcare centre, and what are the consequences for definitions of rational use of antibiotics?

The question is answered in Study II, which analyses how humans and non-human elements take part in the diagnostic work in relation to throat infection at the healthcare centre. The study shows that bacterial throat infection is the product of negotiations and collaborations between various human and non-human actors: doctors, patients, laboratory tests, guidelines and more. Depending on the relations between these elements, different—and sometimes conflicting—enactments of bacterial throat infection emerge. Laboratory tests in particular—which test is used and how—influence how bacterial throat infection is enacted. However, neither laboratory tests nor guidelines determine medical practice in any straightforward manner. Instead, professional clinical judgement is coproduced with laboratory tests and guidelines. The diagnostic process of tonsillitis shows how the most mundane medical diagnoses involve a number of complex relations, which extend beyond categories such as social and medical.

One consequence of bacterial throat infection being enacted differently is that rational use of antibiotics changes. In particular, doctors’ deviance from national guidelines is a way to account for bacteria and risks that the guidelines, and the laboratory tests they promote, do not take into consideration sufficiently.

How do different ways of relating to a specific bacterium influence definitions of rational antibiotic prescribing for an everyday infection?

This question is answered in Study III, which focuses on a medical controversy concerning guidelines for managing throat infection and antibiotic treatment in Sweden. The analysis shows how this controversy unfolds around two different ways of relating to a specific bacterium—Group A Streptococcus (GAS)—the primary bacterial cause of throat infection. According to defenders of the guidelines, this bacterium has a shifting

identity and is potentially harmless. GAS that cause throat infection are not related to as dangerous, and the presence of the bacterium in society needs to be accepted. The critics instead describe GAS as a constant pathogen, which is always potentially dangerous and whose spread needs to be prevented. Importantly, the two sides of the controversy make use of different types of knowledge about GAS. While the defenders, who are mainly general practitioners, draw on statistical knowledge, the critics, who are mainly hospital doctors, make use of case descriptions of patients who have become severely ill or died. The analysis shows how two ‘microbiopolitics’, involving different understandings of human-microbial relations, are created in the controversy and how, as a consequence, different antibiotic prescribing practices are justified. Thus, the study shows how the definition of antibiotic misuse—and rational use of antibiotics—is unstable and dependent on how specific infections and bacteria are conceptualized in specific contexts.

How are different risks and demands managed by doctors in relation to antibiotic prescribing for respiratory tract infections in everyday doctoring?

This question is answered in Study IV, which analyses how potentially conflicting demands and risk rationalities related to antibiotic prescribing for respiratory tract infections are described and managed by the general practitioners in interviews. The study explores how the general practitioners balance and negotiate demands and risk related to the patients, and the risk for AMR through “alignment work”. The study is carried out in the context of intense policy measures intended to make general practitioners antibiotic prescribing more restrictive in the context of AMR. The analysis shows how AMR policy and a “patient first” paradigm often harmonize in the general practitioners accounts. Interviewees describe how refraining from antibiotics can be in the medical interest of the patient and that patients are satisfied without antibiotics.

However, the study also shows that patient and policy interests might be in tension. The general practitioners especially problematize AMR policy and the imperative of being restrictive in relation to the fact that this might result in putting at risk individual patients who are receiving healthcare. In this context, identifying and treating severely ill patients is described as a priority by the general practitioners. However, even when describing severe cases and exceptions from the restrictive use of antibiotics, the general practitioners expressed their loyalty to the AMR policy by describing AMR as an important threat and describing themselves as careful with antibiotics. In this manner, AMR policy is aligned with by the general practitioners, *together* with descriptions of tensions between policy and patient interests.

7.2 Contributions

7.2.1 Unpacking rational antibiotic prescribing as a material semiotic performance

My studies draw on, break with and add to the research on antibiotic prescribing, as described in Section 3.1. Studies by scholars such as Broom et al. (2014), Butler et al. (1998), Cabral et al. (2015) and Stivers (2007), have enabled antibiotic prescribing to be viewed as a sociological phenomenon that involves negotiations between different kinds of risks, rationalities and demands. Thus, they make evident that irrational antibiotic prescribing is not always a matter of a medical professional's lacking knowledge of AMR, nor of recommended ways to manage infections. I make use of the insight that antibiotic prescribing is not a straightforward endeavour of using medical knowledge or, as Stivers (2007:185) put it, "not simply the result of applying a clinical algorithm". However, the focus of these studies is on how social factors make doctors deviate from their medical knowledge on correct prescribing. As a consequence, the definition of rational prescribing is treated as given by evidence. I have instead investigated rational antibiotic prescribing as it is produced in specific sites or practices. Thus, my studies can be considered to answer Timmermans and Haas' (2008) call for sociological studies on the "medical core" of clinical practice (cf. Casper and Berg 1995).

In Study I, I have shown that the establishment of rational use of antibiotics, as a crucial part of AMR prevention in Sweden, was the result of an uncertain and complex process, which involved human and non-human actors. This study demonstrates that these human and non-human actors—bacteria, statistics, news media, and medical experts—took part in the development described in mutual relations with each other. As such, the process was heterogeneous: neither solely social nor solely medical. Importantly this was a process where AMR took a specific form, which in turn was crucial to the contemporary well-established position of policy for rational use of antibiotics as a way to prevent AMR in Sweden.

Study I contextualizes the other studies (II-IV), where I have attended to how rational use of antibiotics is produced in medical practice and the medical debate. My studies show that rational use of antibiotics for everyday infections is characterized by uncertainties and tensions. An everyday infection can be enacted in different and conflicting ways due to the interaction of guidelines, different laboratory tests, and clinical skills. The identity of, and medically appropriate way to identify and manage, a common bacterium is a matter of medical controversy. In interviews, general practitioners describe how they balance and align risks and demands related to patients receiving healthcare and the risks related to AMR, which sometimes are in tension.

These studies show that infections in need of antibiotics, as well as rational use of antibiotics, are produced in webs of relations between various actors and, thus, that they change together with the relations at hand.

One consequence of this is that deviance from, or critique of, a specific definition of rational use of antibiotics, can, in a paradoxical way, be a performance of rational use of antibiotics as a policy goal. For example, in Study III, although the critique against the guidelines for throat infection in the analysed controversy is harsh, it also leaves important aspects of rational use of antibiotics as a policy goal untouched. The critics do not dispute the notion that AMR is a major threat, nor that this threat should be managed through rational prescribing of antibiotics in healthcare. The critique is thus merely a question of how to define what rational prescription is, and I argue that the most critical voices can actually be understood as simultaneously stabilizing and destabilizing the policy goal of rational use of antibiotics (cf. Singleton 1993, Singleton and Michael 1998).

Based on my findings, I argue that social explanations for why medical professionals deviate from, or criticize, specific policy definitions of rational use of antibiotics are not sufficient to understand the cases I have studied. Nor can the deviations and critique simply be explained by medical professionals' ignorance of AMR or of treatment guidelines. Instead, these uncertainties and tensions can be traced to the complex and contingent nature of medical knowledge and medical objects, as well as to the potentially conflicting risks that antibiotic prescribing involves. One implication of my studies for future research is thus to take seriously the uncertain character of and relation between rational antibiotic prescribing and everyday infections and to explore further how rational prescribing is produced in specific relations in which not only patients and doctors, but also laboratory tests, bacteria, infections and different types of risk, etc., are enrolled and take part.

7.2.2 Rational use of antibiotics and population-based medicine

Various sociologists have argued that medical practice is increasingly externally regulated through guidelines, audits and monitoring systems (Bradby 2012, Harrisson 1998, Nettleton et al. 2006, Numerato et al. 2012). Importantly, scholars describe this development as emerging together with a new way of prioritizing medical knowledge (Armstrong 2002, Harrisson 1998, Lambert 2006, Timmermans and Kolker 2004). This sociological literature allows for the examination and problematization of how rational use of antibiotics is defined and illustrates that definitions of rational use of antibiotics always involve prioritizations of *specific* medical knowledge, knowers and risk. In particular, it can be used to problematize the way in which rational use of antibiotics tends to simply be equated with adherence

to evidence-based guidelines, without problematizing the fact that such guidelines draw on specific forms of knowledge while dismissing others.

In light of the sociological literature on external regulation of healthcare and the related knowledge shift, the controversy over national guidelines for management of throat infection, examined in Study III, can be understood as a controversy concerning what kinds of medical knowledge and medical risks should be prioritized. While defenders of the guidelines primarily refer to statistical evidence, prioritized through the evidence-based hierarchy, critics make use of case descriptions of patients who have become severely ill or died. Thus, defenders focus on knowledge and risk at the population level, and critics refer to clinical experience and observations of individual patients. The critics explicitly state that the goal of preventing AMR has gone too far, something that becomes possible to claim based on descriptions of patients who are at great risk. The controversy thus appears to mirror a broader tension between population-based and codified medical knowledge, on the one hand, and clinical experience as well as observations of individual patients, on the other. Importantly, however: for the defenders of the guidelines, who are mainly general practitioners, the statistical knowledge probably tend to align with their clinical experiences, since GAS infections at health care centres seldom are severe.

In Tanenbaum's (2005) terms, the critics are rejecting the epistemological politics of the evidence-based guidelines. Adding to Tanenbaum, I argue that the controversy does not only centre on epistemics, but that it concerns GAS as a medical object in a more fundamental way. In the controversy, two different ways of enacting this bacterium clash. If the controversy had not taken place, it is probable that these two different versions of GAS would not have been pitted against each other, but instead stayed separated in more or less disconnected sites. Thus, this study shows that the controversy centres on GAS as a medical object and that it can be traced to the uncertain nature of this bacterium.

In a similar fashion, I show how the general practitioners in Study II, who deviate from medical guidelines and search for bacteria other than GAS, do not only prioritize medical knowledge in a way that differs from the guidelines. Instead they, in a very practical manner, together with embodied skills and the laboratory test CRP, take part in a practice in which bacteria other than GAS cause bacterial throat infection. These examples resonate with Hinchliffe's (2001) argument that when a specific policy fails to account for the situated and potentially inconsistent or even contested nature of reality, it runs the risks of being useless or rejected (cf. Law and Singleton 2014). Importantly, the guidelines and the way in which they enact bacteria and throat infection seem to work fine in some practices—for instance, phone counselling at the healthcare centre. However, in practices where GAS are lethal flesh eaters whose spread needs to be prevented, or where various other bacteria cause throat infection, they fall short.

On the one hand, rational antibiotic prescribing as a policy goal can be seen as an expression for how medical policy increasingly focuses on population health through implementation of clinical guidelines and the like. On the other hand, my studies from medical practice do not indicate that the risk of AMR is simply prioritized over risks for individual patients receiving healthcare. Neither do the studies suggest that clinical experience and medical professionalism is abandoned for codified knowledge such as clinical guidelines. Medical professionals criticized guidelines that put individual patients at risk (Study III) and described the risk of AMR as something that should never be prioritized over identifying and treating severely ill patients (Study IV). In Study II and IV, I show how clinical experiences or skills were crucial to antibiotic prescribing. In this sense, studies could be used to show how medical professionalism dominates these practices (cf. Harrison 1998). However, this is a simplification. My studies also indicate that codified knowledge, such as guidelines, was sometimes used, and that doctors found the risk of AMR and rational use of antibiotics important. Thus, professionals actively managed specific guidelines and general policy goals of rational antibiotic prescribing in relation to various elements such as laboratory tests, guidelines, clinical skills, and risks for the population and individual patients.

In Study II, I show how nurses used medical guidelines together with clinical skills. In Study IV general practitioners both expressed loyalty to, and problematized, the constant need to account for the risk of AMR. At the same time, these practices were characterized by population-based medicine and medical professionalism (McDonald et al. 2013). Thus, my studies confirm previous research on the complex relationship between codified knowledge, such as evidence-based guidelines, and medical professionalism or discretion (Berg 1997, Gabbay and Le May 2011, Timmermans and Berg 1997, 2003, Timmermans and Kolke 2004). Importantly, this discussion has previously not been carried through in relation to rational antibiotic prescribing, and my studies indicate that more research is needed on the relation between antibiotic prescribing and different forms of medical knowledge and risk.

7.2.3 Conclusion

To conclude, I argue that uncertainties and tensions are part of—not opposite to—rational use of antibiotics. These tensions and uncertainties cannot be reduced to how social or other non-medical factors influence prescribing. Instead, they are the consequence of the complexities of medical practice, where different medical risks, as well as mutable medical objects, need to be managed. As a consequence, I argue that rational use of antibiotics as a policy goal can also be performed when specific definitions of such prescription

are abandoned and problematized. In medical practice and the medical debate, the policy goal of rational use of antibiotics is performed together with mutable, even ambiguous, medical objects, knowledge and risks.

In this sense, the policy goal of rational use of antibiotics does not survive its practices (cf. Singleton 2005), but is performed and re-performed again and again in different and sometimes conflicting ways. Sometimes these performances are ambiguous, and at the same time stabilize and destabilize policy for rational use of antibiotics. This is an important insight in relation to the specific case of antibiotic use, in the context of AMR. It suggests that fighting AMR by reducing unnecessary use of antibiotics is not simply a matter of making doctors adhere to specific definitions of rational antibiotic prescribing. Neither are critique and problematizations necessarily undermining the policy goal as such. This implies the need for a more open approach among policymakers and researchers to what rational use of antibiotics can be and how it relates to specific guidelines as well as different (and potentially contingent) infections, bacteria, laboratory tests and risks.

In addition, my studies have implications beyond rational antibiotic prescribing and AMR. Various scholars have shown that policy is always normative and political. When policy emanates from evidence, it appears to be neutral and natural and thus might be disregarded as open for scrutiny. However, no policy is given by evidence or in the order of things. In my studies, I have examined a policy goal that appears to be given by medical facts, and I have shown how this seemingly non-social phenomenon involves negotiations between various actors. Thus, I argue that policy goals drawing on medical knowledge or science can, and should be, the subjects of critical sociological examination. Seemingly neutral policy goals involve prioritizations and negotiations being made between different forms of knowledge, knowers and risks. The outcome of such prioritizations and negotiations may have societal consequences. As such, we should critically examine policy goals and how they potentially change in practice.

8 References

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