Valorisation
**Relevance for society and economy**

The antibiotic resistance encountered in human pathogens is a huge concern for public health worldwide. Because of this resistance, effective treatment options for bacterial infections are often limited and in some cases may no longer be available at all. This reduces clinical efficacy, increases treatment costs and causes a great amount of otherwise preventable mortality. In the Review on Antimicrobial Resistance, commissioned by the UK government, it was stated that “Antimicrobial resistance (AMR) kills around 50,000 people a year in the US and Europe, and is estimated to kill more than 700,000 people globally.” [1]. The global production and consumption of antibiotics is enormous, and was shown to have drastically increased over the last few years [2], causing a constantly increasing selection pressure on bacteria in all exposed environments. The use and misuse of antibiotics in medicine, agriculture, and aquaculture has been linked to the emergence of resistant bacteria in these settings [3-5]. As such, the antibiotic resistance problem is rapidly increasing. Moreover, with the lack of development of novel antibiotics, the increasing resistance to the current last-resort antibiotics foreshadows a grim situation where untreatable infections will become increasingly more common.

In order to illustrate how catastrophic the problem is likely to become if the current trend is not changed, the authors of the Review on Antimicrobial Resistance made crude estimates of the future burdens of antimicrobial resistance. They estimated that by the year 2050, 10 million people would die annually because of antimicrobial resistance, overtaking even the number of deaths attributed to cancer [6]. The economic costs will similarly be enormous, as indicated by their estimation that “the world’s GDP will be 2 to 3.5% lower than it otherwise would be in 2050”, and that “It would cost the world up to 100 trillion USD” [6].

**Target groups**

The antibiotic resistance problem concerns an exceptionally broad audience, as anyone can be at risk for unfortunate infections with resistant pathogens. As such, this work can be of interest to both professionals in health care as well as the general population. In order to achieve appropriate usage of antibiotics, it is essential that general practitioners, as well as all medical doctors in health care
facilities which prescribe antibiotics understand the mechanisms which drive antibiotic resistance. This work may aid in realizing such an understanding. Since this work addresses the risks of acquiring antibiotic resistant bacteria as a result of international travel, it should also be of interest to general practitioners and infection prevention specialists with regards to assessing risk cases for patients. It is also important to increase the awareness of the general population on the concept of antibiotic resistance, since such an understanding will stimulate the responsible use of antibiotic usage. Additionally, this work can be of interest to policy makers of government ministries of health, as appropriate government regulations are essential in achieving national and global guidelines to tackle the antibiotic resistance problem.

**Activities, innovations, planning and realization**

While antibiotic resistance is increasing worldwide, the situation varies extensively between different countries. As such, international collaborations are required to aid countries which struggle with high and inadequate antibiotic usage. Because of the dissemination of antibiotic resistance through trade, travel and migration, these problems are a global concern and should be tackled as such. Extending the knowledge and resources of countries which are doing relatively well in this respect could lead to reduced and better regulated usage of antibiotics worldwide. This is essential since the reduction of resistant bacteria in highly problematic areas will subsequently result in a decreased spread of antibiotic resistance towards other countries.

An important point of focus would be to work towards a global ban of over-the-counter sales of antibiotics, along with conservative and appropriate prescription by healthcare personal. In order to establish this, it will be necessary to create awareness of the consequences of antibiotic use. For healthcare professionals, this could be realized by additional trainings. To ensure that prescribed antibiotics are used responsibly, awareness must also be created among the general population, through e.g. government regulated informative commercials or education. Since other animals or even the environment may serve as reservoirs of resistance, it is also important to promote regulations of antibiotic usage in agriculture. Currently such regulations are non-existent in many countries, which attributes to the high rates of resistance encountered in animals.
Furthermore, by improving the global surveillance of antibiotic resistance in both pathogens and commensals, possible sources for the dissemination of resistance may be more clearly defined. This work has contributed to identifying such sources of dissemination. Moreover, we have provided novel approaches to perform antibiotic resistance surveillance in whole microbial communities. As we have shown, this allows for the identification of a broader range of risk factors. With information obtained from these efforts, the appropriate precautions can be undertaken to limit further dissemination of antibiotic resistance. This could be reflected in e.g. additional hygiene precautions, controls for imported foods, or screening of hospital admittance of patients returning from high risk areas.

References