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# Antimicrobial resistance is a super wicked problem

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The author has completed the ICMJE form and declares no conflicts of interest.

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Antimicrobial resistance is a global health challenge, for which effective political measures are hard to find. This can be explained by the fact that antimicrobial resistance is a so-called 'wicked problem' that requires a long-term change in its development trajectory.



*Illustration: Derek Ercolano*

Antimicrobial resistance is one of the greatest threats to public health in the 21st century (1, 2). A prognosis published by the UK government in 2014 estimates that in 2050, nearly ten million people will die each year from infections caused by resistant bacteria (3). This scenario has been assessed as uncertain and pessimistic (4), but the current situation is serious enough: the European Centre for Disease Prevention and Control (ECDC) has estimated that each year, approximately 33 000 people in Europe die from infections caused

by antibiotic-resistant microbes, and this is deemed a conservative estimate (5). People who have been infected by resistant bacteria can still usually be treated, but the treatment takes longer, carries an increased risk of adverse effects and costs more.

## Need for global and coordinated action

Antimicrobial resistance has attracted considerable attention in international politics since the World Health Organization (WHO) published a global action plan in 2015 (6). WHO has reinforced its tripartite collaboration with the UN Food and Agriculture Organization (FAO) and the World Organisation for Animal Health (OIE), an interdisciplinary forum that will coordinate the efforts to combat antimicrobial resistance in the areas of human health, agriculture and the environment. In addition, the UN has established the Interagency Coordination Group (IACG) of experts, which delivered its report 'No time to wait' (7) in early 2019.

WHO and the expert group recommends that the world focuses on five core areas to limit the consequences of antimicrobial resistance (Box 1). These five areas are also reflected in national strategies and action plans against antimicrobial resistance, including in Norway (8).

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### Box 1 WHO's global action plan on antimicrobial resistance

1. Increased awareness of antimicrobial resistance and the consequences of resistance
  2. Improved surveillance to understand why resistance develops
  3. Improved protection to reduce the incidence of infection
  4. Reduced use of antibiotics
  5. New business models that strengthen investment in new antibiotics and diagnostics
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## Effect of the measures

It is reassuring to see that we have implemented numerous measures to restrict the development and consequences of antimicrobial resistance, but we are also experiencing a kind of cognitive dissonance: the more we discuss the required measures, the clearer it becomes that the current response is insufficient to solve the problem. We believe that the difficulties in finding an effective response are caused by distinctive characteristics of antimicrobial resistance as a problem. We suggest that antimicrobial resistance should be categorised as a 'super wicked problem', and that this categorisation should have consequences for our thinking about the problem itself and in terms of the solutions that are possible.

## A 'wicked problem'

The concept of 'wicked problem' was originally launched in an article by Rittel and Webber (9). The English word 'wicked' can have connotations of 'intricate' or 'malignant', but we have chosen to use the term in line with recent publications in the social sciences (10). The key insight from this research is that some social problems are so complex and have so many different causes that we cannot expect to solve them, and that at best, we can only minimise their negative effects. Rittel and Webber define ten properties of 'wicked problems' (Table 1) that explain why they cannot be solved through political interventions that may be either well-placed or misjudged. Many of these properties are clearly recognisable in antimicrobial resistance as a public health problem.

**Table 1**

Rittel and Webber's description of properties of wicked problems (9).

|    | <b>Properties of wicked problems</b>                                                                 | <b>Relevance for antimicrobial resistance</b>                                                                                                                                                                                                                              |
|----|------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1  | There is no universal definition of the problem.                                                     | Resistance problems are found in various areas (antibiotics, antivirals, antimycotics), and microbiologists and clinicians often have different understandings of the concept of resistance. The definition depends on the microbes, drugs and infections in question.     |
| 2  | The problem has no defined end point.                                                                | Resistance arises spontaneously through genetic changes in microbes, and resistance to new and future antibiotics is therefore also likely to develop.                                                                                                                     |
| 3  | Possible solutions are not right or wrong, but good or bad.                                          | Most of the measures against microbial resistance are not emphatically right or wrong. Many measures will entail both positive and negative consequences that need to be balanced against each other.                                                                      |
| 4  | Possible solutions cannot be tested in advance to assess their effects.                              | Antimicrobial resistance impacts numerous areas in the health services and society in general, making it impossible to predict all consequences in measures.                                                                                                               |
| 5  | All attempts at solving the problem produce effects that may give rise to irreversible consequences. | Each measure entails opportunity costs (the cost of not having invested in alternatives) and often affects large groups of patients and inhabitants. If the effects have a negative health impact, their effects cannot be corrected later.                                |
| 6  | There is no well-defined set of possible solutions to the problem.                                   | We do not have a full overview of the consequences of antimicrobial resistance for different groups and communities. We are therefore also unable to assess possible alternative solutions in a unified manner.                                                            |
| 7  | Every wicked problem is essentially unique.                                                          | Antimicrobial resistance is often compared to other societal challenges such as global warming or overfishing, but the solutions proposed for these analogies cannot be transferred to the resistance problem.                                                             |
| 8  | Every wicked problem can be considered to be a symptom of another problem.                           | The development of antimicrobial resistance is often a result of other problems, such as overuse of antibiotics, poor access to health services or insufficient infection control. The problem of resistance is unlikely to be solved without addressing these challenges. |
| 9  | There are multiple explanations for the same problem.                                                | Antimicrobial resistance can be described in many different ways that all point to different solutions, e.g. as a health problem, a collective-action problem or as the result of insufficient access to drugs and reliable diagnostics.                                   |
| 10 | Decision-makers cannot be wrong without affecting the population.                                    | Antimicrobial resistance is the cause of considerable mortality and morbidity. Decisions to prioritise some measures above others will entail immediate consequences for life and health in different segments of the population.                                          |

The more we discuss the required measures, the clearer it becomes that the current response is insufficient to solve the problem

The theory of 'wicked problems' appears intuitive, but may well be criticised for being purely descriptive (11). It is obvious that the more complex the problem, the more difficult are the decision-making processes, but this insight is not very suitable for identifying the best possible course of action. The question is therefore whether classifying antimicrobial resistance as a 'wicked problem' has any value. The answer to this problem is two-fold. First, Rittel and Webber's categories are useful for highlighting some of the problems that antimicrobial resistance presents to political decision-makers (Table 1). Second, its

categorisation as a 'wicked problem' is insufficient, because antimicrobial resistance falls into the category of 'super wicked problems' a group of even more complex societal challenges that were introduced in the discussion on global warming (12). 'Super wicked problems' have four further properties (13) that make them especially intractable, all of which are relevant to antimicrobial resistance (14):

i) *The time available for solving the problem is running out.* Antimicrobial resistance is a rapidly growing problem, and since few new antibiotics are being developed, there is a risk that bacterial infections will no longer be treatable.

ii) *Those who are responsible for solving the problem are themselves contributing to its causes.* Many professionals who are working to reduce the effect of antimicrobial resistance are themselves responsible for the use of antibiotics. They may therefore be biased when it comes to their own responsibility. The industry that will be charged with the development of new antibiotics is also responsible for the marketing of antibiotics in many countries. In recent years, the pharmaceutical industry has largely stopped investing in new antibiotics and reduced their production of old antibiotics (15).

iii) *Key actors who are charged with addressing the problem have either a weak mandate or no mandate at all.* A lot of the efforts to combat antimicrobial resistance must be undertaken at the national level, for example through the establishment of surveillance and effective infection control, or through restrictions on the access to antibiotics without a prescription. This is a challenge for many low and middle-income countries. Moreover, coordination of international activities, such as shared monitoring systems, is difficult without sufficient funding. International organisations have been provided with more support in recent years, but they are still insufficiently staffed to be able to help all member states meet their needs.

iv) *Political actions discount the future in an irrational manner.* Even if we are not convinced that up to ten million people will die from infections caused by antibiotic-resistant microbes in the future, we need to recognise that the current level of investment is insufficient to implement the recommendations from WHO. The consequence will be an exacerbation of the situation in terms of resistance, and thus a greater global burden of disease.

By describing antimicrobial resistance as a 'super wicked problem', we underscore the need for quick, comprehensive and sufficiently funded action. The categorisation is both normative and a guideline for action (11), but this is not the only relevance of this concept. Understanding antimicrobial resistance as a 'super wicked problem' also entails consequences for the choice of strategy we make to face up to this challenge.

## What should we do?

Understanding antimicrobial resistance as a 'super wicked problem' has at least three implications for the way in which we should meet the challenge. First, one of the main properties of 'super wicked problems' is that they cannot normally be solved through technological innovation. We should not regard antimicrobial resistance as a problem that we can 'fix', but as a constant development of microbes that will have a permanent effect on the future of health services. The American microbiologist Brad Spellberg wrote that 'we will never truly defeat microbial resistance; we can only keep pace with it' (16). This does not mean that new antibiotics are not required, but that new drugs will never be sufficient, and that we need to place a greater focus on reducing the incidence of infectious diseases through preventive efforts. Most likely, this will be the only strategy that could have an effect on the resistance burden in the long term.

We should not regard antimicrobial resistance as a problem that we can 'fix', but as a constant development of microbes that will have a permanent effect on the future of health services

Second, 'super wicked problems' must be dealt with through measures and interventions

that generate a shift in its development trajectory or 'path dependency'. Path dependency describes the historical development of efforts to combat resistance, the main features of which have remained unchanged since the discovery of penicillin: in response to increasing antimicrobial resistance, new 'resistance-breaking' antibiotics have been developed. Along this path, innovation has not given rise to new ideas for prevention or treatment, but served only as an extrapolation of existing methods that without exception has ended up with resistance, including against the new antibiotics. It is therefore necessary to prioritise research and measures that can help reduce our dependence on antibiotics, and there are numerous examples, ranging from better disease control to the prevention of infections with the aid of vaccines. The Norwegian government's work on a new action plan for infection control is sending an important political signal, but it will also be necessary to secure sufficient funding for the activities in this area, to ensure that the recommendations can be implemented, evaluated and adapted.

Finally, the description of antimicrobial resistance as a 'super wicked problem' can help us understand why ensuring a sufficient level of investment is so difficult. Antimicrobial resistance impacts on so many areas of political action in so many known and unknown ways that predicting future costs is difficult. It is thus difficult to undertake a cost-benefit analysis to assess the amount of resources that we need to use in order to face this problem. At the moment, we do not find it relevant to define what will be enough, as long as we can ascertain that the current level is nowhere near sufficient. In order to successfully combat antimicrobial resistance, efforts must be stepped up both in Norway and in the world as a whole.

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