

On the economic impact of a regional management of multidrug-resistant bacteria

Ökonomische Auswirkungen eines regionalen Managements multiresistenter Erreger

Abstract

The increasing number of people who are colonized or infected with multidrug-resistant bacteria imposes a high economic burden on society which includes the negative impact on health status as an intangible cost. An economic analysis leads to the conclusion that currently too little is done to prevent or control infections. The reasons include insufficient incentives for health care providers, a lack of reliable data on both the prevalence and the effects of infection, and a lack of coordination among the different branches of the health care sector. A regional management of multidrug-resistant bacteria which does not focus on a single branch but rather on the health care sector overall can achieve a substantial reduction in the number of infected people and of the associated economic cost for society.

Keywords: multidrug-resistant bacteria, economic cost, regional management

Zusammenfassung

Die zunehmende Anzahl von Personen, die mit multiresistenten Erregern kolonisiert oder infiziert sind, verursacht hohe volkswirtschaftliche Kosten, zu denen auch die gesundheitlichen Beeinträchtigungen der Patienten als intangible Kosten rechnen. Es ist zu vermuten, dass derzeit in zu geringem Umfang Maßnahmen zur Infektionsprävention und zur Eindämmung derartiger Erreger ergriffen werden. Zu den Ursachen zählen unzureichende Anreize der Leistungserbringer, eine unbefriedigende Datenlage sowie eine aufgrund der sektoralen Aufteilung des Gesundheitswesens mangelnde Abstimmung der Leistungserbringer. Diese Probleme können überwunden werden durch ein in geeigneter Weise ausgestaltetes regionales Management multiresistenter Erreger, das aufgrund seines Fokus auf die gesamte Versorgungskette die Chance bietet, zu einer nennenswerten Senkung der Anzahl infizierter Personen und somit zu einer deutlichen Verringerung der volkswirtschaftlichen Kosten multiresistenter Erreger beizutragen.

Schlüsselwörter: multiresistente Erreger, volkswirtschaftliche Kosten, regionales Management

Introduction

Over the last few years, the number of people infected with multidrug-resistant bacteria has been rising in a number of countries, among them Germany. As a characteristic feature, multidrug-resistant bacteria are not susceptible to several antibiotics. This inhibits the efficacy of antibiotic treatment, with serious consequences for the health of infected individuals, the utilization of resources in the health care sector and the availability of

resources in the economy in general. Following an infection with multidrug-resistant bacteria, a number of effects may arise, each representing an economic cost: First, an individual will suffer from the risk of severe impairment of her health, including premature death. Next, appropriate treatment will take more time to produce the desired health outcome or will require more resources which must be diverted from other uses in the health care sector. In addition, the economy will incur losses in productivity whenever infected individuals belong to the workforce.

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Finally, aggravating these already serious consequences, infected individuals may spread multidrug-resistant bacteria, thus inflicting harm on other individuals and increasing the economic cost to society.

A first objective of the present contribution is to work out in more detail the economic effects which an infection or a colonization with multidrug-resistant bacteria may bring about. Building on this account, it will be argued that the status quo is inefficient. Next, an approach will be outlined which can be used to determine whether strategies to prevent or to reduce infections with multidrug-resistant bacteria provide a net benefit to society. In order to be able to implement a strategy that has been shown to be advantageous in this sense, it is salient to provide appropriate incentives to the main actors involved. In essence, both objectives require a regional management of multidrug-resistant bacteria. By taking into account the entire health care sector within a region, this type of management can be trusted to improve on the current situation.

Method

In order to carry out the tasks outlined above, it is important to be clear about how to assess the costs and benefits associated with strategies to prevent or reduce infections with multiresistant bacteria. Furthermore, the range of effects which need to be taken into account will depend on the perspective of the analysis. More specifically, while the (in-)efficiency of the status quo or of an intervention can only be evaluated from the perspective of society, the issue of (in-)appropriate incentives must be judged from the individual perspective.

First, it is helpful to distinguish three types of costs. *Direct costs* represent the monetary value of resource utilization that takes place due to the production and consumption of health care. Apart from the cost of health care itself, this also includes any cost incurred by the patient in order to receive care, e.g., travel costs. The next type is given by *indirect costs* which cover the productivity losses, also valued in monetary units, due to illness or premature death. Finally, *intangible costs* capture the loss in utility or welfare for the patient which results from a reduction in her health status (including death). In comparison with the other two types, intangible costs are more difficult to measure because it is necessary to develop a valuation from scratch. Intangible costs can be measured either in monetary units (i.e., as willingness-to-pay) or in other units such as quality-adjusted life years (QALYs).

Next, strategies which aim to prevent infections with multidrug-resistant bacteria or to control their impact will usually involve a reduction in the associated costs. Relying on a similar categorization as on the cost side, these benefits may turn up either as *direct benefits*, or as *indirect benefits*, or finally as *intangible benefits*. Whereas direct benefits (or indirect benefits) accrue as reductions in direct costs (or indirect costs), intangible benefits arise from improvements in health status or an extension of length of life.

From the *individual perspective* of an economic unit such as, e.g., a physician, an insurer, or a patient, it makes sense to take into account only those costs and benefits which accrue to the unit itself. Thus, a decision is individually rational if it maximizes benefits over costs for the unit, thereby reaping the greatest net benefit. In contrast, the *societal perspective* takes into account the costs and benefits of all decision units. Hence, a decision is rational from the perspective of society, or *efficient* for short, if it maximizes the net benefit that accrues to society. Otherwise, it is inefficient and it is at least possible to make everyone better off by moving to an efficient decision.

It is important to realize that both the perspectives are necessary to explain why inefficient decisions involving a waste of resources are taken and how they can be improved upon. According to a basic assumption that will also be imposed below, economic units always act individually rational, i.e., they always maximize their own net benefit. Simple though it is, this assumption nevertheless can be quite helpful in explaining inefficient decisions. More precisely, such decisions are likely to occur whenever the associated costs and benefits do not fall exclusively on the unit who takes them.

E.g., patients infected with multidrug-resistant bacteria are likely to receive inefficient health care if the providers have no incentive to take into account all the costs and benefits associated with the treatment they provide. Applying the societal perspective provides the only way to identify those strategies to prevent or control infections that are efficient. In order to promote their implementation, it is essential to modify the incentives which the providers of health care face such that applying an efficient strategy is in their own interest, i.e., becomes individually rational. As claimed above, this demonstrates that both the societal perspective and the individual perspectives of the relevant players must be taken into account in order to arrive at an efficient provision of health care to patients infected with multidrug-resistant bacteria.

Results

Individuals who are colonized with multidrug-resistant bacteria but not yet infected usually do not suffer from any immediate consequences. However, there are substantial risks involving serious medical problems and economic costs, both for the individuals themselves as well as for other individuals who get in touch with them. First, there is the risk of developing an infection, imposing direct and intangible costs and possibly also indirect costs as outlined above. The available studies, usually focusing on one type of bacteria and on a single disease, clearly demonstrate a considerable increase in length-of-stay and in direct hospital costs [1], [2], [3], [4], [5]. Even though the reductions in health status due to an infection with multidrug-resistant bacteria are less well documented, the associated rise in mortality indicates that

intangible costs may well turn out to be very high [6], [7], [8].

At the same time, individuals colonized with multidrug-resistant bacteria put other individuals at risk because their presence increases the probability that further colonization will take place. Therefore, the cost effects described above may also occur among other individuals. An analysis of the costs of multidrug-resistant bacteria from the societal perspective must take these costs into account as well. Economically speaking, they represent external costs because the colonization of one individual may exert a negative impact upon the health status of other individuals [9], [10].

In fact, the external effects may reach very far, both with respect to the number of individual's concerned and over time. Consider the use of antibiotics: Even with proper use in treatment, eventually resistant bacteria will turn up. However, antibiotic misuse on the part of either health care providers or patients substantially accelerates the evolution of resistant strains. Thus, a flawed treatment of patients today imposes a cost on future patients. In economic terms, efficacy of antibiotic treatment can be viewed as a common social good which, due to wrong incentives for the major players in the health care sector, suffers from the tragedy of the commons [11].

In order to move towards a solution of the current problems with multidrug-resistant bacteria, it is necessary to identify strategies for improving the provision of health care. In a further step, care must be taken to make sure that promising strategies will also be implemented by the relevant actors. Applying both steps in a systematic manner regularly and based on appropriate empirical data to check available strategies to prevent or control infections, one obtains a *management* of multidrug-resistant bacteria. Given the problems of the status quo as outlined above, a change from simply dealing with multidrug-resistant bacteria ad hoc to a proper management can be expected to result in a substantial reduction in the associated costs for society.

As a first step, it is necessary to evaluate the costs and benefits to society arising from strategies to prevent infections with multidrug-resistant bacteria. Strategies that confer a net benefit to society improve on the current provision of health care and contribute to attaining the goal of an efficient management. Observe that the term strategy is defined in a narrow sense: In particular, it refers to a specific group of patients receiving care from a specific provider at a specific place. Thus, if the benefits of, e.g., a screening strategy exceed the associated costs, it is nevertheless possible that a further modification, for example by focusing on a different group of patients, may provide an ever higher net benefit to society.

There are good reasons to tackle these tasks within a *regional management* of multidrug-resistant bacteria. As its name suggests, a regional management has a clear focus on a specific region but implies no further restrictions otherwise. Thus, it represents a comprehensive approach which is not confined to a single branch of the health care system. Furthermore, in view of the problems

outlined above it seems necessary to adopt a regional management because such an approach offers a unique opportunity to apply the perspective of society to strategies to prevent or control infections with multidrug-resistant bacteria. This includes the setup and the continuous maintenance of a database relating to multidrug-resistant bacteria in order to record the prevalences of colonized individuals or infected patients as well as other relevant data. A major objective would be to take into account the entire process of the development and also the spread of colonization and infections with multidrug-resistant bacteria. In some contrast to the prevailing approach with its focus on hospitals and on the control of infections, a regional management offers the prospect to recognize both the contribution of other health care providers and of strategies to prevent infections in order to deal with infections with multidrug-resistant bacteria in a manner that provides a maximum net benefit to society.

Discussion

At present, a major problem is that appropriate data on the costs of colonization with multidrug-resistant bacteria are not available. To be sure, attempts to obtain representative data which are not confined to hospitals have intensified recently. Nevertheless, there are still no or at least no systematic data on some of the cost effects explained above. Referring to infections with multidrug-resistant bacteria, this is true for the direct costs outside of hospitals as well as for the intangible costs due to a reduction in length of life or a deterioration of health status. In addition, there is no evidence on the probabilities with which colonized individuals develop an infection or cause other individuals either to be colonized or infected with multidrug-resistant bacteria. These data would need to be collected with respect to the type of bacteria (pathogen) and possibly also with respect to individual attributes such as, e.g., age or prevailing chronic diseases. Note that the lack of data on some important cost effects also has further implications. Since the benefits of strategies to prevent or control infections arise primarily as reductions in the direct, indirect or intangible costs of multidrug-resistant bacteria, the full benefits to society are not known either. More specifically, there is a lack of data on the impact of efforts to prevent infections, and also on the valuation of the corresponding health effects by the affected individuals.

In order to explain the present scale of infections with multidrug-resistant bacteria in Germany, it is necessary to investigate the incentives of health care providers to employ strategies to prevent or control infections. Consider a health care provider who applies a screening test to patients deemed at risk such that patients will be isolated until the result becomes available and will be sanitized if the test yields a positive result. In many instances, for the provider this means incurring a certain cost with the prospect of only a small expected benefit:

First, the remuneration may be insufficient (perhaps even nil) and/or the strategy may not generate enough cost savings for the provider. The latter reason applies, e.g., to ambulatory physicians because the higher cost of treatment due to an infection will occur primarily in hospitals. Furthermore, the additional benefits due to averted infections of other individuals will have no direct effect on the provider under consideration either. A similar statement applies to the careful and cautious therapy with antibiotics which may also contain the development and the spread of multidrug-resistant bacteria: Again, the cost falls primarily upon the prescribing physician whereas the benefit turns up elsewhere in society.

Even though it is not possible currently to describe the economic impact of colonization with multidrug-resistant bacteria in full, the lack of sufficiently strong incentives for health care providers can safely be taken to imply that too little effort is devoted to the prevention or the control of infections. As a gauge, consider the costs and benefits to society of strategies to prevent or control infections with multidrug-resistant bacteria: As argued above, health care providers implementing such strategies will usually reap only part of the associated benefit while bearing the full cost. Therefore, the incentives facing health care providers are too weak to induce them to provide efficient care with respect to the protection from infections with multidrug-resistant bacteria. In turn, this implies that, from the perspective of society, there will be too many infections imposing an overall cost that is unnecessarily high.

If a strategy to prevent infections with multidrug-resistant bacteria conferring a net benefit to society has been identified, the next task is to make sure that it will be implemented. In essence, this means setting appropriate incentives: The net benefit to society needs to be distributed among the relevant actors in a manner such that it is individually rational for everybody to apply the strategy. More specifically, this implies an appropriate remuneration of health care providers, covering at least their own cost due to the effort to prevent or control infections with multidrug-resistant bacteria. Moreover, it may make sense to promote the cooperation among different sectors of the health care system, given that multidrug-resistant bacteria turn up not only in hospitals but also in ambulatory care or in nursing homes.

Applying a regional management in a suitable manner also offers the prospect of overcoming the tragedy of the commons problem that besets the current approach to multidrug-resistant bacteria. By implementing the perspective of society in an entire region, it will be possible to take into account most of the substantial cost effects that are now external. Improving surveillance as well as providing reliable information on the appropriate use of antibiotics may help to improve the efficacy of treatment for future patients. In this sense, a successful regional management may also contribute to save costs in the health care sector and to improve the health of patients in the future.

Conclusion

The current provision of health care to individuals who are colonized or infected with multidrug-resistant bacteria suffers from a number of shortcomings due to, e.g., a lack of data and inappropriate incentives for providers. Implementing suitable strategies to control or prevent infections offers the prospect of reducing the costs associated with multidrug-resistant bacteria substantially, either by improving the health status of patients or by easing the financial burden on the health care system. For several reasons, a regional management represents an approach that can be trusted to improve on the status quo and to reap substantial net benefits for society by better dealing with the problems caused by multidrug-resistant bacteria.

It is true that building up and maintaining a regional management of multidrug-resistant bacteria will involve a considerable cost. However, given the high costs of the status quo which will continue to rise unless precautionary measures are taken, this cost will be more than offset by the benefits that can be reaped by implementing efficient strategies to prevent or control infections. A regional management of multidrug-resistant bacteria represents the first step towards a better integration of the health care system. If this step is taken successfully, it may also act as a role model for dealing with other problems in the provision of health care. At any rate, the potential benefits appear to be sufficiently high to more than justify embarking on this first step.

Notes

Conflicts of interest

The author declares that he has no competing interests.

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