Growth of chronic diseases, agency theory, and cooperation – Opportunities in health management

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Abstract

The growth of non-communicable diseases is affecting both developed and developing countries. However, the application of nuclear technology to medicine (nuclear medicine) is increasing and opening new opportunities in diagnostics and treatment. Few studies have been done on the interaction between chronic diseases, nuclear medicine, and economics. This article analyzes this interaction using concepts from the theory of incentives, especially regarding the principal-agent relationship and the difficulties in promoting technology adoption. It is suggested that cooperation theory can complement the principal-agent relationship to achieve the recommended outcomes.

Keywords:
Nuclear medicine, Principal-agent, Non-communicable diseases

Introduction

Non-communicable diseases are responsible for 56% of deaths and 46% of diseases measured in quality-adjusted life years, in low- and medium-income countries (Lopez et al., 2006). In Brazil, non-communicable diseases are also responsible for a growth in deaths and disabilities. They represent 66% of all deaths, compared with 24% from infectious diseases (World Bank, 2005). This scenario can be attributed to an epidemiological transition. Nevertheless, instead focusing on prevention, policy makers are still more concerned about the costs related to the periods that precede death.

Application of nuclear technology to medicine is increasing due to emerging opportunities such as the possibility of understanding the metabolism and pharmacology of new drugs; assessing the efficacy of new drugs and other forms of treatments; developing new technology platforms; further development of hybrid imaging instruments such as positron emission tomography (PET) to improve disease diagnosis and treatment; and increasing radionuclide production and availability of radiopharmaceuticals (Institute of Medicine, 2007).

Despite the complexities involved in applying nuclear technologies, the physician acts like a gatekeeper in the process of adopting and spreading the use of nuclear technologies. A better comprehension of the economic mechanisms related to the application of nuclear technologies, such as the existing incentives for that application, can shed light on how to manage chronic diseases and deal with the issues associated with epidemiological transition.

In the last 30 years, economic science has benefited from the development of information economics. This field deals with the existing asymmetries between players and the consequences of such asymmetries, and also the design of institutions, contracts, and initiatives to improve economic performance. Information economics comprises the planning of institutions and organizations, development economics, political science, and health care markets.

In a situation in which a contract is established between two persons or institutions, for example, the person who hires is called the principal and the person who performs the task is the agent. Problems with the principal-agent contract occur when the delegation of a task creates an asymmetry of information between the two parties. This delegation process can happen because the principal has no disposition of time or other required resources to execute the task, or has no adequate knowledge for performing it. The consequences of this interaction can be a moral hazard or adverse selection, also known as hidden action and hidden information, respectively.

The moral hazard situation occurs when one party behaves differently when exposed to risky situations. Adverse selection is an economic term used to describe undesirable results as consequence of asymmetry of information.

This article describes how economic mechanisms can be used to improve management of the diagnosis and treatment of chronic diseases. We also suggest how moral hazard situations can be avoided. Despite the contribution that nuclear medicine may offer to diagnosis and treatment options, few studies have been done on the use of nuclear medicine in chronic diseases, from the economic point of view. A framework using concepts from the theory of incentives strengthened the analysis in the theoretical perspective, especially regarding the principal-agent relationship, to establish the effort levels and the compensation used to propose a new insight in the scenario. Therefore, the principal-agent theory can offer an interpretation on how improvements through incentives can increase the role of nuclear medicine in the diagnosis and treatment of chronic diseases.

Principal-agent theory was applied to analyze the consequences of asymmetry of information between the players and the optimal contract designs to deal with these situations, in a theoretical form. In a moral hazard situation, the leading variables, such as effort variables, positively influence the agent's production level and also create a disutility for the agent.

Discussion

It is known that the shift from acute infectious diseases to chronic non-communicable diseases that has been observed in low- and medium-income countries is a complex and dynamic epidemiological process (Mascie-Taylor and Karim, 2003). The burdens of these diseases are leading to losses in the economic production associated mainly with cardiovascular diseases, chronic respiratory diseases, and diabetes. In low-income and middle-income countries, this impact has been responsible for 50% of the total disease burden (Abegunde et al., 2007). In Brazil, around 66% of the total disease burden is related to chronic diseases whereas infectious diseases and injuries account for 24% and 10%, respectively (World Bank, 2005).

It is expected that technology may be used to reduce the impact caused by chronic diseases. More specifically, nuclear technology applied to medicine may be used as a way to alleviate the burden of such diseases, as suggested by the Institute of Medicine (2007).

Nuclear technology may be used to provide a better understanding of the relationship between brain chemistry and behavior in diseases such as depression and eating disorders, to develop higher-resolution and more sensitive imaging instruments and to improve existing ones such as PET and Single photon emission computed tomography (SPECT), and more importantly, to improve disease diagnosis and treatment, among other uses.

We asked whether the theory of incentives could be used to analyze the relationship between the growth of chronic disease and nuclear technology.

Despite the importance that physicians have as gatekeepers of technological adoption, little attention has been given to their role as agents of the health institutions (Fuchs, 2000). A better understanding regarding the incentives, especially the principal-agent relationship, may be useful for the understanding of epidemiological transitions and technology adoption.

The physician utilities depend on the results obtained from their work in a health institution. Hence, the physician is typically risk-averse but their efforts have influence on the health institution's performance. Bigger institutions face more difficult incentive problems (Baker, 2002). Because individuals usually dislike to be monitored, especially when monitoring is linked to future rewards (Ellingsen and Johannesson, 2008), the incentive strategy becomes an important issue when dealing with uncertainty perspectives like technology adoption.

Let us suppose a situation where the cost-effectiveness of nuclear medicine technique over some diseases produces an extra benefit. A health institution wishes to improve the use of nuclear technology, both in diagnostics and treatment, as a way to respond to an increased epidemiological trend, like the increase in the incidence of chronic diseases. The success of this approach demands physician adherence. However, some physicians may find this task daunting and decide for following a lower-effort choice. Another situation that can be suggested is when the physician is waged by his or her efforts in implementing the use of certain technology, so to achieve this goal increases efforts in this direction. In these cases, both the low efforts and high efforts from the physician are considered. The economics provides two approaches for each situation in order to define the best contract situation, at least in theory.

These two situations are usually called the first-best and second-best solutions. In the first-best the effort is observable whereas in the second-best it is not. In an ideal model with unobservable managerial effort and neutral-risk physician, an optimal contract generates the same effort choice and expected utilities for the physician and institution as in the first-best solution. In the neutral-risk physician, the efficiency incentives can be provided without losses, and the full marginal returns from the physician's efforts can be received. In a risk-adverse situation, incentives for high effort can be provided at the cost of the physician risk (Mas-Collel et al., 1995).

Ellingsen and Johannesson (2008) suggested that a fixed wage can be optimal under quite plausible assumptions, however losses can be incurred from ignoring moral hazard and from paying physicians a fixed wage like other administrators (Gayle and Miller, 2008).

In the case in which physician incentives are directly correlated with the outcomes obtained by the institution, the physician has the maximum incentive. The opposite occurs when the outcomes do not correlate with the incentives. A higher expected payment can lower the expected return to the health institution, as the revenues are limited by the production capacity. In a situation with maximum incentive the expected profit is higher with the physician exposure to the risk or effort, so the institution's net benefits are not maximized under maximum incentives for the physician. Considering the reward concept in a broader sense and using the utility and quantity for the principal and the agent as the axis (see Figure 1) it is possible to show that a simple agency relation exists.

Figure 1 represents the use of nuclear technologies where the "x" axis represents the quantity of use (Q), and the "y" axis represents the value in monetary units. The "R" lines are representations of the principal rewards, with longer lines representing bigger rewards. Using the economic concept of utility "U^1" is the indifference curve of the physician and "B" lines are representations of the physician budget. The "P" line represents the production obtained with constraints.

If the physician chooses the B1 line tangent in C1, the increase of effort leads to an increased R that is steeper than the physician rewards. As long as the effort increases and the physician chooses C2, the outcomes of the principal are maximized, because the P line and B2 are now parallel, and the R line is longer than in other situations. The C3 tangent point represents a new budget situation for the physician; however, in this situation the increases related to the physician rewards are steeper than in the P line. If the inclination of B becomes steeper and near to one, the reward of the principal approaches zero.

New production lines represent an increase of production. This means that with new production, the physician should expect an increased reward. The dynamics of the system remain the same.
Thus higher outcomes due to increased efforts can lower the expected return to the principals.

A contract may be established where the revenues for the principal are maximized, even when the production increases or decreases. This illustrates how a contract to be established refers to a situation in which the principal can maximize his rewards without monitoring the agent choices. But, in a constant wage situation, the agent chooses the lowest effort due to the low incentives to acquire new knowledge or training.

The health institution acting as a principal has the task to create contracts with suitable incentives for the agent to perform the desirable effort level. The competition in health care markets made health care compensation more complex and specific in some circumstances, going beyond the monopolist and competitive solutions (ref).

Simple models are useful for the understanding of the basic relations behind the mechanisms, and can work as platforms for new models. Microeconomic theory has developed, in recent decades, a series of models to propose explanations for rewarding systems and contracts. More recently, a study concluded that contractual incompleteness reduces investments in non-contractible and contractible activities and depresses technology choice (Acemoglu et al., 2007). The agents are contractually obliged to perform activities in contractible situations, but are free to choose other activities in non-contractible situations, leading to an ex-post bargain problem that depresses the adoption of technology.

Organizations have been very creative in developing a series of incentives and contracts to improve performances. The monopoly solution and the competitive solution in hidden action are the simplest relations and the foundations of such agreements from the economic point view.

However, the challenges in developing a suitable contract that represents a better relationship between principal and agent and leads to a better diagnosis and treatment, are far from finding a solution. The promise of personalized medicine may illustrate this situation. Personalized medicine emerged in the beginning of this century as an alternative that would offer better solutions with the possibility of lowering overall costs. The main barrier for a broader application of personalized medicine is still nonetheless the incentives issues regarding the alignment of the key stakeholders for the development and adoption of this technology (Davis et al., 2009). The main stakeholders to the development of personalized medicine are the payers, providers, pharmaceutical and biotechnology companies, and diagnostic companies, while the incentives are upon the regulatory environment, coverage, physician incentives, and investment by pharmaceutical and biotechnology companies.

One approach to dealing with the incentives is through cooperation, which may represent a more flexible solution than a contract approach. The cost of punishment, such as lack of payment to the agent, can increase the amount of cooperation but, overall, the payoffs are the same with or without the punishment. Coercion forces the agent to submit and not to cooperate, and can incur additional costs (Dreber et al., 2008; Ohtsuki et al., 2009).

To improve the use of nuclear technologies to deal with the increase of chronic diseases, better incentives can be used. A simple contract mechanism can create ideal situations that lead to technology adoption or control the choices for the principal in a non-observability situation, avoiding the moral hazard effects. However, despite the consistency of this approach new aspects should be considered, like the cooperation of the agents for an increased payoff. The cost of maintaining the contract or the punishment is a stabilizing mechanism for cooperation that can work well in a one-shot situation. But with repeated interaction, which is the most likely scenario, and when reputation is at stake, this mechanism is no longer fully efficient.

The principal-agent model is a simple concept from which we can draw important conclusions. Considering the figure, the shape of the contract does make a difference, whereas steeper slopes create stronger incentives. This configuration may not represent the best solution. One limitation of the principal-agent theory is the focus on effort aversion as source of disagreement between the parties (Miller, 2005).

The advances of cooperation, even in evolution theory, show that cooperation is needed to construct new levels of organization, even in competitive environments (Nowak, 2006).

Corporate governance can be used as a cooperation mechanism capable of reducing the principal-agent problem. The concept of governance is present in many debates about responsibility, reputation, ethics and so on, but it can also be used to promote the adoption of technological strategies to deal with emerging diseases. The potential for nuclear medicine to deal with chronic disease needs more than a contractual approach to deliver its full contribution to society.

Conclusion

The growth of chronic diseases is responsible for both health and economic burdens in many societies in the rise of this century. Few works have focused attention on the interaction between nuclear medicine, chronic diseases, and economics. New technologies advanced through nuclear medicine have the potential to deliver valuable solutions and lower the costs in certain situations. However, the adoption of these technologies in health institutions needs to overcome endogenous and exogenous barriers, such as physician incentives and market factors, respectively.

Contractibility is not enough to produce all desirable outcomes. The cooperation between the agents may also contribute to alleviating the asymmetries in the principal-agent interaction.

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Figure 1. Principal-Agent relation

Adapted from Campbell D.E. (2006), Incentives: Motivation and the Economics of Information, Cambridge University Press, Cambridge, UK. p. 233.

Figure