

What the comprehensive economics of blindness and visual impairment can help us understand

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Since the year 2000, the amount written about the economics of blindness and visual impairment has increased substantially. In some cases, the studies listed under this heading are calculations of the costs related to vision impairment and blindness at a national or global level; in other cases the studies examine the cost-effectiveness of strategies to prevent or modify visual impairment or blindness that are intended to be applied as a guide to treatment recommendations and coverage decisions. In each case the references are just examples of many that could be cited. These important studies have helped advocates, policy makers, practitioners, educators, and others interested in eye and vision health to understand the magnitude of the impact that visual impairment and blindness have on the world, regions, nations, and individuals and the tradeoffs that need to be made to limit the impact. However, these studies only begin to tap into the insights that economic logic might offer to those interested in this field. This paper presents multiple case studies that demonstrate that the economics of blindness and visual impairment encompasses much more than simply measures of the burden of the condition. Case studies demonstrating the usefulness of economic insight include analysis of the prevention of conditions that lead to impairment, decisions about refractive error and presbyopia, decisions about disease and injury treatment, decisions about behavior among those with uncorrectable impairment, and decisions about how to regulate the market all have important economic inputs.

Key words: Economics, blindness, visual impairment, market, government, cost

Economics includes cost-effectiveness and also provides a basic paradigm to explain human and organizational behavior and motivate government action. This article describes the multiple aspects of economics and how they have been used and might be used to study blindness and eye care.

What has been Written about the Economics of Blindness and Visual Impairment?

Since the year 2000, the amount written about the economics of blindness and visual impairment has increased substantially. In some cases, the studies listed under this heading are calculations of the costs related to vision impairment and blindness at a national or global level;^[1-7] in other cases the studies examine the cost-effectiveness of strategies to prevent or modify visual impairment or blindness that are intended to be applied as a guide to treatment recommendations and coverage decisions.^[8-14]

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made to limit the impact. However, these studies only begin to tap into the insights that economic logic might offer to those interested in this field.

What Does Economics Include?

To illustrate what else the economics of blindness and visual impairment may include, it helps to begin with an easy definition of economics: The study of the use of resources under conditions of scarcity. In some ways, this does not need to say anything more than the study of the use of resources, as all resources are scarce. There is only a limited quantity of each resource in the world. Resources include the time each person has available, the money each person has available, and the quantity of physical resources that the entire world has available. The scarcity of goods is part of what determines their value in the market that results in prices that are put on time (through compensation), goods, and services. Economics could be described as driving all decisions.

However, economics is not, and should not be considered, the only driver of resource allocation decisions and associated behaviors. While the prices of time, goods, and services are key determinants of individual and societal resource allocation, individuals and societies have heterogeneous tastes and heterogeneous sets of information.

A simple example of heterogeneous tastes related to the correction of refractive error is individual concerns regarding how the cosmetic aspects of spectacles will affect their lives. Differing amounts of information can also change individuals' eye-related economic behavior. Individuals with a better understanding of the long-term possible consequences of diabetes may be more careful to obtain regular eye exams to identify the incidence and take steps to control the progression

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of diabetic retinopathy while individuals with less information may avoid such exams.

Economics of the Market

Economics is not only about the individual, but is also about markets and populations. One concern with the economics of health in general is that markets do not work in the same way that they do for many other goods and services. The reasons for this are many.

One is the level of uncertainty regarding the effects of behaviors and actions.^[15] Uncertainty may come from the popular press reporting seemingly contradictory effects of the same behavior as reported in the scientific literature. Alternatively, many diagnostic tests do not yield an unambiguous result. Further, the effects of treatment on an individual are uncertain. In fact, nearly every action in health care is associated with a probability of an outcome rather than having a definite consequence. An example related to eye health is the degree of heterogeneity in the effects of glaucoma management that may make it necessary to try multiple treatment strategies and draw out the process of settling on a patient-specific appropriate strategy.

A second reason that markets are thought to not function in health care is the fact that the quantity of information needed to reduce uncertainty is larger than in many other markets. Consider the level of specialization and sub-specialization in medicine in general and in eye care specifically. This leads to what is referred to as a principal-agent relationship.^[16] Medical care (or more specifically eye care) providers act as agents on behalf of patients, the principals. This complicates the economics of the situation as it is challenging to provide incentives for the agent to act only on the principal's behalf rather than for their own good. A higher income country eye care example of this phenomenon is how an ophthalmologist approaches sharing information and a treatment recommendation that patients need to understand the potential effect of surgery to correct refractive error so that the patient can make the best decision.

A third reason that medical care economics in general and eye care economics specifically can be substantially different from economics in other markets is the fact that patients are not always spending their own resources. In some societies, insurance is sold by private companies. In this case, individuals (or their employers on their behalf) pay a premium to insurance companies so that the insurer will pay a substantial fraction of the cost for care. At the time of utilization patients (and providers acting on their behalf) may still face price as a signal about the appropriate utilization of resources and tradeoffs between different uses of resources, but the price signal is weakened by the fact that the individual is not responsible for payment of the total cost. In other countries, the government uses tax funds either to pay physicians a salary and to provide hospitals with a budget or to make payments for specific services provided by all providers. Again, this can substantially modify incentives. The fact that patients rarely use only their own resources makes it necessary to develop tools to simulate welfare maximizing individual and societal level resource allocation. Cost-benefit and cost-effectiveness analysis have emerged to fill this need. An example of the usefulness of cost-effectiveness analysis is the discussion regarding the use of ranibumab (a product developed specifically for eye care)

or bevacizumab (a product with nearly identical properties that is much less costly and has similar effects on vision but a slightly worse side effect profile) to treat age-related macular degeneration in higher income countries.^[17] When most of the money being spent on either product comes from the government (as in the United States), the decisions need to be guided as if they were being made in markets in which patients and providers recognize the consequences of allocating resources in different ways.

A fourth reason that health care may not behave like a typical economic market is that in some cases individuals have to make a decision in which the potential negative consequence of failure is loss of life (for which some people claim there is no value high enough to represent the value of life). In eye care the most feared outcome is the loss of vision that cannot be corrected with current technology. The fear of the permanent loss of something very important may modify individuals' willingness to make tradeoffs in ways that are difficult to anticipate.

The Future of the Economics of Blindness and Visual Impairment

The future of work on the economics of blindness and visual impairment can be substantially more comprehensive than the work done to date. Future work has the potential to expand in a number of directions in which either economics has not been explored at all or the economic explorations to date can be built upon to inform policy that is more likely to increase the utilization of high quality care in a way that is potentially sustainable. The remainder of the paper will provide numerous case studies of how economics can add insight to the evaluation of an issue in eye health research. The research agenda would be to identify the influence of economic factors or the way in which economic factors modify the influence of noneconomic factors.

Economics of the Prevention of Conditions that Lead to Blindness and Visual Impairment

The first case study will be more extensive than the others as it is used to illustrate a large number of concepts. One area that has not been explored extensively in the economics of eye health is how economic factors either directly affect or modify the effects of other variables on behaviors related to the prevention of conditions that affect vision and may lead to visual impairment or blindness. Economic research on primary prevention of conditions that can cause visual impairment and blindness could be considered part of an emerging field described as behavioral economics that examines the incentives and tradeoffs involved in everyday behaviors.

Taken to its logical starting point, the economics of efforts to curb blindness related to diabetic retinopathy begin with efforts to mitigate the prevalence of or prevent obesity. Health professionals are aware that a key sequela of obesity is Type II diabetes that is then associated with diabetic retinopathy. For children and young adults, the problems with vision will occur in the distant future. Economic analysis focuses on understanding how individuals comprehend and value the prevention of diabetic retinopathy and the tradeoffs they would be required to make in the process of preventing obesity.

Another basic example of health behaviors and visual impairment and blindness is the wearing of sunglasses to delay the onset of cataract and the need for cataract surgery.^[18] In this case there are three steps that could be evaluated from an economic perspective. The first is the purchase or other method of obtaining sunglasses, that is, we could ask how this corresponds to the price that individuals are asked to pay. The second is the initiation of the use of sunglasses, that is, in this case how much effort is it to have the sunglasses in a place where they are readily accessible when the person goes outside and having the person remember to use them. The final step is maintaining the use of sunglasses, and economics in this case focuses on a combination of the value of the time and effort to keep track of the sunglasses and the response to the cost of the need to purchase an occasional replacement for a lost or broken pair of sunglasses.

The two examples of prevention may interact—if a person would like to use outdoor exercise to help to avoid becoming obese or to reduce his weight so that the risk of diabetes and diabetic retinopathy would be reduced, then they should also purchase, use, and continue to use sunglasses in order to delay the onset of cataracts. A behavior that could have a positive effect on one eye health issue (i.e., diabetic retinopathy) could have a detrimental effect on another eye health issue (i.e., cataract) if the person changing their behavior with respect to diabetic retinopathy is not counseled about the importance of sunglasses with respect to cataracts or the person does not have the resources to buy and to continue to use sunglasses. This interaction of effects influencing eye health illustrates the basic notion of understanding tradeoffs individuals will need to make. Research can be performed to measure the degree to which individuals make these tradeoffs. An understanding of whether individuals tend to think about their eye health in a systematic way that would lead to be more exercise and better protection of the eyes from the potentially harmful effects of the sun or if the individual simply thinks about the two problems separately and does not see the connection between them will help in the design of the most appropriate social marketing or physician–patient communication material to change behaviors in a way that either benefits all types of health for an individual, or, at the very least, does not needlessly put one aspect of health at risk in an effort to improve another aspect of health.

If economics guides decision making, an individual should not initiate a behavior unless the value of the first bit of that behavior is higher than what it costs. Subsequently, it is assumed that the incremental (or “marginal” to use the economic terminology) cost of more of an activity will go up and the marginal benefit will decrease. Following this logic, at some point the incremental cost of pursuing more of a given health behavior will be higher than the incremental benefit of pursuing more of the activity and the individual will choose to stop pursuing the activity. While economists are not suggesting that individuals literally take out a pencil and paper and calculate the value of their marginal utility, economists have found that when the perceived value of an activity increases, individuals generally perform more of that activity. Thus, we can use economics and an understanding of the inputs into economically motivated decision making to consider how to educate the public about the way in which various health improving behaviors are related to vision so that individuals can make informed tradeoffs.

The tradeoffs that would have to be considered for either of the types of prevention discussed above are made all the more complex because diabetes is one of the sequelae of obesity and diabetic retinopathy is one of the long-term effects of diabetes. Individuals may not understand the complex array of sequelae of either obesity of diabetes without having substantial information provided. The extensive time separation between health behaviors to change obesity and the prevention of visual impairment related to diabetic retinopathy (a trait in common with wearing the sunglasses to delay cataract onset) makes the economic insight even more complicated as individuals have to consider how to make tradeoffs between effort that is required now and health effects that are sometime in the distant future. Individuals are thought to have heterogeneous rates of time preference that reflect how much they care about the future, which affects decisions like these.

Economics of Refractive Error

The economics of solutions to the problem of refractive error only are different from the economics of prevention. The most basic economic question is a comparison of the costs and perceived benefits of being able to see clearly. A tradeoff distinct to refractive error correction is individuals’ perception of their appearance and their ability to participate in specific activities for which wearing spectacles may limit opportunities. These immediate tradeoffs are different from the long-term tradeoffs discussed earlier.

Of course, spectacles are not the only way to correct refractive error. Contact lenses are also available in some settings. These have fewer cosmetic considerations and limit participation in specific activities less than spectacles. However, they are more expensive. They require either cleaning (which takes time and money) or a large supply of daily disposables (which requires space). They may also be associated with discomfort.

Finally, there are surgical options to correct refractive error. These are more expensive; however, if the procedure is successful and without complication it reduces the need for some future costs. The decision involves tradeoffs of accepting the possibility of numerous complications.

Additional economic considerations with respect to refractive error include the need for longitudinal management of the condition by an eye care provider who understands other risks that may be associated with significant myopia. Substantial resources are required to make the time and have the money to return to an eye care professional on a regular basis, receive an examination, and possibly obtain new spectacles. Price is likely to be a key factor.

At a policy level, tradeoffs between the price and quality of spectacles are critical. Can glasses be manufactured and shipped to those who need them at a cost that will be within reach for the target population? Are recycled spectacles an economically efficient options?^[19]

Economics of Presbyopia

The onset of presbyopia occurs at a time when many individuals are at or near their maximal economic productivity. Many individuals in their forties have had a sufficient time to develop their skills and expertise but have not reached a point

at which other (noneye) health considerations have begun to have a negative impact on their ability to perform their work. The inability to manage near tasks with uncorrected presbyopia may have important consequences for personal productivity. If the individual is the head of a household, the economic considerations are critical. The price required to pay to solve this problem is generally less than for myopia. In higher income countries, a person can find readers at the drug store and self identify a reasonable level of correction for a relatively low price. The issue in lower income countries is often availability.

The economics become a bit more complicated if the person has a preexisting issue such as myopia when presbyopia arises. In this case, the individual may need multiple pairs of glasses for different tasks or bifocals or progressive lenses to be functional in the variety of daily settings. The expense and management of multiple pairs of glasses or the effort to learn to use bifocals or progressive lenses appropriately makes the cost of this solution to vision impairment higher than when an individual has only a single cause of visual impairment.

Economics of Disease Treatment

In higher income countries the largest causes of visual impairment related to eye disease include glaucoma, diabetic retinopathy, age-related macular degeneration, and cataract. Cataract is rarely a cause of blindness or even of long-term visual impairment in higher income countries because of the ready availability and relatively low price (or government subsidy for) cataract surgery. The key economic question here is the price and any inconvenience of the surgery that can be compared with the benefits of being able to see clearly again after an intra-ocular lens implant. Given the potential to see relatively clearly for the remainder of one's life and the relatively low rate of complications associated with cataract surgery the benefits would seem to obviously outweigh the costs for most individuals in most cases, although without third party payer support it is not clear how many older adults could easily afford cataract surgery. Cataract surgery has also been demonstrated to be among the most cost-effective procedures in the world in lower income countries.^[20]

The other conditions listed each require long-term management with careful supervision that may be accompanied by pharmaceutical and surgical techniques. A key set of considerations in this case is the degree to which there are costs and benefits to each step in the disease management process. In addition, the uncertainty that was mentioned as a special aspect of health care economics comes into play. The progression of any of the three conditions is not always predictable. Individuals have heterogeneous responses to treatment alternatives. The cost of different alternatives varies greatly.

In lower income countries the key is to determine what government or donor spending is justified by the value of preserving vision rather than tolerating vision loss due to the conditions above and other conditions including onchocerciasis, trachoma, and xerophthalmia.

Economics of Eye Injury

Ocular injury that may result in visual impairment or blindness has been a part of life since the dawn of the human species.

The prevalence of military conflicts increases the incidence of eye injury substantially. Both eye injury and traumatic brain injury without any obvious external ocular injury can result in visual impairment.^[21] The value to a government of the loss of potential productivity of a member of the armed services must be compared with the amount of resources that are available to identify and treat individuals who have suffered ocular injury or otherwise find themselves with visual impairment. Advancing technology may make it possible to restore some amount of sight to some individuals in some higher income countries (and eventually in less affluent areas of the world as well). However, from a societal perspective, the cost of providing a cash payment to the individual or his family of what he would have been expected to earn had he not suffered an ocular or other injury associated with visual impairment or blindness may actually be lower than the cost of providing a high tech solution to restoring vision. This demonstrates how economics has a difficult time capturing what we might call the humanitarian value of providing care or the value that the rest of society gains from making sure that someone who has been injured in service to society is cared for as well as possible. However, with limited resources it is incumbent on society to assess what the most appropriate use of those resources would be.

Economics of the Experience with Blindness of Visual Impairment

Those who are blind or who have visual impairment that cannot be corrected with current technology are likely to face different constraints than individuals with functional vision and are likely to have more limited opportunities to earn an income which will further limit their choices in life. Since economics is ultimately all about making choices given resources and facing constraints (both monetary and physical), these individuals will likely make different decisions and have different experiences with expenditures and with their health outcomes. More studies of the way in which individuals and their families respond to these changes in constraints and opportunities would be useful for understanding the actual impact of blindness and visual impairment on individuals and societies rather than just the projected impact that appears in global burden estimates.

Economics of the Provision of Eye Care Services

The market for eye care services is determined by the supply of relevant providers and relevant government regulation. The provision of eye care must either be supported by the government or a donor or must represent a reasonable business opportunity. When eye care provision is developed in a coordinated regionalized manner with some degree of centralized planning, the planner must consider the costs and benefits of adding more providers, the location of the providers, and the type of providers. Each of these will have an impact on utilization.

When the market is characterized primarily by private providers, the government must decide whether in its regulatory role it will promote or otherwise incentivize high quality care or leave the provision and recognition of quality to the market. The government could decide to take an indirect

role in promoting quality by promoting competition. In this case, new providers will not enter the market if it is not profitable. However, as long as it is profitable and multiple providers come into the market, the existence of competition is likely to enhance quality as this is one way for providers to enhance market share and earn more income.

Conclusion

As can be seen from the multiple case studies discussed the economics of blindness and visual impairment encompasses much more than simply measures of the burden of the condition and analysis of the prevention of conditions that lead to impairment, decisions about refractive error and presbyopia, decisions about disease an injury treatment, decisions about behavior among those with uncorrectable impairment, and decisions about how to regulate the market all have important economic inputs.

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