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Mini Review

COSTS INCURRED BY SUPPLY CHAINS AND DRUG RESISTANCE AS A RESULT OF TREATMENT HETEROGENEITY

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ABSTRACT

The emergence and spread of resistance pose a threat to the efficacy of scarce medications for numerous infectious diseases. To prevent drug resistance, available drugs should be used in a socially beneficial manner, according to numerous studies. When multiple drugs are used to treat a specific disease, this study examines the tradeoff between risk of drug resistance and operational costs. We demonstrate, employing a model of disease transmission and resistance spread, that treatment with multiple drugs improves resistance-related health outcomes at the population level, but that the marginal benefit decreases as the number of drugs used rises. We contrast this benefit with the change in procurement and safety stock holding costs brought about by the supply chain's increased drug variety. We demonstrate that disease prevalence appears to be less important than the duration of a single disease episode and the cost of the drug(s) used when determining the optimal width of drug assortment through a large-scale simulation based on malaria transmission dynamics.

Keywords: Bioavailability; Gastrointestinal fluid; Metabolism

INTRODUCTION

According to our analysis, the best course of action is to administer multiple drugs to the population at the same time, regardless of the prevalence of the disease or the price of the medication. It may be best to use only one drug if the disease is prevalent, the price of the drug is high, discounts are available for purchasing large quantities, and so on. Policymakers can gain insight into the socially optimal size of drug selection for a given context from our model. An extremely serious issue that jeopardizes efficient medical care for millions of people is drug resistance. The development of resistance is strongly influenced by the behavior of individuals and institutions, as well as the regulation and use of available drugs. Decision-makers, such as governments, physicians, and patients, fail to consider the negative impact of their policies or drug use on the future effectiveness of these products when there are no appropriate economic incentives. Even though drug resistance is a biological phenomenon that occurs naturally, many factors can speed up or slow down this process, one of the most important being the drug treatment strategies and policies implemented in various nations.

DISCUSSION

If therapies lose effectiveness due to inappropriate drug use, significant investments in drug development may be undermined; Drug resistance can develop wherever inappropriate use occurs, which has consequences for patients everywhere. An instructive illustration of this is the evolution of drug resistance in malaria. Antifolate medications became widely used as a result of this, and resistance to them soon developed. Artemisinin-based medications, which are currently the most widely used first-line treatment for malaria, are on the verge of repeating this pattern. Multiple first-line treatments for malaria are still almost never used, in part because of worries about higher costs for supply chains and programs. Global policy inaction on this issue is a result of the absence of rigorous analysis comparing the benefits and operational costs of using multiple drugs [1].

Numerous mathematical modeling studies have attempted to comprehend the impact of using multiple therapies simultaneously in a population on the emergence and spread of drug resistance in response to concerns about the evolution of drug resistance and the global health threat it poses. These studies have demonstrated that the development of drug resistance is slowed and delayed when a greater number of therapies (drugs) are administered to the population at the same time. This is primarily due to the low short- and long-term drug-specific selection pressure brought on by the abundance of drugs on the market and the slower degradation of the mean fitness of the parasite population, which makes it more difficult for new types of resistance to enter and spread. In addition, the practice of administering multiple medications concurrently enables a greater proportion of the population to be treated without compromising the ability to treat cases that may be untreatable due to high resistance levels in the future [2].

Despite the fact that these studies demonstrate that increasing drug variety slows the emergence and spread of drug resistance, it also results in increased operational costs. In the pharmaceutical industry, volume discounts are a common practice. This means that more kinds of drugs for the same disease would cost more per unit. Also, when demand is uncertain, a wider range of drugs for a particular disease means more safety stocks, which means more money spent holding inventory. In contrast, there is a demand variability pooling effect that allows one to hold less safety stock in order to maintain the same level of customer (patient) service when all patients are treated with the same drug. For a given number of sourced treatments, an increased drug variety increases the cost of acquiring the drugs, the cost of holding inventory, and, in some cases, the cost of training healthcare workers. When multiple drugs are used to treat a specific disease, this study examines the tradeoff between risk of drug resistance and operational costs [3-6].

CONCLUSION

We quantify and contrast the cost of higher drug variety in the supply chain with the benefit of delayed resistance and disease containment in this paper. Policymakers can gain insight into the drug assortment's socially optimal size from our model. The remaining parts of the paper are laid out as follows: In the second section, we go over the relevant research in epidemiology, supply chain management, pharmaceutical policy, and economics. In section 3, we use a disease model that includes the emergence and evolution of resistance, use the concept to define disease burden, and use simulation analysis to show that the number of drugs used decreases both disease prevalence and total resistance over time. The directional effects of a wider drug portfolio on disease and resistance containment, procurement, and safety stock holding costs are the subject of our joint

investigation. An extensive numerical investigation in supports the analysis, We present some policy insights regarding the socially optimal width of drug assortment and summarize our findings.

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