Evaluation of a pharmaceutical pay-for-performance risk-sharing agreement when patients are screened for the probability of success

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Abstract

Objectives:
Pharmaceutical risk sharing agreements are a type of contract between drug manufacturers and third party payers. These agreements are increasingly being used as part of formulary listing decisions for new oncology products. We develop a game theoretic model of a pay for performance agreement.

Approach:
We model interactions between the payer and manufacturer as a Stackelberg game. The pharmaceutical firm chooses the drug price and then the payer chooses which patients will be eligible for treatment. Following the treatment the manufacturer pays a rebate to the payer for all patients who did not respond to the new drug. We solve for the optimal price and treatment decisions by both parties. We define the social welfare as the sum of the payer’s and manufacturer’s objective functions, and investigate whether a combination of taxes, subsidies and additional rebates can result in the optimal social welfare being chosen by the two parties acting independently in a decentralized system.

Results:
We find a threshold rebate rate beyond which it is optimal to make the drug available to those patients who are least likely succeed rather than those who are most likely to succeed. We create several numerical examples to investigate how the distribution of the drug manufacturer and the net health benefits purchased by the payer. We find that a single rebate based on performance does not, in general, lead to socially optimal outcomes, but that social optimal outcomes can be achieved using appropriately designed taxes and subsidies.

Conclusions:
A pay for performance risk sharing agreement may be welfare-improving for certain ranges of rebate rate. Formulary managers should be aware of the incentives created by different types of agreements when negotiating with drug manufacturers.

Notation

Objective Functions:
\( V_p = \text{Payer’s objective, Net Monetary Benefit} \)
\( V_M = \text{Manufacturer’s objective, Profit} \)

Decisions:
\( L = \text{lower bound on probability of success to have access to the new drug} \)
\( U = \text{upper bound on probability of success to have access to the new drug} \)
\( p = \text{price of the new drug} \)

Parameters:
\( \pi = \text{probability of success} \)
\( \alpha = \text{rebate rate} \)
\( b = \text{incremental benefit of the new drug} \)
\( c_v = \text{verification cost per patient receiving the new drug} \)
\( c_i = \text{invoicing cost per patient claiming a rebate} \)

Model


\( V_p = \int_L^U \left[ b - (p + c_i) \pi + \left( (\alpha p - c_v) - (p + c_i) \right)(1 - \pi) \right] f(\pi) d\pi \)
\( V_M = \int_L^U \left[ (p - w) \pi + \left( (\alpha p - w) - (p - w) \right)(1 - \pi) \right] f(\pi) d\pi \)

Choose usage criteria \((L, U)\) to maximize NMB

Choose price \(p\) to maximize profit

Results

Risk Sharing and Access

Payer and Manufacturer Performance

Threshold Rebate for Equal Total Benefit

Social Welfare Maximization

Define social welfare as the sum of the two parties’ objectives, \( V_S = V_p + V_M \)

Observation:
Two parties making separate (decentralized) decisions could result in a reduction in social welfare.

Solution:
Can maximize \( V_S \) with the following:
1. Properly designed taxes (or subsidies) on the verification and invoicing costs
2. An additional transfer payment that includes separate payments on success and failure.