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Patient-Reported Outcomes

Conceptual Model and Economic Experiments to Explain Nonpersistence and Enable Mechanism Designs Fostering Behavioral Change

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ABSTRACT

Background: Medical nonpersistence is a worldwide problem of striking magnitude. Although many fields of studies including epidemiology, sociology, and psychology try to identify determinants for medical nonpersistence, comprehensive research to explain medical nonpersistence from an economics perspective is rather scarce. **Objectives:** The aim of the study was to develop a conceptual framework that augments standard economic choice theory with psychological concepts of behavioral economics to understand how patients' preferences for discontinuing with therapy arise over the course of the medical treatment. The availability of such a framework allows the targeted design of mechanisms for intervention strategies. **Methods:** Our conceptual framework models the patient as an active economic agent who evaluates the benefits and costs for continuing with therapy. We argue that a combination of loss aversion and mental accounting operations explains why patients discontinue with therapy at a specific point in time. We designed a randomized laboratory economic experiment with a student subject

pool to investigate the behavioral predictions. **Results:** Subjects continue with therapy as long as experienced utility losses have to be compensated. As soon as previous losses are evened out, subjects perceive the marginal benefit of persistence lower than in the beginning of the treatment. Consequently, subjects start to discontinue with therapy. **Conclusions:** Our results highlight that concepts of behavioral economics capture the dynamic structure of medical nonpersistence better than does standard economic choice theory. We recommend that behavioral economics should be a mandatory part of the development of possible intervention strategies aimed at improving patients' compliance and persistence behavior.

Keywords: behavioral economics, financial incentives, health behavior, laboratory experiment, medication persistence, medication adherence, mental accounting, patient behavior, patient compliance, prospect theory.

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Introduction

Poor treatment persistence with prescribed medicines has long been recognized as a major obstacle for effective treatment and health care efficiency [1–3]. More recent studies for a wide range of chronic diseases such as asthma, diabetes, and hypertension reveal that only 50% to 65% of the patients adhere to the recommended medication usage [4–7]. The deviation from the prescribed medication-taking behavior exposes the patient to higher risks and leads to poorer health outcomes and increased morbidity and mortality [2,8,9]. The associated costs for additional health care services and forgone investments for the development and utilization of new and efficacious but ultimately ineffective drugs and therapies have escalated into billions of dollars annually [10–14]. Employers report poor health habits as the main challenge to maintaining affordable benefits [15].

Traditionally, one approach to shortcomings in patient behavior has been to view the problem as information gap. Various

interventions aimed at enhancing medication persistence, such as patient education and training, feedback loops and reinforcement, or drug presentation and functionality, were shown to be at best moderately effective and rather limited in promoting sustained behavior change [16–19].

A second approach to realign behaviors is to provide the patient with financial incentives. Once considered as a promising approach toward achieving healthy behavior, the effectiveness of their use remains insufficient and inconclusive, leaving many questions about potential modifiers including form, size, and duration of different financial incentive programs unanswered [20,21].

These empirical findings strongly suggest that the problem of nonpersistence is rooted in numerous causes and requires interventions that use insights from different fields of studies including epidemiology, psychology, sociology, and economics [11,22]. Researchers have started bridging behavioral economics and health to understand how potential modifiers rooted in the psychology of patients such as reasoning fallacies, cognitive

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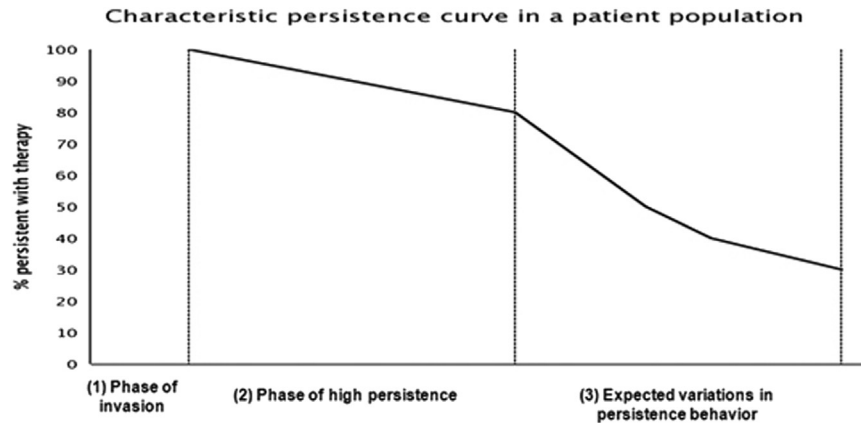


Fig. 1 – Three phases in a stylized medical treatment for chronic diseases.

biases, and errors in belief formation affect the patient's medical decision-making process and prevent behavioral changes. Understanding human biases allows constructing levers through technologies, social networks, gamification, contracts, and incentives. Employers, insurers, pharmacy benefit managers, and companies are starting to experiment with approaches using behavioral insights [23–28]. Comprehensive research about the reasons of nonpersistence from the behavioral economics perspective, however, is scarce. Although patients are viewed as economic agents who perform a cost-benefit analysis when deciding about medication intake [29], the empirical application of economic models to derive individual determinants of nonpersistence and to predict behavior is limited [22]. The reasons why the existing research in health care is slow on that matter is manifold and apparent:

1. The few attempts to economically explain medical nonpersistence only consider rational choice behavior and ignore promising approaches from behavioral economics that augment standard economic theory along with greater psychological realism [30].
2. There is no theoretical framework that captures the dynamic nature of medication-taking behavior and links the individual decision to the observed outcome over time.
3. The empirical research based on observational data or clinical studies lacks the ability to identify the general drivers of the patient's decision-making process to discontinue with therapy. Instead, existing clinical meta-analyses and retrospective studies identify determinants that imply correlations rather than causal relationships with observed outcomes [31].
4. With a focus on clinical trials (randomized and controlled as well as pragmatic) to assess the impact of behavioral incentives, there is a lack of a scalable approach to design, test, and calibrate tailored incentive schemes.

The aim of the study is to explain medical nonpersistence from an economics perspective. We develop a conceptual framework that augments standard economic choice behavior with psychological concepts of behavioral economics to understand how patients' preferences for discontinuing with therapy arise over the course of the treatment. This integrated model incorporates the key features of a medical treatment and generates numerous behavioral predictions. Using the method of experimental economics, the predictions are validated within an economic setting, allowing for general conclusions about the individual's decision-making process and economic behavior in medical treatments. We proceed as follows. In a first step, we describe the different concepts of our framework and illustrate how we abstract from the medical context and create an

equivalent economic environment to clearly isolate the potential economic drivers of medical nonpersistence. In a second step, we explain the method of experimental economics and present how we designed a randomized economic experiment to validate the applicability of the conceptual framework by testing the underlying behavioral hypotheses under controlled conditions.

Methods

Conceptual Framework

We build upon a discrete choice framework that models the patient as an active agent who evaluates the benefits and costs for continuing with therapy and decides upon the assessment of this trade-off. Referring to the typical decreasing shape of persistence behavior observed in clinical studies [4,7,12,13,32,33], we argue that this assessment on the part of the patient varies along the treatment and identify three phases: 1) the phase of invasion, 2) the phase of high persistence, and 3) the phase in which discontinuation with therapy is expected to occur (Fig. 1). The phase of invasion represents the beginning of the medical treatment. The patient is managing access to the medicine and takes the medicine without experiencing any improvements because a certain time and a certain threshold level are needed for the medicine to become efficacious. After this threshold level is met, patients are observed to comply extremely well ("phase of high persistence"), yet fail to do so at a specific point in time and then start discontinuing with therapy ("phase of expected variation in persistence behavior"). Assuming that the costs and benefits are constant throughout the treatment, standard rational choice theory is unable to explain the behavioral deviation in the third phase. Once agreeing to the treatment and complying well at the beginning, the patient is always better off by continuing with therapy.

A broad range of empirical studies conclude that individuals fall prey to reasoning fallacies and do not make perfectly rational decisions because rationality may be limited by time, risk and uncertainty, incomplete information on alternatives, and complexity [23,34–37]. We therefore build our conceptual framework on the principles of behavioral economics and include limited human rationality into the economic decision-making process. The patients' decision-making process is assumed to follow the concept of mental accounting [38,39]. This concept has been used to explain a wide range of consumption and spending behavior [40,41]. The economic evaluation of alternatives follows the prospect theory [42] and is modeled by a special value function whose shape exhibits three essential characteristics (Fig. 2): 1) the value function is defined over gains and losses relative to some

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