

**TB-ILAAJ: A STUDY OF BEHAVIORAL ECONOMICS INSIGHTS AND APPLICATIONS TO REDUCE THE BURDEN OF TUBERCULOSIS IN INDIA THROUGH A MOBILE APPLICATION**

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**ABSTRACT**

Behavioral economics is a branch of economics that merges psychological, cognitive, emotional, and circumstantial factors to better understand human decision making. It posits that humans are not perfectly rational actors; rather, they are prone to inherent biases that can be predicted. Through understanding these nuances of human decision making, behavioral economics has wide-ranging applications in designing better policy and incentives. This paper looks specifically at applications of behavioral economics in developing a theoretical personal healthcare app to ensure and incentivize patient adherence to long-term Tuberculosis treatment regimes. Namely, the theoretical app applies behavioral economics theories including loss aversion, dual-system theory, nudges and choice architecture, uncertainty, and mental bandwidth. Through these behavioral nudges, the app has the potential to not only lead to better health outcomes for patients, but also better public health outcomes by reducing the burden of TB in India.

**Keywords:** TB–Ilaaj, Healthcare app, TB patient, Behavioral economics, Public health system.

**INTRODUCTION**

Behavioral Economics is a relatively new branch of Economics that studies the effects of psychological, emotional, cognitive, and sociocultural factors on decision making. It has applications in designing products and policies that lead to better, more effective outcomes.

In this paper, I will look at applications of behavioral economics particularly within personal healthcare, and how insights from the field can enable us to build a mobile app to improve health outcomes. I will incorporate concepts from behavioral economics, including loss-aversion, scarcity, uncertainty, and dual-process theory, to explain the rationale behind an app designed to incentive medication adherence for Tuberculosis patients. Through leveraging insights from behavioral economics, the theoretical app aims to promote greater medication adherence while

simultaneously emphasizing patient autonomy. The result is better outcomes for patients/app users, healthcare providers, and India's public health system.

## **BEHAVIORAL ECONOMICS & ITS APPLICATIONS**

When it comes to decision-making, consumers go through a whole journey to make up their minds, beginning with a need or want and ending at a choice or decision. Decision-making is influenced by a number of economic decisions, which are impacted by psychological, cognitive, emotional, cultural and social factors. Behavioral economics uses psychology to explain the decision-making processes behind an economic outcome (Heshmat 2017). In doing so, it offers a potentially richer set of tools to understand and influence behaviors as compared to traditional economic theory.

The key factor that differentiates behavioral economics from neo-classical, or traditional, economics is that the latter assumes that people act rationally and in their own self-interest; that they are aware of the decisions that they are making, they know what is best for them and with the resources available to them, and they make the best use of it. Behavioral economics, on the other hand, emphasizes variability in human decision making, and that biases and errors recur predictably in certain circumstances (Heshmat 2017). These irrational decisions and choices are often based on inadequate knowledge, lack of information about the available alternatives, and cognitive factors that prevent people from incorporating learnings from the outcomes of decisions made in the past.

As Daniel Kahneman (2015) explained, "it seems that traditional economics and behavioral economics are describing two different species." Behavioral economics shows that humans are exceptionally inconsistent and fallible. We choose goals and then frequently act against them due to self-control problems. Behavioral economics tries to map and understand these decision errors, using our knowledge of the human mind. Neuroscientists argue that the mind consists of many different parts or mental processes, each operating by its own logic. However, many social scientists argue that the behavioral goal of any individual is to maximize happiness. In this respect, behavioral economics goes hand in hand with cognitive psychology, which attempts to guide individuals toward healthier behaviors by correcting cognitive and emotional barriers in the pursuit of genuine self-interest (Heshmat 2017).

Thaler & Sunstein, in their book *Nudge* (2008), elaborate on many of the habits, biases, and other tendencies that underlie decision making—in particular, ways in which decision-making deviates from what would be predicted by economic theory. These variations are not trivial, but reflect a systematic pattern of cognitive biases. For example, one insight we can learn from their work is how, when someone makes up his or her mind about a particular thing, he or she feels ownership

towards it, even when he or she is aware of the alternatives available. This particular behavior is known as the endowment effect. (Thaler & Sunstein, 2008).

Another related phenomenon is loss aversion. In this scenario, people have a heightened tendency to focus on avoiding losses, even at the cost of engaging in risky behavior to do so. People factor in the losses as opposed to counting on the gains, so avoiding losses becomes their main goal. (Ibid).

An example of this has been illustrated in an experiment done by Kahneman (2015), in which he studied two groups of people and asked them to indicate which choice they find preferable. The 1<sup>st</sup> group was told that an outbreak of a disease will kill 600 people, but at the same time were offered two alternative ways in which medical officials can combat it. In the 1<sup>st</sup> program, or program A, 200 will be saved; under the second one, or Program B, there was a one-in-three chance that 600 people will live but a two-in-three chance that no one will. Most of the people chose Program A, which is the risk-averse response. A second group of people was given the same basic data, but the choice was framed in terms of people dying rather than living. They were particularly told that under Program A, 400 people will die, and under Program B there is a one-in-three chance that no one will die and a two in three chance that 600 people will die. When framed this way, most people chose Program B: a reversal in preferences. Shockingly, results of a test given to public health officials revealed the same pattern. Evidently, when framed in a way that there was a chance to prevent all 600 people from dying, people chose this risky alternative rather than the risk-averse choice of ensuring that “just” 400 of them would die.

When we put all of these learnings of behavioral economics together, we derive numerous insights about what drives human behavior. The first insight is that people tend to be oriented or inclined towards the present, rather than the future. They are more concerned about losing something that they already have, as opposed to running behind something that they don't currently have.

The second insight is that people are cognitively limited. As a result, to make the many complicated decisions necessary for daily life and functioning, most people turn to heuristics, or rules of thumb, rather than going through all possible choices. More often than not, people are influenced by how choices are framed, and because too much choice can lead to decision fatigue, their decisions may not be consistent.

The third learning is that people's preferences are mutable. Their decisions are greatly influenced by the environment that they are in. Not only do people's preferences evolve over time, but they are influenced greatly by the environment and can be manipulated, especially through advertising, nudges, and choice architecture.

One of the key areas where behavioral economics can be applied to influence individual behavioral change is in the area of healthcare.

## **BEHAVIORAL ECONOMICS AND HEALTHCARE**

Why do people avoid activities such as exercise and regularly taking prescribed medications that could prevent major illnesses and improve their quality of life? Why do we opt for junk food over healthy food, despite knowing the long-term detrimental effects of a diet containing excess salt, fat, and sugar? Why do smoking cessation programs that offer free guidance, information, and support, still fail?

As these examples illustrate, people often make healthcare related decisions that are not in their best interest. In fact, many of the most vexing problems in the healthcare field are neither medical nor scientific in nature; they are behavioral.

One of the most popular explanations for why patients, and even healthcare providers, continue to make choices that are not in their best interest is that patients and physicians, like consumers, are predictably irrational in their decision-making. Behavioral economists believe that without any acknowledgment of this irrationality, various interventions that are designed to encourage patients to adopt healthy behaviors, or to incentivize physicians to adopt effective approaches, will not succeed (Hostetter, 2013).

Given the scarcity and uncertainty involved in health care for many people, it is not surprising that consumers often have difficulty making wise choices in this area. To address this, some behavioral economists have developed new approaches for intervening with patients and doctors, called “nudges”(Ibid).

Nudges seek to preserve people’s freedom to choose among a range of options, while still guiding the patient or physician toward choices that are in their best interest (Ibid). A simple example is placing a basket of fruit, instead of chips or junk food, in prominent view in a school cafeteria, to encourage healthy food choices among students. Another example in which nudge theory proved effective was in a 2019 trial run by University of Pennsylvania’s Medicine Nudge Unit, in which researchers found that adults trying to lose weight using personal fitness trackers had better success when they added a “nudge” of competing with others to achieve their daily goal for number of steps. (Patel, 2019).

In addition to these behavioral insights, another trend that has had a major influence on the healthcare field is the revolution of data and artificial intelligence. Thanks to personal healthcare devices such as Fitbit and data analytics, healthcare systems now have access to a repository of

data, making it potentially easier for healthcare professionals to detect, treat and cure a particular disease.

There are also broader benefits which can be reaped using this technology, in the form of consumers leveraging this information to improve their overall health and well-being. Personal fitness devices and healthcare apps can play a major role in facilitating healthy behavior change through the principles of behavioral economics, by providing relevant, timely data, and behavioral nudges to its users.

### **THE BIG IDEA**

One of the greatest behavioral challenges in healthcare is getting patients to adhere to the medication, as prescribed to a doctor. Often, patients are well-intentioned and logically know that the medication regime is best for their improved health. However, behavioral factors often thwart efforts to build habits of filling and taking medication as prescribed, especially for drugs that need to be taken for years or even a lifetime. This is true for long-term medications to treat diseases such as hypertension, diabetes and - especially relevant in countries like India - tuberculosis (TB).

In India, there are approximately 220,000 annual reported deaths due to Tuberculosis. The disease continues to pose a public health crisis for India, which, according to the World Health Organization (2011) bears the highest burden of TB, as compared to any other country.

The causes of TB in India are complex and multi-faceted. One of the leading reasons that patients cannot stick to treatment regimens is because the majority of TB patients are unable to afford the treatment drugs prescribed. To address this, the latest phase of the state-run tuberculosis program, the Revised National Tuberculosis Control Program (RNTCP) has launched initiatives including providing free drugs to all those infected in the country, to increase access to TB care for patients below the poverty line (Anand & McKay, 2012).

Despite free access to the drugs, many people still do not successfully adhere to their medicine regime, which can last anywhere from 6 months to 2 years, or longer. The RNTCP's DOTS (Directly Observed Treatment, Short Course) is meant to ensure medicine adherence. Yet many patients report feeling disempowered or stigmatized as a result of the treatment, and its close monitoring decreases patient autonomy.

To address these issues in the treatment of Tuberculosis, I have developed a theoretical mobile app, **TB-Ilaaj** (Ilaaj means "cure" in Hindi), which leverages insights from behavioral economics to promote medicine adherence in TB patients, while creating a greater sense of

patient autonomy. Through incentives, or nudges, applied in the right way and at the right time, TB-Ilaaj would help TB patients take a more active role in the own healthcare, leading to improved health outcomes for the users, and for the country as a whole.

## **USER EXPERIENCE**

When a patient is diagnosed with Tuberculosis at either a public or private clinic in India, they would get information about the TB-Ilaaj app. With lower than ever data tariffs and inexpensive smartphone producers like Xiaomi entering the Indian market, smartphones have become increasingly accessible to consumers across all income brackets, and most urban households have at least one smartphone per household. Therefore, the TB-Ilaaj mobile app would be relatively accessible to most users who could benefit from its features.

Patients would be informed that, upon downloading the app and registering themselves as users, they would receive Rs. 5000 in their bank account (approx. USD 70). This would not only incentivize them to download the app, but would also be a crucial part of the app's reward feature detailed below.

Once a patient has the mobile app, there would then be a three-part process involved in taking their medication:

1. Trigger – this would be the initial nudge, or prompt, that captures the user's interest and inspires him or her to take action. As the trigger, the app would deliver a pop-up notification reminder on the phone to take the daily dose of medicine. In order to dismiss the reminder, the user would need to move onto the next step – Action.
2. Action – this is the act that directly supports improved health; in this case – taking the required dosage of TB medication. The user would need to take a selfie of him or herself taking the pill, and post it to the app, in order to dismiss the first notification. If the user fails to post this update to the app within 60 minutes, he or she would continue to get reminders at 15-minute, and eventually 5-minute intervals.
3. Reward – the final stage of app engagement would be the reward, to help formulate habits that stick and turn into long-term behavior change. Drawing on behavioral economics insights, particularly the theory of loss-aversion, the user's reward would be tied to the Rs. 5000 that was deposited to their account upon downloading the app. More details on how this reward system would work are discussed below.

## **OTHER APP FEATURES & NUDGES FOR DRUG ADHERENCE**

### **Embedded Educational Messaging Content**

While external, extrinsic rewards such as cash transfers can be highly effective in developing drug-adherence habits in the short-term, these rewards themselves do not drive long-term habit formation. Rather, habit formation comes from intrinsically understanding the medication's value.

In order to support these long-term habits, TB-Ilaaj would also prompt engagement with educational content, namely short embedded videos that users must watch at specified intervals. These short educational videos would cover not just how TB affects the patient's health, but also the detrimental effects on the health of their loved ones. This idea is based on the research of Adam Grant and David Hofmann (2011), who found that hygiene habit formation was more effective when the campaign messaging highlighted not just the impact of health-related action on the actors, but, more importantly, its consequences for others.

### **Default Settings**

Other research on behavioral economics in healthcare (Patel et. al., 2016) indicates that people, overwhelmingly, tend to stick with default options when given a choice. For example, organ donation rates are over 90 percent in countries where citizens need to override a default and opt out of donation, as opposed to less than 30 percent in countries where citizens must choose to opt in. (Johnson & Goldstein, 2004).

Keeping this in mind, TB-Ilaaj would have a default option in which patients are automatically enrolled in automatic drug refills, which would be delivered to their homes on a monthly basis. Through the RNTCP program, the government of India already provides TB medication, free of cost, through state-administered clinics. However, patients must make a point of going to the clinics to obtain these drug refills. Often, there is a gap here between intent and behavior, and patients lapse on their treatment regime because they have not managed to go to the clinic to get the prescription refilled.

TB-Ilaaj users would have the choice to opt out of these automatic refills. However, they are more likely, according to behavioral economics, to stick with the default setting. Therefore, most users would end up availing these automatic refills, at least ensuring that the drugs are delivered and available to them throughout their regime.

### **Loss Aversion & Rewards**

Behavioral economics has also yielded interesting, and sometimes counterintuitive, insights on

the use of cash rewards and incentives in promoting healthy behavior. In one study, Dr. Kevin Volpp and his co-researchers (2015) ran several experiments to test which financial incentives are most effective in smoking cessation programs. In their experiment, subjects were randomly assigned to one of three groups. Group one, the control group, received the “usual care”, which consisted of educational materials and free smoking cessation aids. The second group was a part of a reward program, in which participants could receive up to \$800 over the span of six months if they quit smoking. The third group was a deposit program, in which the smokers initially gave \$150 of their money, but if they quit smoking, they got their deposit back, as well as a \$650 bonus.

Compared with the control (usual care) group, participants in both incentive groups were much more likely to have quit smoking at the end of six months. However, the deposit program was twice as effective as the reward program in getting people to quit smoking. This is because people were more reluctant to part with their own money than they were eager to receive a bonus. Essentially, this was loss-aversion in action.

Keeping this insight in mind, TB-Ilaaj would deposit Rs. 5000 as incentive for downloading the app. The reward system would also be linked to this Rs. 5000. For each day that users upload their pill-taking selfie to the app, they get to keep the Rs. 5000. For every day that they miss uploading the selfie, however, Rs. 100 would be deducted from this total. It's important that the Rs. 5000 be deposited at the beginning of the program, rather than being given as a bonus on successful completion, because depositing it makes users feel that it's something they already own, allowing their sense of loss-aversion to come into play.

### **Dual Process Theory**

In his 2015 book “Thinking Fast and Slow”, the economist Daniel Kahneman proposed the theory that when an individual makes decisions, he or she often uses two completely different systems of thinking, called dual-process theory. The first system is intuition, commonly known as gut-feeling, which attributes to fast, automatic, emotional and sub-conscious decisions. The second system is slightly slower and more deliberate. This involves consciously working through different sets of consideration, applying various filters and concepts, and then weighing each against one's goal (Kahneman 2015).

Psychological research indicates that intuition-based decision making is sometimes more accurate, specifically in areas where we have gathered a lot of data and information using reliable sources and fast feedback (Ibid). For example, when a person is insulted, he or she will most likely react either by getting sad or defensive. This is because his or her intuition has been trained in a manner by repeatedly witnessing similar occurrences and receiving feedback on the

consequences. The second system, on the other hand, tends to be appropriate for decisions wherein we do not have a lot of experience; such as decisions involving numbers, statistics, logic, abstractions, or models, as well as phenomena our ancestors never dealt with (Ibid).

Most of the time, people are operating on System one thinking. System one is automatic and requires little effort to use, whereas System two is controlled and requires mental exertion. System two is easily distracted and defeated, while system one is always on. Most of the time, system two accepts system one's suggestions and rationalizes those instinctual, emotional thoughts.

Several studies in the area of behavioral design policy look at how people function as, basically, semiautomatic pilots, relying on intuition and System one thinking. People often don't think about everything they do; they just go about and "do it." A classic example is mindless eating, where one doesn't stop and count calories and think, "Do I need three more french fries, or do I really need this extra quarter of chicken?" People just eat what is on their plate.

Applying this theory to TB medicine and treatment, we can see how few people have the experience and exposure to turn to System two thinking when it comes to deciding whether or not to adhere to the medicine regime. Most people, when they start to feel their symptoms disappear, rely on their instinct, which tells them they are getting better and no longer need the medication, rather than the medical knowledge, which shows that they must continue with the medication to fight off antibiotic resistant strains of TB.

TB-Ilaaj would help compensate for users' natural tendency towards System one thinking, by providing System two rationale, saving users' the mental burden of needing to calculate it themselves. At key points when TB patients tend to think they're cured, and therefore may opt out of their medicine regime, the app would provide facts and data about drug-resistant strains of TB, and the importance of adhering to the regime, not for the benefit of the patient, but for the benefit of friends, family, and others who might become infected.

### **Scarcity of Resources & Mental Bandwidth**

The "scarcity of resources" is often understood as the central problem in behavioral economics (Kersting & Obst 2016). The problem of scarcity can be derived from applied behavioral research in the discipline of market design, which deals with the architecture of markets while accounting for certain aims and goals (Felix 2016). The common theory of resource scarcity is that when an object or resource is not readily available, whether because of limited quantity or time constraints, one tends to perceive that object or resource as more valuable (The BE Hub 2019).

Similarly, people face issues of scarcity in that they have a brain power limit, or “mental bandwidth,” which is made up of attention, cognition, and self-control (Mullainathan & Sharif, 2013); this consists of finite resources that may become reduced or depleted through internal and external needs that capture our attention, and impede our ability to focus on other things. This scarcity mindset entails a feeling of having less of something or not enough of something (Mullainathan & Sharif, 2013). According to Mullainathan and Sharif (2013), anyone can experience cognitive scarcity, but it is particularly pronounced for people living in poverty.

The positive side of this is that it may induce limited focus that can be used productively. However, the downside is ‘tunneling,’ which inhibits the cognitive power required to solve problems, reason, or to retain information. The reduced brain power or bandwidth also impairs executive control, compromising people’s ability to plan and at the same time increasing impulsiveness whereby the focus becomes immediate—put food on the table, find shelter, or pay the utility bill (Ibid). From this problem, the question arises as to which external conditions must be present in order for people to behave in line with the assumptions of *homo economicus*, or rational man, since this would result in an efficient outcome (Felix 2016).

When it comes to TB patients in India, financial scarcity does not enter the picture, as the drugs are provided free of cost. Mental bandwidth, however, is a prominent consideration, as TB patients have many conflicting goals, including: the desire to be healthy, the desire for their family members to be healthy, the utility of their time spent adhering to medication regimes, the memory space required to retain the details of their medicine regimes, and the desire to not be socially stigmatized by peers or healthcare providers as a result of their TB. These conflicting agendas and objectives compete for space in a TB patient’s brain, thus depleting mental bandwidth.

TB-Ilaaj would help reduce the mental load, thus freeing up mental bandwidth in the following ways: the app itself, by helping ensure medicine adherence, allows the patient to keep himself and his family healthy; the app gives prompts for when to take medication, and ensures automatic refills through the default opt-in, thus eliminating the need for patients to remember those details; the app, by the nature of being self-monitored, gives patients greater privacy and autonomy in their own treatment and care. Thus, they are exposed to less social stigma, and are more likely to adhere to their treatment regime.

### **Uncertainty**

Uncertainty is another prominent factor in behavioral economics. Behavioral economics assumes that when people are in uncertain environments, they do not rationally calculate the optimal choices to reach any decision (Raue 2018). Instead, people often follow “rules of thumb,” or

heuristics, which make complex decisions seem easier. As a result, people in complex decision-making situations adopt a characteristic called bounded rationality, where they can “consciously process only a limited amount of information” (Ibid.).

Uncertainty aversion or ambiguity aversion, is the tendency to favor the known over the unknown, including known risks over unknown risks (Ellsberg 1961). For example, when choosing between two bets, people are more likely to choose the bet for which they know the odds, even if the odds are poor, than the one for which they don't know the odds (Ibid). This aversion has gained attention through the Ellsberg Paradox: Suppose there are two bags each with a mixture of 100 red and black balls. A person or decision maker is asked to draw a ball from one of two bags with the chance to win \$100 if red is drawn. In one bag, the person or decision-maker knows that exactly half of the pieces are red and half are black. The color mixture of pieces in the second bag is unknown. Due to uncertainty or ambiguity aversion, decision-makers would favor drawing from the bag with the known mixture than the one with the unknown mixture (Ibid). This phenomenon occurs despite the fact that people would, on average, bet on red or black equally if they were presented with just one bag containing either the known 50-50 mixture or a bag with the unknown mixture.

To reinforce medicine adherence, TB-Ilaaj would draw on uncertainty aversion by having a feature that allows users to compare the risks of taking their medicine, versus abandoning the regime at various points in time. By demonstrating quantifiable risk, rather than leaving it ambiguous, TB-Ilaaj would allow users to make better-informed decisions about their own treatment, while nudging them towards continuing with their medicine regime.

## **CONCLUSION**

In order to succeed, TB-Ilaaj would require the cooperation of government authorities, public and private clinics, and would need financial support for initial startup costs. If these prerequisites were satisfied, however, then the app, by drawing from behavioral economics insights, would have vast scope and potential in ensuring medicine adherence for TB patients in India.

Depending on its success, the model could even be applied in other countries, or to other long-term medications. Through the app, users would not only be empowered to take their health into their own hands, but would also have a higher success rate of treating the disease, leading to healthier individuals, a healthier population, and a healthier country.

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