Improving Medication Adherence Programs with Behavioral Science

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Abstract
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Keywords
medication adherence, behavioral science, behavior change

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IMPROVING MEDICATION ADHERENCE PROGRAMS WITH BEHAVIORAL SCIENCE

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Keywords: Medication Adherence, Behavioral Science, Behavior Change
Motivation

Medication nonadherence is a significant problem in the United States and is associated with 125,000 deaths, 10% of hospitalizations and $100 billion in avoidable health care services annually (Kini & Ho, 2018). Patients with chronic illnesses have the lowest adherence rate where 30% to 50% of medications are not taken as prescribed (Kini & Ho, 2018). Chronic diseases not only account for the lowest adherence rates, but the economic burden due to chronic diseases such as heart disease, obesity and cancer has reached $3.8 trillion in direct and indirect costs (Reed, 2019). Cost, forgetfulness, and ease of fulfillment have been shown to be major barriers that prevent patients from adhering to their prescribed medication (Gebremedhin & Werner, 2017). Government officials and healthcare payers such as Medicaid, Medicare, and private insurance companies, are interested in solving this problem not only to lower mortality rates and increase quality of life, but also to reduce the significant economic burden of healthcare costs. National health spending reached $3.6 trillion in 2018 and is expected to grow at an average rate of 5.5 percent hitting $6 trillion by 2027 (Figure 1) (Centers for Medicare & Medicaid Services, 2019). Increasing medication adherence will improve the quality of patient health and indirectly lower costs by reducing avoidable hospitalizations and preventing disease progression.

A specific population of interest are patients with chronic diseases because they have the lowest adherence rate averaging 50% in developed countries worldwide and even lower rates in developing countries (World Health Organization, 2003). Low-income individuals are disproportionately affected by chronic diseases and there are competing needs from those suffering from chronic poverty with needs of treating chronic health conditions (World Health Organization, 2003). Medication nonadherence is increased for chronic disease states, such as hypertension, where missing a day of medication does not result in immediate negative
consequences. Nonadherence is greatest when patients are asymptomatic to missed doses and when medication has to be taken over a long period of time (Jimmy & Jose, 2011). Therefore, chronic disease states present a large market opportunity.

Interventions and health programs tried thus far have seen mixed results and generally fall under six categories: patient education, medication regiment management via reduction of pills, clinical pharmacist consultation for disease co-management, cognitive behavioral therapies, medication-taking reminders and incentives (Kini & Ho, 2018). The most significant limitations seen in adherence solutions are cost-effectiveness and patient engagement (Gebremedhin & Werner, 2017). The interventions that have been most successful are logistically complicated, labor intensive and expensive; therefore, a cost-effective behavioral science design is needed to overcome these barriers. There is a large market opportunity to develop a low-cost health program that increases patient engagement and medication adherence (Figure 2). It is important to note that adherence is simultaneously influenced by multiple factors including social, economic, health care team, characteristics of the disease, disease therapies and patient-related factors (World Health Organization, 2003).

**Medication Adherence with Digital Health**

With the healthcare industry shifting to value-based and outcome-based payment models, patient outcomes are increasingly important for securing favorable medication reimbursement. Pharmaceutical and biotech companies are therefore becoming more incentivized to focus on patient outcomes to increase revenue (Taylor et al., 2017). To adapt to the evolving market, Pharma is investing and partnering with digital health companies that are developing products to improve patient adherence rates and focusing on patient-centric strategies for customer-centered commercialization (Taylor et al., 2017). Improving engagement with customers through
technology is a key component in patient-centric models, and partnerships with digital health companies help facilitate that shift.

The Food and Drug Administration defines digital health as a broad scope of categories including mobile health, health information technology, wearable devices, telehealth, telemedicine, and personalized medicine (FDA, 2019). Digital health companies have found an opportunity to use technology to develop effective programs to combat barriers and improve medication adherence. Digital programs aim to improve medication adherence through digital medication tracking and reminders, educational and motivational tools, gamification and incorporating behavioral economics principles into the design to increase engagement and improve results. An analysis from Express Scripts revealed that value-based programs keep costs down and improve patient outcomes; increased adherence for diabetics was facilitated through the Mango Health digital application that increased consumer engagement with positive health behaviors (Renfrow, 2019).

Investment in digital health has seen significant growth with $8.1 billion spent on funding in 2018 compared to $5.7 billion in 2017 (Figure 3) (Day & Zweig, 2018). Biotech and pharmaceutical companies have been increasing investment in digital health since 2014, with 25 transactions in 2018 (Figure 4) (Day & Zweig, 2019). Pharmaceutical companies are beginning to invest more in partnerships with digital health companies in an attempt to address current issues with medication adherence. Successful digital health companies will develop programs that have high patient activation, while minimizing patient responsibility. As the technology becomes more passive and integrated, patient activation is simplified for the end-user, the efficacy of the adherence product increases, and patient adherence to therapy dramatically increases (Gebremedhin & Werner, 2017). Companies that understand the challenges of the
afflicted patients and can design products to integrate seamlessly into the daily lives of the end-user will be the most successful in achieving high adoption and adherence rates.

**Incorporating Behavioral Science**

Behavioral economics explains how people are predictably irrational, and it can also reveal how to utilize decision errors in order to help people. Using behavioral economics to create an impactful intervention for behavior change is a less expensive and more efficient method than investing resources in the development of new treatments. With increased investment in digital health, and medication adherence as a key market opportunity, incorporating behavioral science in program design can have a significant impact on behavior change. This paper identifies several behavioral drivers that contribute to medication nonadherence and identifies key behavioral science concepts that should be considered in the design of digital health programs aimed at changing adherence behavior. I present an overall framework and methodology for incorporating behavioral science in program design and the importance of testing and analyzing data before scaling. I then address key behavior-change challenges in the field and conclude with a case study on a medication adherence program partnership between HealthPrize and Boehringer Ingelheim.

**Behavioral Drivers**

A behaviorally inspired program needs to consider behavioral drivers to design a more effective intervention. This will subsequently lower the incidence of nonadherence in a more cost-effective manner with a greater impact. Several underlying decision errors contribute to challenges individuals face in forming healthy behavior change.
A significant behavioral driver attributed to medication nonadherence is present bias. Present bias is the tendency for people to discount larger future rewards and prefer smaller immediate rewards. Present bias causes patients to discount future payoffs which makes it hard to motivate change when rewards are more distant, especially when the change requires constant work. Because of hyperbolic discounting, adhering to medication in the future may be seen as having more value than adhering today, which leads to an endless cycle of procrastination.

Medication nonadherence is increased for chronic disease states, such as cardiovascular disease, where missing a day of medication does not result in any immediate negative consequences. If there are no painful symptoms that the medication addresses, then there is no immediate reward (pain alleviation) associated with taking the medication. Nonadherence is greatest when patients are asymptomatic to missed doses and when medication must be taken over a long period of time (Jimmy & Jose, 2011). The immediacy and saliency of feedback is essential to encourage a behavior, which is lacking for this type of medication and disease state.

Time inconsistency with hot and cold states can also cause patients to make choices that are not always in their best interest. Emotions and environmental context impacts decision-making; facing temptations (a hot state) versus thinking about future wellbeing away from temptation (a cold state) results in very different decisions. While in a hot state, patients do not always consider long-term consequences, which is especially true for patients taking medication that doesn’t provide immediate feedback such as symptom relief. The peanuts effect is the tendency for people to be less risk averse with decreasing monetary amounts, meaning that people are willing to take more risks when “playing for peanuts.” This is a challenge for behavior change programs, because small gains or losses tend to not be very motivating. This effect is seen when people miss a dose of their medication, because it is easy for them to
rationalize that one missed dose would not affect the overall efficacy. Strong incentives for motivating medication adherence are needed to counteract these powerful biases and decision errors.

Program Design Features Incorporating Behavioral Drivers

Behavioral science should be considered in many aspects of program design. For example, simple changes in the wording of messages can have a large impact on behavior. Several program design elements are discussed in this section that require evaluation from a behavioral science perspective in order to make the largest possible impact on behavior change. The main program design elements discussed in this section include incentives, defaults, reminders, messaging and goal setting, where decision heuristics and associated biases are further discussed within each topic.

Incentives

Financial incentives work by changing the ratio of benefits to cost, and as prices of a service change, utilization will change. While financial incentives have the potential to improve adherence, the feasibility and scalability have been barriers due to insufficient resources. A behaviorally inspired approach can provide a cost-effective alternative that is feasible and scalable across the United States. A behavioral approach in the design of financial incentives is important, because how they are situated and framed can have a large impact on their success. This is particularly crucial for chronic disease patients, especially those that do not receive a direct positive or negative health effect immediately after adherence or nonadherence. Present bias, prospect theory, framing effects, mental accounting, and non-cash rewards should be considered when designing incentives for medication adherence programs.
Present Bias.

Due to present biased preferences, external rewards are essential to provide motivation to supplement insufficient intrinsic motivation for behaviors that do not have immediate benefits, such as taking medication for chronic illnesses. Hyperbolic discounting causes people to overweight immediate costs and benefits relative to those occurring in the future. Therefore, effective financial incentives should be as close in time as possible to the desired action.

How incentives are situated and framed can have a significant effect of their success; providing the incentive at the time when risks of negative outcomes are high are more likely to increase the desired behavior change (Thirumurthy et al., 2019). Present-biased preferences can be exploited to help individuals by altering immediate costs and benefits by making healthy behaviors more convenient and less immediately costly (Loewenstein et al. 2007). Offering small incentives in the short term to help people achieve smoking cessation has shown to be much more successful than relying on the greater delayed incentives associated with cessation (Volpp et al. 2009). Extending from the success with smoking cessation, these financial incentives could be used in other contexts where present bias is a behavioral driver such as medication adherence.

Prospect Theory, Loss Aversion and Framing Effects.

Loss aversion is the tendency to prefer avoiding losses as opposed to acquiring equivalent gains, because “losses loom larger than gains” (Kahneman & Tversky, 1979). The disutility associated with losing money is much greater than the utility of receiving that exact same amount of money. This is represented in the value function of prospect theory, where the slope is much steeper in the loss domain. Loss aversion also explains the endowment effect where people overvalue items they possess. This has been demonstrated in many experiments, most famously in an experiment at Cornell where students that were endowed with a mug, also priced the mug
approximately twice as high as the students that were willing to pay to acquire it (Kahneman et al. 1990).

An important insight from prospect theory is that people are reference dependent in how they perceive outcomes, so framing the same information in the loss or gain domain has a different effect. Designing program incentives in the loss domain so that the financial reward is endowed at the beginning but with the potential to lose it, induces loss aversion which can be much more effective than a traditional gain domain incentive. This was shown to be successful in an experiment that utilized loss aversion with financial incentives to improve teacher performance (Fryer et al. 2012). In the treatment group, teachers were given a bonus in advance and had to give the money back if their students did not perform sufficiently. The control group implemented the bonus in the standard gain domain fashion. The results from this study yielded a large difference in teacher quality with a significant increase in test scores for the loss domain group. Another design consideration is to allow participants to have the ability to win back deductions as well as win additional rewards by completing extra goals. This component is key to keeping people engaged and motivated by the potential to win more rewards rather than only being motivated to avoid losses.

**Mental Accounting.**

It is also important to consider other biases and heuristics that would make health programs more successful. Mental accounting is the tendency for people to organize their money in separate accounts associated with their intended use which violates the economic principle that money is fungible (Thaler, 1999). With mental accounting, making gains more salient will cause the intervention to be more effective. Many insurance companies and employers use premium health insurance discounts to motivate healthy behavior; however, this strategy may not
be as effective as offering people a separate bonus check rather than a discount because a bonus check is in a separate mental account than the healthcare account. Patel et al. (2016) found no significant effect for obese participants in a workplace wellness weight loss program who were offered a discounted premium incentive of $550 versus the control group. Adjusting premium prices or adding funds to a paycheck is not nearly as salient as giving participants a separate bonus check. For example, adding $100 becomes invisible when added to a paycheck, but if presented as a gift card or bonus check then it becomes much more salient and pleasurable as the person can then choose to assign the funds to whichever “mental account” they desire. Also, if rewards are too small, then they will not be very motivating. In delivering financial rewards it is more effective to bundle them and deliver monthly to create larger aggregate payments.

Non-cash Incentives.

Incentives that motivate people to perform a particular behavior do not always have to be financial rewards. People actually tend to think more frequently about non-cash rewards than financial rewards while performing the incentivized task, which creates a stronger positive effect associated with non-cash incentives (Jeffrey & Adomdza, 2010). Jeffrey and Adomdza showed that people performed better when incentivized with merchandise or travel rewards compared to people incentivized with an equivalent cash reward. People exert more effort when rewards are highly salient. While cash incentives can be motivating with the benefit of allowing the individual to choose how to use it, the cash incentive can also be put towards paying bills, which is why merchandise or experience incentives can be ultimately more satisfying than cash.
Defaults

Status quo bias is the tendency for people to stick with their current default choice or routine even if a better alternative exists. This was famously demonstrated when consumers in Pennsylvania and New Jersey had the option to purchase lower cost automobile insurance for the limited right to sue or higher cost insurance for the full right to sue (Johnson et al., 1993). In Pennsylvania, the default was for the higher cost insurance and in New Jersey, the default was for the lower cost insurance; however, the consumer had the ability to choose either option. In Pennsylvania, 70% of drivers chose the default higher cost insurance, while in New Jersey 79% of drivers stuck with the default lower cost insurance. These results demonstrate the significant power the default option has over consumer decision-making.

Motivating people to change from the status quo can be challenging. Change can require a lot of effort and if the alternatives aren’t powerful enough, people are more inclined to continue with their current behaviors. Anticipated regret also ties in with status quo bias, because a bad outcome from sticking with the default hurts less than a bad outcome from making a choice or an action. This anticipated regret can paralyze people from moving away from the status quo and from deciding on something other than the default option. It is important to capitalize on this tendency, by designing choice architecture to make the default option beneficial for the consumer. With medication adherence, designing the program to automatically reorder medication can reduce medication gap periods and alleviate consumers’ stress from having to remember to reorder each month. This feature can be designed as ‘opt out’ rather than ‘opt in’ so that people are automatically enrolled and can choose to opt out if desired; this is an example of liberal paternalism where it is designed to the people without restricting their choice.
Reminders and Messaging

Medication adherence reminders are another key design aspect in health program design. Many chronic disease patients require taking daily pills and sometimes more than once per day. This can be inconvenient and easy to forget, or there can also be other social factors at play that cause individuals to miss a dose. It is also important to note that reminders and messages can be effective at first but may also cause people to unsubscribe if messages come at an inconvenient time. One study found that reminder donation emails increased one-time donations by 66 percent, but also increased unsubscribing from the mailing list by 76 percent (Gravert, 2019). While being reminded to take a medication is much different than being asked to donate, this study provides an important lesson that timing of messages can be crucial to their success; messages should be customizable to the individuals’ schedule and needs.

Social Norms.

Incorporating social norm theory by diagnosing and measuring collective behaviors will ensure that health programs work effectively. A big mistake people often make is assuming that informational campaigns will change behavior. This not only assumes people are rational, but also that the behavior is a custom and factual beliefs alone are driving the behavior. Therefore, presenting people with information on why medication adherence is good for their health is not enough to motivate change.

Preferences are formed from a combination of beliefs and/or expectations. The types of beliefs and expectations include factual beliefs, personal normative beliefs, empirical expectations and normative expectations. Empirical expectations are beliefs about what the individual expects others do (Bicchieri, 2015). Normative expectations are second order beliefs about what personal normative beliefs one expects others to have (Bicchieri, 2015). While these
beliefs and expectations may exist, not all of them contribute to the motivation behind the behavior.

The classification of preferences as conditional or unconditional is an important measurement step in diagnosing collective behaviors. Preferences involve individual or social beliefs and expectations that contribute to different reasons for participation in group behaviors. Conditional preferences depend on what one believes others do or what one believes others think they should do, while unconditional preferences are individual choices regardless of others’ actions or beliefs (Bicchieri, 2015). Classifying preferences as conditional or unconditional provides insight into the reasoning behind individual involvement in a collective behavior. Conditional preferences are necessary for social and descriptive norms, whereas unconditional preferences play a role in customs and moral norms.

A descriptive norm is an interdependent behavior that is conditionally preferred based on the expectation that others engage in the behavior. A social norm is an interdependent rule of behavior that is conditionally preferred because others are engaging in the behavior and individuals expect that others think they should also engage in the behavior. Measurement is essential for correct diagnosis of collective patterns of behavior in order to design effective interventions to promote positive change. It is an iterative design process that requires multiple stages and testing.

Norm creation and norm abandonment are two social norm strategies to change a behavior. This requires changing beliefs, a collective decision by the community to change, introduction of sanctions, creation of normative expectations and the creation of empirical expectations. For norm abandonment there must be the creation of new empirical expectations before normative expectations. Research has shown that second-order normative expectations are
more powerful predictors of behavior that personal normative beliefs (Jachimowicz, Hauser, O’Brien, Sherman, & Galinsky, 2018). Thus, creating a new social norm can be a very effective strategy to promote positive behavior change.

A social norm intervention strategy can address multiple motivations because sometimes creating a new social norm gets rid of independent motivations such as customs, factual beliefs and personal normative beliefs. There are some specific individuals or groups of people that can be leveraged in order to promote positive social change. Centola claims that social norms can be changed by small minority groups when they reach a critical mass that crosses a tipping point (Centola, Becker, Brackbill, & Baronchelli, 2018). After this threshold is reached, behavior change occurs rapidly, accepting the minority groups’ point of view.

Social comparison feedback is one strategy that could be used to increase medication adherence. Communicating to patients where they stand in comparison to their peers would be effective for those motivated by social expectations. It is important to only provide this feedback to patients at the lower end of the spectrum. If social comparison information is given to the people with the highest adherence rates, this may cause the reverse effect in their adherence. Social comparison feedback was looked at by Wesley Schultz and colleagues who tested normative messaging to promote household energy conservation (Schultz et al., 2007). A descriptive normative message revealing energy usage of neighbors produced the desirable energy savings behavior change in some but the opposite effect in others depending on their baseline usage. Households that were high energy users reduced, but households that were low energy users ended up consuming more energy as a result of the messaging. Providing descriptive normative information is intended to decrease undesirable behavior of those people engaging in the behavior at a high rate, but it can also increase the undesirable behavior in those
individuals who were engaging in that same behavior at a low rate (Schultz et al., 2007).

However, Schultz’ experiment showed that adding an injunctive message conveying social approval or disapproval eliminated the negative boomerang effect; the low rate energy consumers continued at the same rate with the addition of the injunctive message (Schultz et al., 2007). When providing social comparison information about medication adherence rates, interventions should either only provide the information to bottom half or they should add injunctive messaging to ensure a reverse effect does not occur for high adherers.

It is also important to determine the reference network important for this behavior, especially if the behavior is interdependent. If the relevant reference network is uncertain, more vague terms can be used in messages such as “in your community” to allow participants to fill in the people that matter for this behavior. Another factor to consider is whether the individual should receive adherence reminders or instead if sending the reminder to a caretaker, family member or friend would be more effective.

In general, if an individual observes many other people doing (empirical expectations) or thinking (normative expectations) something, their actions or thoughts convey information about what may be best for the individual to think or do. Therefore, people’s health behaviors may be influenced by others and diagnosing and measuring behavior is crucial to creating effective messaging that will motivate behavior change.

**Anticipated Regret.**

Anticipated regret can be a powerful motivator by making rewards other people are receiving more salient to each individual. People do not want to feel like they missed an easy opportunity to earn rewards. Unlike the feeling of disappointment which is experienced when a different outcome would have produced a happier result and is out of the control of the
individual, regret is experienced when a different choice made by the individual would have produced a better result. By making people aware of what they could have easily won, “the counterfactual looms incredibly and painfully large” (Ariely, 2012). Anticipated regret is a powerful concept that can be incorporated into health programs through messaging to increase effectiveness without the use of additional money.

**Goal Setting**

Goal setting is another feature of health program design that can be used to help motivate individuals and keep them on course for changing their behavior. Goal setting has been shown to produce intrinsic motivation and increase performance beyond what is achieved by using solely monetary incentives (Corgnet et al., 2015). Cal Newport, professor and author of *Deep Work*, said that having a recording of all the things you still need to do can help you stay focused on the upcoming task (Newport, 2006). If not, that incomplete work could eat away at your concentration. This stems from something called the Zeigarnik Effect, which is the tendency to remember incomplete tasks instead of completed ones. Setting goals that are challenging but attainable is important to motivate without people giving up all-together if the goal is too far from their baseline ability. Setting goal gradients that are achievable and tied to rewards can be useful for motivating a behavior.

**Team Performance.**

Goal setting can also be tied to team performance in a cooperation setting or a competitive setting to spark motivation. A recent study compared four different team incentive structures: 1) individual incentives, 2) social comparison (competitive) incentives, 3) social support team work incentives and 4) combined competitive and support team incentives, to determine which had the largest effect on increasing physical activity (Zhang et al., 2016). The
researchers found that the combined (competitive and support) incentive group and the competitive only group had a significantly higher effect in increasing exercise class attendance. This study showed that social comparison is most effective for increasing physical activity. Therefore, health programs should consider including competition and notify participants of their performance compared to others.

**Behavioral Science Framework and Methodology**

Standard economics tells us that providing people with information or economic incentives is enough to change behavior; however, behavioral economics tells us that people are not perfectly rational, and many decision heuristics and biases discussed previously play a role in decision-making. We can use these decision errors in order to design programs that steer people towards medication adherence. In order to systematically measure and test design features incorporating decision errors, it is important to develop a framework and methodology to measure the impact on behavior change.

The first step is to identify the behavior of interest, such as medication adherence, and set goals for getting from one state to another. Reducing the rate of nonadherence from the current rate of 30% to 50% by even just a couple of percentage points can make a large impact. The next step is conducting a literature review around this behavior to understand how far away we are from our goal and what are the underlying behavioral drivers – why are patients not adhering to their medicine. The literature review is also crucial to understand what other studies that have already been conducted and how we can incorporate their research to inform design decision and expand beyond what has been tried in the past. Also, in this stage it is important to narrow in on specific decision heuristics or a design feature to narrow the scope (e.g. framing incentives in the
loss domain). After the literature review, conducting quantitative and/or qualitative data reviews will facilitate the evaluation of what factors are most important on influencing behavior change. This includes reviewing quantitative data to look for differences in demographics, socioeconomic status or other trends with nonadherence. The review of qualitative data through surveys or interviews will assess important factors on nonadherence and what could influence behavior change. Insights from this research can then be used to design an intervention experiment with a few different program design feature options or one design feature change to compare against the control. It is important to first pilot this change to conduct proper testing and analysis before scaling to ensure significant results. Additional measures could include a post-experiment survey to assess the point of view of the participant and determine what components were most motivating for them.

Challenges

**Motivation Crowding Out**

Finding the sweet spot for health program incentives can be tricky. It is important to provide program incentives that are not so large that motivational crowding out of intrinsic motivation occurs. Large incentives have been shown to increase engagement during the intervention, but later crowd out intrinsic motivation which results in a large drop off after the intervention ends (Sen et al. 2014). Smaller incentives may work better but not too small, because small payments can also be worse than none at all (Gneezy & Rustichini, 2000).

Another concern is for participants at the lower end of the spectrum who may be demotivated and stop participating altogether if they are far from the top performers. Setting ceiling goals that are hard to reach or comparing people at different ends of the spectrum can be
very demotivating. Rewarding people for improvement in addition to top performance provides incentive for all individuals. Also, for group comparison or team performance features, grouping people that have a similar starting point may help prevent motivational crowding out from occurring.

**Long Term Behavior Change**

Sustaining long term behavior change requires the elimination of existing habits and the formation of new habits. While financial incentives may work in the short-term, the goal is for habit formation to occur so that medication adherence continues to be high once the financial incentive is removed. In a weight loss experiment, Charness and Gneezy found that financial incentive-based interventions can facilitate habit formation post-intervention (Charness & Gneezy, 2009). While this is the hope for all interventions, sustained behavior change remains a significant challenge behavioral scientists are trying to tackle. It is also important to consider why incentives lead to sustained post-intervention behavior change in some contexts but not others. While some environments may enforce the desired behavior change, other environmental settings may work against the behavior. Modifying the environment when possible to reinforce the desired behavior can help sustain behavior change after the health program ends.

**Proof of Concept: Case Study**

**HealthPrize**

HealthPrize is a digital health company that partners with pharmaceutical companies to develop patient experience and adherence platforms to motivate patients to take their prescribed regimens. HealthPrize partnered with Boehringer Ingelheim to combat low patient adherence rates through the development of a digital platform. This platform, RespiPoints, provides chronic
obstructive pulmonary disease (COPD) and asthma patients with educational and motivational tools. It is well documented that patients with COPD often fail to adhere to medication regimens, which leads to increased hospitalization rates, increased mortality, and decreased quality of life (Boven et al., 2014). RespiPoints is a web and mobile platform that leverages insights from behavioral economics by using a gamified structure to engage and reward patients for participating in various activities. These activities are designed to increase adherence and motivate healthy behavior. Patients can accumulate points by reporting taking daily medicine, verifying monthly refills, reading educational information, or completing weekly quizzes and surveys. Accumulated points can then be redeemed via the in-app marketplace for gift cards. Patients are also able to track doctor appointment dates and share self-reporting data with their physician (HealthPrize Technologies, 2018).

This partnership has already proven to be successful in a number of ways. First, in just nine months, the average number of prescription refills increased by 2.8 fills per patient with a verified prescription, a projected 3.9 fills over 12-months. Second, patients showed an 85% decrease in gap days, defined as the period of time between the expiration of the old prescription and the refill, from 10.9 to 1.6 gap days (Figure 5). Another success has been that the platform functions as a marketing engagement tactic that has increased patient reacquisition. Prior to signing up for RespiPoints, 16.2% of the total users on the platform were considered to have discontinued therapy, meaning that they had more than 60 gap days between refills. Therefore, the program was successful in reinitiating treatment in an inactive patient segment. Lastly, the program showed high participation, engagement, and satisfaction rates. Patients maintained a 56% active participation rate over the course of the study, with an average of 50 minutes of interaction per month and 4.6 visits to the site weekly (Figure 5), and 71% of participants said
they would be “very likely” to recommend the platform to a friend or family member using the same treatment (HealthPrize Technologies 2018).

BI partnered with HealthPrize to use its digital platform technology to enhance revenue by improving adherence, capturing inactive patients, increasing health literacy, and providing brand differentiation (Boehringer Ingelheim 2018). After a successful pilot program, BI and HealthPrize opened the platform in April 2018 to any patient taking one of three BI medicines for asthma or COPD (Boehringer Ingelheim 2018). The success of this case study offers useful lessons to other health programs interested in improving user engagement and increasing medication adherence.

**Conclusion and Next Steps**

Medication nonadherence is a significant global problem and utilizing decision heuristics and biases that drive behavior in the design of program features can increase uptake and improve efficacy. HealthPrize and other digital health companies focused on medication adherence, can apply this framework for incorporating behavioral science in program design to further improve upon the success of their programs. These types of interventions can be described as libertarian paternalism because they help steer people towards healthier choices without limiting options or restricting freedom of choice. Using these techniques at scale is a low-cost strategy to promote healthy behavior change, which is in the best interest of patients, physicians and payers.

With the shift to value-based care, government, employers and insurers are very interested in programs that increase healthy behaviors such as adhering to medication. Financial incentive programs based on healthy behavior have increasingly been used by employers and insurance companies to reduce health care costs. Although there has been much uptake and excitement
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around these programs, thus far, we have not seen significant behavior change. Utilizing behavioral science to identify behavioral drivers and incorporate them into program design is essential to improve these programs. Incorporating the behavioral science concepts from this paper into the design of health programs to increase medication adherence is a cost-effective solution that will have a much larger impact on improving health and lowering healthcare costs.
References

http://danariely.com/2012/03/10/regret/


BEHAVIORAL SCIENCE IN HEALTH PROGRAM DESIGN


Appendix

Figure 1. United States Projected Health Expenditures

Source: Centers for Medicare & Medicaid Services 2019

Figure 2. Investment Matrix to Determine Potential Digital Health Products

Source: Gebremedhin & Werner 2017
Figure 3. Digital Health Funding 2011-2018

Source: Day & Zweig, 2018

Figure 4. Corporate Investor Digital Health Transactions 2014-2019

Source: Day & Zweig, 2019
Figure 5. Impact of RespiPoints Program on Patient Behavior

*Source: HealthPrize Technologies, 2018*