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An Intermittent Reinforcement Platform to Increase Adherence to Medications

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Medication nonadherence is an enormous burden to the world's healthcare system. Half of the 3.5 billion annual prescriptions dispensed in the United States are not taken as prescribed.¹ Poor adherence leads to considerable morbidity, mortality, and avoidable healthcare costs in the United States.²⁻⁵ Between 33% and 69% of all medication-related hospital admissions in the United States are due to poor adherence, costing the healthcare system \$100 billion each year.^{2,5-7} These trends apply in the rest of the world as well.⁸

All parties suffer from the present situation of widespread nonadherence: patients suffer from worse symptoms and disease; physicians and other healthcare workers expend more effort but achieve less; and healthcare payers spend more on reactive rather than preventive care as nonadherence for chronic disease therapies leads to absenteeism, presenteeism, and direct healthcare costs.

Methods to improve adherence fit into 5 classes: education, improved schedules, expediting consultations/pharmacy pickups, improved communications between clinicians and patients, and cost.¹ A common feature of all these methods is that they act upon the patient rather than motivate the patient to act (consider the nuisance of an alarm or implicit criticism of a physician). It should come as no surprise that, overall, past efforts to increase adherence have proven minimally effective.^{1,9-11} Although some interventions have shown a modicum of success for short-term adherence, no intervention has led to sustained improvements in adherence for asymptomatic chronic illnesses such as hypercholesterolemia.¹⁰

The present intervention was designed to motivate patients to reach for their medication bottles on time and as prescribed. The intervention learned from patient behavior and tailored rewards and educational messages in order to optimize medication adherence. It harnessed Dynamic

ABSTRACT

Context: Nonadherence to daily health behaviors is an enormous burden to the US healthcare system. Current interventions to improve medication adherence often are costly, intrusive, and overall minimally effective. Most are passive: they act on the patient (through outgoing contact and strategies) rather than motivate active engagement in therapy.

Objective: To test the efficacy of an automated intermittent reinforcement platform to drive patient utilization and improve medication adherence rates.

Study Design: Four-month prospective cohort pilot program (1-month enrollment phase).

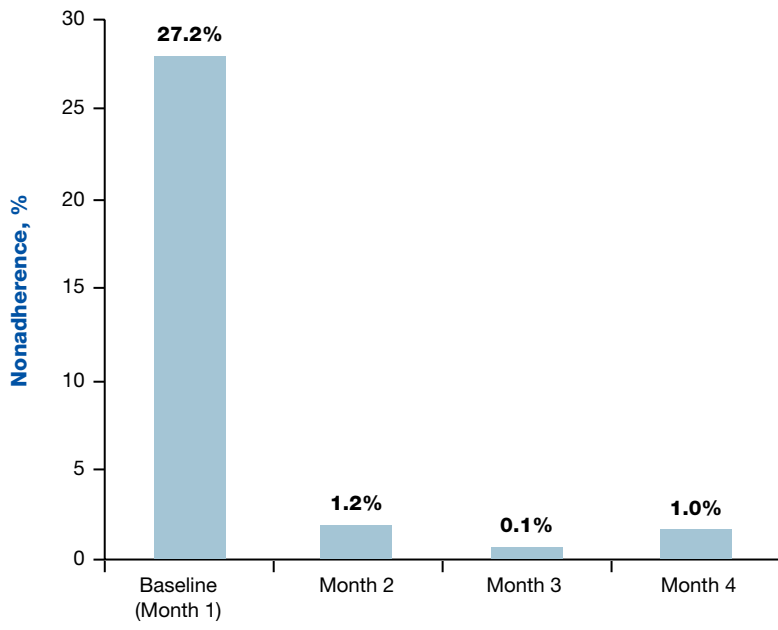
Methods: Specially labeled bottles were dispensed to 50 unique individuals who were continuing statin therapy. Enrollment occurred voluntarily by phoning a toll-free number and entering an assigned code. The system learned from user behavior and automatically tailored reward points to reinforce desired behavior. Educational messages were delivered at peak acceptance points and refill needs were predicted and facilitated automatically. Adherence was measured directly through deidentified refill data as well as indirectly through call frequency.

Results: Adherence increased and remained at high levels with the intervention over the course of the program. Adherence as measured by refill rate improved from 72.7% to 97.9%, a 34.6% relative increase ($P = .0016$). Average medication adherence for participants, as measured indirectly by call frequency, was 87.62% over the course of the study. Participant feedback was uniformly positive, and a correlation was found between call frequency and prescription refills.

Conclusion: Motivating patients with an automated, intermittent reinforcement platform is a highly effective way to increase medication adherence and limit costs.

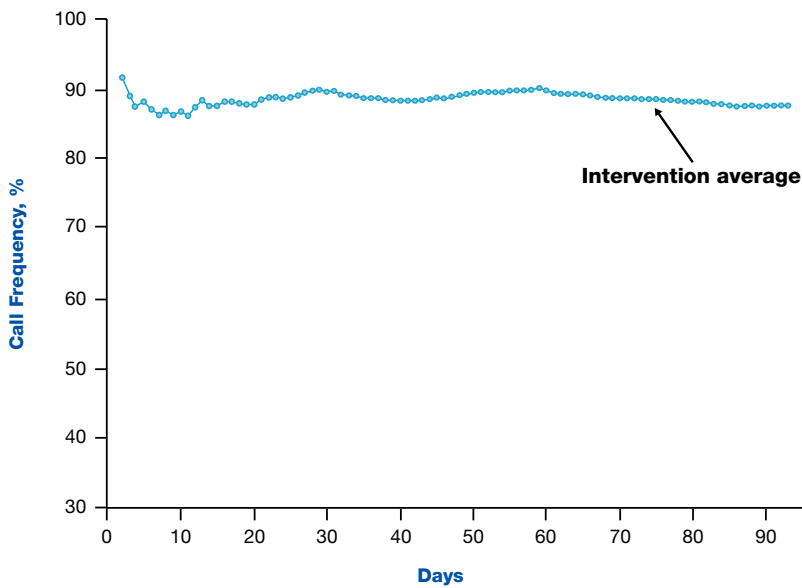
(*Am J Pharm Benefits*. 2009;1(2):91-94)

Figure 1. Decreases in Statin Nonadherence With Dynamic Intermittent Enforcement Automated Reinforcement Platform^a



^aNonadherence rates at baseline were determined by collecting refill records from the year preceding the start of the intervention through enrollment (month 1). By way of example, 0% nonadherence would be refill latency of 0 days.

Figure 2. Medication Adherence for Study Participants^a



^aFor clarification, 100% call frequency would be 1 call each day during the program period.

make it practical and scalable. In this study, we tested the intervention in a real-life setting: a community pharmacy dispensing statin prescriptions.

METHODS

A high-volume Massachusetts pharmacy (~600 scripts per day) sequentially dispensed 50 bottles labeled with unique codes and an instructional brochure to English-speaking adults on once-a-day statin therapy. In order to test the system’s scalability with respect to a busy pharmacy setting, eligible participants were not routinely educated by pharmacists on the intervention. Participants had the option of calling the toll-free phone number each time they took their statin to hear an educational message and for an opportunity to earn points redeemable monthly for Health Rewards, such as gift cards to health food stores for \$5 to \$20.

Using proprietary behavioral algorithms, the HealthHonors DIR reinforcement platform learned from each participant’s unique behavior, calculated appropriate reward values and messages, and tailored these variables to each participant in order to optimize adherence. Twelve-month refill dates were obtained from the pharmacy for program participants who redeemed points and for 10 nonparticipating statin users selected sequentially from refill dates at the completion of enrollment. Sample size calculations for control and intervention groups were based on results from our previous studies (unpublished data). All data were deidentified and provided solely as a list of dates. Call frequency also was collected as a surrogate marker for adherence. Data were compared between groups as well as within groups using standard statistical methods for available refill dates, call

Intermittent Reinforcement (DIR), a reinforcement platform previously shown to increase adherence to pills by 33% (MVK, MSS, unpublished data, 2006). Dynamic Intermittent Reinforcement now has been fully automated to

frequencies, and other metrics as described below. Enrollment was completed within 1 month of the start of the study, and call data and refill rates (converted to scripts per year by extrapolating refill latency over a 12-month

period) were measured for the next 3 months of the intervention. A *t* test was used to evaluate statistical significance between refill latencies.

RESULTS

Database Performance

The database registered a total of 876 unique call events. No call errors were recorded and none were reported by users. A total of 33 events were repeat calls and did not trigger reward calculations. The DIR algorithms calculated reward values and frequencies reliably. Each call lasted 10 to 20 seconds.

Participation and Retention

Fifty patients received their bottles and brochures within pharmacy bags, and were not educated on the use of the program. Twelve patients began using the system spontaneously despite the absence of counseling, and no additional counseling was instituted in order to maintain pharmacy workflow.

Aggregate medication adherence over the course of the entire study, as measured directly by participant refill rate, increased from 8.734 scripts filled per year to 11.759 scripts filled per year, a 34.6% increase ($P = .0016$). In contrast, statin refill rates of 10 randomly selected nonparticipants did not improve during a similar time interval (9.12 scripts filled per year before the start of the study vs 9.33 scripts filled per year after the start of the study; $P > .5$). Month-to-month nonadherence dropped from 27.2% at baseline (month 1) to 1.2% at month 2, 0.1% at month 3, and 1.0% at month 4 with the intervention (**Figure 1**).

Participants had frequent, near-daily engagement with the reinforcement platform. Average medication adherence for participants, as measured indirectly by call frequency, ranged between 86% and 92%, with an aggregate average of 87.62% over months 2, 3, and 4 (**Figure 2**). There was high correlation between adherence as measured indirectly (call frequency) and directly (pharmacy refill data).

Participant and Pharmacist Feedback

Feedback was obtained when participants redeemed their points for Health Rewards. This feedback was uniformly positive across all participants. Participants noted that the system was intuitive and helped increase their medication adherence. Representative comments by unique participants included the following: “it works—I’m using my medication every day now”; “this is the first time that I have taken my pills every single day”; “it helps me take my medicine closer to the same time each day”;

PRACTICAL IMPLICATIONS

An automated intermittent reinforcement platform to drive patient utilization and improve medication adherence rates (Dynamic Intermittent Reinforcement) was tested in a 4-month prospective cohort pilot program.

- Adherence as measured by refill rate improved from 72.7% to 97.9% over the course of the study.
- Average medication adherence as measured indirectly by call frequency was 87.62% over the course of the study.
- Participant feedback was uniformly positive.

“it’s actually quite fun”; “it’s easy to use”; “it’s that extra boost I need to keep on target”; “I’m on target at 100%, haven’t missed a pill for the past 3 months—let’s keep going!”; and “I don’t respond well to annoying reminders; this helps me take charge by making the call.”

Pharmacy staff reported that the program did not interfere with their workflow and received positive feedback from their patients on the intervention.

CONCLUSIONS

Data presented in this paper show that an automated reinforcement platform increases medication adherence, as measured by prescription refill rates, for chronic hypercholesterolemia therapy. A relative increase of 34.6% in refill rates was observed for participants using the intervention over the course of 4 months. Adherence rates for participants, as measured by prescription refills, were well over 90%. Daily call frequency was near 90% and correlated well with refill latency. Among those who called at least once, 75% continued using the system throughout the duration of the study. Participant feedback was uniformly positive. Taken together, these pilot data suggest that DIR is an unobtrusive, informative, scalable, and effective way to increase adherence to chronic disease therapies.

These data are relevant given the dearth of practical and scalable interventions to address medication adherence in patients with chronic diseases in a real-life setting. Passive systems such as reminder packaging, sound or light alarms, and educational tools have proven largely ineffective in increasing adherence beyond academic settings.¹ Active systems such as healthcare professional counseling have been effective in some settings but also have proven to be labor-intensive, expensive, and not easily scalable.¹ By automating a reinforcement platform, the current program was shown to fit seamlessly into the workflow of a busy pharmacy setting. The database is

highly scalable and currently capable of handling more than 1 million calls per day. In addition, the database is versatile and can be accessed both by phone and the Internet.

Limitations of the current study are its small sample size and absence of an age-, sex-, and comorbidity-matched control group. As such, despite statistical significance, results must be interpreted with caution. To address these shortcomings, we have launched a randomized clinical trial to further test the effect of DIR on statin adherence in a larger study and also have accrued compelling engagement and adherence data from large commercial programs.

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(MVK, MSS); obtaining funding (MVK, MSS); administrative, technical, or logistic support (MVK, MSS); and supervision (MVK, MSS).

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