The Success Of Behavioral Economics In Improving Patient Retention Within An Intensive Primary Care Practice

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Abstract

Background

A minority of the U.S. population comprises a majority of health care expenses. Health system interventions for high-cost populations aim to improve patient outcomes while reducing costly over-utilization. Missed and inconsistent appointments are associated with poor patient outcomes and increased health care utilization. PEAK Health— Mount Sinai's intensive primary care clinic for high-cost patients— employed a novel behavioral economics-based intervention to reduce the rate of missed appointments at the practice. Behavioral economics has accomplished numerous successes across the health care field; the effect of a clinic-based behavioral economics intervention on reducing missed appointments has yet to be assessed.

Methods

This was a single-arm, pre-post trial conducted over one year involving all active patients (286) at PEAK Health. The intervention consisted of: a) clinic signage, and b) appointment reminder cards containing behavioral economics messaging designed to increase the likelihood patients would complete their subsequent visit; appointment cards (*t1*) were transitioned to an identical EMR template (*t2*) at 6 months to boost utilization of this component. The primary objective, the success of scheduled appointments, was assessed with *visit adherence*: the proportion of successful over all scheduled appointments, excluding those cancelled or rescheduled. The secondary objective, the consistency of appointments, was assessed with a 2-month *visit constancy* rate: the percentage of patients with at least one successful visit every two months for one year. Both metrics were assessed via a χ^2 analysis and together define *patient retention*.

Results

The *visit adherence* rate increased from 74.7% at baseline to 76.5% ($p = .22$) during *t1* and 78.0% ($p = .03$) during *t2*. The 2-month *visit constancy* rate increased from 59.5% at baseline to 74.3% ($p = .01$) post-intervention.

Conclusions

A low-resource, clinic-based behavioral economics intervention was capable of improving *patient retention* within a traditionally high-cost population. A renewed focus on *patient retention*— employing the metrics described here— could bolster chronic care efforts and significantly improve the outcomes of high-cost programs by reducing the deleterious effects of missed and inconsistent appointments.

Background

Studies demonstrate that within the United States, a small percentage of the population comprises a significant portion of health care expenses. Analyses across multiple groups—including Veterans Affairs,

Medicare, and Medicaid populations—estimate that 5% of patients account for nearly half of annual spending.^(1–4) While not all of these patients are consistently high-cost, a cohort of individuals remains so over time.⁽⁵⁾ Persistently high-cost patients are afflicted with numerous chronic conditions and psychosocial needs while lacking access to consistent care. These factors undermine their ability to manage their health and lead to an increase in preventable emergency department (ED) utilization and hospital admissions. Health systems have implemented a variety of programs designed for such high-cost patients, ranging from care coordination efforts to specialized primary care practices.^(6–10) The shared goals of these programs are to advance patient outcomes while reducing health care utilization and spending within such populations.

Missed appointments are a ubiquitous issue for medical practices. Rates for adult primary care practices range from 15% – 33%.⁽¹¹⁾ In addition to decreasing clinic revenue and productivity, missed appointments adversely impact both health care utilization and patient outcomes.⁽¹²⁾ Within academic primary care practices, patients with a propensity for missed appointments have significantly higher rates of ED visits and hospitalizations compared to all other individuals. These same patients exhibit worse clinical outcomes than those less likely to miss appointments, including lower cancer (colorectal, cervical, and breast) screening rates and above-goal low-density lipoprotein and hemoglobin A1c measures.⁽¹³⁾ The consistency of appointments has also been shown to impact health care utilization, as ambulatory practice patients with a higher continuity of care demonstrate a decreased risk of ED visits.⁽¹⁴⁾

Since the deleterious effects of missed and inconsistent appointments directly oppose the goals of high-cost programs, PEAK Health—Mount Sinai’s intensive primary care program for its high-cost population—sought to reduce the rate of missed visits within its practice. The group partnered with the behavioral economics firm VAL Health to implement a low-resource intervention capable of improving patients’ adherence to scheduled appointments. Behavioral economics combines the field of psychology with economic theory to employ the subconscious aspects of our decision-making processes; interventions based upon these tenets harness our unconscious biases to ‘nudge’ individuals towards a favorable outcome.

The ability of a clinic-based behavioral economics intervention to reduce a practice’s missed appointment rate, especially within a population traditionally disconnected from care, has yet to be determined. The primary objective of this study was to assess whether the intervention improved PEAK Health patients’ adherence to scheduled appointments. A secondary objective was to determine if the intervention simultaneously increased the consistency of patients’ appointments over time. Both of these outcomes—the success and consistency of patients’ engagement with their source of care—comprise *patient retention*. We hypothesized such a behavioral economics intervention could improve high-cost patients’ retention in care through increases in both *visit adherence* and *visit constancy*.

Methods

Study Design & Setting

This was a single-arm, pre-post interventional trial conducted at Mount Sinai's PEAK Health practice over the course of a year. The study was determined to not meet the definitions of Humans Subject Research and was considered exempt from IRB review and oversight. The PEAK Health program is an intensive primary care clinic located in East Harlem that provides targeted care for the health system's high-cost population. Patients are referred to the practice through numerous sources—including the ED, primary care practices, and via risk-based analytics tools—and are eligible to enroll if they exhibit high health care utilization (*i.e.* ED visits or inpatient admissions), uncontrolled chronic conditions, and psychosocial drivers of their barriers to and patterns of care.

Patients are assigned to multidisciplinary 'pods' consisting of a treating provider (MD or NP), a licensed social worker, and a care coordinator. Within the program's transitional care model, patients' goals are identified and reached through successive multidisciplinary visits before 'graduating' individuals back to a traditional primary care provider. The clinic employs extended appointments, frequent follow-up, the capacity for urgent and home visits, and an emphasis on holistic, preventative health. At the close of the study period, PEAK Health had 286 patients enrolled in its program. All patients active at the practice during the study period were privy to the components of the intervention.

Intervention

The study intervention consisted of specialized: 1) clinic signage featured throughout the practice (Fig. 1a), and 2) appointment reminder cards located at provider workstations (Fig. 1b). Both components were developed by ValHealth using proven behavioral economics concepts (e.g. social norms, saliency, pledging) that leverage our decisional biases and were designed to increase the likelihood patients would return for their subsequent appointment. The signage was located at the front of the clinic's waiting area and within each exam room, such that patients engaged with the material at each stage of their visit. Appointment reminder cards— located in each exam room— were intended to be completed by patients at the close of each visit with information regarding their next appointment.

Both components were implemented at PEAK Health simultaneously and remained in the clinic for the 12-month study period. Adoption of the intervention was ascertained through visits to the practice and frequent check-ins with clinic staff. Midway through the study, the appointment reminder card was transitioned to an electronic medical record (EMR) template to boost adoption of this component. Providers printed the templates within an after-visit summary and, similar to the appointment reminder cards, instructed patients to complete them at the close of each visit. Successful adoption of the EMR template was confirmed by reviewing after-visit summaries within patients' chart following implementation of this component at 6 months.

Outcome Metrics & Statistical Analysis

The primary objective, the success of scheduled appointments, was assessed by calculating the practice's *visit adherence* rate: the proportion of completed appointments over all scheduled appointments, excluding those that were cancelled or rescheduled. *Visit adherence* rates were calculated from appointment outcome data tracked by administrative staff daily and compared between the study's

baseline (6-months pre-implementation) and intervention (12-months post-implementation) periods via a χ^2 analysis. The intervention period was divided into two 6-month blocks representing implementation of the physical appointment reminder card (*t1*) versus the EMR template (*t2*).

The secondary objective, the consistency of appointments over time, was assessed by calculating each patient's *visit constancy* rate, defined as a proportion of time intervals containing at least one completed appointment over a single year. Follow-up appointments at PEAK Health are scheduled every two weeks to two months depending on patients' care needs; the *visit constancy* time interval was thus set at 2-months to capture this entire range of appointments. Lists of patients were generated pre- and post-intervention, and the number of 2-month intervals with at least one completed appointment was assessed for each patient over the previous year. Completed appointments were confirmed via the presence of PEAK Health provider notes within the EMR, and intervals in which patients were intentionally not scheduled were excluded from the analysis. The percentage of patients that achieved a perfect (100%) *visit constancy* rate (*i.e.* completed an appointment within each 2-month interval annually) was compared pre- and post-intervention by a χ^2 analysis.

Results

Demographic information for the PEAK Health program at the start of the intervention period has been provided (Table 1). Briefly, 58.2% of the patients identify as female, 34.2% of patients identified their race as African American or Black, and the average age of the population is 59 years old (range: 20 to 100 years old).

Table 1
Demographic information for Mount Sinai's PEAK Health clinic.

Sex	
Female	58.2%
Race (Self-Reported)	
African American or Black	34.2%
White	5.0%
Other*	60.8%
Age	
0–20	0.3%
21–40	12.9%
41–60	38.6%
61–80	40.7%
81–100	7.4%
* 79% of “Other” self-identified their ethnicity as Hispanic or Latino.	

For the primary objective, 1,716 expected appointments were scheduled at PEAK Health during the 6-month baseline period (2,320 appointments booked; 604 cancelled or rescheduled). Within the intervention period, 3,218 expected appointments were scheduled (4,348 appointments booked; 1,130 cancelled or rescheduled); 1,701 of these appointments were scheduled during *t1* (558 appointments cancelled or rescheduled), and 1,517 were scheduled during *t2* (572 appointments cancelled or rescheduled). PEAK Health patients' missed appointments decreased from a total of 434 in the baseline period compared to 399 during *t1* and 333 in *t2*. Notably, the practice's *visit adherence* rate increased from 74.7% (1,282/1,716) at baseline to 76.5% (1,302/1,701; $p = .21$, 95% *CI*: -1.0–4.7%) during *t1* and 78.0% (1,184/1,517; $p = .03$, 95% *CI*: 0.4–6.3%) during *t2*— the latter representing a significant increase in the *visit adherence* rate compared to baseline. The rate of cancelled or rescheduled appointments did not differ throughout the study. 26.0% (604/2,320) of all appointments were cancelled or rescheduled during the baseline period compared to 24.7% (558/2,259; $p = .31$, 95% *CI*: -1.2–3.6%) during *t1* and 27.3% (572/2,089; $p = .31$, 95% *CI*: -1.3–4.0%) during *t2*, suggesting that improvements in *visit adherence* were due to a true decrease in missed visits.

For the secondary objective, a total of 84 patients were active during all 2-month intervals at the close of the baseline period, the year prior to implementation of the intervention; at the close of the study period, one year after implementation of the intervention, 199 patients were active during all 2-month intervals. Of note, this increase in the number of active patients can be attributed to an intentional and unrelated effort by PEAK Health to expand their program in the months around the study. In the baseline period,

59.5% of patients (50/84) achieved a perfect 2-month *visit constancy* rate, or completed at least one visit in every 2-month interval over the year; following implementation of the intervention, the number of patients that achieved a perfect 2-month *visit constancy* rate increased to 74.3% (148/199; $p = .01$, 95% *CI*: 3.1–26.9%), representing a significant increase in the number of patients attaining consistent care at PEAK Health after deploying the behavioral economics intervention.

Discussion

The objective of this study was to determine if a clinic-based behavioral economics intervention could improve the success and consistency of appointments within an intensive primary care program for high-cost patients. Both metrics discussed here are necessary to characterize *patient retention*, as each has its own benefits and restrictions. *Visit adherence* is limited in its ability to assess retention in those lost to follow-up; such patients may have a high proportion of completed appointments while remaining disconnected from care overall. *Visit constancy* adds context by providing a view of successful appointments across time. However, this measure fails to reflect retention in those requiring more frequent engagement. Such individuals may attend visits at regular intervals compared to average patients while still missing a number of appointments overall—a situation accurately captured by *visit adherence*. Ideal retention in care is therefore achieved through optimization of both metrics.

Patient retention has received attention as a vital component for high-quality care. The value of this metric was originally described in the HIV care setting, where it was demonstrated that suboptimal retention in care was associated with substandard outcomes for such patients.⁽¹⁵⁾ A focus on retention arose, leading to the publication of the aforementioned metrics in the literature.^(16, 17) Just as the original authors posited that these measures “could have more widespread application” in “long-term disease management more broadly”, we similarly propose the employment of *patient retention* metrics in the chronic care field.⁽¹⁵⁾ A focus on retention could provide tangible benefits in this setting, notably in programs for high-cost populations.

Standardized metrics provide an objective method to evaluate *patient retention* and assess efforts— such as this study— to improve retention in care. Consistent tracking of retention data could also inform real-time practice decisions, allowing providers to identify patients at risk of being disconnected from care and intervene appropriately. Improvements in *patient retention* naturally coincide with a reduction in missed appointments through the promotion of successful and consistent engagement. Given the deleterious effects of missed appointments on clinic productivity and continuity of care, any practice could benefit from improved retention in care.⁽¹²⁾ As already discussed, the negative effects of missed and inconsistent appointments directly oppose the goals of programs for high-cost patients: to advance health outcomes while reducing health care utilization and spending.^(13, 14) Given this opposition, improving *patient retention* could be particularly impactful for such initiatives.

Despite the theoretical benefit of targeted programs for high-cost populations, a number of publications describing these models have reported unsatisfactory results.^(9, 10, 18) The promotion of successful and

consistent appointments through improved retention in care could assist these groups to achieve programmatic success. If high-cost programs are conceptualized as a vehicle for the treatment of high-cost populations, *patient retention* can be viewed as adherence to this treatment. Optimizing treatment adherence could be the key to achieving such programs' target goals, just as attaining blood pressure control is often achieved by increasing adherence to antihypertensive medications.⁽¹⁹⁾ Indeed, certain programs recognize this and have begun publishing strategies for boosting engagement within their high-cost settings.^(20, 21) Authors reporting on high-cost initiatives should be encouraged to share data describing their program's degree of *patient retention* as a means of effectively contextualizing their outcomes. A renewed focus on retention could challenge the perception that patients with traditionally intermittent care and poor outcomes cannot be successfully reached.

Limitations of this study do exist. Due to the project timeline, appointment outcome data was collected for just 6-months prior to implementation of the intervention, leading to a shortened baseline period for the *visit adherence* metric. Division of the intervention period into two 6-month blocks based upon utilization of the physical appointment card (*t1*) versus the EMR template (*t2*), however, allowed for an equivalent analysis of the primary objective data. Because *visit constancy* is a proportion of successful appointments across time, identical yearlong periods were required for comparison of this data pre- and post-intervention, leading to a longer baseline period compared to the primary objective. The duration and timing of the post-intervention period for both objectives was identical, despite differing baseline lengths.

Due to PEAK Health's appointment structure and the frequency of follow-up visits, providers work directly with patients to book their subsequent appointments. While this workflow is not feasible in most clinics, provider input is not required for completion of appointment reminder template; any staff responsible for scheduling appointments could maintain the integrity of this intervention component, which relies upon the act of completing the reminder itself by the patient. Finally, given the inevitable expansion of telemedical services in the chronic care field and the use of our intervention in the physical space, the applicability of these results could appear limited. However, an online strategy could feasibly be achieved — through a 'waiting room' screen and an email appointment confirmation request, for example— as the power of the intervention is derived from strategic use of behavioral economics messaging, which can certainly be communicated in the virtual space.

Conclusion

Behavioral economics interventions have accomplished a variety of successes in the health care field, from increasing cancer-screening rates to altering prescriber ordering practices.^(22, 23) One study in particular has shown that behavioral economics-based text message reminders were successful in similarly reducing a health system's missed appointment rate.⁽²⁴⁾ Here, we have proven that a clinic-based behavioral economics intervention is capable of improving both patients' adherence to scheduled appointments and consistency of appointments across time. These modest yet significant gains in *patient retention* have been accomplished in a population of traditionally disconnected patients with a

now increased appointment burden at little to no cost— further supporting the utility of such a behavioral economics intervention and the feasibility of high-cost care strategies.

Future studies might assess whether a combination of behavioral economics interventions, such as text message and clinic-based approaches, could produce summative increases in *visit adherence* and *constancy*. Additionally, applying a similar intervention within the virtual space could elucidate the effects of behavioral economics messaging on *patient retention* in the telehealth environment. Finally, an examination of key patient- and practice-specific outcomes measures— such as average hemoglobin A1c levels and ED utilization— between patients that exhibit differing degrees of retention could further illuminate the benefits of improved *patient retention* in chronic care settings.

Considering just 5% of the population accounts for nearly half of all health care expenses in the United States, the success of programs for our high-cost population is vital for the sustainability of our nation's health care system. Bolstering *patient retention* has the potential to significantly improve the outcomes of such programs through a reduction in the deleterious effects of missed appointments and inconsistent engagement. Employing behavioral economic strategies, such as the clinic-based intervention described here, has proven to be an effective, low-cost method for increasing retention in care that could be particularly impactful for high-cost programs— despite being feasible in nearly any care setting.

Abbreviations

ED – Emergency Department

EMR – Electronic Medical Record

Declarations

Ethics Approval & Consent to Participate: The IRB at the Icahn School of Medicine at Mount Sinai reviewed this study protocol and determined it did not meet the federal regulatory definition for human subjects research, as per 45 CFR 46.102 (f). This determination by the IRB took into account ethical considerations of the study and included waiving the need for consent.

Consent for Publication: Not applicable.

Availability of Data & Materials: The datasets generated and analyzed during this study are not publicly available due to clinic and patient privacy concerns but are available from the corresponding author on reasonable request.

Competing Interests: SK serves as a consultant for Resolve to Save Lives and has led partnerships on chronic conditions supported by the Arnhold Institute for Global Health at the Icahn School of Medicine at Mount Sinai and Teva Pharmaceuticals.

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Authors' Contributions: PG was the primary author— conducting the review of the literature and the preparation of the manuscript and its revisions. PG, EL, SK, AW, and BO participated in the rollout and upkeep of the study intervention at the practice. MD, SS, and NM provided feedback on the intervention and fulfilled primary roles in its implementation. PG and AC analyzed all the relevant data comprising the study outcomes. All authors edited and approved the final manuscript.

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References

1. Cohen SB. The Concentration and Persistence in the Level of Health Expenditures over Time: Estimates for the U.S. Population, 2011–2012. Statistical Brief (Medical Expenditure Panel Survey (US)). Rockville (MD)2001.
2. Coughlin TA, Long SK. Health care spending and service use among high-cost Medicaid beneficiaries, 2002–2004. *Inquiry*. 2009;46(4):405–17.
3. Zulman DM, Pal Chee C, Wagner TH, et al. Multimorbidity and healthcare utilisation among high-cost patients in the US Veterans Affairs Health Care System. *BMJ Open*. 2015;5(4):e007771.
4. Sommers AC, M.. Medicaid's high cost enrollees: how much do they drive program spending? The Kaiser Commission on Medicaid and the Uninsured. 2006.
5. Johnson TL, Rinehart DJ, Durfee J,et al. For many patients who use large amounts of health care services, the need is intense yet temporary. *Health Aff (Millwood)*. 2015;34(8):1312–9.
6. Shumway M, Boccellari A, O'Brien K, Okin RL. Cost-effectiveness of clinical case management for ED frequent users: results of a randomized trial. *Am J Emerg Med*. 2008;26(2):155–64.
7. Raven MC, Doran KM, Kostrowski S, Gillespie CC, Elbel BD. An intervention to improve care and reduce costs for high-risk patients with frequent hospital admissions: a pilot study. *BMC Health Serv Res*. 2011;11:270.
8. Dorr DA, Wilcox AB, Brunner CP, Burdon RE, Donnelly SM. The effect of technology-supported, multidisease care management on the mortality and hospitalization of seniors. *J Am Geriatr Soc*. 2008;56(12):2195–202.
9. Sledge WH, Brown KE, Levine JM, et al. A randomized trial of primary intensive care to reduce hospital admissions in patients with high utilization of inpatient services. *Dis Manag*. 2006;9(6):328–38.
10. Zulman DM, Pal Chee C, Ezeji-Okoye SC, et al. Effect of an Intensive Outpatient Program to Augment Primary Care for High-Need Veterans Affairs Patients: A Randomized Clinical Trial. *JAMA Intern Med*. 2017;177(2):166–75.
11. Deyo RA, Inui TS. Dropouts and broken appointments. A literature review and agenda for future research. *Med Care*. 1980;18(11):1146–57.
12. Moore CG, Wilson-Witherspoon P, Probst JC. Time and money: effects of no-shows at a family practice residency clinic. *Fam Med*. 2001;33(7):522–7.

13. Hwang AS, Atlas SJ, Cronin P, et al. Appointment "no-shows" are an independent predictor of subsequent quality of care and resource utilization outcomes. *J Gen Intern Med*. 2015;30(10):1426–33.
14. Nyweide DJ, Bynum JPW. Relationship Between Continuity of Ambulatory Care and Risk of Emergency Department Episodes Among Older Adults. *Ann Emerg Med*. 2017;69(4):407–15. e3.
15. Mugavero MJ, Davila JA, Nevin CR, Giordano TP. From access to engagement: measuring retention in outpatient HIV clinical care. *AIDS Patient Care STDS*. 2010;24(10):607–13.
16. Mugavero MJ, Westfall AO, Zinski A, et al. Measuring retention in HIV care: the elusive gold standard. *J Acquir Immune Defic Syndr*. 2012;61(5):574–80.
17. Horstmann E, Brown J, Islam F, Buck J, Agins BD. Retaining HIV-infected patients in care: Where are we? Where do we go from here? *Clin Infect Dis*. 2010;50(5):752–61.
18. Finkelstein A, Zhou A, Taubman S, Doyle J. Health Care Hotspotting - A Randomized, Controlled Trial. *N Engl J Med*. 2020;382(2):152–62.
19. Bramley TJ, Gerbino PP, Nightengale BS, Frech-Tamas F. Relationship of blood pressure control to adherence with antihypertensive monotherapy in 13 managed care organizations. *J Manag Care Pharm*. 2006;12(3):239–45.
20. O'Brien CW, Breland JY, Slightam C, Nevedal A, Zulman DM. Engaging high-risk patients in intensive care coordination programs: the engagement through CARInG framework. *Transl Behav Med*. 2018;8(3):351–6.
21. Yee TL, Carrier A. E.. High-Intensity Primary Care: Lessons for Physician and Patient Engagement. 9: National Institute for Health Care Reform Research Brief; 2012.
22. Lewis S, Young B, Thurley P, Shaw D, et al. Evaluation of a nudge intervention providing simple feedback to clinicians of the consequence of radiation exposure on demand for computed tomography: a controlled study. *Clin Med (Lond)*. 2019;19(4):290–3.
23. Mehta SJ, Asch DA. How to help gastroenterology patients help themselves: leveraging insights from behavioral economics. *Clin Gastroenterol Hepatol*. 2014;12(5):711–4.
24. Berliner Senderay A, Kornitzer T, Lawrence G, et al. It's how you say it: Systematic A/B testing of digital messaging cut hospital no-show rates. *PLoS One*. 2020;15(6):e0234817.

Figures

Figure 1

a: Template of the clinic signage component of the behavioral economics intervention, featured within PEAK Health’s waiting and exam rooms. b: Template of the appointment reminder card component of the behavioral economics intervention, located next to each provider workstation. The format and language were mirrored within an EMR template that was introduced at 6-months post-implementation to boost adoption.