

Identification of new tools from behavioral economics and social psychology to help control chronic diseases

Braden K. Mogler, BS^{1,2}, Suzanne B. Shu, PhD^{3,5}, Craig R. Fox, PhD^{3,5,6}, Noah J. Goldstein PhD^{3,5,6}, Ronald G. Victor, MD^{3,7}, José J. Escarce, MD, PhD^{3,4}, and Martin F. Shapiro MD, PhD^{3,4}

Author Affiliations:

¹ David Geffen School of Medicine at UCLA

² Charles R. Drew University of Medicine and Science

³ Department of Medicine, David Geffen School of Medicine at UCLA

⁴ UCLA Jonathan and Karin Fielding School of Public Health

⁵ UCLA Anderson School of Management

⁶ Department of Psychology, UCLA

⁷ Cedars-Sinai Heart Institute

Corresponding Author:

Martin F. Shapiro

mfshapiro@mednet.ucla.edu

911 Broxton Plaza

Los Angeles, CA 90095

(310) 794-2284

Word Count: 3,425

Graphics: 2 figures, 1 table

Abstract

Despite a revolution in therapeutics, the ability to control chronic diseases remains elusive. We present here a conceptual model of the potential role of behavioral tools in chronic disease control. Clinicians implicitly accept the assumption that patients will act rationally to maximize their self-interest. However, patients may not always be the rational actors that we imagine. Major behavioral barriers to optimal health behavior include patients' fear of threats to health, unwillingness to think about problems when risks are known or data are ambiguous, the discounting of risks that are far in the future, failure to act due to lack of motivation, insufficient confidence in the ability to overcome a health problem, and inattention due to pressures of everyday life. Financial incentives can stimulate initiation of health-promoting behaviors by reducing or eliminating financial barriers, but may not produce long-term behavior change without additional interventions. Strategies have been developed by behavioral economists and social psychologists to address each of these barriers to better decision-making. These include: labeling positive behaviors in ways consistent with patient life goals and priorities; greater focus on more immediate risks of chronic diseases; intermediate subgoals as steps to a large health goal; and implementation of specific plans as to when, where, and how an action will be taken. Such strategies hold promise for improving health behaviors and disease control, but most have not been studied in medical settings. The effectiveness of these approaches should be evaluated for their potential as tools for the clinician.

Introduction

Chronic diseases affect 133 million Americans¹ and often are not being managed effectively. For example, of 75 million people with hypertension in the United States, one-third go untreated and more than half do not adequately control their blood pressure². Efforts to improve chronic disease control have included patient and public education programs and pay-for-performance for providers^{3,4}. In this paper we contend that while education and financial incentives can sometimes be helpful, they may be insufficient and have the potential to be counterproductive in many clinical situations. Drawing on research from behavioral economics and social psychology, we identify a broader range of behavioral tools that we believe can contribute to more effective control of chronic disease. These tools, developed in nonclinical contexts, are based on a more realistic conception of patient behavior than is commonly assumed in clinical interventions and their efficacy in specific clinical settings should be evaluated. Within this paper we will describe scenarios in which behavioral tools might be applicable if further clinical research finds them to be effective in their translation to chronic disease management.

Provider strategies and the rational patient

When providers attempt to promote better control of chronic diseases they typically assume that patients are what behavioral economists describe as “boundedly rational,” making decisions that maximize their self-interest, subject to limits of their attention, memory and other cognitive abilities^{5,6}. To the extent that providers pay attention to these issues, they may have strategies that emphasize *education*, *feedback*, and *reminders*. Some health systems also apply strategies in *cost management*.

If patients are rational, education concerning better health practices ought to stimulate their motivation and intention to change⁷⁻¹⁰. According to the Health Belief Model (HBM), individual perceptions (perceived disease susceptibility and severity) and modifying factors (demographic, sociopsychological variables, and other people and information sources that modify the perceived disease threat) predict likelihood of patient action (including perceived benefits of and barriers to action)¹¹. For instance, more accurate health beliefs have been associated with better medication adherence in diabetes¹². In general, patients who accurately perceive health costs of non-treatment and benefits of effective treatment programs should rationally choose to adhere to those programs.

Once a patient decides to initiate a strategy for controlling a disease, she must learn to calibrate her specific behaviors to achieve the desired health results. Providers generally give feedback on progress at the time of clinical visits. In some situations, they enable patients to obtain more frequent feedback as with home blood pressure or serum glucose monitoring. Of note, overly frequent feedback has been shown in non-clinical contexts to be demotivating because normal fluctuations in an undesired direction generally cause a stronger response than equivalent gains^{13, 14}.

Even when patients have learned how to control a disease, they may find regimens to be time-consuming or unpleasant, or may be distracted from the task of disease control by competing demands^{15, 16}. Thus, some providers use reminder strategies, such as phone calls before appointments and automatic prescription refills to ensure that a patient's attention remains adequately focused on disease control.

Education, feedback, and reminders may be insufficient in inducing sustained control of chronic disease by boundedly rational patients if they are deterred by the financial cost, time

investment required, adverse effects of medications, or structural barriers to care. Traditional strategies attempt to address these barriers by lowering costs of treatment (e.g., by providing free medications, coverage and access improvements, and case management¹⁷⁻²⁰). A new strategy that has been the focus of some recent research is the use of financial rewards, which presumably lowers the cost of treatment²¹⁻²⁵.

These strategies for promoting control of chronic diseases are summarized in Figure 1, with a model of rational patients facing at least one diagnosed and treatable chronic disease. Note that we focus on patient-level barriers to sustained chronic disease control. Provider- and system-level barriers may also exist, but are beyond the scope of the present paper.

Shortcomings of current strategies to control chronic diseases

Traditional strategies that rely on a model of rational patients have yielded limited success in chronic disease management. Patient education alone is not associated with improved adherence, and knowledgeable patients are often poor adherers^{26,27}. Education may affect objective ability to control a disease, but may or may not have an impact on self-efficacy, which is perceived capability. High self-efficacy is very important in achieving chronic disease control, and has been found to predict more successful hypertension self-management in African Americans^{28,29}. Even sophisticated interventions involving education, reminders, and more have not been particularly successful in improving adherence or treatment outcomes¹⁹.

Behavioral research indicates how these strategies may backfire. First, when appropriate control is not achieved (possibly due to low ability, low self-efficacy, or both) providers sometimes adjust medicines, redouble education efforts, and inform patients that their efforts have not been successful, without addressing the lack of self-efficacy that may be the fundamental problem. Second, education often centers on explaining the risks of poorly

controlled chronic disease to invoke fear. Unfortunately, many people deny and dismiss information that they find frightening (the “*ostrich effect*”) ³⁰⁻³³. Fear can motivate if carefully applied, but only when accompanied by specific strategies for neutralizing it (e.g. a clear strategy to control the disease) ^{34, 35}. Third, very technical or overwhelming education may cause patients ironically to feel less knowledgeable and turn away from instructed behaviors ^{36, 37}. This tendency to choose a “known” risk (e.g., continuing without treatment) over an unknown risk (a confusing treatment) is called *ambiguity aversion* and appears to be driven by people’s preference to act in situations where they feel relatively knowledgeable or competent ^{38, 39}. Most clinicians have likely dealt with patients that feel overwhelmed when initiating treatment of chronic diseases; ambiguity aversion highlights why these patients may choose inaction instead of following medical advice. In short, when educating patients, it matters not just *what* you say, but *how* you say it.

A fourth challenge in educating patients to initiate treatment is “*present bias*,” whereby patients heavily discount future health costs and overestimate more immediate ones. They thus may underestimate the long-term dangers presented by chronic diseases while focusing on the more salient challenges of initiating and adhering to treatment regimens and follow-up ⁴⁰. This may be particularly important with diseases such as hypertension that have a long asymptomatic phase. For example, the distant risk of a stroke may be underestimated compared to the obvious and proximate difficulties of dealing with common medication side effects and costs of care, all in an attempt to control a disease that appears to have no real effects in the patient’s life.

Finally, removing financial and structural barriers to adherence is clearly beneficial, particularly for poorer patients who would otherwise not be able to afford treatment. However, doing so does not guarantee adherence or disease control. Direct financial incentives may induce

patients to alter behavior in the short run, but the long run is where the action is in chronic diseases, and we do not know what the long-term effects are. They might have a positive impact by promoting self-efficacy, a negative effect by undermining intrinsic motivation (see below) to control the disease, or no effect at all.

The role of intrinsic motivation

Intrinsic motivation is the inherent reward present in certain behaviors (Figure 1)⁴¹. This construct comes into play in the stages of change model, which is useful in determining a patient's level of motivation to change⁴². Clinicians also attempt to evoke patients' intrinsic motivations when using motivational interviewing⁴³, which was developed with the understanding that placing responsibility for change internally ("internal attribution") was more effective than placing responsibility on external factors⁴⁴. Intrinsic motivation to control disease is likely to emerge from a desire to be healthy or live longer and may be enhanced by relationships (e.g. wanting to live to see a grandchild attend college), personal goals (e.g. wanting to travel to another country), personal beliefs about the importance of life, or any other factors that patients identify as primary reasons to live longer. Of course, several factors may also diminish intrinsic motivation to seek medical treatment (e.g. anecdotes from friends about bad experiences with health care, fatalistic religious beliefs, unrealistically positive views of one's health status, mistrust of providers)⁴⁵. Thus, interventions designed to promote more effective control of chronic disease should take into account the potential positive or negative impact on intrinsic motivation.

New tools to control chronic disease

Applying an expanded model of patient behavior to chronic disease control can facilitate evaluation and incorporation of new behavioral tools that clinicians could use to address non-

optimal patient choices (Figure 2). The choice of tools applied to control chronic disease should take account of where the patient stands on the control continuum (represented by the rectangular boxes in the figures). Effective interventions could render patients able and competent to manage their chronic disease. Tools that warrant evaluation in clinical settings based on their success in other arenas include financial incentives with trait labeling, overcoming present bias, goals as reference points, and implementation intentions (Table 1).

Financial incentives and trait labeling

Recent studies have examined direct *financial incentives* to modify patient behavior. These are extrinsic motivators that can influence choice, according to the theory of operant conditioning⁴¹. They have effectively produced short-term behavior changes in clinical and social science applications^{21-25, 41, 46}. For example, financial incentives have been used to increase adherence to medications like warfarin, improve uptake of Hepatitis B vaccinations among drug users, and increase rates of completing smoking cessation programs^{21-25, 46}. Results have been mixed in their use as an incentive for weight loss^{21, 25}. If incentives are used in treating a chronic disease for a discrete period, behaviors that are driven by the incentives are likely to return to prior levels once the incentives are discontinued⁴⁶.

Moreover, there is evidence in non-medical research of an “*undermining effect*” of even successful extrinsic rewards upon intrinsic motivation^{41, 47}. When children were promised a reward for playing with a marker, they were even more likely than at baseline to do so. However, when the reward was later removed, children were even less likely than at baseline to play with the marker⁴⁸. The effect is explained by attribution theory, which states that individuals receiving rewards may attribute their behavior solely to earning the reward and not to any intrinsic desire^{47, 48}. Thus, the positive effect of financial incentives as extrinsic motivators must be carefully

weighed against the potential negative effect of incentives on intrinsic motivation. This does not present a problem when the desired outcome is a discrete event (e.g. encouraging vaccination or even stimulating initial chronic disease management efforts), but warrants more extensive investigation in situations in which the duration of treatment is likely to extend beyond the duration of any incentives, as is the goal in sustained chronic disease management. This undermining effect may explain why only one out of 19 incentive-based interventions related to smoking cessation has successfully affected long-term behavior⁴⁶. Sustaining incentive-induced short-term behavior change may require supplementary interventions to enhance intrinsic motivation in order to counteract any undermining effect of financial incentives.

One such strategy is *trait labeling*: presenting a positive label along with the extrinsic incentive that can be internalized by patients as the reason for their behavior⁴⁷. This might take the form of labeling positive behaviors in ways consistent with patients' life goals and priorities. For example, consider a hypothetical clinical trial in which financial incentives are provided to promote weight loss. The undermining effect might be blunted using trait labeling by delivering the following message to a patient: "The fact that you worked really hard in the last month to lose ten pounds really shows how much you want to be well enough to see your granddaughter graduate from college. This reward is in recognition of that hard work." In this case the positive trait label may be internalized so that the patient attributes her positive behavior change to the intrinsic motivator (wanting to live to see a granddaughter graduate) rather than the extrinsic motivator (money), regardless of which is actually supporting the behavior⁴⁷. Instead of helping the patient explore their motivation for change as in motivational interviewing, a trait label is provided in order to change the patient's attribution for their behavior (from external to internal) with the goal of increasing intrinsic motivation and self-efficacy. A similar strategy could be

evaluated for smoking cessation, accompanying a financial incentive with this statement: “Your commitment to cessation classes shows you are truly dedicated to quitting so you can feel better and maximize your health. This gift is an acknowledgment of your progress toward your goals.” Such trait labels could be modified for each patient based on their stated reasons for acting to change long-term behaviors such that positive behaviors are attributed to each patient’s intrinsic drive. While such approaches have been used successfully in several studies in the social psychology literature, we are aware of no health interventions to date that have involved use of both financial incentives and trait labeling. Such a combined strategy takes advantage of the theory that extrinsic motivators can at different times strengthen or weaken intrinsic motivation by using financial rewards to “launch” the behavior (assisting the patient’s baseline motivation), but then framing the positive behaviors as being motivated by internal reasons in order to avoid the undermining effect⁴⁹.

Overcoming present bias: making risks salient

Some clinicians implicitly understand the need to address *present bias*, when they refer to both short and long-term costs of diseases in their efforts to nudge patients toward healthier behaviors. Behavioral research suggests that these discussions can be more effective if they focus on highly salient and more immediate benefits that accrue through specific preemptive small-cost actions (i.e. treatment adherence). In studies of low-income workers in India, including pictures of the household children on salary envelopes increased amount saved by 15%, presumably by reminding individuals that small cost actions now (saving) have longer term implications that they care about⁵⁰. In a clinical setting, rather than discussing the consequences that patients might expect to experience 20 or 30 years from now, patients might be told, “If you take your medication regularly and bring your blood pressure to normal, the chances of a stroke in the next

four years will go down by as much as 28%”^{51, 52}. Because patients may focus on the immediate costs of treatment (e.g. common and frustrating adverse medication effects; time required for frequent clinical visits) while underestimating less obvious long-term benefits, this strategy aims to tip the balance in favor of adherence by emphasizing more salient risks that are worth the relatively small short-term costs. Clinical researchers could easily compare provider counseling that focuses on more immediate versus long-term disease risks to establish the effect on patient uptake of and adherence to treatment.

Goals as reference points: steps to self-efficacy

Patients with low self-efficacy (i.e., low confidence in their ability to control the disease) tend to have worse outcomes²⁹. Any tool that improves a patient’s disease control may improve self-efficacy, simply through the positive experience of reaching a goal perceived to be unattainable. Using a *goals as reference points* strategy may improve self-efficacy, even before full disease control is achieved. This involves breaking large goals into intermediate subgoals that serve as reference points^{53, 54}. People exert more effort the nearer they are to a goal, so partitioning a large goal into a number of more attainable and more proximate subgoals will generally increase motivation⁵³. This could be easily evaluated in weight loss, for example with this statement: “Your target weight is 175 pounds, but we can start with a very manageable goal of losing 5 pounds to reach 210 pounds. Can you do that?” In hypertension, some patients may struggle with forgetting pills some days and feel little urgency to refill prescriptions. For such patients, control may be perceived as more attainable if the end goal of taking medication each day, checking blood pressure most days, and lowering blood pressure to below 140/90 mmHg is divided into subgoals, the first of which could be simply focusing on taking medication most days, measuring blood pressure sometimes, and achieving any drop in blood pressure. For

patients struggling to be more active, the end goal of moderate to vigorous exercise one hour most days may be introduced, along with a subgoal of 20 minutes of mild exercise twice a week. Completing these subgoals is experienced as a success (thereby increasing self-efficacy), whereas the same accomplishment in the context of a single large goal is experienced as a loss and can be de-motivating because the end goal has not yet been achieved^{53, 54}. Goals as reference points strategies have been successful in other settings, and research is warranted to determine their effect on patient adherence to chronic disease therapies.

Implementation intentions

Implementation intentions are specific plans as to when, where, and/or how an action will be taken^{55, 56}. They are already used in some clinical situations. For example, smokers who chose a specific quit date were more likely to quit than those who committed to quitting sometime in the next two months⁵⁷. In another example, college seniors who received vaccine education, chose a day to visit the clinic, and circled the clinic on a map were nine times more likely to obtain vaccinations than those receiving persuasive education alone⁵⁸. Scaring students about the dangers of tetanus did very little to induce vaccination (an excellent example of the ostrich effect), whereas having them circle the health center on a map and find a time on their calendar had a huge impact⁵⁸. These examples highlight that while education to inform patients why they should modify their behavior is necessary, assisting them with plans as to how, where, and when they will do so may be more important in actually stimulating behavior change. Linking intentions to a specific plan is particularly useful in moving from uncontrolled disease to initiation of control, but also may be useful to maintain treatment adherence. Implementation intention interventions for chronic disease control might include having patients specify a) when in the day they will take their medicines, b) when they will measure their blood pressure or

glucose, c) what they will do if they run out of medicine, or d) what action they will take if they note particularly abnormal readings of blood pressure or glucose. Because implementation intentions have already shown success in some clinical settings, we believe further interventions applied to treatment initiation in other chronic diseases could prove effective.

Conclusion

There is great need for research into the effectiveness of a broader range of behavioral interventions in clinical settings that have the potential to assist patients in achieving sustained disease control. In this paper we have outlined the stages of disease control and its relationship to underlying behavioral constructs. In addition we have proposed some tools that could improve success in disease management. Further clinical research is required to determine the effectiveness of these tools in practice and refine the conceptual model presented here. Overall, the tools discussed in this paper have been highly effective in inducing change in other areas of human activity. Some have proven to be even more effective than financial incentives that are gaining popularity in health research today. Behavioral economics and social psychology suggest a much fuller repertoire of potential clinical interventions than financial incentives; many behavioral tools beyond those discussed here may prove useful in clinical research^{59, 60}.

Analogous to treatment of hematologic malignancies, tools effective for initiating control (induction) may differ from those needed for maintaining short-term control (consolidation), or for sustaining long-term disease control (maintenance). Some tools may have short-term benefits, but cause longer-term harm. Some patients may need multiple strategies to stimulate initiation of control, followed by different strategies at later stages. Thus, “treatments” may need to be given in combinations and be delivered concurrently, sequentially, or both. Such comprehensive strategies must: 1) influence intrinsic patient attributes including knowledge and

beliefs, ability and self-efficacy, and intrinsic motivation to control the disease; and 2) restructure the surrounding choice environment or “architecture” to make desired actions more attractive and easier to accomplish^{59,60}. Table 1 summarizes the relationships amongst tools (discussed in this paper and some others), their behavioral or attitudinal targets, and the stages of chronic disease control.

Chronic disease care is far from routine. Influencing patient behavior to achieve chronic disease control is a challenging and complex enterprise that may benefit from a broad range of tools. If application of these newer behavioral tools proves effective, their use will require an investment of substantial time both to educate providers and to administer sometimes intricate cognitive interventions. Although behavioral interventions could add costs to systems and providers, they may ultimately prove cost-effective for society.

References:

1. Chronic Diseases and Health Promotion. 2009; <http://www.cdc.gov/chronicdisease/overview/index.htm>. Accessed June 27, 2011.
2. Egan BM, Zhao Y, Axon RN. US Trends in Prevalence, Awareness, Treatment, and Control of Hypertension, 1988-2008. *JAMA: The Journal of the American Medical Association*. May 26, 2010 2010;303(20):2043-2050.
3. Cutler TW, Palmieri J, Khalsa M, Stebbins M. Evaluation of the relationship between a chronic disease care management program and California pay-for-performance diabetes care cholesterol measures in one medical group. *J Manag Care Pharm*. Sep 2007;13(7):578-588.
4. Harris M, Smith BJ, Veale A. Patient education programs--can they improve outcomes in COPD? *Int J Chron Obstruct Pulmon Dis*. 2008;3(1):109-112.
5. Simon HA. A Behavioral Model of Rational Choice. *The Quarterly Journal of Economics*. February 1, 1955 1955;69(1):99-118.
6. von Neumann J, Morgenstern O. *Theory of games and economic behavior*. Princeton, NJ: Princeton University Press; 1944.
7. de Bes J, Legierse CM, Prinsen CA, de Korte J. Patient education in chronic skin diseases: a systematic review. *Acta Derm Venereol*. Jan 2011;91(1):12-17.
8. Hachinski V, Donnan GA, Gorelick PB, et al. Stroke: working toward a prioritized world agenda. *Stroke*. Jun 2010;41(6):1084-1099.
9. Lagger G, Pataky Z, Golay A. Efficacy of therapeutic patient education in chronic diseases and obesity. *Patient Educ Couns*. Jun 2010;79(3):283-286.

10. Yawn BP. Optimizing chronic obstructive pulmonary disease management in primary care. *South Med J*. Feb 2011;104(2):121-127.
11. Janz NK, Becker MH. The Health Belief Model: a decade later. *Health Educ Q*. Spring 1984;11(1):1-47.
12. Brownlee-Duffeck M, Peterson L, Simonds JF, Goldstein D, Kilo C, Hoette S. The role of health beliefs in the regimen adherence and metabolic control of adolescents and adults with diabetes mellitus. *J Consult Clin Psychol*. Apr 1987;55(2):139-144.
13. Gneezy U, Potters J. An Experiment on Risk Taking and Evaluation Periods. *Quarterly Journal of Economics*. 1997;112(2):631-645.
14. Kahneman D, Tversky A. Prospect Theory: An Analysis of Decision under Risk. *Econometrica*. 1979;47(2):263-291.
15. Katz MH, Cunningham WE, Fleishman JA, et al. Effect of case management on unmet needs and utilization of medical care and medications among HIV-infected persons. *Ann Intern Med*. Oct 16 2001;135(8 Pt 1):557-565.
16. Cunningham WE, Andersen RM, Katz MH, et al. The impact of competing subsistence needs and barriers on access to medical care for persons with human immunodeficiency virus receiving care in the United States. *Med Care*. Dec 1999;37(12):1270-1281.
17. Applegate BW, Ames SC, Mehan DJ, Jr., McKnight GT, Jones GN, Brantley PJ. Maximizing medication adherence in low-income hypertensives: a pilot study. *J La State Med Soc*. Jul 2000;152(7):349-356.
18. Bewley A, Page B. Maximizing patient adherence for optimal outcomes in psoriasis. *J Eur Acad Dermatol Venereol*. Jun 2011;25 Suppl 4:9-14.
19. Haynes RB, Ackloo E, Sahota N, McDonald HP, Yao X. Interventions for enhancing medication adherence. *Cochrane Database Syst Rev*. 2008(2):CD000011.
20. Lareau SC, Yawn BP. Improving adherence with inhaler therapy in COPD. *Int J Chron Obstruct Pulmon Dis*. 2010;5:401-406.
21. John LK, Loewenstein G, Troxel AB, Norton L, Fassbender JE, Volpp KG. Financial incentives for extended weight loss: a randomized, controlled trial. *J Gen Intern Med*. Jun 2011;26(6):621-626.
22. Seal KH, Kral AH, Lorvick J, McNeese A, Gee L, Edlin BR. A randomized controlled trial of monetary incentives vs. outreach to enhance adherence to the hepatitis B vaccine series among injection drug users. *Drug Alcohol Depend*. Aug 20 2003;71(2):127-131.
23. Volpp KG, Loewenstein G, Troxel AB, et al. A test of financial incentives to improve warfarin adherence. *BMC Health Serv Res*. 2008;8:272.
24. Volpp KG, Troxel AB, Pauly MV, et al. A randomized, controlled trial of financial incentives for smoking cessation. *N Engl J Med*. Feb 12 2009;360(7):699-709.
25. Wall J, Mhurchu CN, Blakely T, Rodgers A, Wilton J. Effectiveness of monetary incentives in modifying dietary behavior: a review of randomized, controlled trials. *Nutr Rev*. Dec 2006;64(12):518-531.
26. Dean AJ, Walters J, Hall A. A systematic review of interventions to enhance medication adherence in children and adolescents with chronic illness. *Arch Dis Child*. Sep 2010;95(9):717-723.

27. Wells JR. Hemodialysis knowledge and medical adherence in African Americans diagnosed with end stage renal disease: results of an educational intervention. *Nephrol Nurs J.* Mar-Apr 2011;38(2):155-162; quiz 163.
28. Du S, Yuan C. Evaluation of patient self-management outcomes in health care: a systematic review. *Int Nurs Rev.* Jun 2010;57(2):159-167.
29. Warren-Findlow J, Seymour RB, Brunner Huber LR. The association between self-efficacy and hypertension self-care activities among African American adults. *J Community Health.* May 6 2011.
30. Frey D, Stahlberg D. Selection of information after receiving more or less reliable self-threatening information. *Personality and Social Psychology Bulletin.* December 1, 1986 1986;12(4):434-441.
31. Galai D, Sade O. The 'Ostrich Effect' and the Relationship between the Liquidity and the Yields of Financial Assets. *SSRN eLibrary.* 2003.
32. Gul F. A Theory of Disappointment Aversion. *Econometrica.* 1991;59(3):667-686.
33. Karlsson N, Seppi DJ, Loewenstein GF. The 'Ostrich Effect': Selective Attention to Information about Investments. *SSRN eLibrary.* 2005.
34. Maddux JE, Rogers RW. Protection motivation and self-efficacy: A revised theory of fear appeals and attitude change. *Journal of Experimental Social Psychology.* 1983;19(5):469-479.
35. Rogers RW, Mewborn CR. Fear appeals and attitude change: effects of a threat's noxiousness, probability of occurrence, and the efficacy of coping responses. *J Pers Soc Psychol.* Jul 1976;34(1):54-61.
36. Jacoby J, Szybillo GJ, Jacqueline B-S. Information Acquisition Behavior in Brand Choice Situations. *Journal of Consumer Research: An Interdisciplinary Quarterly.* 1977;3(4):209-216.
37. Malhotra NK. Information Load and Consumer Decision Making. *Journal of Consumer Research: An Interdisciplinary Quarterly.* 1982;8(4):419-430.
38. Fox CR, Tversky A. Ambiguity Aversion and Comparative Ignorance. *The Quarterly Journal of Economics.* August 1, 1995 1995;110(3):585-603.
39. Fox CR, Weber M. Ambiguity Aversion, Comparative Ignorance, and Decision Context. *Organizational Behavior and Human Decision Processes.* 2002;88(1):476-498.
40. Soman D, Ainslie G, Frederick S, et al. The Psychology of Intertemporal Discounting: Why are Distant Events Valued Differently from Proximal Ones? *Marketing Letters.* 2005;16(3):347-360.
41. Deci EL, Koestner R, Ryan RM. A meta-analytic review of experiments examining the effects of extrinsic rewards on intrinsic motivation. *Psychol Bull.* Nov 1999;125(6):627-668; discussion 692-700.
42. Prochaska JO, DiClemente CC. Transtheoretical therapy: Toward a more integrative model of change. *Psychotherapy: Theory, Research & Practice.* 1982;19(3):276-288.
43. Hettema J, Steele J, Miller WR. Motivational Interviewing. *Annual Review of Clinical Psychology.* 2005;1(1):91-111.
44. Miller WR. Motivational interviewing with problem drinkers. *Behavioural Psychotherapy.* 1983;11(2):147-172.

45. Victor RG, Leonard D, Hess P, et al. Factors associated with hypertension awareness, treatment, and control in Dallas County, Texas. *Arch Intern Med.* Jun 23 2008;168(12):1285-1293.
46. Cahill K, Perera R. Competitions and incentives for smoking cessation. *Cochrane Database Syst Rev.* 2011(4):CD004307.
47. Cialdini RB, Eisenberg N, Green BL, Rhoads K, Bator R. Undermining the Undermining Effect of Reward on Sustained Interest. *Journal of Applied Social Psychology.* 1998;28(3):249-263.
48. Lepper MR, Greene D, Nisbett RE. Undermining children's intrinsic interest with extrinsic reward: A test of the "overjustification" hypothesis. *Journal of Personality and Social Psychology.* 1973;28(1):129-137.
49. Frey BS, Jegen R. Motivation Crowding Theory. *Journal of Economic Surveys.* 2001;15(5):589-611.
50. Soman D, Cheema A. Earmarking and Partitioning: Increasing Saving by Low-Income Households. *Journal of Marketing Research, Forthcoming.* 2010.
51. Controllable Risk Factors - High Blood Pressure (Hypertension). <http://www.stroke.org/site/PageServer?pagename=HighBloodPressure>. Accessed July 7, 2011.
52. Randomised trial of a perindopril-based blood-pressure-lowering regimen among 6,105 individuals with previous stroke or transient ischaemic attack. *Lancet.* Sep 29 2001;358(9287):1033-1041.
53. Heath C, Larrick RP, Wu G. Goals as Reference Points. *Cognitive Psychology.* 1999;38(1):79-109.
54. Latham GP, Locke EA. Self-regulation through goal setting. *Organizational Behavior and Human Decision Processes.* 1991;50(2):212-247.
55. Gollwitzer PM. Implementation Intentions, : Strong Effects of Simple Plans. *American Psychologist.* 1999;54(7):493-503.
56. Gollwitzer PM, Brandstatter V. Implementation Intentions and Effective Goal Pursuit. *Journal of Personality and Social Psychology.* 1997;73(1):186-199.
57. Armitage CJ. Efficacy of a Brief Worksite Intervention to Reduce Smoking: The Roles of Behavioral and Implementation Intentions. *Journal of Occupational Health Psychology.* 2007;12(4):376-390.
58. Leventhal H, Singer R, Jones S. Effects of fear and specificity of recommendation upon attitudes and behavior. *J Pers Soc Psychol.* Jul 1965;34:20-29.
59. Thaler RH, Sunstein CR. Libertarian Paternalism. *The American Economic Review.* 2003;93(2):175-179.
60. Thaler RH, Sunstein CR, Balz JP. Choice Architecture. *SSRN eLibrary.* 2010.
61. Deutsch M, Gerard HB. A study of normative and informational social influences upon individual judgment. *Journal of Abnormal and Social Psychology.* 1955;51(3):629-636.
62. Johnson EJ, Goldstein D. Do Defaults Save Lives? *Science.* November 21, 2003 2003;302(5649):1338-1339.
63. Thaler RH, Sunstein CR. *Nudge.* New Haven: Yale University Press; 2008.
64. Karlan D, McConnell M, Mullainathan S, Zinman J. *Getting to the Top of Mind: How Reminders Increase Saving:* Yale University;2010.

Table 1: Behavioral tools potentially useful to address non-optimal patient choice & achieve sustained chronic disease control, what they affect, and in which stage(s) they may be appropriate (initiation of treatment, achievement of control, sustained control).

Tool	What it affects	Which stage(s) it may be appropriate
1. Financial Incentives	Extrinsic motivation (increase), Costs & barriers, Intrinsic motivation (decrease)	Initiation of Treatment, Achievement of Control
2. Trait labeling	Intrinsic motivation	Achievement of Control, Sustained Control
3. Social norms ^a	Knowledge & beliefs, Self-efficacy, Intrinsic motivation	Initiation of Treatment, Achievement of Control
4. Overcoming present bias	Knowledge & beliefs, Costs & barriers	Initiation of Treatment
5. Goals as reference points	Knowledge & beliefs, Self-efficacy	Initiation of Treatment, Achievement of Control
6. Implementation intentions	Attention, Costs & barriers, Self-efficacy	Initiation of Treatment, Achievement of Control
7. Intelligent defaults ^b	Attention	Achievement of Control, Sustained Control
8. Reminder strategies with a twist ^c	Intrinsic motivation, Attention	Achievement of Control, Sustained Control

^aSocial norms: explicit statements about how the majority of people act in order to influence individual behavior⁶¹

^bIntelligent defaults: set to the choice most people would likely prefer if they had unlimited time and resources to decide, while allowing individuals to choose differently^{62, 63}

^cReminder strategies with a twist: creative reminders meant to increase salience and tip the cost-consequence ratio to ensure that patients act the way they intend to, notwithstanding all of life's distractions⁶⁴

Figure 1: Patient-centered continuum of chronic disease control (rectangles), attributes that influence progression along this continuum (ovals), commonly used strategies that providers typically use to influence patient behavior (+) and their shortcomings (-), and the hypothesized effects of intrinsic motivation.

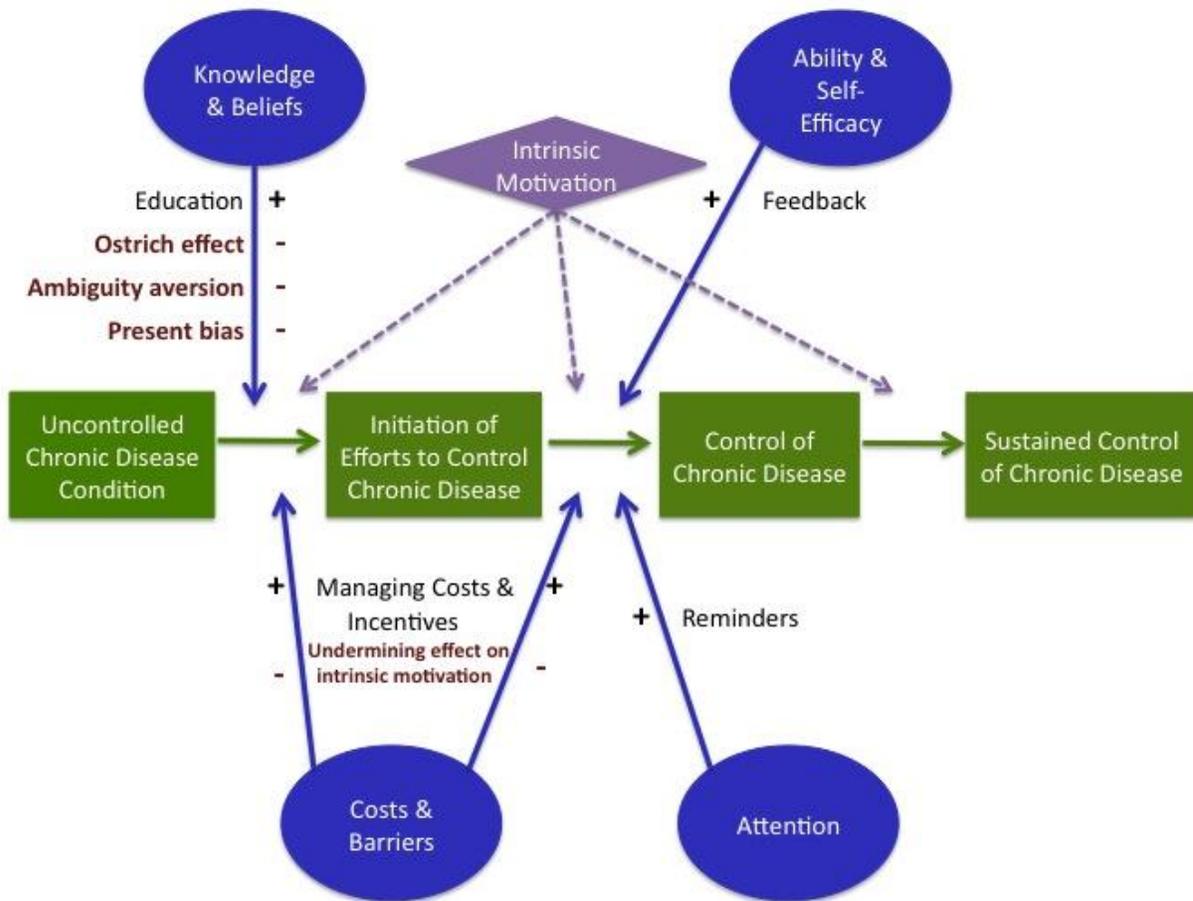


Figure 2: Potential behavioral tools to address non-optimal patient choices in chronic disease management. For brief explanations of tools not discussed in this paper, see footnotes to Table 1.

