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ORIGINAL ARTICLE

Observational Study

Patient attitudes about financial incentives for diabetes self-management: A survey

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Abstract

AIM: To study the acceptability of incentives for behavior changes in individuals with diabetes, comparing financial incentives to self-rewards and non-financial incentives.

METHODS: A national online survey of United States adults with diabetes was conducted in March 2013 (n = 153). This survey was designed for this study, with iterative testing and modifications in a pilot population. We measured the demographics of individuals, their interest in incentives, as well as the perceived challenge of diabetes self-management tasks, and expectations of incentives to improve diabetes self-management (financial, non-financial and self-rewards). Using an ordered logistic regression model, we assessed the association between a 32-point score of the perceived challenge of the self-management tasks and the three types of rewards.

RESULTS: Ninety-six percent of individuals were interested in financial incentives, 60% in non-financial incentives and 72% in self-rewards. Patients were less likely to use financial incentives when they perceived the behavior to be more challenging (odds ratio of using financial incentives of 0.82 (95%CI: 0.72-0.93) for each point of the behavior score). While the effectiveness of incentives may vary according to the perceived level of challenge of each behavior, participants did not expect to need large amounts to motivate them to modify their behavior. The expected average amounts needed to motivate a 5 lb weight loss in our population and to maintain this weight change for a year was $258 (interquartile range of $10-100) and $713 (interquartile range of $25-250) for a 15 lb weight loss. The difference in mean amount estimates for 5 lb and 15 lb weight loss was significant (P < 0.001).

CONCLUSION: Individuals with diabetes are willing to consider financial incentives to improve diabetes self-management. Future studies are needed to explore incentive programs and their effectiveness for diabetes.

Key words: Patient incentives; Diabetes self-management; Motivation; Weight loss; Patient engagement

Core tip: Patient incentives have shown potential in modifying behaviors such as smoking cessation or weight loss. This online survey for individuals with diabetes explores their attitude towards incentives (financial, non-financial and self-rewards) for diabetes self-management. Although nearly all participants showed positive expectations about financial incentives, they favored financial incentives for less challenging behaviors, and non-financial incentives for more challenging behaviors. This survey also enquired about expected amount of incentives, in particular for a 5 lb weight loss, maintained over a year.

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INTRODUCTION

Behavioral changes are key part of diabetes self-management[1], but they are difficult to implement and maintain. Setting goals is a key step to behavior change. Findings from a group of Swedish investigators about patients' willingness to pay to improve their diabetes self-management emphasize the importance of certain goals for patients, such as weight loss, less frequent or severe hypoglycemic events and lower HbA1c levels[2].

Financial incentives have shown potential in supporting patients to modify their behaviors[3], such as for smoking cessation[4] or weight loss[5,6]. Acceptability and feasibility of incentives may vary with different health behaviors, as the complexity of the behaviors vary widely. The effect and type of incentives for one-time vaccinations[7] may differ from incentives for repeated, constant efforts for weight loss[8]. Financial incentives for health and wellness are being used by a rapidly growing number of employers, with nearly 90% companies using such measures in the 2013 survey from Fidelity Investments and the National Business Group on Health (57% increase since 2009)[9]. While some authors have suggested using financial incentives for diabetes self-management behaviors, evidence for incentivized diabetes self-care is still scarce[10]. There is to our knowledge only one study on patient incentives for diabetes self-management, comparing incentives to peer mentors or usual care[11]. Although this study did not find a significant benefit, the sample was small and the reward design was solely based on the outcome (change in HbA1c value).

Incentives programs can reward different types of goals. Some programs provide outcome-based incentives, where rewards are given for achieved final results (*e.g.*, HbA1c or BMI, body mass index). These outcome-based rewards can favor individuals who are healthier at baseline. Other programs reward the total amount of behavior change-related results, thus favoring individuals who are more obese, for example, who then have more weight to lose. Finally, some incentive programs reward the process, such as attendance at group sessions, or tracking and reporting results. These are more equitable, because it is more attainable for all participants. Furthermore, prior research suggests that process-based rewards may be more effective than outcome-based rewards, and that associating them could have an additional effect.

Incentives programs also differ in the rewards that are given. Some programs have financial incentives, others offer vouchers and discounts[12], and yet others propose badges and stars without financial stakes. Self-rewards are another type of reward, which one gives oneself for reaching self-defined goals. Rewards are typically used to address present bias, the tendency to value small immediate rewards over large rewards in the distant future. Controversies about using financial incentives for long-term behavior change have been raised due to the "undermining effect[13,14]". Long-term behavior changes are driven by intrinsic motivation, or inherent motivation, rather than by extrinsic motivation, which are rewards that are external to the behavior[15]. Prior studies on rewards have shown that the removal of extrinsic rewards can results in a decrease in intrinsic motivation, the so-called undermining effect[13,14].

The goal of this study was to explore patients' expected responses to financial and non-financial incentives to improve their diabetes self-management. We hypothesized that expected responses to the type of incentive (financial, non-financial or self-reward) would differ with the perceived level of challenge of the incentivized behavior. We also wanted to explore the amount of money participants considered necessary to motivate behavior change. These results can help guide the creation and implementation of new patient-centered approaches for diabetes self-management.

MATERIALS AND METHODS

Setting

The survey was developed by the authors through an iterative process of editing and was tested on two groups of altogether 15 students and faculty at the University of Washington. The feedback led to modifications to simplify the survey, and resulted in a final set of 10 questions in addition to demographic information. Two individuals of the test groups had diabetes. The survey was available in English.

This online survey was launched to a panel of

Table 1 Overview of survey questions

Survey question themes
Three most difficult and three easiest diabetes self-management tasks:
Tracking health parameters
Choosing foods
Adapting medications or insulin
Affording healthcare
Adjusting meds and diet around unexpected events
Perceived challenges for living with diabetes (detailed in Table 2)
Perceived helpfulness of incentives for motivating healthier behaviors:
Cash rewards (weekly, monthly or yearly)
Tangible rewards, *e.g.*, vouchers (weekly, monthly or yearly)
Decrease in future insurance premium
Non-financial rewards (badges, stars)
Social support (sharing with friends)
Self-reward (setting money aside for a self-set goal)
Potential sources of funding for the rewards (employer, insurance, self-paid)
Estimated amount needed to lose weight and keep it off for a year:
To lose 5 lb
To lose 15 lb

three hundred members of a commercial survey website in March 2013. This company has a large panel of international volunteer members who can be filtered according to personal information such as age or country of residence. Eligible members receive recruitment emails, and choose freely whether to respond or not. All participants gave their informed consent prior to their inclusion in the study. Participants who complete the proposed surveys receive website points, which can be exchanged for tangible gifts.

Recruitment

Our survey was administered in English, and was restricted to United States residents. It was open until 300 participants responded. We also filtered out individuals younger than 18 years old. The survey was open to individuals with type 1 or type 2 diabetes, but excluded those with gestational diabetes. We did not offer any supplementary compensation for completing the survey. (We had no involvement with the reward points that are part of the website). The study was approved by the Institutional Review Board of the University of Washington.

Measures

Participants completed the 10-question survey on diabetes self-management, goals and barriers (Table 1). We asked them to identify the three most difficult and the three easiest barriers among the following diabetes self-management tasks: tracking health, choosing foods, cooking appropriate meals, adapting medications or insulin, affording healthcare, adjusting meds and diet around unexpected events. We then asked them which diabetes-related behaviors were challenging: structuring a daily routine around diabetes management, impact on social relationships, thinking about diabetes all the time, social support from family, friends and workplace, changing foods, seeing how others think of them, and understanding the relationships between glucose, diet and exercise.

We asked the participants to anticipate their responses to different rewards to help improve diabetes self-management: financial rewards, non-financial rewards and self-rewards. For the financial rewards, we asked participants to estimate the helpfulness of rewards, according to their frequency (weekly, monthly or annual) and type (cash, vouchers or reduced annual insurance premium) to improve their health behaviors. We used a 4-point scale with our predicted small sample to avoid having a neutral option. For the non-financial rewards, we enquired about the anticipated effect of receiving stars or badges, or sharing results with friends, in helping improve their behavior. Finally, we asked participants about the helpfulness of self-paid rewards (*e.g.*, setting money aside for a self-set goal) in improving health behaviors.

We explored who the participants thought should pay for the rewards to improve their health behaviors (health insurance companies, employers or self-paid rewards). We adapted two questions from Long *et al*[16]'s survey instrument, which were: "If you were overweight, how much money would you need to receive to persuade you to lose 5 pounds and keep it off for 1 year?" and likewise for a 15-pound weight loss. Finally, we explored their use of mobile technology (in general and for diabetes).

Statistical analysis

We conducted descriptive analyses describing means and distributions. We defined financial incentive as any cash incentive (weekly, monthly or yearly), any voucher or reduction in insurance premium. We considered recognition by badges or stars and sharing results with friends as a non-financial incentive. Helpfulness of incentives was a binary variable, defined as not helpful or helpful (somewhat helpful to very helpful). To explore associations between diabetes tasks and type of reward, we used a logistic regression model to compare expectations of self-management tasks perceived as difficult or easy. We proceeded similarly for the behaviors that are related to diabetes self-management, separating not helpful or somewhat challenging behaviors from those that are challenging. We then created a score ranging from 0 (easy) to 24 (hard) based on how difficult these behaviors were perceived to be (Table 2). Using a logistic regression model, we studied the association between the score and the three types of reward. In this model, we also analyzed the effect of age and of weight loss motivation, using the estimated amount needed to lose 5 lb and keep it off during a year. We used a cutoff of $30000 to avoid bias from outliers in these analyses.

The percentage of complete cases was 76%. Missing covariate data were infrequent (≤ 3%) other than for income (7%). Missing data were multiple-

Table 2 Challenges of diabetes self-management behaviors

Behavior	*n* (%)
Having to structure my daily routine around diabetes management	77 (50.3)
Coping with the impact of diabetes on my social relationships	64 (41.8)
Thinking about diabetes all the time	74 (48.4)
Having insufficient support from family and/or friends	52 (34.0)
Having insufficient support from my workplace	51 (33.3)
Seeing how other people think of me	88 (57.5)
Having to change what I eat	49 (32.0)
Understanding the relationships between glucose, diet and exercise	72 (47.1)
Overall mean	65.9 (43.1)

For the score, each behavior was rated 0 to 3 points (total of 0 to 24 points).

Table 3 Participant characteristics by type of diabetes

Diabetes	Type 1	Type 2[1]	*P*-value
Value	17 (11.1)	136 (88.9)	
Female	6 (35.3)	71 (52.2)	0.20
Age (x)	39.6 ± 3.5	44.8 ± 1.3	0.18
United States. region			0.06
West	1 (5.9)	26 (19.1)	
Midwest	4 (23.5)	29 (21.3)	
Northeast	9 (52.9)	30 (22.1)	
South	3 (17.6)	51 (37.5)	
Hispanic	1 (7.6)	13 (9.3)	0.80
White race	14 (84.7)	120 (88.9)	0.14
Education (highest attained level)			0.98
High school	8 (47.1)	61 (44.9)	
College	5 (29.4)	40 (29.4)	
Graduate school	4 (23.5)	35 (25.7)	
Income > $50000/yr	7 (42.9)	72 (52.9)	0.45
Current smoker	4 (21.8)	32 (23.5)	0.87
Smartphone user	14 (80.6)	53 (38.8)	0.005

[1]Limited to white and black race. Data are expressed as mean ± SD or *n* (%).

imputed with 10 imputed datasets using imputation by chained-equations[17]. The imputation model included the covariates used in all our analysis (with dependent variables), as well as the region of residence. Categorical variables were compared using χ^2 tests. *P* values from regression models were derived from Wald tests with robust standard errors. A *P*-value < 0.05 determined statistical significance. No interaction was tested. All analyses were conducted on Stata 11 (Stata Corporation, Texas).

RESULTS

Out of the 300 responders, 153 participants were eligible and consented to participate. Excluded participants differed from the inclusion group only by the higher proportion of female individuals (69.4% *vs* 50.4%). Age, region of residence, race, ethnicity, type of education and income were not statistically different among inclusion and exclusion groups.

The included participants had a mean age of 44.2 ± 1.2 years, with 50.4% women. Graduate school education was achieved by 25.5%, and 34.1% had an annual income of > $75.000/year. Nearly a quarter of the participants were smokers (23.0%) at the time of the survey. Smartphone ownership was 43.7%. We present the detailed participant characteristics by type of diabetes in Table 3. There were 11.1% individuals with type 1 diabetes and 88.9% individuals with type 2 diabetes. Although the mean age was not statistically different, participants with type 1 diabetes were significantly more likely to have a smartphone. Individuals with type 1 diabetes were located more in the northeast area of the United States. and less in the West and South areas.

Almost all participants (96.7%) had positive expectations from the use of incentives (financial or non-financial) to improve their diabetes self-management. Only six individuals were not interested in incentives. There was no significant difference in demographic characteristics (age, gender, race/ethnicity, education, income) among those interested in incentives or not. While all individuals with type 1 diabetes were interested in incentives, six individuals who were not interested in incentives had type 2 diabetes. Forty-five percent of participants with an interest in incentives were smartphone users, although there was no significant difference in smartphone use between those with or without interest in incentives.

Overall, the participants expected financial incentives to motivate themselves more than non-financial rewards (96.0% *vs* 60.0%), and 70.2% of individuals expected self-rewards to be helpful in improving diabetes self-management. The self-management tasks rated as the three easiest were: keeping track of health parameters, making food choices and cooking appropriate meals. The tasks considered most difficult were: affording diabetes costs, and adjusting diet and medications around unexpected events. Participants expected financial incentives to help improve food choices and healthcare costs the most, whereas self-rewards were expected to help improve adjustments to unexpected events the most. Non-financial incentives were expected to help improve adapting insulin doses the most.

We studied the participants' responses to the three types of incentives according to whether these factors were considered a challenge for diabetes self-management or not. We found that overall, 94% expected a positive outcome with financial incentives, compared with 60% with non-financial incentives, and 69% with self-rewards. Participants expected financial incentives to help improve the food habit changes the most, whereas non-financial incentives and self-rewards were expected to improve support from the workplace and impact on social relationships the most.

We assess the association of perceived level of challenge (0 is easy, 24 is challenging) and type of incentive (financial, non-financial and self-rewards) in Table 4. We found in the unadjusted analysis that for

Table 4 Effect of behavior score on the 3 types of rewards

Score	OR financial incentive (95%CI)	*P*-value	OR non-financial incentive (95%CI)	*P*-value	OR self-reward (95%CI)	*P*-value
Score	0.82 (0.72-0.93)	0.002	1.06 (1.01-1.10)	0.01	1.00 (0.96-1.04)	0.98
Score adjusted for age	0.82 (0.72-0.93)	0.002	1.06 (1.01-1.11)	0.01	1.00 (0.96-1.05)	0.94
Score adjusted for weight loss motivation[1]	0.83 (0.73-0.95)	0.005	1.07 (1.02-1.11)	0.006	1.01 (0.96-1.05)	0.75

[1]Estimated amount needed to lose 5 lb and maintain it for a year.

an increase in the behavior score by one point, the odds ratio comparing expected response to financial incentives with no response to financial incentives would be 0.82 (P = 0.002). When comparing expected responses to non-financial incentives to no response to these incentives, we found an OR of 1.05 (P = 0.01). The level of perceived difficulty with these behaviors was not associated with expecting to respond to self-rewards in our dataset (OR = 1.00, P = 0.98). We obtained similar results when adjusting for age or for the weight loss motivation (assessed by the amount needed to lose 5 lb and keep it off for a year). This means that when these behaviors are perceived to be more difficult, the participant less expected to respond to financial incentives. Yet for non-financial incentives, when more behaviors are perceived to be difficult, participants expected to respond more to non-financial incentives.

We asked participants to provide an estimated amount needed to motivate losing 5 and maintaining it for a year, and the amount for a 15 lb weight loss. We excluded 2 outliers for each analysis, using a $30000 cutoff. To motivate a 5 lb weight loss, participants gave estimates that ranged from $0 (12 participants) to $2.15 billion. On average, the estimated amount to motivate people to lose 5 lb was $258, with a median of $50 and interquartile range of $10 to 100. When asked how much money participants needed to lose 15 lb and keep it off for a year, the range of responses was identical. They expected themselves to be motivated with an average of $713 (median of $100, IQR $25-250). Only 8 participants responded with $0 for this question. The difference between these two estimates was statistically significant (P < 0.001).

DISCUSSION

In this national web-based survey of individuals with diabetes, we explored perceptions of financial and non-financial incentives to improve diabetes self-management. We found that nearly all surveyed individuals were interested in incentives, with no difference in socioeconomic status, or demographic features (age, race, gender and SES). In fact, the only significant difference was in the type of diabetes, as all individuals with type 1 diabetes were interested in incentives.

Smartphones offer a unique opportunity to monitor behaviors[18] and provide rewards. Smartphone use was reported by nearly half of surveyed individuals interested in incentives and smartphone adoption is increasing rapidly[19]. The easy availability of smartphones creates opportunities for low-effort tracking and immediate gratification through smartphone applications with reward systems. This short delay favors the efficacy of feedback for behavior changes[20], and is a unique possibility offered by these devices. Many applications already exist for diabetes management[21,22], including applications with non-financial reward systems[23]. Applications with financial rewards are also available to motivate users to exercise, and recent developments like near field communication technologies facilitate money management on mobile devices. Using a smartphone app could also allow for better individualization of the reward program, by adapting to each user's stage of disease and self-management, and by identifying areas that are more challenging for each person.

Individuals overall were optimistic about the effectiveness of incentives, and expected financial incentives to be a stronger motivation than non-financial incentives for behavior change. Furthermore, when considering how difficult behavior changes were perceived to be, using a 32-point score, we found that participants expected to be significantly less likely to use financial incentives for more challenging behavior changes in the unadjusted analysis. In fact, participants were more likely to use non-financial incentives when facing the difficult behaviors. Interestingly, the perceived level of difficulty for behavior change was not associated with the use of self-rewards. These findings persisted after adjusting for age and weight loss motivation.

Our findings suggest that financial incentives could have a potential role to play in motivating select behavior changes for diabetes self-management. The different response by perceived level of challenge suggest that perhaps a combination of incentives is needed to improve the various self-management skills. In Polonsky *et al*[24]'s recent study about perceived obstacles for glucose self-monitoring, avoidance behaviors (including forgetting, lack of time or reminders of diabetes) were predictors of a low frequency of glucose testing. Whether avoidance also predicts low success of other self-care behaviors is uncertain. Based on our findings, avoidance behaviors that are perceived to be less challenging could have a positive response to financial incentives, while more

challenging behaviors would require the use of non-financial incentives.

The amounts of financial incentives are important to consider. An interesting finding from our survey is the relatively low amounts of money that participants expected as incentive for weight loss ($258 for the 5 lb weight loss and $713 for the 15 lb weight loss), particularly if we consider that current out-of-pocket costs for diabetes are estimated at $350-500/mo[25,26]. This concurs with findings from another study which explored the use of financial incentives in diabetes, where participants suggested $25 per month for tracking and reporting glucose results[27]. Employers typically employ similar amounts for action-based incentives, or rewards for taking action (joining a weight loss program, for example) after going through a risk assessment[28]. Prior research has found that very large amounts can lead to lower performances, because the individual feels pressure to perform well. Likewise, amounts that are too small lead to lower performances, even lower than those who do not have any incentive[29]. These considerations suggest that our participants' intuitions about the reward amounts are in the right ballpark, although this needs to be evaluated empirically.

The strengths of our study include its focus on the use of incentives, both financial and non-financial, in a diabetic population. Although the relatively moderate number of participants may limit its generalizability, its web-based modality allowed us to recruit nationwide. This modality however also has its limitations, as the participants are self-selected, and received tokens in exchange for taking part in the survey (no compensation was given by the investigators, this was solely a feature of the survey company). Our population may therefore be disproportionately biased in their interest in incentives. A final limitation to our study lies in its design as a survey, as we assess the participants' expected response to incentives, which may differ from them their actual response to incentives. Future studies are needed to confirm our findings, and to further explore the acceptability and feasibility of incentives for diabetes self-management in a larger population.

According to our nationwide survey, patients with diabetes are willing to consider using incentives, both financial and non-financial, to improve diabetes self-management. While the financial incentives may be more effective for behavior changes that are perceived as less challenging, non-financial incentives may be useful for the more challenging behaviors. Participants did not expect to need large amounts to motivate them to modify their behavior. Our findings suggest that the effectiveness of incentives could vary, and may depend on the perceived difficulty of the incentivized task. Future studies are needed to confirm these results in interventional studies on larger populations.

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COMMENTS

Background

Financial incentives have shown potential for modifying behaviors such as smoking cessation. Diabetes self-management requires many behavior changes, which may benefit from such incentives. Little is known about patient attitudes in response to incentives for diabetes self-management.

Research frontiers

Although incentives have been studied for certain behaviors, the current research hotspot is patient acceptance of incentives for diabetes self-management, in particular for the goals, type (financial, non-financial or self-reward) and amount of incentives.

Innovations and breakthroughs

Beyond patient attitudes and expectations about their response to incentives, this survey provides suggestions about goal-setting in reward programs, in relation to the perceived level of challenge of certain behaviors. Individualization of goals and rewards could be feasible with the exponential adoption of mobile devices, which could both track and reward behaviors ubiquitously.

Applications

The results of this study can help guide future interventional studies with incentives, both in goal-setting in terms of types of behaviors, types of rewards, and amounts for financial incentives.

Terminology

Financial incentives include all rewards relating to monetary rewards or equivalents such as vouchers (cash or discount for a future purchase, for example). Non-financial incentives are rewards such as badges or stars in social networks that provide recognition from others for an achieved feat. Self-rewards are rewards that a person gives themselves when they reach a predefined goal, often planned as small rewards that accumulate to reach a large, final reward.

Peer-review

In this well-written paper, the author investigates the patient willingness to change diabetes self-management behaviors in response to rewards. The reviewers found this approach to improve patient engagement interesting. The results can help guide the creation and implementation of new patient-centered approaches for diabetes self-management.

REFERENCES

1 Executive summary: Standards of medical care in diabetes--2013. *Diabetes Care* 2013; **36** Suppl 1: S4-10 [PMID: 23264424 DOI: 10.2337/dc13-S004]

2 **Jendle J**, Torffvit O, Ridderstråle M, Lammert M, Ericsson A, Bøgelund M. Willingness to pay for health improvements associated with anti-diabetes treatments for people with type 2 diabetes. *Curr Med Res Opin* 2010; **26**: 917-923 [PMID: 20163195 DOI: 10.1185/03007991003657867]

3 **Giuffrida A**, Torgerson DJ. Should we pay the patient? Review of financial incentives to enhance patient compliance. *BMJ* 1997; **315**: 703-707 [PMID: 9314754]

4 **Sigmon SC**, Patrick ME. The use of financial incentives in promoting smoking cessation. *Prev Med* 2012; **55** Suppl: S24-S32 [PMID: 22525802 DOI: 10.1016/j.ypmed.2012.04.007]

5 **Kullgren JT**, Troxel AB, Loewenstein G, Asch DA, Norton LA, Wesby L, Tao Y, Zhu J, Volpp KG. Individual- versus group-based financial incentives for weight loss: a randomized, controlled trial. *Ann Intern Med* 2013; **158**: 505-514 [PMID: 23546562 DOI: 10.7326/0003-4819-158-7-201304020-00002]

6 **Volpp KG**, John LK, Troxel AB, Norton L, Fassbender J, Loewenstein G. Financial incentive-based approaches for weight

loss: a randomized trial. *JAMA* 2008; **300**: 2631-2637 [PMID: 19066383 DOI: 10.1001/jama.2008.804]
7 **Giles EL**, Robalino S, McColl E, Sniehotta FF, Adams J. The effectiveness of financial incentives for health behaviour change: systematic review and meta-analysis. *PLoS One* 2014; **9**: e90347 [PMID: 24618584 DOI: 10.1371/journal.pone.0090347]
8 **Paul-Ebhohimhen V**, Avenell A. Systematic review of the use of financial incentives in treatments for obesity and overweight. *Obes Rev* 2008; **9**: 355-367 [PMID: 17956546 DOI: 10.1111/j.1467-789X.2007.00409.x]
9 New Health Care Survey Finds Spending on Wellness Incentives Has Doubled in the Last Four Years, 2013. Available from: URL: http://www.businessgrouphealth.org/pressroom/pressRelease.cfm?ID=207, 2013
10 **Lorincz IS**, Lawson BC, Long JA. Provider and patient directed financial incentives to improve care and outcomes for patients with diabetes. *Curr Diab Rep* 2013; **13**: 188-195 [PMID: 23225214 DOI: 10.1007/s11892-012-0353-9]
11 **Long JA**, Jahnle EC, Richardson DM, Loewenstein G, Volpp KG. Peer mentoring and financial incentives to improve glucose control in African American veterans: a randomized trial. *Ann Intern Med* 2012; **156**: 416-424 [PMID: 22431674 DOI: 10.1059/0003-4819-156-6-201203200-00004]
12 **Promberger M**, Brown RC, Ashcroft RE, Marteau TM. Acceptability of financial incentives to improve health outcomes in UK and US samples. *J Med Ethics* 2011; **37**: 682-687 [PMID: 21670321 DOI: 10.1136/jme.2010.039347]
13 **Deci EL**. Effects of externally mediated rewards on intrinsic motivation. *J Pers Soc Psychol* 1971; **18**: 105-115 [DOI: 10.1037/h0030644]
14 **Deci EL**, Koestner R, Ryan RM. A meta-analytic review of experiments examining the effects of extrinsic rewards on intrinsic motivation. *Psychol Bull* 1999; **125**: 627-628; discussion 692-700 [PMID: 10589297 DOI: 10.1037/0033-2909.125.6.627]
15 **Ryan RM**, Deci EL. Intrinsic and Extrinsic Motivations: Classic Definitions and New Directions. *Contemp Educ Psychol* 2000; **25**: 54-67 [PMID: 10620381 DOI: 10.1006/ceps.1999.1020]
16 **Long JA**, Helweg-Larsen M, Volpp KG. Patient opinions regarding 'pay for performance for patients'. *J Gen Intern Med* 2008; **23**: 1647-1652 [PMID: 18663540 DOI: 10.1007/s11606-008-0739-1]
17 **White IR**, Royston P, Wood AM. Multiple imputation using chained equations: Issues and guidance for practice. *Stat Med* 2011; **30**: 377-399 [PMID: 21225900 DOI: 10.1002/sim.4067]
18 **Mulvaney SA**, Ritterband LM, Bosslet L. Mobile intervention design in diabetes: review and recommendations. *Curr Diab Rep* 2011; **11**: 486-493 [PMID: 21960031 DOI: 10.1007/s11892-011-0230-y]
19 **Smith A**. Smartphone ownership 2013. Available from: URL: http://www.pewinternet.org/2013/06/05/smartphone-ownership-2013/
20 **Carton JS**. The differential effects of tangible rewards and praise on intrinsic motivation: A comparison of cognitive evaluation theory and operant theory. *Behav Anal* 1996; **19**: 237-255 [PMID: 22478261]
21 **Chomutare T**, Fernandez-Luque L, Arsand E, Hartvigsen G. Features of mobile diabetes applications: review of the literature and analysis of current applications compared against evidence-based guidelines. *J Med Internet Res* 2011; **13**: e65 [PMID: 21979293 DOI: 10.2196/jmir.1874]
22 **El-Gayar O**, Timsina P, Nawar N, Eid W. Mobile applications for diabetes self-management: status and potential. *J Diabetes Sci Technol* 2013; **7**: 247-262 [PMID: 23439183 DOI: 10.1177/193229681300700130]
23 **Cafazzo JA**, Casselman M, Hamming N, Katzman DK, Palmert MR. Design of an mHealth app for the self-management of adolescent type 1 diabetes: a pilot study. *J Med Internet Res* 2012; **14**: e70 [PMID: 22564332 DOI: 10.2196/jmir.2058]
24 **Polonsky WH**, Fisher L, Hessler D, Edelman SV. What is so tough about self-monitoring of blood glucose? Perceived obstacles among patients with Type 2 diabetes. *Diabet Med* 2014; **31**: 40-46 [PMID: 23819529 DOI: 10.1111/dme.12275]
25 Consumer reports. Get help with the high cost of managing diabetes, 2009. Available from: URL: http://www.consumerreports.org/cro/2013/01/get-help-with-the-high-cost-of-managing-diabetes/index.htm
26 Freedom Benefits. Health insurance for diabetics, 2013. Available from: URL: http://www.freedombenefits.net/affordable-health-insurance-articles/health-insurance-for-diabetics.html
27 **Blondon K**, Klasnja P, Coleman K, Pratt W. An exploration of attitudes toward the use of patient incentives to support diabetes self-management. *Psychol Health* 2014; **29**: 552-563 [PMID: 24256342 DOI: 10.1080/08870446.2013.867346]
28 Your company wants to make you healthy. The Wall Street Journal 2013. Available from: URL: http://online.wsj.com/article/SB10001424127887323393304578360252284151378.html?KEYWORDS=incentives for health - articleTabs=article
29 **Kamenica E**. Behavioral economics and psychology of incentives. *Annu Rev Econ* 2012; **4**: 427-452

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