A systematic review on incentive-driven mHealth technology: As used in diabetes management

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Abstract

Introduction

Mobile Health (mHealth) technologies have been shown to improve self-management of chronic diseases, such as diabetes. However, mHealth tools, such as Apps, often have low rates of retention, eroding their potential benefits. Using incentives is a common mechanism for engaging and retaining patients that is applied by mHealth tools. We conducted a systematic review aiming to categorise the different types of incentive mechanisms employed in mHealth tools for diabetes management, which we defined as Incentive-driven Technologies (IDTs). As an auxiliary aim, we also analysed barriers to adoption of IDT technologies.

Methods

Literature published in English between January 2008 and August 2014 was identified through searching leading publishers and indexing databases: IEEE, Springer, Science Direct, NCBI, ACM, Wiley and Google Scholar.

Results

A total of 42 articles were selected. Of these, 34 presented mHealth tools with IDT mechanisms. Many of these contained more than one IDT, with Education the most common (n=21), followed by Reminder (n=11), Feedback (n=10), Social (n=8), Alert (n=5), Gamification (n=3), and Financial (n=2). The remaining 8 articles were review papers and a qualitative study of focus groups and interviews with patients with diabetes, where no new technologies were proposed, from which we defined barriers for adoption.

Discussion

We identified that while mHealth technologies have advanced over the last 5 years, the core IDT mechanisms have remained consistent. Instead, IDT mechanisms have evolved with the upgrades in technology, such as moving from manual to automatic content delivery and personalisation of content.

Keywords
Incentive, mHealth, self care, diabetes, motivation

Introduction

The introduction and widespread use of mobile devices in recent years has led to the healthcare industry embracing a concept known as mobile health (mHealth). This term refers to the use of portable mobile devices, e.g. smart phones, PDAs and tablet computers, for administering, monitoring, diagnosing and treating medical conditions [1]. Research into mHealth technologies has shown and suggested an array of real and potential benefits for both patients and practitioners by increasing the range and efficiency of healthcare while reducing the associated costs [1]. One area that is set to gain the most from this transition into mHealth is management of chronic diseases [2]. These often require a set of complex, time consuming tasks to be completed regularly, away from hospitals [3]. Further, the monetary costs and resource intensive nature of these diseases puts a huge strain on healthcare systems and governments worldwide. For example, in the United States in 2010, eighty-six percent of all healthcare expenditure was on people with one or more chronic diseases [4]. Recently, mHealth studies have begun to explore how mobile technologies can ease the burdens associated with managing chronic diseases [5, 6]. One such example that compared traditional paper-based logbooks to mHealth self-monitoring in overweight and obese adults found mHealth users self-monitored exercise more frequently and had a lower final BMI than non-mHealth participants [7]. However, while these studies provide useful solutions, it is important to also explore how they drive users to not only initially adopt the technology, but retain it as a longer-term management tool [6].

Diabetes is a severe, widespread and heavily studied chronic disease requiring lifelong self-monitoring and medical care in order to avoid long-term complications and reduce the risk of death. An organised, systematic approach to managing the disease, with regular input from professional health care providers is recommended to combat the high costs and risks of complications [8]. This results in a heavy economic burden for families and society [8]. It has been shown that improved patient self-management, through monitoring and education, could benefit diabetes treatment significantly [9]. However, self-management implies complex daily tasks confronted by people with diabetes, including measuring blood glucose levels, injecting insulin, physical activity, and diet intake monitoring. Meanwhile, healthcare professionals are overburdened and hence unable to properly assist many of the time consuming management tasks [3]. These factors have prompted a number of mHealth applications for diabetes management to be proposed and studied. A survey by Tatara et al. [10] found that mHealth tools have a positive effect on patient confidence in diabetes management and were used more frequently than desktop solutions. Similarly, a longitudinal study by Chen et al. [11] concluded that mobile telecare tools, which "promote preventative care, self-management, and clinical consultations from a distance", were effective in enhancing blood glucose monitoring and improving glycaemic control among patients with diabetes. A pilot study by Robinson et al. [12] further noted that the tools eased burdens on health care providers. However, without an incentive to use the tool as part of a daily management routine the potential benefits may not be achieved by patients, the healthcare system or the wider community [13]. Here, this incentive refers to any aspect of the tool that encourages or motivates the user to adopt and return to the solution, e.g. as is common in retail reward programs.

In response to the need for incentives, research exploring the adoption and spread of mHealth tools has made calls for using technologies to entice and retain users, such as real-time alerts, and social connectivity [14-16]. These are often presented as solutions for the limited adoption of mHealth tools for chronic diseases management [2, 6]. However, no studies have been performed to systematically analyse and define existing mHealth incentives and how they are applied in practice. In response, we define Incentive-driven Technologies (IDTs), to be core features that act as reward mechanisms for retaining, engaging and empowering users. While the IDT nomenclature is new, the use of IDTs in mHealth solutions is widespread. IDT mechanisms have been embedded in most mHealth tools, yet, the vast majority simply view the mechanisms as technological features rather than as technological incentives. That is, most tools present at least one feature designed to, for example, improve ease-of-use, or enjoyment, over other methods of completing the same task, without mentioning the incentive it provides to users.

The aim of this study is to perform a systematic review to define and determine which IDTs are used in mHealth for diabetes management. This is a foundational step in answering how effective each of the IDTs is in producing positive clinical outcomes, e.g. improved glycaemic control. We chose to focus on diabetes management as a case study within the wider group of chronic disease management due to: (i) the complexity and range of tasks involved; (ii) the large number of studies into the area, particularly those embracing mHealth; and (iii) the growing burdens that the disease is placing on the global community; thus making our findings applicable to wider chronic disease management and mHealth in general. We begin by defining and justifying the selection of 7 core IDT mechanisms. Each of these is analysed and summarised in regards to the development of mobile technologies over time, including content delivery and content generation. We then discuss our findings and how the IDTs have been used to guide the development of meaningful mHealth tools. In addition, we summarise the key barriers to adoption relating to mHealth IDT tools for diabetes management. This has been presented as an auxiliary point in the discussion and was gathered from review papers on mobile interventions for diabetes management.

Methods

Literature published in English between January 2008 and August 2014 was identified through searching leading publishers and major indexing databases: IEEE, Springer, Science Direct, NCBI, ACM, Wiley and Google Scholar. We chose the period beginning with 2008 by analysing Google Trends for terms relating to mHealth, and noting that the first international mHealth Summit occurred in 2009.

The search terms of 'mHealth AND (smartphone or mobile device) AND chronic disease AND (incentive or motivation or intention)' were used; note that 'chronic disease' was searched instead of diabetes to acquire more results. The search terms were defined after multiple pilot searches that included alternate boolean logic and the use of synonyms or related terms, such as cellphone, Android and iPhone. The final string was selected as it returned results specific to the mHealth domain that weren't necessarily smartphones. Articles were selected if they described at least *one mHealth tool for diabetes management* that presented at least *one of the 7 core IDTs*. Two reviewers independently screened titles and abstracts to determine inclusion status. A second screen of full-text articles was performed to ensure that the articles described mHealth IDTs for diabetes. Figure 1 presents our article selection process: 2182 articles were identified by searching the selected databases; from these articles, 1730 publications were retained after removing duplicates. After the title and abstract screening process, 58 publications were selected for full text analysis. The final number of articles, after screening for the two inclusion criteria, was 42.

When analysing the articles, we split the selection into two groups. The first, consisting of 34 of the articles, presented IDT mechanisms via pilot studies, prototypes, framework development, and trials. These were used to categorise, analyse and form results about IDTs in mHealth for diabetes. These articles are presented in the Content Delivery Medium, Content Generation Technique and Incentive-driven Technology sections below. The second group, which contained the remaining 8 articles, was of review papers and a qualitative study of focus groups and interviews with patients who have type 2 diabetes. These 8 articles were not included in the categorisation of IDTs as they did not present new

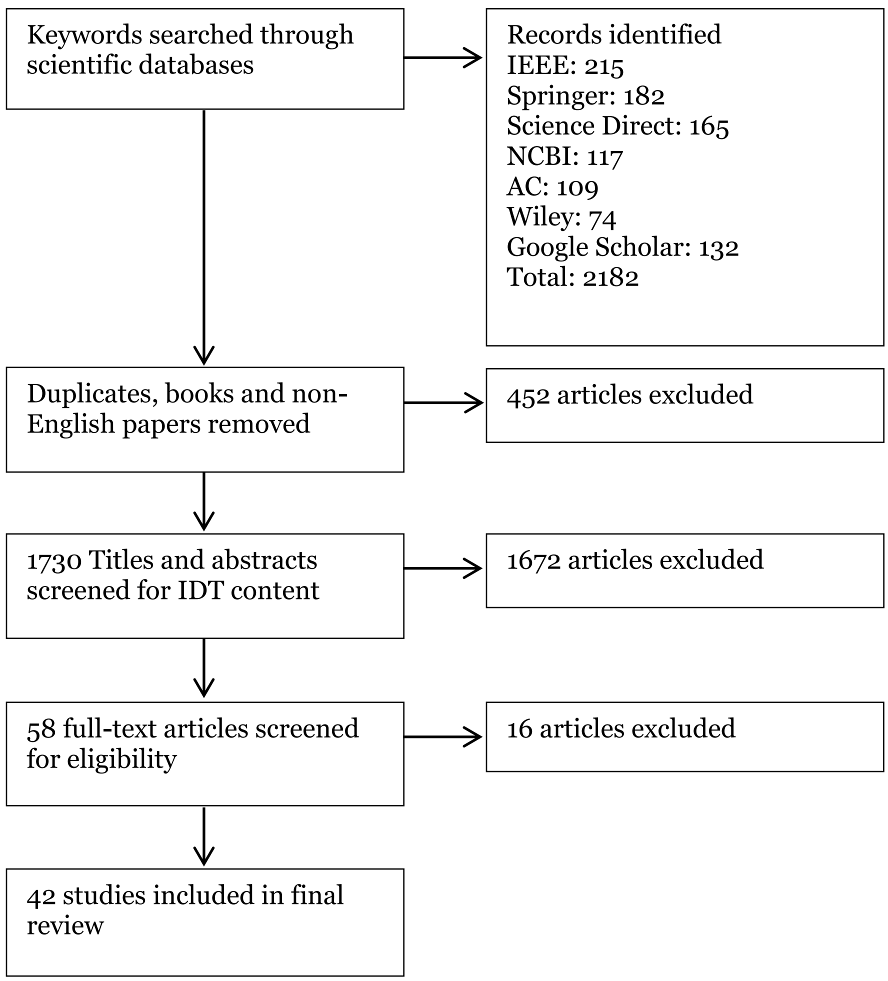

Figure 1. Flow diagram of paper selection process. Exclusion was based on describing at least one mHealth tool for diabetes management that presented at least one of the 7 core IDTs.

technologies and therefore were used to form a summary of barriers for adoption as presented in the discussion.

Results

Data from the selected articles were categorised into the 7 core IDTs. For each IDT, we identified two key aspects, the content delivery medium (CDM), which refers to the method by which data is distributed to users, categorised into the six mediums presented in Table 1, and the content generation technique (CGT), comprised of manual, semi-automatic, or fully automatic methods. Our designation of CDM can refer to both the back-end process of transporting the data, e.g. use of the internet, and the front-end product, such as a mobile app. The categorisation of IDT with associated CDMs is provided in Table 1. In the following sections, we first define and explore CDM and CGT before analysing the individual IDTs.

Table 1. Categorisation of IDT articles and their CDMs. The number represents the number of IDT papers, while the articles are referenced alongside the CDM(s) used.

IDT	#	CDM
Reminder	11	App [17-22] Internet [17, 23, 24] Sensor [17-19, 24-26] SMS [19, 20, 23, 25-27] Voice/Video Message [22]
Alert	5	App [18, 21, 22, 28] Internet [11] Sensor [11, 18] SMS [11] Voice/Video Message [22]
Feedback	10	App [29-35] Internet [29, 31-34, 36-38] Sensor [29-32, 35-38] Voice/Video Message [32] Wii [38]
Social	8	App [19, 22, 28, 39-41] Internet [29, 39, 42, 43] Sensor [19, 39, 41] SMS [19] Voice/Video Message [22]
Education	21	App [17-19, 21, 22, 26, 29, 33, 39, 40, 44, 45] Internet [11, 17, 23, 33, 38, 39, 42, 46] Sensor [11, 17-19, 26, 29, 35, 38, 39, 44-46] SMS [11, 19, 23, 26, 27, 45, 47] Voice/Video Message [18, 22, 48]
Financial	2	App [41] Sensor [27, 41]
Gamification	3	App [40, 41] Internet [49] Sensor [41, 49]

Content Delivery Medium

The CDM designates how IDT material is distributed to users on their mHealth devices. Over the time frame considered, the evolution of IDT content delivery has followed the evolution of technological advancements. That is, the core technologies of the smartphone era: Apps, the Internet, SMS and sensors, have been utilised by IDT mHealth tools as they became available. In line with reduced costs and more powerful smartphone devices, there has been a rapid growth in the number of studies that present Apps, from 1 in 2008 to 6 in 2014. In regards to sensors, which ranged between 2 and 6 per year, the types of sensors used have changed in accordance to newly introduced devices. Early studies presented simpler sensors, such as blood glucose monitors [37] or pedometers [25], while as they became more readily available, newer studies began to make use of advance wearable devices, e.g. a study by Kahol in which participants wore sensors to measure movement and physiology while playing a virtual reality game [49]. Similarly, as smartphones have become more adept at displaying multimedia and mobile networks themselves have improved, i.e. from 3G to 4G, higher bandwidth content such as video and voice messages, e.g. [18, 22], have been delivered. Finally, while not an mHealth device itself, one study [38], utilised the Wii gaming console for content delivery alongside an mHealth tool. A snapshot of this can be seen in Figure 2.

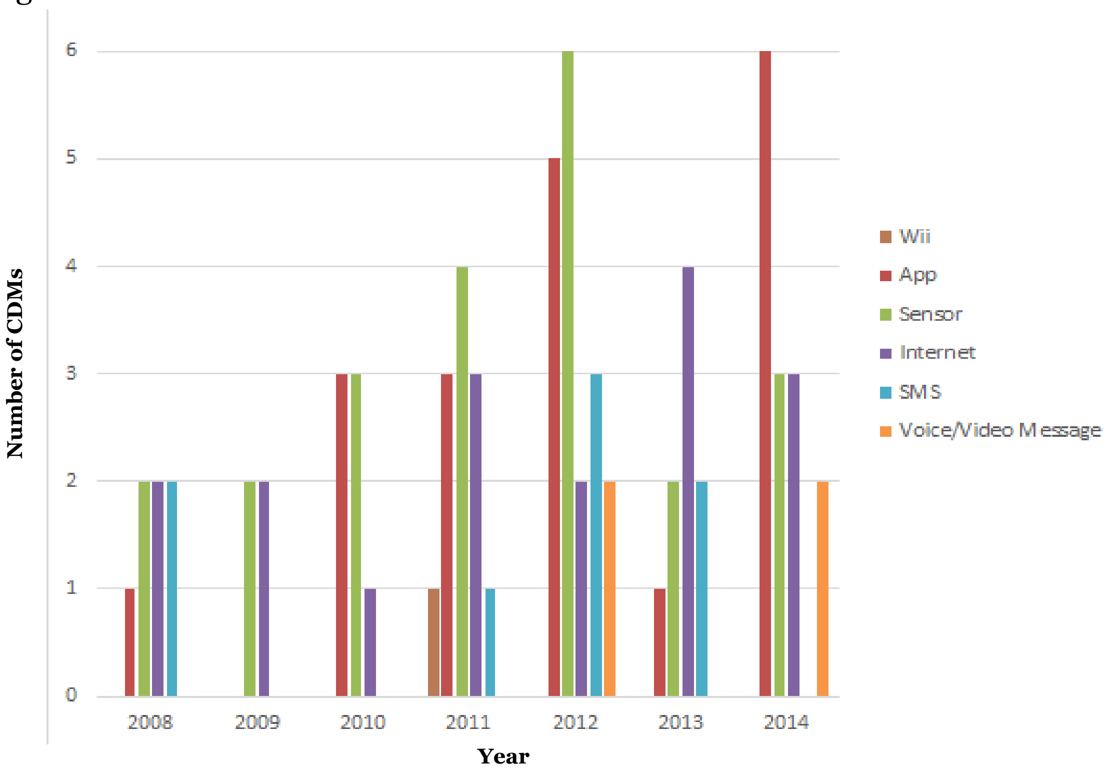

Figure 2. Breakdown of content delivery mediums over time illustrating the evolution of IDTs as different mediums became available.

Content Generation Technique

The CGT refers to how IDT information is delivered to the users' mHealth devices. We categorised using three broad terms of manual, semi-automatic and automatic methods. Manual refers to content generated entirely by humans, such as educational messages or answers to questions that have been written, filmed, or recorded, e.g. by a diabetes educator. Semi-automatic methods denote that the content was created in part with some manual input, e.g. individual educational facts, that are then altered, or stitched together by the mHealth software for particular scenarios. Finally, automatic refers to content, such as graphs, motivational messages, or alerts, that are entirely generated by an algorithm, such as a server-side script that generates alerts based on blood glucose readings.

Each IDT category had its own unique relationship with CGTs, as highlighted in Figure 3. Each year has three columns, one for manual, one for semi-automatic, and one for fully automatic IDTs. For example, in 2008, a reminder IDT and a social IDT had content generated manually, another reminder and an education, semi-automatically and, finally a second education IDT was fully automatic. The social IDT, by its very nature, in that two or more users of the mHealth solution are communicating, has remained completely manually generated. Similarly, the financial IDTs were exclusively manual with

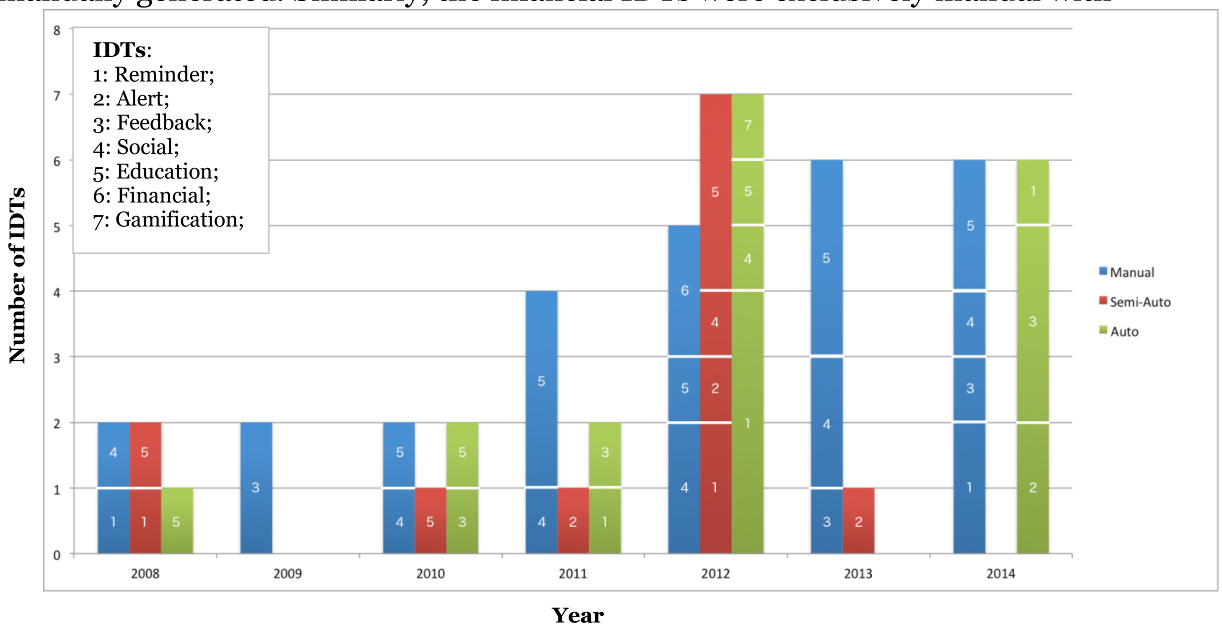

Figure 3. CGT used by IDTs over time.

The y-axis is the total number of articles where each of column is split by horizontal lines where the numbered labels represent a categorisation of IDT. 9 articles presented multiple forms of CGT for different IDTs, while 19 articles present multiple IDTs. Thus there are more than 34 segments.

researchers paying participants. The other 5 IDTs have shown a trend towards automation to varying degrees. Where possible, these tools utilise algorithms that perform tasks such as text analysis and personalisation of messages fully automatically.

Incentive-driven Technology

IDT extends upon two established frameworks: the Persuasive System Design (PSD) framework [50], an influential framework that discusses the "process of designing and evaluating persuasive systems … [highlighting] seven underlying postulates behind persuasive systems … [and] further lists 28 design principles for persuasive system content and functionality" [50], and the Behavioural Intervention Technologies (BIT) framework [51], which was designed specifically to guide mHealth solutions that aim to change behaviours and cognitions. We combined these frameworks for two reasons. First, BIT, while built on top of the PSD framework, had a narrower focus than we required in our study. Thus we selected missing categories from PSD. Second, for categories in both, we selected from the BIT framework as it is more recent and thus more appropriate for modern mHealth tools. From the PSD framework, we designated reminder from the Dialog Support principles, which we further distilled into patient-facing *Reminder* and practitioner-facing *Alert* categories, and *Social* as a conglomeration of the Social Support principles. Meanwhile the *Education* and *Feedback* categories were derived from the BIT framework's conceptual 'how' in behaviour change. As education is often seen as an end-goal rather than a method for engaging users, it is important that we emphasise that our IDT definition includes empowering users to better manage their diabetes, something that education does achieve. Further, educational content that is relevant to the user can engage and retain users in the sense of consulting with the mHealth tool rather than, or before, consulting with a medical practitioner, easing the burdens on healthcare systems. We supplemented these models with the *Financial* and *Gamification* IDTs, which we included due to these IDTs being present in multiple articles, having attributes designed to improve user retention, engagement and empowerment. The IDT definitions are further elucidated under in each of the following sections. Data were coded to each group on the basis of incentive provided rather than naming defined in the source articles. It is worth noting that most (n=19) articles presented multiple IDTs. The combination of education and reminder was the most common (n=8), with education being used alongside other IDTs a total of 16 times. All IDTs were used in a combination at least once, with the alert and financial IDTs never being used on their own.

Reminder

The Reminder IDT refers to sending a message or an alarm to the user, such as getting a regular notification of personal goals they had set [23]. The IDT was used in 11 of the selected studies, 2 of which personalised the reminder messages sent to users. One sent specific messages based on blood glucose readings with suggestions of how to alter their management [17], while the other suggested increasing blood glucose readings or making an appointment with practitioners based on trends in logs and measurements [18]. Of these studies, 6 were published in 2012, 2 each in 2014 and 2008 and 1 in 2011. Only the earliest of these was a manually-driven reminder system, while the personalised systems were reported in 2012 and 2013. This IDT was commonly combined with education (n=8) as the objective of most reminder systems was to empower users to improve their management, similar to the empowerment gained by more educated users.

Alert

Alert is similar to reminder, except that it is considered to be 'practitioner-facing', and instead of a simple notification, it can be implemented to warn the medical practitioner that something could be wrong. An example is an alert that is sent when recordings of blood glucose level, insulin injections, heart rate, or body weight are outside a defined range [11]. The IDT was presented in 5 studies. The use of this IDT has been largely consistent since 2011, with 1 article in each of the first three years and 2 in 2014.

Feedback

Technologically similar to both the reminder and alert IDTs, feedback is a case where, for example, a practitioner, or a software algorithm, can send a message to the user stating whether their management has been good or bad. Equivalently, a user can provide feedback to a practitioner about a change in their management routine. Feedback was presented by 10 of the selected studies, with 4 in 2014, 2 in 2009, and 1 each in 2010, 2011, 2012 and 2013.

Social

The social IDT involves connecting users with each other so they can talk and provide support to one another through the mHealth tool, e.g. the use of a chat service [43]. The IDT was employed in 8 studies. One study [43] used social as the only incentive, while the other seven combined it with other techniques. Publication of social IDTs has been largely consistent over time, with 2 each in 2012 and 2013, and 1 in 2008, 2010, 2011 and 2014. Most of the studies intended the social IDT to promote peer-to-peer communication and the development of 'support networks', e.g. allowing adolescents to exchange experiences and support one another [41]. These peer support networks are thought to improve adherence to self-management tasks by giving patients somewhere to turn for advice/support from others in a similar situation. This IDT was often aimed at younger users or pregnant women with type 1 diabetes, who are newly introduced to the tasks of self-management and therefore require more support and guidance. The IDT was commonly combined with both education (n=5), where users could, for example, have a buddy to assist each other with their learning [19], and with 2 of the 3 gamification IDTs, which also aimed at younger users.

Education

The most widely used IDT was education, with 21 studies. The term refers to using technology to present instructional and informational content to the user with a common view of minimising the need for visits to educators or practitioners. Among the studies, 2 presented personalised education facilities using computerised and semi-automatic behaviour change theory algorithms, which adapted the content to a user's usage trends in order to better target the user's needs. The first suggested personalised diabetes management strategies [21], while the other provided personalised suggestions on how to improve self-care based on blood glucose readings and questions posed by users [23]. Two of the studies were published in 2008, 3 in 2011 and 2014, 4 in 2010 and 2013, and 5 in 2012.

Financial

The incentive of providing financial remuneration, or an equivalent reward system, e.g. vouchers, was proposed in 2 of the selected studies, both from 2012. The concept behind [41] was in conjunction with gamification, wherein improvement in management, e.g. increased measurement frequency, and sustained engagement with the tool resulted in rewards, such as iTunes redemption codes. The other study [27] provided a financial incentive to cover the costs associated with increased text messaging which was required by the study as part of the intervention.

Gamification

Gamification itself is not a new concept with roots in Lenin's early 20th century theory of "social competition" and more recently in attempts by management consultants in the 1990's to introduce fun into workplaces [52]. It is, however, quite a recent trend in mHealth for diabetes that has been enabled by modern technologies. The IDT involves providing a platform such as digital rewards, e.g. unlockable video content, levelling up, or activity-based experiences to make management more fun and rewarding to the users. Of our selected studies, 3 presented this IDT. As noted by Marczewski [53], they did not begin appearing until 2010, with 1 published in each of 2010, 2011, and 2012. These studies were generally aimed at teens and adolescents in an attempt to attract the younger generation that were not well equipped to deal with the recurring, complex tasks involved in diabetes management [40, 41]. They are commonly designed to reduce food intake, increase physical exercise and improve the regularity of monitoring.

Discussion

We found that a large number of articles have explored and presented findings on mHealth tools for diabetes management that make use of IDTs. We categorised these using the 7 IDT mechanisms, considered alongside the CDM and CGT, as well as the interplay of different IDTs and the personalisation of the content. These aspects are discussed below.

Development of Incentive Technologies

During the review period there have been huge changes and improvements in the technology used by mHealth applications, which are leveraging the latest technological developments. However, the core IDT mechanisms presented with these technologies have remained largely unchanged. Feedback has become more personalised through the use of modern algorithms, such as automated software that analyses trends in blood glucose measurements, instead of simple responses upon entering data; social support has moved from physical public centres and groups to virtual mobile- and internet-based communication; while more recently gamification is now delivered via mobile devices for health improvement, as opposed to traditional workplace-based gamification. All of these serve as incentives to motivate, retain and empower users; nevertheless it is technological innovation that has driven change, not new incentive techniques.

Clinical Effectiveness

While performing our study, we attempted to measure the clinical effectiveness of IDTs. However, it was impossible to distil this information due to the studies not being exclusively about the effectiveness of the incentives themselves; moreover, most studies included multiple IDTs that we were unable to separate. It would therefore be spurious to attribute given results to IDT implementation. However, 7 studies did report improved HbA1c levels in study participants, 2 studies noted reduced systolic blood pressure, and 13 mentioned improved management practices and self-efficacy, such as increased measurement frequency, increased exercise, improved diet and increased complication checks, e.g. checking feet. However, we note that none of these results were attributed to specific IDTs.

Content Generation

As illustrated in Figure 3, the CGTs illuminate a number of interesting aspects regarding the use of IDTs. First, the most striking aspect is the rapid rise then fall of semi-automatic techniques, from 1 in both 2010 and 2011, to 7 in 2012, and back to 1 in 2013, with 0 in 2014. This resulted in a dichotomy of fully automatic and fully manual techniques. Upon further inspection, it is clear that where possible, technologies and algorithms have been implemented to improve the autonomy and to reduce manual strain, for example automatic generation of personalised feedback [30]. However, where this is not possible, such as with the social IDT, which at its core is human generated messages, manual solutions still continue to be used. In this case, the communication platforms are automatic, but the content is generated manually.

User Perceptions

IDT mechanisms, fundamentally, intend to influence users by motivating them to adopt and return to the tool. However, the tools presented by many of the articles were not positively perceived by the users. In one study, mobile devices were found to frustrate older users [47], while another study which employed the game console, Wii, was reported as not useful [38]. Similarly, Chen et al. [11] revealed that, "technological difficulties were the main reason for a decline in the use". Correspondingly, tools that aimed to reduce manual labour, e.g. by simplifying operational tasks, were found to be appreciated by users [11, 59, 60]. Consequently, meaningful technology-based intervention, must be developed with consideration of its role within the user's wider work, home, and social life, rather than in the isolation of clinical effectiveness. That is to say, it doesn't matter how technologically advanced a tool is, nor how good the IDT mechanisms are, if a tool is hard to use, or perceived as not helping with disease management, it will not be adopted. Finding the balance between clinical effectiveness and positive user perceptions, a difficult task even with the help of IDTs, is therefore one of the key components that must be considered when developing an mHealth solution.

Age of users

The age structure for patients with Type 1 and Type 2 diabetes is quite diverse and needs to be addressed in a study exploring as large a spectrum as ours. While many of the articles presented solutions and findings in light of the age of participants, we did not include this in our analysis as our aim was to review *which* IDTs were used in mHealth for diabetes management and not *who* the users of these IDTs are or were. We note that appropriate incentive mechanisms may change with age and diabetes management experience. For example, in general, Type 1 insulin dependent people with diabetes might be younger users who are more technologically-savvy. Therefore, gamification may be more appropriate as the technology itself is not an obstacle; instead providing an incentive to monitor, or exercise, is. In contrast, older users may not have the same level of technological-savvy. However they are at higher risk of severe complications. Hence, a simple alert or reminder system may be more appropriate to these users. This balance between IDT mechanisms, age and experience must be considered when developing mHealth solutions within, and beyond, the realm of diabetes management. Personalisation techniques may begin to take this into account, whereby, as well as presenting personalised messages, they alter the IDT mechanisms which are prioritised or 'switched on/off' for each user.

Barriers for Adoption

Adoption and widespread use of mHealth IDT tools for diabetes management has a number of barriers. We accepted 8 studies [13, 54-60] that presented review and interview findings into mobile interventions for diabetes management where we drew out the needs and barriers relating to IDTs. A common theme amongst these studies was the need to consider the patient and clinician burden in the upkeep of IDT mHealth tools, especially regarding data entry. It was noted that this barrier to adoption can be alleviated by further automation and analysis of patterns and metrics [55]. Relatedly, it was suggested that further studies need to be undertaken to demonstrate the clinical outcomes of automatic data transfer between devices [54]. A current lack of timely and personalised feedback in many applications [59], the need for ongoing self-management that goes beyond introductory points currently presented [13], integration of IDTs with provider systems, and consideration of the target communities in developing IDT tools [60] were also noted as current barriers. Similarly, Dyer [57], concluded the need for practitioners to learn more about the tools and technologies before they can realise their potential. Another study [56] that served to highlight the differences between patients through interviews found that respondents were divided as to whether there was benefit of virtual social support networks. The respondents further noted the need for real-time technology assistance, especially for older users, and a desire for continued personalisation. Finally, Sieverdes et al. [58], raised concerns over most applications that aim to influence a users' behaviour not being based on standards of care or theoretical behaviour change models.

Conclusions

In this study, we defined the concept of Incentive-driven Technology, as used by mHealth tools, to be core features designed to act as motivating mechanisms for retaining and empowering users. We then identified 7 core IDT mechanisms that are used by mHealth tools for diabetes management and classified 34 articles into these categories. Education was the most commonly used IDT, followed by Reminder and Feedback, with most articles presenting more than one mechanism. Our study has shown that while the technologies used to deliver and generate mHealth content have developed over time, the core IDT mechanisms have remained the same. Instead, existing techniques adapt to the changes in technology, such as moving from manual to automatic content delivery and personalisation of content.

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All authors made meaningful contributions to the study design and development of the research aim. MdeR, YJ and JK contributed to acquisition and analysis of the data. RN and MK contributed insight and guidance relating to analysis of the data. All authors contributed to writing and/or revising the article and all authors provided their final approval of the version to be published.

Abbreviations
BIT: Behavioural Intervention Technologies
CDM: Content Delivery Medium
CGT: Content Generation Technique
IDT: Incentive-driven Technology
mHealth: Mobile Health
PSD: Persuasive Systems Design

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