USING GUESSING GAME TO INCREASE COMPLICATION AWARENESS OF PATIENTS WITH NEWLY DIAGNOSED TYPE 2 DIABETES

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Abstract

Background. Prevention of complications is widely considered as the main aim of diabetes control. And diabetes education is the cornerstone for type 2 diabetes (T2D) management. However, traditional lecture-based diabetes patient education activities have small and short-lasting efficacy. Therefore, technology-based initiatives for diabetes patient education are urgently required.

Objective. To evaluate Guessing, a popular game, as tool in increasing complication awareness of patients with newly diagnosed T2D during diabetes care.

Patients and Methods. In a cohort study, 103 patients were split into Guessing Game group and control group. The opinions of patients and educators in Guessing Game group were surveyed. Patient performance was evaluated by test scores and the attendance to diabetes complication screening clinic.

Results. A majority of patients and all educators believed that Guessing Game enhanced complication awareness. Educatees achieved higher total scores and test scores in "Fill in the Gaps" (one of 2 types of test item), more actively attended complication screening clinic, after using Guessing Game as an education tool.

Conclusion. Guessing Game is an attractive and effective educational intervention to increase complication awareness of T2D patients.

Key words: diabetes education, diabetes complications, game-based learning, type 2 diabetes.

INTRODUCTION

At present, diabetes mellitus (DM) is a serious public health problem as its prevalence is increasing, and the number of persons with this disease is estimated to be double by 2025 (1). The emergence of acute or chronic diabetic complications is believed as the major cause of mortality and disability among people afflicted with DM. Type 2 diabetes (T2D), also called

non-insulin-dependent diabetes, is the most common form of DM, and has a significant association with the occurrence of complications. Poorly controlled T2D is associated with increased rates of a variety of microvascular (including retinopathy, nephropathy and neuropathy, etc.) and macrovascular (including accelerated atherosclerosis, heart attacks and stroke, etc.) complications (2), which further result in the impaired patient quality of life, greater healthcare expense, and less patient satisfaction with treatment (3, 4). For example, about 50-80% of all individuals with T2D die of macrovascular complications, of which the best example is cardiovascular or cerebrovascular disease, and kidney failure also among the leading causes of death (5). Therefore, prevention of complications is widely considered as the main aim of T2D management (6). Significant T2D complications typically manifest 15-20 years after diagnosis (7). But the risk of complications could be actually improved due to earlier detection or improved management strategies (8).

Diabetes education is considered to be the cornerstone for T2D management (9). For the effective prevention against complications, optimum medical follow-up must be associated with therapeutic patient education aiming to increase the awareness among diabetics about their potential complications and management. There is ample evidence (10-12) that diabetics with better knowledge of their potential complications have better prognosis and delayed development of complications. Increasing complication awareness through the educational interventions (e.g. diabetes educator programs) would allow for early detection and prompt initiation of adequate therapy. Importantly, awareness of T2D complications as potential causes of death or disability could form an incentive for patients to improve glycemic control, self-

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management, and actively participate in complication screening.

Despite the effectiveness of diabetes education in improving patients' knowledge and attitude to complications, traditional diabetes patient education activities (e.g. didactic lectures, group discussion) mainly rely on passive modes of learning, in which educatees are simply as the recipients of information. Such lecture-based modes of learning could not foster the recall of knowledge, let alone understanding of how to adapt new information to novel problems and daily experiences with chronic care (13). Both patients and healthcare professionals revealed that they were bored with current diabetes education, because they felt "tiresome and boring" and lack in interaction (14, 15), thus resulting in small and short-lasting efficacy of education program (16-18). Therefore, technology-based initiatives for diabetes patient education are urgently required (19).

Use of games is an active-learning approach for teaching of basic diabetes concepts. Gaming has to be widely used as an innovative and challenging method in medical education (20). It is well known that games can incorporate principles and concepts of adult learning, promote effective participation and self-learning. Games also provide the opportunity for educatees to reinforce previously learned knowledge and acquire new information. In addition, game-based methods and strategies for training and education encourage mutual learning and interaction among educatees, and thus increase their levels of motivation. Importantly, game-based learning adds more entertainment to learning experience than many other educational formats, makes the learning experience more enjoyable and potentially more effective (20). Many video games, such as "INSULOT"(14), "InsuOnline"(21) and others (22,23), have already been designed and applied to deliver diabetes education showing good results, and represented a promising new way to improve diabetes patient outcomes. However, all these previous researches (14,21-23) demonstrated that video games were accepted as attractive learning tools, but mainly for diabetic children or young adults. Given the prevalence of T2D in the middle-aged and elderly, it is necessary to investigate game design applicable to a much larger diabetes population, especially considering the acceptance and adoption by the older patients.

To cement the patients' understanding of T2D complications, we designed Guessing Game as a way to review what the educators had delivered in the lecture during diabetes care. Guessing is a kind of interesting popular game, in which the object is to be guessed

by some information. Guessing Game can be played co-operatively, some player(s) know the answer, but cannot tell the other(s), instead they must help the other(s) to guess it. Our goal in designing this game was to encourage patients to be active participants in their own learning process. Previously, we have reported Guessing Game can contribute to a positive learning experience in medical undergraduate education (24). In this article, we further describe and evaluate the use of Guessing Game as a tool in increasing complication awareness of patients with newly diagnosed T2D in diabetes care, and endow this game form with further extensions and wider applications.

PATIENTS AND METHODS

Setting and population

Between April 2014 and April 2015, a total of 103 patients with newly diagnosed T2D, receiving diabetes care in the Department of Endocrinology and Metabolism, Xi'an No. 4 Hospital, Xi'an, China, were enrolled in this study, including 48 males and 55 females, with average age of 46.7 ± 10.3 years. According to the World Health Organization criteria (25), newly diagnosed T2D diabetes was defined as having either fasting plasma glucose (FPG) ≥ 7.0 mmol/L and/or 2 h postprandial plasma glucose (PPG) ≥ 11.1 mmol/L, or a 2 h plasma glucose ≥ 11.1 mmol/L during a 75 g oral glucose tolerance test in patients without history of diabetes. This study has been approved by the Ethics Committee of Xi'an No. 4 Hospital. All participants gave written informed consent.

Measures

Fifty-two patients volunteered to participate in Guessing Game-based diabetes education aiming to increase awareness of diabetes complication (Group 1). The other enrolled subjects ($n = 51$) were as control (Group 2), in which only the traditional depiction teaching was used. The indexes including age, gender, body-mass index and education level were comparable between the two groups. Concretely, in the time of 30 min after group lectures on T2D acute and chronic complications in diabetes care, Guessing Game was carried on in Group 1, while key contents of the lectures were emphasized by educators, and patients were called to answer some questions in Group 2. Other education processes are completely the same in two groups. In Group 1, 52 patients were divided into 10 teams of about 5-6 patients each at their own choice, and each team had an elected team leader. In every

lesson, 2 representatives of each team were designated to attend the game by team leader, while other patients as audiences or cheerleaders. The lecture on common T2D complications in our hospital consists of 4 lessons, including acute complications (hyperglycemia hyperosmolar state, diabetic ketoacidosis, and hypoglycemia), microvascular disease(diabetic nephropathy, cardiomyopathy, retinopathy, neuropathy, and encephalopathy), macrovascular disease(coronary artery disease, peripheral vascular disease, and stroke), others (diabetic foot and lipohypertrophy). Thus, all the participants have the chance to play the game. Two representatives of every team must be co-operative. The rule of Guessing Game is that one representative had known a complication name following lot-drawings, and then this representative should describe this name with other information(10 second limit), for example, signs and symptoms, risk factors, ways of monitoring or management, but cannot mention this complication name itself or any word contained in the name. His (her) partner found out results according to his (her)

explanation (Fig. 1). Finally, educators revealed the standard answer, and decided whether this team can get credit or not. Every team usually has 3 chances. As incentives, the winning team could receive some prizes.

At the end of the course, patients and educators' opinions toward Guessing Game were evaluated with survey instruments in Group 1. Patient performance was assessed by comparing the scores in a simple exam on T2D complication, and the attendance to diabetes complication screening clinic between Group 1 and 2 as educating efficiency evaluation.

Patients' opinions

In Group 1, an anonymous survey instrument was developed to assess patients' perceptions of Guessing Game as a valuable tool to increase complication awareness. The instrument was composed of 7 statements with a 5-point Likert scale used for responses (disagree-agree 5-point, 1- strongly disagree and 5 -strongly agree)(Table 1). In addition to the 7 survey items, participants were asked to provide

Figure 1. Profile and example of Guessing Game used to increase complication awareness of patients with newly diagnosed T2D.

Table 1. Participant perceptions of Guessing Game as a tool to increase complication awareness of patients with newly diagnosed T2D (n=52)

Question	Mean(SD)	Strongly disagree	Responses, %			
			Disagree	Neutral	Agree	Strongly agree
Guessing Game enhanced my awareness on T2D complication.	4.5(0.7)	-	3.8	5.8	36.5	55.8
Guessing Game helped me review material covered more effectively.	4.6(0.6)	-	-	3.8	36.5	59.6
Guessing Game oriented me to the topics I should focus on.	4.5(0.7)	-	3.8	5.8	34.6	57.7
Guessing Game built a friendly relationship between me and other patients /or educators.	4.8(0.4)	-	-	-	19.2	80.8
The material on the game was pertinent.	4.5(0.7)	-	-	13.5	26.9	59.6
Guessing Game was very funny.	4.5(0.6)	-	-	3.8	38.5	57.7
I felt very relaxed during Guessing Game.	3.4(1.1)	1.9	23.1	25.0	28.8	21.2

additional comments about Guessing Game if they desired.

Educators' opinions

Diabetes educators are “directors” and “hosts” of game-based learning, so their opinions are very important. An anonymous survey instrument similar to the above was developed to assess educators' perceptions of Guessing Game as a tool to enhance patients' complication awareness (Table 2). And the implementation situation of this education method was also inquired in educators' opinion.

Patient performance

In both Group 1 and 2, total 10 test questions on diabetes complications (The maximum mark was 10) were checked by the same educators in blind method. Two types of test item were included in the exam paper: “Choice Question”(50%) and “Fill in the Gaps”(50%). In addition, the subjects who attend the complication screening clinic during 6 months after the implementation of control or Guessing Game measure were obtained from the computer system. And the exam scores and the attendance to diabetes complication screening clinic were compared between Group 1 and 2, to assess if the game can be educationally effective.

Data analysis

Data from survey instruments that were filled out completely were coded and entered into SPSS14.0. All Likert-scale responses with any degree of agreement were as positive responses, and all responses with any degree of disagreement were grouped together as negative responses. Results of exam scores were expressed as mean±standard deviation (S.D.). One-way analysis of variance with post hoc Tukey test was carried out to perform the statistical analysis. Chi-square test was used to analyze the difference in the attendance to diabetes complication screening clinic between Group 1 and 2. Differences were believed to be significant when the p value was less than 0.05.

RESULTS

All patients in Group 1 actively participated in Guessing Game-based diabetes education. They were motivated to make adequate preparations, and highly engaged in the gaming process.

Patients' evaluations on Guessing Game as an enjoyable tool to increase complication awareness

All patients in group 1 (n=52) completed the survey instrument. Patients' evaluations related to

Table 2. Educators' perceptions of Guessing Game as a tool to increase complication awareness of patients with newly diagnosed T2D (n=5)

Question	Mean(SD)	Responses, %				
		Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Guessing Game enhanced complication awareness of Chinese patients with newly diagnosed T2D.	4.6(0.5)	-	-	-	40.0	60.0
Guessing Game created a new educator-patient relationship, the harmonious and relaxed atmosphere can promote education effectiveness.	5.0(0.0)	-	-	-	-	100
Guessing Game helped patients review material covered more effectively.	5.0(0.0)	-	-	-	-	100
Guessing Game oriented patients to the topics they should focus on.	5.0(0.0)	-	-	-	-	100
Guessing Game enhanced the opportunity for the patients to learn from others.	5.0(0.0)	-	-	-	-	100
Guessing Game has substantial materials.	4.8(0.4)	-	-	-	20.0	80.0
I will continue to organize this game-based learning in my classes.	4.6(0.5)	-	-	-	40.0	60.0

Table 3. Test scores after Guessing Game as a tool to increase complication awareness of patients with newly diagnosed T2D (n=103)

Type of Test Item	Test Scores of Group1	Test Scores of Group2	p
Choice Question	3.962(0.950)	3.980(0.927)	0.459
Fill in the Gaps	4.115(1.247)	3.157(1.782)	0.001
Total scores	8.077(1.908)	7.137(2.367)	0.014

Guessing Game were overwhelmingly positive. Their responses in the survey captured the multiple benefits of Guessing Game as supplements to traditional lecture formats. The participants strongly supported the application of Guessing Game in increasing patients' awareness about T2D complications (Table 1). And 92.3% of the participants indicated that Guessing Game enhanced their awareness on T2D complication. Only 2 participants (3.8%) disagreed but not strongly with the idea, one of whose additional comments were filled with "I'm accustomed to traditional teaching".

As for the reasons of positive evaluation to this new education method, 96.1% of the participants believed that Guessing Game helped them review material covered more effectively, 92.3% agreed that Guessing Game oriented them to the important topics they should focus on, and 100% indicated that Guessing Game can build a friendly relationship between them and other patients/or educators.

Besides, 86.5% of the participants believed that the material on the games was pertinent, and 96.2% of the participants thought "Guessing Game was very funny". But only 50% of the participants indicated "I felt very relaxed during Guessing Game".

Survey of diabetes educators

All 5 educators involved in group 1 completed the survey instrument. All faculty members agreed about Guessing Game as a tool to enhanced complication awareness of patients with newly diagnosed T2D (Table 2), they indicated that Guessing Game can build a new educator-patient relationship, and the harmonious, relaxed atmosphere can promote education effectiveness. From the perspective of educators, the advantages of this method include that it helps patients review material covered more effectively, orients patients to the topics they should focus on, and enhances the opportunity for the patient to learn from other patients. It is most important that they all want to continue to organize this game-based learning in their classes later on.

Patient performance

Compared with control group, the total scores of test on diabetes complications ($p < 0.05$) and the scores of "Fill in the Gaps" ($p < 0.01$) were significantly higher in Guessing Game group, despite the fact that no significant difference was found when comparing "Choice Question" scores (Table 3). In addition, 61.5% of participants in Guessing Game group (32 of 52) compared to 39.2% control patients (20 of 51) attended the complication screening clinic in 6 months after the

implementation of Guessing Game or control diabetes education measure ($p < 0.05$).

DISCUSSION

In the present study, we investigated game design and usability for Guessing Game as a new educational game to deliver diabetes education on T2D complications. As a popular game, Guessing Game has been familiar to either old or young people. In the Guessing Game-based diabetes education, patients must be involved in active learning, than only listen to the lectures. They must review material previously presented in lectures effectively, and be engaged in solving problems. The patient responses to the 7-question survey captured the multiple benefits of Guessing Game as supplements to traditional lecture format. They reported that Guessing helped them to review material covered more effectively, orient them to the topics they should focus on, and build a friendly relationship between them and ward mates/or educators. A majority of patients believed that Guessing Game enhanced their awareness on T2D complications. The above opinions were also affirmed by all educators implementing this new education method according to another 7-question survey, and the improved attendance rate of Guessing Game participants to diabetes complication screening clinic, the latter of which suggested Guessing Game moved an activated patient towards self-management. Moreover, patients achieved higher test scores in "Fill in the Gaps" of all the 2 types of test item after using Guessing Game as a study tool. Participants in the examination must accurately remember the topic in "Fill in the Gaps". In other words, as an active-learning instructional tool, Guessing was helpful to improve the accuracy of patients' memories for knowledge about T2D complications.

In order to do better in the games, patients have more initiative in study and review driven by competition. And Guessing Game let study and review becomes interesting. Especially, this educational game requires the participants to pay a lot closer attention to the details of materials on T2D complications, so as to lead a better comprehension and retention of the learning material. The process of cooperation with other patients in the games was also conducive to promote and reinforce social interaction and mutual learning among T2D patients, which fits the patient's preferences (26). Besides, fun and good learning environment in Guessing Game-based education also create a casual, relaxed atmosphere, which could promote the

communication between patients and educators to improve patient outcomes (27). Furthermore, Guessing Game is an educational tool easy to be implemented, because there is substantial complication knowledge which can become the material of the game, which was reflected in the results from surveys of patients and educators. Importantly, as a simple and interesting game, Guessing is not only an acceptable and familiar game for Chinese patients, but it also has been used in Western education(28,29), suggesting the worldwide application of this effective game for diabetes education has great potential, not only in China.

Nevertheless, some of the un-negligible issues have been detected in the survey. Most interestingly, only 50% of the patients reported they felt “very relaxed” during Guessing Game-based education. Games are usually tools for achieving a comfortable learning environment and removing the stress of individual performance. But why so many patients felt different about game-based learning in China? In the traditional teaching class in China, educatees only need to listen in a “relaxed” state. But as competitive games, Guessing would put some pressure on the participants. Just as they said in additional comments, some educatees considered themselves “accustomed to traditional teaching methods”, thus they do not adapt to learn in this new way. To help educatees adapt more readily, if this project were to be repeated, educators should do more to provide a more relaxed environment for patients. For example, they promote more educator-patient communication after class, build a “pleasant educator” image, inject humor into game, and decrease the difficulty of topic appropriately, etc.

In conclusion, Guessing Game could be used as an enjoyable and effective tool to increase complication awareness of patients with newly diagnosed T2D in diabetes care practice. Guessing Game is easy to be implemented and might be acceptable worldwide as a simple and enjoyable game genre. However, the educatees in China appeared to need time for well adapting the new diabetes educational method.

Conflict of interest

The authors declare that they have no conflict of interest.

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