Journal of Diabetes Science and Technology
Volume 6, Issue 4, July 2012

SYMPOSIUM

Video Games for Diabetes Self-Management: Examples and Design Strategies

Debra A. Lieberman, Ph.D.

Abstract

The July 2012 issue of the *Journal of Diabetes Science and Technology* includes a special symposium called "Serious Games for Diabetes, Obesity, and Healthy Lifestyle." As part of the symposium, this article focuses on health behavior change video games that are designed to improve and support players' diabetes self-management. Other symposium articles include one that recommends theory-based approaches to the design of health games and identifies areas in which additional research is needed, followed by five research articles presenting studies of the design and effectiveness of games and game technologies that require physical activity in order to play.

This article briefly describes 14 diabetes self-management video games, and, when available, cites research findings on their effectiveness. The games were found by searching the Health Games Research online searchable database, three bibliographic databases (ACM Digital Library, PubMed, and Social Sciences Databases of CSA Illumina), and the Google search engine, using the search terms "diabetes" and "game." Games were selected if they addressed diabetes self-management skills.

J Diabetes Sci Technol 2012;6(4):802-806

Introduction

Why Video Games for Diabetes Self-Management?

In the United States, diabetes is increasing in prevalence, and it is now the seventh leading cause of death; if today's trends continue, by the year 2050, an estimated 48.3 million people in the United States will have type 1 or type 2 diabetes—almost double the current number.[1] Its cost to the nation was $174 billion in 2007, and that cost is rising every year.[2,3]

Patients who have type 1 or type 2 diabetes have daily self-management responsibilities that are essential for keeping their blood glucose level under control—such as measuring blood glucose, taking medications or insulin as needed, eating appropriate foods, being aware of symptoms, responding quickly when blood glucose rises too high or falls too low, and adhering in other ways to their individual treatment plan—and poor self-management that fails to control blood glucose adequately, which is a serious problem for many diabetes patients, can lead to severe complications or early death.[4–7] Effective interventions are needed to improve patients'

Author Affiliation: Department of Communication, University of California, Santa Barbara, Santa Barbara, California

Keywords: diabetes, health, physical activity, research, serious game, video game

Corresponding Author: Debra A. Lieberman, Ph.D., Department of Communication, 4005 Social Sciences and Media Studies Building, University of California, Santa Barbara, Santa Barbara, CA 93106-4020; email address lieberma@isber.ucsb.edu

diabetes self-management skills and behaviors, and several well-researched interventions have been identified that successfully enhance diabetes self-management knowledge and skills,[4] reduce diabetes-related urgent care and emergency clinical utilization,[5] and help lower the cost of care and improve patients' quality of life.[6,7]

Video games offer great promise for the delivery of diabetes self-management interventions because they provide new and unique ways to motivate and support health behavior change.[5] The medical profession has become interested in health video games, as demonstrated, for example, by the publication of this special symposium on "Serious Games for Diabetes, Obesity, and Healthy Lifestyle" in a medical science and technology journal. The symposium provides research evidence demonstrating that well-designed and well-implemented video game interventions have the potential to improve physical activity and thereby help address the nation's obesity and diabetes crisis. It contains research articles on effects of active video games[8–11] and effects of a technology-supported alternate reality game.[12] The symposium also contains an article that recommends general strategies for health game design and identifies areas needing additional research,[13] in addition to this article about diabetes self-management games.

Serious games are entertainment video games that have been designed to accomplish a beneficial purpose, such as influencing learning, civic engagement, or health behavior change.[14] The field of health games is an active and innovative segment of the serious games field, with games that address topics ranging from healthy lifestyle improvement to prevention to self-care to disease self-management, and for health care providers, there are games that teach and rehearse clinical skills and assist with diagnosis and delivery of treatments.[15]

Video games can enhance health-related learning and behavior change.[16] They are experiential and interactive, immersing the player in worlds that offer compelling challenges and immediate progress feedback. Research on health video games that are developed with behavioral health theory and evidence integrated into their design has found that these well-designed games can improve learning, skill development, self-concepts, attitudes, emotions, social relationships, social support, motivation, and many other factors that are known to promote healthy behaviors and outcomes.[15–17]

There are hundreds of video games that focus on improving players' nutrition, weight management, or physical activity,[15–17] and these healthy lifestyle behaviors are essential for good health, including the prevention of type 2 diabetes. This article does not examine the healthy lifestyle games that contribute to prevention. It looks only at games specifically designed to improve diabetes patients' self-management behaviors, which are important to carry out consistently in order to maintain good health and avoid serious future complications.[4–7]

Following is a discussion of diabetes self-management games that were found by searching several sources. They were retrieved from the Health Games Research online searchable database (*www.healthgamesresearch.org/db)* that contains extensive information about health games and related resources. Bibliographic databases ACM Digital Library, PubMed, and Social Sciences Databases of CSA Illumina were also searched using keywords "diabetes" and "game." An online search using the keyword phrase "diabetes game" on Google was also conducted to find any additional games that may not have been included in published research literature. This article is not a systematic or comprehensive review of diabetes video games, and it is not a synthesis of research findings. Instead, it describes 14 examples of diabetes self-management video games and sets of games that were found in these searches.

Diabetes Self-Management Video Games

Captain Novolin, published in 1992, challenges players to fight evil doughnuts, milk shakes, sodas, and other sweets while making sure that Captain Novolin keeps his blood glucose in the normal range by eating healthy foods and using insulin. This decision-making game rehearses diabetes self-management skills and good food choices and is the first console video game for diabetes self-management.

Dbaza's *Diabetes Education for Kids*, published in 2003, is a computer-learning program interspersed with game challenges to teach children with diabetes about diabetes care and self-management. It provides basic information about self-care and blood glucose monitoring and offers opportunities to rehearse common social situations involving diabetes self-care needs. A pilot study with 83 children with diabetes found that they enjoyed the program and gained knowledge about diabetes self-management, and the knowledge persisted in a 1-month delayed posttest.[18–20]

Detective, *Buildup Blocks*, and *Egg Breeder*, published in 2004, are three Japanese-language diabetes self-management games (the first two are for the Game Boy Advance

handheld game system and Egg Breeder is a computer game). They were created for children recently diagnosed with diabetes to provide basic information about diabetes and to help them rehearse self-management. *Detective* is a simulation game that engages the player in the role of a diabetic detective who is chasing a criminal but at the same time must take insulin and choose the right foods in order to remain healthy and strong. The goal of the game is to help players learn how insulin and food affect blood glucose as they see the effects of their choices. *Buildup Blocks* asks quiz questions and challenges the player to make good food choices in order to play a visual puzzle game with blocks. *Egg Breeder* engages players in caring for a "diabetic egg." As players rehearse problem-solving tasks related to diabetes self-management, the game addresses diet, exercise, blood glucose monitoring, insulin use, and medical adherence.[18] A pilot test with children found that the three games were entertaining, were easy to use, and provided information that players perceived as useful.[21]

The Diabetic Dog is an online game that challenges teens and young adults to nurture their pet dog that has diabetes. In this virtual pet simulation game, taking care of the dog includes managing its blood glucose through testing, insulin, and proper diet.

Didget is a blood glucose meter from Bayer that connects with a Nintendo DS or Nintendo DS Lite handheld game system and shares the patient's saved glucose testing data with the game system. Children and teens with diabetes who use *Didget* can earn reward points for having good test results and for testing consistently three times a day for at least one week. They can use their reward points to unlock new game items, characters, and game levels. While *Didget* is a blood glucose meter and not a game itself, it is part of a game system that turns the player's blood glucose monitoring behaviors and diabetes self-management outcomes into a game challenge that can yield game rewards. A study found that *Didget* was precise and clinically accurate when young people with type 1 diabetes used it, and they considered it to be easy to use, motivating, and helpful.[22]

Glymetrix Diabetes Game, published in 2009, provides quiz games and card games that test players' knowledge about diabetes self-management. The games are integrated into an extensive clinical system that supports patients and clinicians in the management of diabetes.

GRIP is a Dutch-language diabetes self-management game designed to connect health information from the patient's personal electronic medical record file to a game in which players learn to make decisions and develop skills based on their current personal health information. The game enables parents and clinicians to monitor the patient's condition over time. Players observe how daily activities and food choices influence blood glucose levels.

HealthSeeker, published in 2011, is a social game that enables friends to support their friends with diabetes who have decided to improve their health behaviors. By bringing people together, it is intended to reduce the isolation that people with diabetes often experience and to improve diabetes self-management.

INSULOT, published in 2005, is a mobile phone game developed to teach players about effects of insulin dosage and carbohydrate consumption on blood glucose levels. Using slot machines as the gameplay interface, players must estimate the dosage of insulin that will keep blood glucose within a normal range.[23]

The Magi and The Sleeping Star is an action-adventure diabetes simulation video game that was announced in 2009 and has not yet been published. It will be a high production value adventure game in which the player is a magi, a powerful young magical hero who has type 1 diabetes. He goes on a quest to save the world while using his magical abilities to defeat robotic enemies along the way. The magi's magical power is a direct reflection of how well the player is managing his blood glucose level by making proper insulin and nutrition choices in the game.

Packy & Marlon, published in 1994, is an action-adventure side-scrolling Nintendo console game for children and adolescents with type 1 diabetes. In the game, rats and mice have invaded diabetes summer camp, and it is up to diabetic elephant heroes Packy and Marlon to find food and diabetes supplies to save the camp. In four simulated days, players guide their elephant to meet game challenges and to stay healthy enough to win by keeping his blood glucose in a normal range through blood glucose testing, taking insulin, and eating appropriate foods from food groups. A 6-month randomized clinical trial with children and adolescents with type 1 diabetes found that this game reduced players' diabetes-related urgent care and emergency visits by 77%.[5]

Starbright Life Adventure Series CD-ROM: Diabetes, published in 1999, is a computer game that takes children with diabetes through an interactive day in the life of a child with diabetes so that they can learn how to

manage this chronic condition. The game offers fast-paced exercises, quizzes, and arcade-style challenges that provide information intended to help players gain more control over their disease. Outcome studies found improved knowledge and disease self-management.[18]

Conclusion

The 14 diabetes self-management games described in this article use a variety of game play genres, and the games typically involve players in problem-solving and decision-making in simulations of diabetes self-management, usually by asking players to balance food and insulin to keep a game character's blood glucose within a normal range. This format requires players to rehearse skills repeatedly until they win the game, so these games provide practice and show cause and effect, while also providing basic information about diabetes self-management. This approach was tested in a randomized controlled trial of the *Packy & Marlon* game, which found improvements in diabetes-related knowledge, self-efficacy, communication with family and friends, self-care behaviors, and clinical utilization.[5,15]

New ideas and theoretical models are emerging in the field of diabetes self-management video games.[24–31] These advances are providing a strong evidence-based foundation of behavioral health principles that could be integrated into the design of future games to more successfully engage and motivate players, improve and support their diabetes self-management, and lead to better health outcomes.

Funding:

Support for this work was provided by the Robert Wood Johnson Foundation's Pioneer Portfolio through a grant to its national program, "Health Games Research: Advancing Effectiveness of Interactive Games for Health."

Acknowledgments:

The author thanks Erica Biely and Susana Peinado for assistance with bibliographic searches.

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