Review Article

Digital games as an effective approach for cancer management: Opportunities and challenges

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Abstract:

OBJECTIVE: Cancer is one of the most preventable and common chronic diseases that have economic, social and psychological burden for patients, families, and the society. Cancer can be monitored by new information technology. Digital games as a uniquely powerful interaction tool support optimal care management program operation in all dimensions. The aim of this review article is to describe opportunities and challenges of this new modern technology on the delivery of cancer care services in cancer management domains for cancer care improvement.

METHODS: This study was un-systematic (narrative) review article. In this research, 50 full-text papers and reports had been retrieved, studied exactly, and arranged based on study aims. We searched papers based on specific and relevant keywords in research databases including PubMed, ScienceDirect, Scopus, and Google scholar.

CONCLUSION: In cancer management domain, digital games are as an effective medium for health education and intervention, disease self-management training, attention distraction to relieve pain, enhance clinical outcomes, improvements in lifestyles, and physical and psychosocial activity promotion when active participation and behavior rehearsal are required for cancer patient. In spite of potential benefits of new technology, sometimes people confront various challenges such as social isolation, unusual anxiety, and disorder in physiological times of body, low physical activities, decrease academic performance, increase aggressive behavior, and physical pain. These problems can be partly overcome by proper planning, good design, and usage of suitable and continuous monitoring.

Keywords:

Cancer management, challenges, digital games, opportunities

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Introduction

Cancer is one of the most preventable and common chronic diseases that have economic, social and psychological burden for patients, families, and the society. According to American Cancer Society reports, About 1,660,290 new cancer cases are expected to be diagnosed, and about 580,350 Americans are expected to die of cancer, almost 1600 people per day.[1] In Iran, the incidence of cancer has gone even further than expected according to the World Health Organization.[2] In this

country, cancers are the third cause of death and the second prevalent chronic diseases.[3] Diagnosis of the disease in advanced stages reduces life expectancy and poor life quality of patients. Early screening, prevention, treatment, and management of this disease can control the extensive financial and life losses.[4]

Outside of the health care organizations, patients with chronic disease such as cancer are often left to manage the frequent needs of their condition alone. Individuals with this complex disease are at increased risk for several adverse outcomes, including

sub-optimal self-care, poor medical treatment adherence, and long-term psychological sequel such as anxiety and depression. The patient and his relative's readiness in face to this disease and conscious understanding of care process could help the medical personnel during the care period because this leads to the cooperation and responsibility of patient. Besides, teaching the preventive methods and the individual care of patients during and after the medical procedures could help medical personnel to improve the disease condition. Behavioral and psychological training for medical staff in the face of people with certain diseases is considered as requirements in order to facilitate the healing process.[5] This disease can be managed and monitored by new information technology. Advances in technology have resulted in a wave of information and communications technologies (ICTs) solutions that can help providers and patients enhance communication, coordination, and quality of cancer care and better manage disease.[6]

Digital games as a uniquely powerful interaction tool support optimal care management program operation in all dimensions. In fact, digital game is the practical application of ICT in the delivery of care and cost-effective for different entities of it. Games are now a dominant form of media even larger than the motion picture industry and are enjoyed across gender, age, and cultural boundaries. Games for health provide an enticing medium for attracting attention and promoting changes in health and related behaviors.[7] Health electronic games, while a new term, have actually been on the market for than 32 years, starting with the year 1982 released of the Atari Joy Board, a precursor to the Wii Fit. Today, over 300 health digital games have been developed for consumers, patients, and professionals.[8,9]

Seventy-five percent of homes have video game systems in America. Major users of computer games are between 7 and 34 years and predominantly male in America. Currently, most computer game players are 15–24 years old boys. Nintendo reports that 29.6 million Wii consoles have been sold worldwide in just 19 months from the November 2006 launch through June 2008, equating to approximately $8.9 billion in sales assuming a $300 average selling price. Worldwide video gaming is a growth business with sales (hardware and software) of $42 billion in 2007, and estimated to eclipse $68 billion by the year 2012 according to a Price Waterhouse Coopers industry report.[10,11] In Iran, among 75 million of the population about 46 million people, between 7% and 40% are familiar with game industry and about 54% of play games users. Among the more than 20 million users in this country, about 12 million are males (60%) and 8 million girls (40%) who dedicated on average about 2 h of their time per day to computer games. The studies have shown that everyone dedicate on average

more than 124 min/per day to this media, so the Iranian people dedicate about 40 million h/day to computer games.[12] This digital media included applications that aim to raise awareness about certain physical and mental health issues, promoting health and well-being either as part of prevention or in support of those who are dealing with health problems. These applications have been developed for all ages and backgrounds, such as children in hospital; people who need to change their diets and improve their fitness, mentally-ill patients in rehabilitation, and the active aging of older people.[9] In the field of this entertainment technology for health, cancer can be regarded as a principally issue as it still presents a common cause of death in developed and developing countries. In these areas, the health based digital games can provide the real necessary conditions and environment that is required for disease and certain subject, and also it can transfer the necessary experience and information to the addressed.[11]

These games have different types depending on the purpose for which they are designed. The health care games are among the most common purpose digital games in order to transfer information, health and care teachings, practices, transfer values, ideas and also mind teaching in ideal method in order to improve behavioral, physical, cognitive, and emotional functions and ultimately are designed to manage the disease.[13]

The digital game industry has enjoyed the most rapid growth, and products of this industry have included the extensive range of age groups (childhood to adulthood). Children and adolescents not only devote their time to these games but also influence and learn from them.

These effects can be positive or negative depending on the purpose of designers, game type and time devoted to it.[14] In general, information technology products, also to the facilities and services in the information and communication, it can have a constructive influence on mental health, cognitive functioning, or social activities of individuals. Among the positive effects of these games can refer to behavior evolution, creativity, focus and precision, increase IQ, learning complex concepts, and improve the cognitive skills, visual skills, intelligence, etc. On the other hand, if such game is not selected in proportion of age, culture, and game content, it is possible to have dangers such as social isolation, decreased academic performance, increased the aggressive behavior, exacerbated the attention and focus problems, etc. These problems can be partly overcome by proper planning, supervising the correct planning of games, and ultimately to promote an appropriate culture of electronic games.[15] The aim of this review article is to describe opportunities and challenges of this new modern technology on the delivery of cancer care

services in cancer management domains for cancer care improvement.

Methods

This study was un-systematic (narrative) review article. We searched papers based on keywords or combination of keywords such as "video," "game," "health game," "electronic game," "digital game," "cancer care management," "care management," "helpful effect," "harmful effect," "challenge," and "opportunities," as well as combinations of these terms. In research, papers searched based on specific and relevant keywords in research databases including PubMed, Science Direct, Scopus, and Google scholar.

Because this study aims to survey the opportunities and challenges of electronic games in the management of cancer, so study sample includes the articles of opportunities, challenges, strengths, weaknesses, or positive and negative effects. There is no finding of any article titled electronic games opportunities and challenges in particular in the field of cancer, so the search focuses on more articles in the field of health, health care and health management in the field of cancer. Most articles have published in the countries of America, Australia, and UK during 2008–2014. Sixteen of total 50 searched papers discuss the game as a tool to better manage the patient's condition, changing to healthy behavior, and training and promoting knowledge in the field of health. Sixteen articles examine cancer, required care, and techniques needed to use the game to improve the health of patients and their families. Coping with mental and behavioral disorders as well as the physical factors to optimize the health of cancer patients, enabling the patient to control the disease and improving the lifestyle are among the other key findings in these articles. Eighteen articles examine the positive and negative effects of this technology in the field of health. Finally, this paper is an overview of all articles that have searched in mentioned databases.

The inclusion criteria of papers were as follows: (1) Their relevance to aim of the study, (2) their English language, (3) their full-text availability, (4) appropriateness of their structure, and (5) time limitation between 2008 and 2014. Also, exclusion criteria had been considered as follows: (1) Articles published in conferences and seminars, (2) articles just with their abstracts, (3) articles out of considered time limitation, and (4) articles published only in websites. Ultimately, 50 full-text papers and reports had been retrieved, studied exactly, and arranged based on study aims. Selected papers were reviewed again by two of researchers to verify their quality in terms of abstracts, introduction, methodology, results, conclusions, and references.

The importance of game in cancer management

Chronic nature of cancer is such that influence on body, mind and the individual and social performance of the patient. Therefore, a comprehensive study on the health and quality of life in these patients is of particular importance. Scientific evidence suggests that only a portion of chronic diseases such as cancer are treated by specialist staff, while most diseases are managed by the individual and his family.[16] Interventions based on self-management data can lead to positive changes in attitudes and beliefs, improve the related health information, development of health skills, and individual performance. Activities related to lifestyle, such as physical activity, nutrition and rest, control and monitoring of health status, activities of self-control and adherence to treatment regime during and after treatment (chemotherapy and radiotherapy) are often used as self-management variables.[16] In the past decades, educational approach to patients with cancer has changed, and this improves the motivation of educators and patients. As a result, patients will gain more benefits. Traditional education seems sufficient to meet knowledge needs of patients, but the knowledge of the impact of psychosocial and environmental matters on patient behavior caused to perform training techniques to change the behavior of patients.[17]

Currently, a wide range of games for health focuses on learning and distraction, frequently dealing with chronic conditions, for instance, diabetes, asthma and severe illness such as cancer.[18]

In cancer care domain, electronic games are experiential, creating a platform for active learning. Rather than a didactic presentation requiring memorization or assimilation of out-of-context facts, games promote situated learning in which patients discover and learn through exploration and experimentation. Through gameplay, patients vicariously experience desirable and undesirable consequences without putting themselves in harm's way. By helping patients see the big picture, electronic games help players make meaningful connections between events, thereby increasing the likelihood that knowledge and skills attained in the game world will be retained and applied in the real world.[19,20]

Another clinically evaluated game that directly focuses on cancer and which improves the patient's adherence to medication plans and perceived self-efficacy is the action game Re-mission.[21] Re-mission is a game made for adolescents and young adults with cancer. The goal of the game is to improve treatment in this often hard-to-reach age group of patients. In the game, players control nanobot named Roxxi. Roxxi files through the body of different cancer patients to destroy cancer cells and tumors with chemotherapy and radiation. She also

combats side effects of treatment such as pan, nausea, infection, and constipation.[15]

Re-mission is a video game with 20 levels that takes the player on a journey through the body of young patients with different kinds of cancer. The game was created by HopeLab staff in collaboration with video game developers and animators and scientific and medical consultants. Re-mission is designed to be fun and challenging.

Study results indicated that playing Re-mission game led to more consistent treatment adherence, faster rate of increase in cancer knowledge, and faster rate of increase in self-efficacy in young cancer patients.[22] Re-mission is a first-person shooter game designed to help young adults with cancer learn how to better manage their condition. Finding from research indicate that young people who played Re-mission maintained higher levels of chemotherapy in their blood and showed higher rates of antibiotic utilization than those in the control group, indicating that Re-mission helps patients adhere to cancer therapy regimens.[23] Also, more simplistic games for kids and teenagers with cancer have been designed such as Bens game and Onko-Ocean. The objective of the Bens game is to destroy all mutated cells and to collect the seven shields that provide protection against common side effects of chemotherapy. In the game, children with cancer can express their emotion, which in turn relieves little pain. The game is designed in cooperation with Ben, who brought his own experience with his disease to the game.[24]

Opportunities of digital games for cancer management

Cancer is a chronic disease that requiring a high degree of adherence to the long medical treatment plan through care management, which may be difficult for individuals of any age. A majority of cancer patients do not comply with the treatment regimes that could save their lives. The solution to this problem is clearly complex, yet psychosocial and physical factors play a prominent role.[25] Thus, digital games as a new method have become very popular for capturing the attention of peoples in the promotion of healthy lifestyles to help them learn about a variety of health conditions and treatment. Electronic games also have the applicable to be an effective intervention for optimizing care management.[26]

Some of the most helpful impacts of this technology are: Natural part of human behavior, help people to adjust the individual's objectives to achieve them in practice, provide feedback, enhance motivation and also stabilize the behavioral changes, help extend communication and increase the information of this generation than previous generations, increasing the sympathy and support others,

learn better, improve visual-space skills, and reduce the aggression.[27] Also, the electronic games can be used specifically as a research tool to attract the individual cooperation in different ages to measure the individual specifications such as self-esteem, self-concept, personal purposing, and individual differences. This digital tool also provides an opportunity to user in order to experience new things, excitement and competition to be able to do amazing work, fly, kill, and even die without any real consequences.[28]

Most modern games require quick decisions by users that must be done in a fraction of a second. Trial and errors that users can do in their game will help them to make a decision in the real world faster than others. Users in their real life influence some factors and they must make a decision, so they can find this ability to make better and more productive decisions than a common person.[29] The most potential opportunities of using digital game-based approach for cancer care are including: Direct effective impact in reducing pain and anxiety before surgery, decreasing adverse effects of chemotherapy such as nausea and vomiting, low cost, readily available, easy to implement, enjoyable and acceptable therapies by the patients, making them ideal for interventions for conditioned side effects treatment cancer, optimal stress management, increase motivation, needed supervision low, release of tension and fears in a safe environment, enhance adolescents perceived self-efficacy in prevention programs, promote training and education, and improve their health outcomes.[28,30] Of course, digital games are not just used for health promotion and health education among patients. They can also be utilized as medical education and training tools for medical students and health professionals in this field. Through the use of professional training games, users can test their medical knowledge, practice skills, and correct errors without any risk to patients in real life. Increase medical Student's *t*-test knowledge of general principles in cancer care, and promote teamwork (medical oncology, radiation oncology, and surgical oncology) skills in solving clinical problems are other advantages of this digital tool in education domain.[31]

A well-designed game can be played frequently without making the player feel bored. The fun aspect is thus another key component of the digital game-based health education and health promotion approach, which draws the player in and keeps the player's interest in using the game. The element of fun is also the primary feature that makes attention distraction. Another unique feature of this modern technology is their ability to engage and motivate users, raise patient awareness about disease, improvements in lifestyles, self-management, and enhance clinical outcomes such as psychosocial health and wellness.[32]

Challenges of digital games for cancer management

Games have different dimensions, in addition to the aspects of joy, happiness, excitation releasing, teaching, and knowledge improvement; they also have the negative dimensions because of the misuse and incorrect design which lead to the cognitive, mental and physical damages.[33] The aggregation diffusion, the use of aggressive solutions for real challenges in life, the increasing of focus and attention problem, mental illusions, disorder in physiological times of body, adherence to the computer games and obesity because of low physical activities, fascination in face to the game, loss of time and place sense, and unusual anxiety are among the disadvantages of incorrect use of this digital media which lead to psychosocial disorder in individuals.[34] The impact of computer games on the individual mental health, its severity, and importance is depend on factors such as the degree and severity of violence in computer games, viewer's ability to identify and distinguish the fantasy world of the real world, the ability to motivate his desires and his framework that has grown in value to that person or those already living there and also that value lies in the context and content of the play.

Actually, the virtual world but near to the reality which is imagined in computer games is so attractive and fascinating that the children and adolescents influence all believes which are induced to them by the game designers, so that they undergo the alienation and thinks like them.[22] Another major concern about the digital games due to their widespread use among people is that these games may create a more attractive atmosphere than their homework that interfere with academic performance, and eventually lead to academic failure. In fact, inappropriate use of this technology prevents the moral, emotional, social, and cognitive development. Increased aggression and violent behavior, technology addiction, depression, stress, anxiety, emotional abuse, and psychological aspects of this tool are harmful.[35] Addicted people to the game spend hours and days playing computer while they cannot cut this connection and did not show an interest to leave the set, they sleep less, their physical movement reduce, did not eat food, withdrawal from their family and social relationships, and finally their real-life activities, and social relations will be broken.[36]

Uninformed use of digital games is not only lead to psychological changes that mentioned but also can produce the physical pain for a person who plays it. Injuries such as eye fatigue and various eye problems such as blurred vision, lack of compliance, double vision, and eyelid tic can be named. The weakness of one's vision, eyestrain are among the effects of watching the game for hours that follow with the neck pain, back pain, spinal distortion and increase both blood pressure and heart rate. Some of these diseases are rare, and these symptoms will stop a short time after the person leaves the computer game, but others are produced because of overuse and addiction to this game.[37,38]

Digital games as new technology of human knowledge have penetrated into all aspects of human life. They can have negative aspects for people and their families such as other technology improvements because of incorrect designing or misuse, so it is required to supervise their design, content, playing time and proportion of game with age ranking in order to decrease its disadvantages, and increase its productivity.[39]

In this context, the careful parent's supervision and consideration age ranking for games lead to decrease mental losses because some games have aggressive, nonethical images, etc., which they can have harmful impacts if there is not any control on them. In a play and a real environment, people can play due to their abilities and this may be an incentive to develop them, when a game is not in proportion to the user, it just impose the mental stresses and will distress him and he will not be able to discern his strengths and weaknesses.[40]

Carefully designed digital game can have a positive impact on health behavior in people with chronic illness such as cancer and that digital game-based interventions may constitute a component of a broader integrative approach to healthcare that synergistically combines rationally targeted physical and behavioral interventions to aid patients in the prevention, detection, treatment, recovery from disease, and care management.[20]

Discussion and Conclusion

One of the necessities of life in today is to enjoy teaching and learning. The new methods and technologies can facilitate teaching and learning. Today, health education will achieve by definition of physical, social, spiritual, and mental health among different classes of people using the learning and practical skills well. The most widespread technology that has revolutionized the field of teaching and learning is information technology and communication.[41]

Development of digital media and multimedia are among increasing development of these technologies. Today, the individual requires an environment to present different media with together. The use of digital media in the health is one of the most obvious signs of this technology and its ability to transmit information at different levels of health care.[42] There are various types of digital media that electronic games are known as the most interactive among them. Health based games can increase the world

of digital media in order to provide the forced training experiences to integrate updated health information in the path of production of transitional change.

These forced media required a kind of understanding based on media skill or literacy that can diagnose kinds of media and their productions. In other words, media literacy is a technique that enables us to face media messages as dynamic audience and diagnose them well. Media knowledge can teach the audience of media to remove the consuming and passive state and enter to the active mutual transaction and will gain more benefits to them.[43]

Finally, the medium is designed to make a positive impact on the players. So long as the experience facilitates in the context of real-life simulation, the intrinsic motivation will create. This describes a state of complete absorption or full incorporation in an activity, and it will refer to desired experience and individual can manage the condition better. Player places in a psychological state during a desired experience and he is performing a purpose based activity, and any other thing is not sense. It has a positive impact on the learning process and can be considered as a desired outcome of a game. If a game can present challenges to learner that is related to his skills, the possible experience is higher.[44]

In health domain, game can provide the possibility of practice in theoretical learning, practical skills, and activity in individual or group conditions to patients. The effective learning can present learning purposes in structural learning environment and must be embodied in context adopted to culture and represent daily conditions, because learning include individual structure of knowledge which can make by interacting to the personal environment or culture. Also learners (patients) should accept responsibility for their own learning and personal motivation to explore different areas of knowledge as well.[45]

In healthcare, digital games are powerful teachers that have significant effects in several domains, some of which could be considered helpful and some of which could be considered harmful. These digital media can be effective tools for health education and intervention, disease self-management training, therapy, physical activity promotion, attention distraction to relieve pain, and medical education.[46] In the cancer care management domain, digital games are as an effective medium for education, self-management training, and physical and psychosocial activity promotion when active participation and behavior rehearsal are required for cancer patient. In addition, this technology proves to be a better channel to gain attention and to motivate individuals.[47] With the usage of suitable and good design to enhance the application of digital game, healthcare providers and researchers can take advantage of the unique characteristics of its when the particular purpose of a health education or intervention program requires behavior rehearsal in a safe way.

When designing games for health, game designers need to work closely with healthcare providers and researchers to incorporate the theoretical elements and implement game features based on theories so as to maximize the effectiveness of game and reduce the possible disadvantages of its. However, designing digital games for health related purposes goes beyond enjoyment and entertainment. Therefore, when making designing decisions, game designers need to take into consideration the content and subject matter, the users, and the environment where the game will be played.

Limitation
Despite of possibilities of electronic database in developed countries, unfortunately, some resources of this database did not exist in Iranian libraries or other data centers and there are no other methods except access the Internet. In other hand, it is not possible to access the full-text of to some resources. Meanwhile, some information is available in Internet world network by payment high costs.

This article is a part of dissertation which based on health electronic game design. The researcher has been able to overcome some problem in collaboration with Health Information Management Research Center, Tehran University of Medical Sciences, Tehran, Iran.

Conflicts of interest
There are no conflicts of interest.

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