Integrating virtual reality to expand the public health role of community pharmacists

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Abstract

Objective: To describe a potential future role of the community pharmacist in public health using virtual centers that provide immediate feedback to patients regarding behavior changes.

Summary: Community pharmacists would provide a comprehensive standardized patient-centered interview to collect pertinent information regarding patients that, together with a computerized body scan of the individual, would be fed into the virtual center to create a baseline likeness of the person. The virtual center then would predict the person's appearance and overall body health at a predetermined interval in the future, as well as provide feedback to the patient, engaging multiple senses and using an advanced body suit to represent changes in body mass and exercise tolerance as the person moves in the center. Pharmacists would work with the patient to identify patient-centered behavior changes, which would be programmed into the virtual center to demonstrate to the person how their new lifestyle goal may change their future appearance and health. Achievements and social networking in the virtual world would be incorporated to motivate patients to continue to make positive decisions regarding their health.

Conclusion: Virtual reality technology can be a powerful motivational tool that community pharmacists can use in a variety of ways to help patients implement and sustain positive lifestyle changes.

Keywords: Virtual reality, lifestyle modifications, community pharmacists, public health, Internet.

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Technology for computer simulation activities continues to evolve, creating opportunities for both the business and social worlds. A number of business industries use computer simulation to help train employees, simulating a real-life experience and allowing users to learn from their mistakes and improve their skills without the consequences experienced in a real-life environment. Whether learning to drive a car or pilot an airplane, working in an operating room on a critically ill patient, or managing a financial portfolio during an economic crisis, computer simulation activities have allowed users to create an environment where they can practice and improve skills in an arena where mistakes do not necessarily cost dollars or lives.

One interesting evolution of the computer simulation technology is the establishment of a virtual world through the Internet, in which users can establish new, often fictitious identities and live out an alternate "virtual existence" through their computers. Linden Lab is one of the pioneers of this industry; in 2003, the company launched its simulation technology for the game Second Life.[1] Since the launch of Second Life, its user base, referred to as "residents," has grown and evolved substantially, as has the technology itself. In 2008, Second Life residents spent nearly 29 million hours gaming in Second Life, and in 2010, there were more than 20 million resident accounts.[2] The Second Life "world" has its own internal currency, has land available to purchase, and even has designated areas that are restricted to adult access only. Several areas in this platform are intended to recreate famous cities or places that exist in real life. Religions and different country embassies also are represented in this virtual world.

Online gaming, in which people pay a recurring fee to exist in an online gaming world, has been a highly successful industry. Three primary components have been identified that motivate involvement in online gaming: (1) achievement, which incorporates advancement, mechanics, and competition; (2) social, which incorporates socializing, relationships, and teamwork; and (3) immersion, which incorporates discovery, role playing, and customization.[3] The achievement component often documents players' successes by displaying unique symbols of status that the player collects or even wears on their character. The social aspect reinforces these achievements, as collecting status symbols becomes much more important when one can display those to others and "show off" their accomplishments. Also, some of the more advanced games have accomplishments that can only be achieved through cooperation and teamwork, and they create matching processes where a single player can search out and find "friends" to play with in the online world. Finally, to maintain each person's interest, it is important that the platform continue to add new content and create characters that are highly customizable, so that each person has a unique character that continues to evolve and improve with time.

There are many published examples of applications of Second Life and other virtual reality technologies in health care for both education purposes and provision of patient care services. As a motivating tool, patients have used virtual reality to help combat diabetes and obesity, facilitate weight loss, and increase physical activity.[4–8] Evidence also exists that predicting future risks through genetic testing, such as a high risk for type 2 diabetes, can influence and motivate patients to implement healthy behaviors in an effort to minimize their risks of developing the disease.[9,10] As virtual reality technologies grow and evolve, they can play an even greater role in health promotion and disease prevention to combat one of the major challenges of chronic disease management and/or prevention—the lack of reinforcement patients experience when implementing healthy behavior changes. This is well observed with hypertension, where a person

At a Glance

Synopsis: Virtual reality technology can be a powerful tool for motivating patients to implement and sustain positive lifestyle changes. The authors provide a detailed description of potential community pharmacy–based virtual centers, which would use advanced technology to predict patients' appearance and overall body health at predetermined intervals in the future and provide feedback to patients. Achievements and social networking in the virtual world would be incorporated to motivate patients to continue to make positive decisions regarding their health. Pharmacists would act as coaches, helping patients to prioritize their behavior changes and work toward finding feasible goals and achievements that can be maintained over time.

Analysis: *The value of virtual simulations has been demonstrated in areas such as rehearsing surgical procedures, planning complex architectural designs, and learning to drive a car or pilot an airplane. The authors note that although virtual reality technology could be a powerful tool in reinforcing positive and negative aspects of patients' lifestyle choices, the patient–pharmacist relationship would be the foundation of these behavioral interventions. Working with patients, pharmacists would use well-established guidelines to set realistic goals for patients and work with patients over time to continually refine their goals. Although a virtual center could provide instant gratification for behavior change, patients would quickly realize that attaining a predicted body/health status translates to self-discipline and hard work, and pharmacists could support patients in accomplishing lasting changes.*

may not feel any different when their blood pressure is uncontrolled or at goal but may actually experience adverse effects from antihypertensive agents, thus leading to discontinuation of the medications. Motivating these patients to make healthy changes and work to gain better control over their disease often can be challenging and sometimes requires a major event, such as a transient ischemic attack or chest pain, to get the person's attention. Given the success and popularity of these virtual reality games and the challenges faced by patients in incorporating positive lifestyle changes, we propose using and expanding on these existing technologies to help motivate patients in implementing and sustaining healthy changes and follow a plan outlined by community pharmacists.

Intervention

This project proposes implementing a network of virtual centers in community pharmacies that would be used to demonstrate to patients predictive models of their body and its performance at predetermined points in the future, based on patients' current health behaviors. Rather than waiting for these major events to occur, virtual centers would use computer algorithms to predict how positive and negative changes made in the person's behaviors today may affect their body and their health in 10, 20, or 30 years. For example, the predictive technology could be used to demonstrate the deleterious effects that cigarette smoking, weight gain, or alcohol abuse has on the body at designated time intervals in the future. Having the patient actually experience or "live" in this predicted body could be an effective means of demonstrating the importance of healthy behaviors and incentivize patients to modify their lifestyle. Indeed, research has shown future health status to be an important motivator for change.[11–15]

Description of virtual centers

Capitalizing on the emerging technology of Second Life, virtual worlds will be created for patients in which they can experience and even interact in virtual centers placed on location in community pharmacies. These centers are envisioned to be roughly 8 feet in height and 5 feet in diameter—a virtual "capsule" for patients to sit or stand in, while allowing some room for movement. The machines themselves will be designed to have a "flashy" exterior to capture people's interest. This should generate attention and questions from pharmacy patrons as they enter or browse the pharmacy. In the initial launch phase, a dozen or more of these virtual center sites would be established, in order to gain popularity among those patients who use the devices and take advantage of motivating patients to "achieve" higher status or ranking within the center. The centers themselves would use existing and future technologies to best achieve the existence of a new reality for patients. The patients would experience their predicted reality using visual helmets or goggles that change the landscape based on turning of the head, movement within the capsule to reinforce whatever movements the patient may make, surround sound technology to emphasize the different sounds within the "world," possible olfactory stimulus to engage the sense of smell, and an advanced body suit that could provide direct feedback to the patient, accentuating strength with improved body development or reproducing and accentuating the effects of fatigue on the sedentary individual. Instead of focusing on extensive interaction with a virtual world, the emphasis would be on creating a virtual environment that is perceived by the patient as being as real as possible. Generating a virtual body that is better (or less) able to perform in the world as a result of health changes made in the past (i.e., today's interventions) would be the focus. The patient's predicted condition would be generated from extensive data programmed into these machines based on existing knowledge of how nutrition, activity, medication use, current laboratory measures, ethnicity, and family history risks predict disease and health in the future.

Baseline assessment

Before engaging in the virtual center, community pharmacists would conduct a standardized patient-centered interview, collecting medication and medical histories with the patient. As part of the interview, the pharmacist would assess patient adherence to medications, current level of exercise, and nutrition habits, including caloric intake and the breakdown of macronutrients consumed. In addition, the community pharmacist would perform a baseline assessment of the patient, including determining the patient's weight and blood pressure and using point-of-care technologies to determine fasting lipid panel, fasting plasma glucose, glycosylated hemoglobin, and other relevant labs (e.g., international normalized ratio). The interview and objective measures collected would follow a standardized process, such that the virtual center could be programmed with extensive baseline information. Accuracy of the baseline data is paramount, as predictive technologies would rely on the virtual center having a close estimate of the patient's current health. After all of these data are fed into the virtual center, a profile would be created for the patient. The center also would perform a computer body scan of the patient, in order to capture physical details and better reproduce the patient's current appearance and predicted future appearance.

Virtual predictions

Using computers to predict future outcomes based on a number of different variables already occurs extensively in the military, in business, and in health care. It is anticipated that complex algorithms could be built and refined based on existing and future data to give high-

probability accounts of how a person's body would change based on specific behaviors. These algorithms would be refined as the virtual centers were used over time based on users' data, so that the predictive nature of the centers continued to improve. Initially, patients would enter the virtual center and experience what the computer predicts their health to be in 10 years, based on their current behaviors. This essentially would give patients an idea of how their body might perform if nothing changed in their self-care. Because the goal of these predictions would be to demonstrate any positive or deleterious effects on the body with current behaviors, a priority would be placed on functions and characteristics that would be prioritized by most patients, such as their ability to ambulate and breathe and their appearance. The value of this prediction would be to allow patients to "experience" their new body, feeling improvements or detriments in their condition, and view their new body, in some type of three-dimensional mirror, with predictive effects of aging based on their self-care.

These predictive effects could have very powerful effects on the individual. Smokers, for example, may notice that their skin and body's aging process have accelerated, to where they may look 10 or 15 years older than their true biologic age at a given time. Compound this visual representation, complete with stained teeth and fingers, with a physical sensation of labored breathing and fatigue under easy exertion, and the patient glimpses a frightening future based on a modifiable behavior. The machine could be set to show predictions at 20 or 30 years into the future, perhaps with an ominous message to those who may not be reliably predicted to survive for those lengths of time. These predictions also can show sedentary individuals how their current weight problem will continue to increase in severity, to where they are staring at themselves in 10 years in a severely obese state and can feel the impact of that extra weight on their body, perhaps even immobilizing them. The power for these predictions to demonstrate the impact of behavior should not be understated. If patients with diabetes suddenly see themselves hooked up to a dialysis machine or missing a foot, they may become more motivated to control their blood glucose and blood pressure.

The second purpose of the predictive technology will be to demonstrate how behavior changes implemented in the present will affect the "future patient." The pharmacist would work with the patient to determine an initial behavior goal to work at implementing, such as 30 minutes of walking 4 days a week. That goal is programmed into the virtual center, assuming strong adherence to this goal over the predicted interval, such as 10 years. The patient now can visualize and feel the difference that this exercise goal would produce, again based on a complicated algorithm and existing predictive models of how modest exercise can affect a patient's health. Instead of staring at a morbidly obese "future you," the patient might now see a person who weighs the same as or aless than the patient currently. Since this new "future patient" should be in direct contrast to the one predicted with no changes to current behavior, this would generate concrete feedback to the person on the importance of these health behavior changes on shaping his/her future.

Other applications

Although this predictive technology function is anticipated to be a strong motivational tool at the start of the intervention, ongoing motivation of the patient to work with the pharmacist and implement healthy behavior changes is important. One method for accomplishing this would be to emphasize the social aspect of these virtual centers. Assuming that the implementation of these machines could be accomplished on a relatively large scale across a region or even across the country, the use of these centers could become popular or even competitive for the users. Implementation of healthy behavior changes is somewhat individualized for each person, but a number of universal changes have been strongly documented to have a positive impact on health, including smoking cessation, continuous moderate or vigorous activity, reduction in low-density lipoprotein cholesterol, and reduction in body mass index or waist circumference. As use of these virtual centers increased, patients might be allowed to capture their predicted "future patient" images and post them on social network sites such as Facebook, showing their peers and contacts how their healthy behaviors might improve their future predicted appearance. With continued participation over several months to years, one could envision an evolution of the "future patient," where each new intervention continues to improve the 10-year model, and each new prediction is captured and displayed, so that the future patient continues to look better and better.

Another possible use of the technology would be to implement unique medals, badges, or visual achievements that can be earned with continued participation. This concept is based on the successes of online gaming, in that patients could gain higher status for their future patient by implementing and continuing to make healthy interventions. Perhaps patients would have unique "health banners" or trophy cases displayed behind them, and these would become stocked with recognitions and commendations as patients work harder to implement healthy behaviors. These could be displayed for other users, demonstrating patients' high levels of achievement in living a healthier life.

Taking the Second Life model into consideration, perhaps an expansion to these virtual centers could be some type of home unit that allows participants within the program to interact with each other in this virtual world, displaying the status symbols they have achieved. This could facilitate the social and immersion

aspects identified as important motivators for continued use of the virtual tool.[3] Perhaps different parts of this "world" would only be unlocked or accessed after the person has reached a certain level of health status, creating a type of "private elite health country club" for those truly dedicated to making their lives healthier. Under this model, each successive goal could be more difficult to achieve, leading to patients working harder and more diligently to access new content or display ever-more-intricate badges and achievements. Although this application of the technology would depend on its popularity within a population, those drawn to this type of competitive environment could be tremendously motivated. Cooperation and teamwork could be components of this expanded vision as well; friends could share their successes and implement healthy behavior changes as a group, possibly attaining a goal that was not possible for the individual. This also could have powerful positive effects, as data already suggest that an individual's risk for obesity is considerably higher when other people in that person's social network are obese.[16] It stands to reason that the opposite also would be true; interacting and socializing with people committed to making healthy behavior changes should have positive effects on the individual as well.

Role of the pharmacist

A major strength of this theoretical model would be that pharmacists would see patients on a routine basis rather than only when patients are sick. For these centers to be effective, they must be used by patients. Patients also must have easy access to health care providers for answering questions, providing education/counseling, and making appropriate referrals for seeking further care. The ubiquity of community pharmacies and accessibility of community pharmacists make this an ideal setting for placement of this technology. In addition, the placement of these machines within a community pharmacy maximizes the visibility of the technology. At 5 feet in diameter and 8 feet in height, along with the intentional flashy exterior, patrons will certainly notice the devices. Because many benefits of the devices would lie in preventing chronic illness or poor health outcomes, reaching people before they are chronically ill is critical. Pharmacists are in an optimal position to identify patients who may benefit from this technology and promote its use. Although these virtual centers certainly could be used in other areas of pharmacy practice, their optimal placement would be in community pharmacy settings, where people routinely browse and walk-in traffic is high.

Given that these virtual centers could be implemented by health professionals other than pharmacists, pharmacists will need to create a unique niche using these virtual centers for a focus on medication and behavior changes. In addition to being trained on the best pharmacotherapy approaches to achieving optimal health outcomes, pharmacists also are trained to provide recommendations to implement healthy lifestyle modifications, which often are the first-line therapies recommended by pharmacists to treat chronic conditions (e.g., hypertension, dyslipidemia, prediabetes). Successful goal setting is a vital, difficult skill to learn and apply to patients, and maintaining behavior changes over time is daunting at best. The pharmacist has the training to help patients set appropriate goals and should work to help the patient recognize goals that are achievable and those that are not feasible. While the predictive capability may show a supermodel representation of the clinically obese 30-year-old woman who decides she's going on a radical weight loss plan, the pharmacist needs to recognize the limited feasibility and sustainability of such diets and help the patient make a more modest modification that can be sustained over time. Using well-established guidelines for setting realistic goals for patients and working with them over time to continually refine their expectations and goals are the cornerstones of success for this program. Although the virtual center can provide instant gratification for the behavior change, patients will quickly realize that attaining that predicted body translates to a good amount of self-discipline and hard work and most cannot accomplish these lasting changes on their own. The pharmacist will need to take on the roles of coach and guide in helping patients to prioritize their behavior changes and work toward finding feasible goals and achievements that can be maintained over time. The most challenging behavior changes, such as stopping smoking or overeating, often are riddled with failed attempts and circumstances in which the person "falls off the wagon" and repeats the risky behavior. Ongoing encouragement and management are critical for getting patients past these roadblocks and helping them successfully implement their plan. The pharmacist will need to explain that these occurrences are normal and expected and that patients should not abandon their pursuit of healthier lives. The pharmacist is the foundation of the behavioral interventions; the technology is merely a tool to help reinforce the positive aspects of these behaviors.

Costs and reimbursement

This type of technology would likely carry a substantial initial cost and require regular maintenance. Although predicting the extent to which insurance payers would reimburse this type of service is difficult, the model is consistent with many existing successful health care plans and some federal sources are funding virtual reality technology.[8] The Kaiser Permanente model, for example, places a very high emphasis on preventive medicine and the promotion of healthy lifestyles. Key health care issues such as the extreme rise in obesity and continued high prevalence of diabetes are beginning to receive

more attention nationally and often can be prevented with education and lifestyle modifications. The Affordable Care Act will change the existing system with bundled payments, an emphasis on the medical home model, and strong efforts to prevent hospital readmission or use of emergency departments for primary care. The potential benefits offered by these virtual centers are consistent with these new philosophies: keeping patients healthy and motivating them to make positive changes that can prevent bad outcomes.

As these centers gain wider acceptance, insurance payers may cover the services for patients who fit certain "high-risk" criteria, most likely allowing a restricted number of uses per year. The hope is that as data are collected regarding the success of these consultations, the coverage will expand to include greater numbers of qualifying people. In the initial phases of implementation, perhaps these services will be considered concierge or be reimbursed by fee for service directly from patients. Maintaining pharmacist education and management would be a critical component of virtual center use; as mentioned above, the center is a tool but must be accompanied by realistic goal setting and education for maximum benefits to occur. The reimbursement sought would be for a 1-hour consultation appointment, during which the virtual center would be used. Patients interested in additional uses beyond what is reimbursed or those with suboptimal coverage could opt to pay a fee out of pocket, similar to many medication therapy management reimbursement models. Finally, patient assistance programs would be sought for the underserved, either directly from the manufacturer who provides the centers or through fundraising and grant efforts on local, state, and national levels.

Discussion

Simulation is already widely recognized as a tool in helping to train professionals in their trade, and with expanded technology comes expanded applications for that technology. Patients already are being exposed to computer simulations, in areas such as demonstrating how a surgical procedure will be performed on a patient or using a game interface with children to effectively assess their pain.[17–19] Likewise, computer models to predict outcomes have been used for combat scenarios, political contests, and finding strong compatibility between people through online dating. Within health care, predictive computer models are used in drug development, estimating the body's response to different surgical procedures, and predicting possible drug resistance.[20–23] The virtual world platform Second Life actually has established medical clinics within its realm and has been used as a venue for educating nurses.[24,25] This current work expands on existing technology to apply computer prediction technology and computer virtual reality platforms to patient education programs.

Changing adult behavior to improve future health and control over chronic disease has long been recognized as a very challenging task. The health care provider must help the person understand the seriousness of the chronic condition and the values of working hard to prevent or manage that condition, which, in many cases, takes quite a bit of time and work by the patient. Programs that have shown success usually do so by finding ways to motivate individuals and by implementing reward systems such that people feel they are accomplishing goals and are recognized for their efforts.

Although the popularity of these centers is difficult to predict, children today are immersed in technology. A technology that adults consider novel and cutting edge could be perceived as normal by children. Today's youth are exposed to ample touch-screen applications, computers being introduced and used extensively in elementary school settings, and constantly evolving video game interfaces available on tablets, phones, computers, and televisions. The younger generation may very well embrace these virtual centers as simply a continuation of what they've grown up with. Using the gaming industry as an example, in just over 30 years, players have evolved from the early 1980s sitting in a room playing role-playing games with stacks of books, miniature figurines, and their imaginations to the present day where people across the globe can enter into a virtual world and interact together, with the computer providing realistic images, sounds, and in some cases feedback by touch. It is anticipated that if virtual technology existed for this new generation, it would be quickly embraced and used for a variety of purposes. Extending one of these purposes to health care seems natural.

The practice of pharmacy continues to evolve away from the product-oriented dispensing function to a more cognitive service–based model, in which pharmacists are using their advanced drug and disease knowledge to manage patients and help prevent and manage chronic disease. Long recognized as the most accessible health care provider in the system, pharmacists are in an excellent position to implement a behavior modification program on a large scale, using virtual reality technologies to reinforce their recommendations by providing instant gratification to the patient, allowing them to actually see, feel, and even smell what the future may hold for them if they were to implement these healthy strategies. Using these same technologies to "continue the momentum" with patients by giving them goals to work toward, complete with status symbol achievements that they can earn and display with pride, could provide the motivation needed to actually achieve and sustain these health benefits. Implementation of virtual centers aligns well with medication therapy management services and assists patients in developing an informed and feasible medication-related action plan. Whether the patient is motivated by positive perceived changes to their phy-

sique and health status or "scared into action" by witnessing deterioration of health based on their present course, these predictive models can be very powerful tools in helping to implement healthy behaviors.

Conclusion

Virtual reality technology can be a powerful tool for motivating patients to implement and sustain positive lifestyle changes. Community pharmacists' front-line access to patients on a routine basis and their unique training on medication and lifestyle changes makes the community pharmacy an excellent setting for implementing these virtual centers. The current trends in health care suggest that a much stronger emphasis will be placed on preventive medicine and promoting healthy behaviors, and these centers, coupled with the expertise of pharmacists, could be essential tools for accomplishing these goals. As the profession continues to evolve, these virtual centers could create unique patient care opportunities for pharmacists.

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