CancerSPACE: An Interactive E-learning Tool for Healthcare Professionals

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ABSTRACT
This paper describes the development of CancerSPACE (Simulating Practice And Collaborative Education), a simulation-based, online e-learning tool for healthcare providers that aims to increase cancer screening rates for underserved and minority populations that bear a disproportional share of the cancer burden. It presents insight into the purpose of developing this type of educational tool as well as the reasoning and theories behind development. This paper also discusses different obstacles that were faced throughout development and how they were subsequently approached. The goal is to guide others in development of simulated e-learning tools which are focused on improving chronic and preventive care. Once the final version is completed, CancerSPACE will be evaluated to help expand the evidence-base available for guiding future efforts.

Keywords: Cancer, Screening Rates, Disparities, Community Health Center, Provider Education, Games, National Cancer Institute.

INTRODUCTION
The burden of cancer on patients, families, businesses, and the nation is punishing. Cancer affects one in two men and one in three women during their lifetimes. Cancer is the United States’ second leading cause of death among all races and genders year after year, closely following cardiac disease. The physical, emotional, and financial toll of cancer on patients and families is an all too common story. The financial toll of cancer is leading to medical bankruptcy increasingly often, requiring society at large to underwrite the additional costs of treatment which can last years. Even setting aside moral, ethical, and humane motivations for pursuing aggressive cancer screening interventions in order to reduce the incidence and mortality of this disease, the bottom line for business and industry creates further motivation.

Millions of working hours are lost as employees battle the disease or care for others during their fight. This translates into years of productivity lost annually, and the portion of the cost of healthcare borne by employers compounds the effect.

Screening for some types of cancer before there is evidence of the disease can significantly reduce incidence and mortality from cancer, however, significant numbers of patients in the healthcare system aren’t getting the routine cancer screening tests that they should be. Can an interactive, educational tool that simulates barriers to cancer screening in the clinical environment help?

Simulations have been used for decades to achieve various performance objectives across various industries and academic fields. Simulations mimic actual behaviors and situations allowing a user to gain practical experience without the associated harms and risks, as well as gain practice with uncommon situations. They have been used as part of common practice and have been proven effective at training people in various fields including aviation, military, business, nuclear, and medical [1] [2]; the archetype being flight simulators, wherein pilots can rehearse emergency procedures that are not possible to model without endangering lives and aircraft. Flight simulators have proven exceedingly effective at achieving the outcome of fewer preventable plane crashes.

Simulations are popular among students, and are a good way to supplement traditional learning methods. While it is important to have high learner
satisfaction, it is also important to balance that information with the other factors. Looking at simulations from a user’s side, they allow for high knowledge attainment by creating an environment in which the user can repetitively practice a scenario until they have thoroughly learned the information and can be used at a pace which is comfortable for the user and conducive to their learning. From an organizational standpoint, simulations have the ability to reduce financial costs and save staff resources [3]. They do not require direct supervision or instructors to present information during the learning sessions. Finally, they do not require multiple staff members to be absent from work at the same time since, unlike a seminar, they can be completed anywhere at any time. In clinical care, this can provide benefits to the user, the health center, and even the patients because of less disruption during normal office hours.

Advances in digital communications technologies are increasing the capabilities and reach of simulation based e-learning tools and they are now being used in more diverse ways, including more frequently in the education and training of healthcare professionals. In the medical field, simulations allow the user to gain useful experience without the potential of causing harm to a patient and practice procedures which they are rarely likely to encounter in a clinical situation. Some simulations are strictly computer based, others use mannequins, and some integrate both to form a more comprehensive program. Most medical simulations have historically focused on acute care and improving medical procedure skills, examples include SimMan® and the LAP Mentor™.

While health care simulations have been used in the education and training of health professionals in acute care settings such as emergency departments and surgical wards, only recently have medical simulations begun to be used to improve chronic and preventive care. One example includes the ‘Nutrition Game’ created by Ohio University. This allows users to see how foods they eat, including fast food, impact their health [4]. However, examples of simulation use in chronic and preventive care are few and even fewer incorporate educational methodologies that have been shown to have the greatest level of effectiveness. Moreover, research to date has not revealed any simulation based e-learning tools aimed at screening rates in populations bearing the disparate proportions of the cancer burden.

CancerSPACE (Simulating Practice And Collaborative Education) is a simulation-based e-learning tool designed and developed, at the National Cancer Institute, for the context of chronic and preventive care, as opposed to traditional healthcare related simulations which focus primarily on improving acute care and procedural expertise. The National Cancer Institute’s endeavor to develop an interactive, e-learning application represents an organizational leap in cancer communications and education methodologies and delivery systems. It represents the first effort within the Institute to adopt social media principles into NCI’s cancer education portfolio. An E-learning tool was selected as the appropriate method to promote cancer screening, in this case, because it overcomes some of the barriers of previous educational initiatives. Traditional educational programs such as train the trainer and educational seminars reach a limited audience and force workers to take time off to receive training. A simulation format was chosen because of the reasons detailed elsewhere in this paper.

CancerSPACE primarily aims to support increasing cancer screening rates in Federally Qualified Community Health Centers (FQHC’s) by advancing patient/provider communications skills, addressing screening barriers and interventions, as well as improving clinical processes.

The mission of FQHCs is to provide free or low cost health care services, including cancer screening and other preventive services, to medically underserved areas and populations. In addition, the CancerSPACE tool contains features allowing health educators, professionals, and medical faculty to create custom simulations, thereby easily adapting it to educational content about HIV prevention, diabetes, asthma, obesity, or practically any other chronic condition.
CANCERSPACE: DEVELOPMENT AND CONTENT

The setting for CancerSPACE is the “All Hands Community Health Center” and the tool uses avatars as patients, practitioners, and clinical staff. Upon entering the clinic, the user may choose a Day in the clinic to experience. Each day contains a number of challenges the user will encounter which necessitates making decisions. Throughout the simulation, the user is presented with various types of questions, scenarios, and activities aimed at advancing knowledge of cancer screening, improving clinical processes, and facilitating effective patient/provider communications (Figure 1). It also aims to address specific barriers to screening and their associated interventions, and encourage learners to integrate evidence checking into clinical decision making process. The enhanced functionality of the tool benefits trainers and authors who want to create their own content. It contains an authoring component in the form of a “wizard” that allows trainers to easily develop their own custom scenarios and challenges from drop-down menus. Authors can choose avatars, voices, and backgrounds, and put it together with text to create their own Day in the clinic.

The CancerSPACE team conducted background research to determine the components of a simulated activity that are effective at improving learning. While there are many suggestions of effective simulation components, a review of 109 studies seems to have captured and summarized the ten most important [5]. Below is a description of each, as well as a how they were included in CancerSPACE.

Feedback

The most important feature of any simulation is feedback. A person’s knowledge of how they have performed on a task is a central feature of effective learning and useful at improving information retention [6]. CancerSPACE presents feedback in a variety of ways. First, a positive or negative image along with an auditory cue, are presented after each question, indicating whether the user chose the correct or incorrect answer. At the same time the CancerSPACE mentor gives facial and written feedback which scrolls across the top of the screen. In addition, correct and incorrect answers are translated into points that increase or decrease on a visual counter. Finally at the end of each “Day” the user receives an overall “Day” summary feedback and a score. Points are translated into screening rates that draw out on a line graph.

Figure 1: A vignette style clinical challenge.

Repetitive Practice

In order to achieve skill improvement “focused, repetitive practice” is important. Repetitive practice allows the user to correct errors, improve performance, and automate performance. CancerSPACE allows for repetitive practice by giving the user the opportunity to go back and encounter the same scenario or question multiple times. In activities which simulate a patient/provider conversation the user can redo the same scenario multiple times and see how different responses affect a patient’s willingness to complete cancer screening. Ideally, by repetitively encountering these interactions, the situation becomes normalized to the user and will be implemented in clinical practice.

Curriculum integration

Integrating a simulation and making it relevant to the associated non-simulation based curriculum is an important aspect to their effectiveness. CancerSPACE can be easily integrated into a
general cancer screening curriculum, or be a part of mandatory educational sessions. Its intended use is by trainers as a supplement to a larger curriculum. Nevertheless, some users may find it useful as a stand-alone tool, as well.

**Multiple learning strategies**

Incorporating various learning strategies into a simulation is desirable. It allows for a higher chance of fulfilling the intended goal of the simulation, as well as making it adaptable to the learning styles of multiple users. Information in CancerSPACE is presented in a variety of formats ranging from basic multiple choice questions to activities and interactive scenarios where the user is able to have a mock conversation with a patient. CancerSPACE presents information from basic screening guidelines to more challenging concepts on overcoming patient barriers. It is designed to challenge different types of users and present skills and information with varying degrees of complexity.

**Capture clinical variation**

Simulations are most useful when they include variation. Variation can portray itself in terms of patient conditions, illnesses, ethnicities, age, demographics, and so on. While CancerSPACE was developed with FQHCs in mind as the target audience, there is still a great deal of clinical variation present. The patients, as well as the clinical staff are ethnically diverse with diverse dialects and accents. The tool also addresses cancer screening issues across a range of different ages and cultural backgrounds, as reported in the scientific literature. CancerSPACE allows users to interact with “patients” and apply different interventions to solve a problem, without having to face the real world consequences of saying the wrong thing or choosing the wrong intervention. This environment also allows the user to reflect on a plan of action and think about how it could be improved in order to better address a specific situation.

**Individualized learning**

It is important for a simulation to be adaptable to the learner. In CancerSPACE, learning becomes individualized by allowing users to self-pace their learning and encounter one problem multiple times if they choose. It was also developed in accordance with self directed learning approaches and adult learning theory.

**Defined outcomes and objectives**

Creating defined outcomes and objectives help the user to target their learning. Clearly defined goals encourage the user to create meaningful associations with the content and a focus on an end result. CancerSPACE has defined objectives and summarizes concepts learned for the user at the end of each Day in the clinic on a summary screen.

**Simulator validity**

It is important for a simulation to replicate the experience it is trying to mimic as closely as possible and for the information presented to the user to be reputable and valid. The CancerSPACE team has worked to make the virtual clinic environment and the characters presented in it as similar to those which the users experience in the real-world clinical environment.

While the components presented by Issenberg et al. are of obvious importance and are fundamental features incorporated into the development of CancerSPACE, the development team felt it was also important to include theoretical components from behaviorism and adult learning theory in order to best fit the most effective learning methodologies. Behaviorism is the idea that positive and negative reinforcements can help guide learning [7]. The “feedback” section, described above, is an example of how behaviorism is portrayed in CancerSPACE, with reinforcements presented in image, written, and numerical form. Additionally, the opportunities to practice and apply learning are factors that affect long-term retention and behavior change. Adult learning theory, otherwise known as andragogy, suggests that adults learn best when learning is self-
directed. Taking this into account, programs and learning tools which allow users to be in control of their learning, or encourage learners to be active participants in their learning, are the best way to teach adults [8].

The material and core knowledge components presented in CancerSPACE are a combination of current evidence based recommendations, best practices, and research tested interventions. Evidence based recommendations were derived from studies put forth by the U.S. Preventative Services Task Force (USPSTF) and supplemented using information from other studies and organizations. Best practices and interventions were obtained through an extensive literature review as well as through the Research Tested Intervention Programs (RTIPS) which were developed by organizations within Health and Human Services.

Since CancerSPACE was developed toward meeting educational needs of the FQHC’s, many clinical staff members working in FQHC’s were included in and consulted throughout the development process. Clinical staff input was essential at making CancerSPACE as realistic and applicable as possible to the FQHC’s while also including information and scenarios which are important and useful for the populations they serve.

FUTURE DEVELOPMENT: DISSEMINATION AND EVALUATION

Two types of evaluation are currently being planned for CancerSPACE, a preliminary comparative study involving six community clinics, and a larger evaluation of the use of the tool for medical students. The preliminary study will be conducted with community health centers located in the Mid-Atlantic and Northeast regions of the United States. The purpose of this study is to determine whether CancerSPACE meets its primary educational objectives. In addition, this study will assess if these learners using the tool gain knowledge about cancer screening and to what degree the learners are satisfied with this method of learning. Findings from this study are expected in early summer, 2010.

A second and larger scale evaluation will be conducted to assess the function and utility of CancerSPACE as an e-learning tool for medical students. As discussed earlier, the simulations presented in CancerSPACE mimic actual behaviors and situations and allow a user to gain practical experience. This tool can supplement traditional medical learning by providing simulations that will likely be encountered in a clinical setting. This evaluation will be conducted in collaboration with school of public health and school of medicine researchers at a major university. Findings from this study may have implications on medical education with regards to preparing future providers on how to overcome barriers and increase cancer screening outcomes.

In conjunction with evaluation results, the CancerSPACE team is exploring possible enhancements to the tool. While the target audience for this tool is healthcare providers, it’s anticipated that it could be adapted into a cancer prevention or treatment decision aid tool for patients. Such a tool could help patients learn about cancer screening, different options available to them, and potential risk factors for the disease. In the future it is anticipated that CancerSPACE will be made more comprehensive so that clinics can tailor the information specifically to their needs, and share created content with other authors. A component currently in development to facilitate this is a database that will allow users to create and store their own Days and Challenges for insertion into the tool, and make it available for others to download if they choose. Moreover, it could also be used as a foundation for creating similar e-learning tools for other chronic diseases.

The development of CancerSPACE has given the development staff a better understanding of new technologies and how they may be applied to help further cancer communications. The avatars which were used in the development of CancerSPACE are now being employed to help both staff and the public gain a better understanding of cancer communications and cancer research at NCI.
CONCLUSION

Overall, the evidence indicates that simulations are effective at improving learning; however they should be used in conjunction with traditional learning methods and curriculums rather than as a substitute [9]. They are useful at teaching uncommon situations, and raise student satisfaction, potentially resulting in easier and more effective learning. There is an obvious need for more research and evaluation in the area of medical simulations that deal with patient/provider interaction. It is anticipated that future endeavors with CancerSPACE will include completing a controlled trial with separate FQHC’s to determine the effectiveness of this type of simulation, in terms of immediate information gained, long term information retention, and overall improvements in clinical cancer screening rates.


