Evaluating the Effectiveness of Using Video Game Technology to Train Public Health Workers in Their Emergency Response Roles

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THESIS

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This thesis is dedicated to my husband Martin, who has been my biggest cheerleader throughout my educational pursuits. I am forever indebted to him for his selflessness and love. Also to my daughter Joia, who is my continued source of motivation and to my grandparents, the late Albany and Gertrude Benson, who instilled in me the importance of excellence in education. I was honored to have them in my life and I continue to be blessed by the memories of their unconditional love for me.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

ASPR	Assistant Secretary for Preparedness and Response
CADE	Center for the Advancement of Distance Education
CBRNE	Chemical, Biological, Radiological, Nuclear, Explosives
CDC	Centers for Disease Control and Prevention
CRI	Cities Readiness Initiative
CDPH	Chicago Department of Public Health
DVC	Dispensing and Vaccination Center
EMS	Emergency Medical Services
HAZMAT	Hazardous Materials
HRSA	Health Resource Services Administration
IOM	Institute of Medicine
PHEP	Public Health Emergency Preparedness
POD	Point of Dispensing
RSS	Receiving, Staging, Storage
SNS	Strategic National Stockpile
TTX	Tabletop Exercises
UIC	University of Illinois at Chicago

SUMMARY

An evaluative study of the Chicago Department of Public Health's DVC simulation game (medical screener role) was carried out using a randomized approach. In the study, members of CDPH's clinical staff (physicians, nurses and clinical therapists) were randomly assigned to one of two groups, a game group and a face-to-face group. All study participants were given pre- and post-tests consisting of knowledge items regarding issues and skills that are addressed by the game. The pre-post data was utilized to determine an estimate of the effect of the game on participants' knowledge.

Both groups evidenced improvement in knowledge from the pre-test to the post-test. The Face-to-Face group had a slightly higher post-test score than the Game Group (66% vs. 62%), however the difference between the scores was not statistically significant. This result indicated that the two interventions resulted in approximately equivalent, improvements in knowledge.

A subset of the Game group played the game a second time and took a second post-test. The result was another statistically significant increase in knowledge from a mean of 60% correct on post A to 67% on post B. The second iteration of the game therefore, resulted in the Game group participants achieving a mean that was slightly higher than that for the Face-to-Face group, though the difference was not statistically significant. This result indicated that continued exposure to the game does result in increased knowledge in the medical screener role.

I. INTRODUCTION

"The critical determinant of mortality following anthrax bioterrorism is local dispensing capacity."

(Bravata, Zaric, Holty, Brandeau, Wilhelm, McDonald, Owens, 2006)

A. Background

As an emergency preparedness official, the sentiment conveyed in the opening quote is an ever present reminder of the importance of developing local capacity to respond to acts of bioterrorism and other public health threats. Local jurisdictions have made tremendous improvements in their efforts to effectively develop plans for dispensing oral antibiotics in large-scale emergencies and disasters. However, in my practice I have not encountered many colleagues who truly believe that those plans can meet the demands of time constraints placed on local jurisdictions in mass dispensing scenarios, such as the restrictions brought about by the Cities Readiness Initiative (CRI), which will be discussed later in this proposal.

Since the September 11, 2001 terrorist attacks on the World Trade Centers in New York and the subsequent anthrax attacks in October 2001, the U.S. federal government has invested billions of dollars in public health to prepare for acts of terrorism, infectious disease outbreaks and other large-scale public health incidents and emergencies. Federal funding for public health emergency preparedness efforts rose from $67 million to nearly $1 billion in one year alone (FY2001 to FY2002) (CDC, 2005). By FY2007, that figure had risen to over $5.5 billion, including supplements for smallpox and pandemic influenza planning and response (CDC, 2008 report). "The infusion of federal bioterrorism preparedness funding, beginning in earnest in mid-2002, offered state and local governments an unprecedented opportunity to retool their public health systems in sync with national needs" (Turnock, 2004).

During the early years of emergency preparedness funding, federal guidance dictated work activities centered around seven main areas of focus. These areas were: preparedness planning and readiness assessment; surveillance and epidemiology capacity; laboratory capacity for biological agents; laboratory capacity for chemical agents; Health Alert Network/Communications and IT; Public Information/Risk Communication; and Education/Training (Turnock, 2004). Of particular importance to this proposal are the activities that were initially required of preparedness grantees around education and training. Activities for this focus area were aimed at ensuring that state and local health agencies had the capacity to assess the training needs of public health professionals, and other professionals that might be involved with providing care to the public following a bioterrorism attack, some of which would include emergency department personnel, and mental health providers (Turnock, 2004). These activities also sought to *provide* the necessary training and education of these professionals. As the body of persons responsible for carrying out public health's mission across the many sectors of public health, the public health workforce was then and still is essential to a jurisdiction's ability to respond effectively. However, these initial training requirements, although based on previously developed competencies for bioterrorism, were not highly specific in mandating what these initial training and education requirements should look like and did not account for the continued increases in training requirements that have developed each year since preparedness funding began. The challenge for preparedness has not just been training workers across the seven focus areas of the initial iterations of the preparedness grant. Planning for response to the "disease du jour" of the year, including West Nile Virus, Smallpox and Pandemic Influenza has required specialized skills and capacities that warrant additional training. Legislative maneuvers, including multiple homeland security presidential directives have also mandated additional training. Requirements for public health to integrate with other disciplines across the public safety spectrum and operationalize response plans have brought further training requirements to build skills that public health workers previously did not have the need or the time to acquire.

Some research would contend that since the early funding years, “preparedness funds have hired or supported contracts with trainers, planners, epidemiologists, laboratory workers, public information officers, and other specialists. The efforts of these individuals have resulted in a more competent public health workforce, codified emergency preparedness and response plans, and developed corrective action reports from exercises and drills that concretely illustrate systems are in place to respond to health threats at the local, state and national levels” (Fraser, 2007). But how effective are these plans and even more importantly, how comprehensive have the education and training efforts undertaken over the years, combined with exercises and drills, which are designed to not only test the feasibility of plans but also the effectiveness of training, been in measuring the true competence of the public health workforce in carrying out their response roles? Some reports suggest that substantial contributions to the preparedness of the public health workforce are derived from worker experience to real-world disasters and events, such as floods and earthquakes (Turnock, 2003). The stark reality of preparedness exercises is that during an exercise or drill, not every worker gets to “play”. Most capabilities tested during drills and exercises are those that public health workers do not typically perform on a day-to-day basis. Some capabilities, particularly mass prophylaxis, require workers to not only develop the skill to execute the mission but also add the element of speed so workers must also gain efficiency of skill. Real-world disasters and events offer the best experience in terms of measuring skill development, but these events are often few and far between. For those of us in the practice world, years of preparedness work has taught us that the magnitude of training requirements, combined with the continuously increasing initiatives that bring with them additional training needs, creates difficulties and challenges to training that make meeting these requirements near impossible, that is without the implementation of creative mechanisms or those that provide an avenue for training large numbers of workers in a manner that is both cost-effective and ensures skill competency.

B. Purpose of the Study

The purpose of the proposed study is to evaluate the effectiveness of video game technology to train public health workers in their emergency response roles. Specifically, this study will evaluate the Chicago Department of Public Health's (CDPH) Dispensing and Vaccination Center (DVC) simulation game. The game was developed by the CDPH, in conjunction with the University of Illinois at Chicago's Center for the Advancement of Distance Education (CADE). The DVC game is a computer-based simulation of an actual Dispensing and Vaccination Center and is an example of what has been termed "serious game" technology. A DVC is a center that CDPH would establish to provide prophylaxis to the citizens of Chicago in the event of a large-scale emergency. DVCs are located within sites that are not normally used for clinic operations, typically large gymnasiums, but must be set-up and configured in a manner that not only lends itself to clinic operations, but also ease of flow to accommodate the large numbers of "patients" expected to flow through them. The DVC simulation is designed to train staff to complete a number of different roles that are required to effectively implement a DVC. The focus of this study will be on one of those roles, the medical screener. The medical screener is the first point of contact for the public as they enter the DVC and as such is critical to maintaining proper organization within the DVC. The medical screener is charged with triaging the members of the public and sending the non-symptomatic people to the Forms Review station and the symptomatic people to the Medical Evaluation station. In addition to greeting members of the public and asking a series of screening questions to ascertain where each person needs to be directed, the medical screener has responsibilities regarding maintaining the flow or through-put of individuals, notifying security staff of possible security risks, maintaining supplies and communicating with other DVC staff. The goal for the medical screener is to do this as quickly as possible while maintaining a sense of order.

II. LITERATURE REVIEW

Prior to the events of September 11th, emergency preparedness, particularly in public health, was not viewed as a meaningful and worthwhile area of study. Even in the several years since the attacks on the World Trade Center and the subsequent anthrax attacks, research in emergency preparedness is still scarce and difficult to come by. It has only been recently that the Institute of Medicine (IOM) has recommended several research priorities in emergency preparedness, one of which is the enhancement of the usefulness of training. In its letter report to the Centers for Disease Control, the IOM has recommended that CDC fund schools of public health to conduct research that will "create best practices for the design and implementation of training, i.e. *simulations*, drills and exercises that facilitate the translation of their results into improvements in public health preparedness" (IOM, 2008). Unfortunately, these recommendations are new and there has not been sufficient time for the research to be carried out, nor for any of the research findings to be actualized and implemented into practice.

For the purposes of this proposal, a literature review was completed. The purpose of this literature review was to study the issue of workforce preparedness, primarily to examine issues and problems with workforce preparedness and draw conclusions that would support the idea that video game technology can be useful in public health for workforce preparedness for response to disasters and other emergency events. Because this particular area of study is very new, almost unheard of in public health, it was important to develop a context for the applicability of this study to public health and to provide a context for future study of this concept in public health.

Several areas were examined during the course of the literature review. The areas were:

workforce preparedness, including lack of worker readiness related to emergency situations and general problems with public health workforce development; simulation technology, including examples of success with training using virtual world simulation technology; assessment of distance education; and learner attitudes related to distance training and education. Some minimal literature, primarily open source information available via the Internet, was also reviewed with regards to several CDC programs and requirements that are placed on public health emergency preparedness funding grantees. However, the vast majority of information contained in this proposal related to CDC grant requirements and funding mandates was generated via the writer's knowledge of the CDC's Public Health Emergency Preparedness (PHEP) Cooperative Agreement and its associated requirements for grantees, as well as the writer's extensive knowledge in the field of public health emergency preparedness. In an effort to identify work that others have done with regards to the areas of examination for this study, the following key words were utilized in conducting the literature search: workforce preparedness, preparedness training, public health workforce development, distance education, using simulation technology for public health preparedness, and simulation training. Additional bodies of work were also identified via analysis of referenced materials within the articles that were identified during the keyword search.

A. <u>Workforce Preparedness</u>

"Workforce is the most essential element in our collective efforts in assuring the public health." (Woltring, Novick, 2003). Public health workforce development is one of the most widely studied aspects of public health practice. Yet agreed upon standards for measuring worker competence and improving worker deficiencies, as well as adequate resources to implement such standards, still remain non-existent. Some of the difficulty with assessing workforce preparedness stems from the varied backgrounds of public health workers and the inability to determine the level at which intersections between formal education in public health and years of practical experience in the field contribute to and promote worker competence. In his “Roadmap for Public Health Workforce Preparedness”, Turnock reports information which indicates that at the time of the report, roughly 75% of the public health workforce lacked formal education in the field. Conversely, the report also indicates that on the job training in emergency situations is a major contributor to the improvement of workforce preparedness.

There have been many initiatives aimed at improving workforce competency. Government initiatives, i.e. CDC and HRSA programs, have attempted to improve workforce competency by providing increased funding to public health; academia and the practice arena have made collaborative attempts to pinpoint problems with workforce development; and countless studies and reports have been generated detailing research findings related to the problems with public health workforce development. Yet despite all of these efforts, public health infrastructure, particularly the workforce, remains grossly inadequate to meet the unique challenges that twenty-first century problems have brought to the forefront of public health practice. Acts of terrorism, emerging infections, rising rates of chronic diseases and other public health challenges cannot be effectively mitigated without a strong public health infrastructure (Lichtveld, Cioffi, 2003). Unfortunately, public health has been consistently ineffective in developing mechanisms for training the workforce to meet the demands associated with assuring the public’s health.

Countless reports and studies have identified funding needs, proposed policy recommendations and other measures necessary to improve public health infrastructure. Emergency preparedness has led to an increased interest in the “employment, training and uses of workers who are prepared to respond to emergencies” (Gebbie, Turnock, 2006). However, without an evidence-based method for determining worker competence, it is difficult to truly measure the level of workforce preparedness that exists.

There are numerous skills that public health workers, particularly emergency preparedness staff acquire through real-world experience. Response to natural disasters, such as floods and hurricanes provide opportunities for public health emergency preparedness (PHEP) staff to develop skills necessary to mitigate these types of disasters (Turnock, 2003). Disease outbreaks, such as meningococcal disease and influenza also afford similar opportunities. It is the addition of a time factor that complicates and severely limits the benefits that PHEP workers gain from real world experiences such as these. Missions such as the CDC's CRI initiative places strict time requirements on the response aspect of an event. Additionally, extremely large numbers of staff are needed, making it nearly impossible to train staff in their roles via traditional training modalities. Because speed of performance is an issue, workers need to know their roles so that their focus in drill/exercise scenarios can be on efficiency of performing the role.

B. Gaming/Simulation Technology

Serious gaming and virtual world technology have the potential to catapult training of the public health workforce into the 21st century. These technologies allow trainees to interact with colleagues and navigate challenges in 3-dimensional, simulated environments or scenarios where they can "role play, communicate and interact in real-time via the Internet" (Heinrichs, Youngblood, Harter, Dev, 2008). Gaming and virtual world technologies can be developed and adapted for both individual and team training needs, thereby allowing for a wide range of capability development among workers. Assessments and/or knowledge tests can also be built into games, thereby allowing for supervisory review of worker performance, post training. This then provides supervisory personnel with evidence-based indicators of employee performance and easily identifiable mechanisms for determining gaps in employee learning. This then can be used to determine continued training needs.

Evaluation of how simulation technologies have been used in other fields of study indicates that advantages to public health are inevitable. These technologies, while initially expensive to develop, prove to be both cost-effective and non-resource intensive in the long-term. Additionally, these trainings can be “accomplished easily even when participants are geographically remote from one another.” Documented accounts of simulation technology utilization shows both use and applicability in the fields of education (driver’s education simulation); aviation (flight simulation and cockpit resource management); the military (flight simulations); and acute care medicine (anesthesia crisis resource management, neonatal resuscitation and emergency medicine crisis resource management), among others (Heinrichs, et al, 2008).

In their evaluative study of simulation technology, Henrichs et al utilized simulation exercises to train pre-hospital (EMS) and in-hospital teams to conduct triage after a CBRNE incident. In these exercises, emergency medical services (EMS) workers responded to the scene of a dirty bomb explosion where they found injured patients needing transport to hospital facilities for injuries sustained in the explosion. The subsequent portion of the exercise then tested in-hospital staff in triaging of patients coming into the hospital, by ambulance, on foot or by car following the release of a Sarin gas attack on a commuter train. Once being placed into their scenarios, pre-hospital workers were then required to respond to the call, set up triage areas, perform the appropriate triaging of patients, place patients in ambulances and transport them to medical facilities. In-hospital workers began play at the point where patients began arriving at hospitals. They were required to review the triage status of incoming patients, perform any necessary reclassifications, and perform decontamination of patients (Heinrichs, et al, 2008).

This study, along with the endless opportunities made possible by simulation technology is of particular relevance and importance to the training of public health personnel required to fulfill roles during an emergency response. Simulation technology can serve as an intermediary between tabletop exercises (TTXs) and functional/full-scale exercises or real-world disasters/events. These technologies can provide public health workers with limitless exposure and access to the training environment. Workers can learn their roles fully using this technology, which then alters the focus of full-scale and functional exercises to throughput or speed of performance rather than role learning. This position is further validated by the results of the Heinrich et al study. Study results indicated that 69% of the volunteer subjects were not gamers, or persons who regularly play serious games. Additionally, 62% had no prior training in response to mass casualty CBRNE incidents. Sixty-two percent also reported that the session changed their feelings and attitudes about working as a member or leader of a team. Feelings of immersion into the scenario and increased confidence in their ability to respond to a CBRNE incident were also reported.

C. Relevance to Practice

In 2004, the U.S. Centers for Disease Control and Prevention developed and implemented the Cities Readiness Initiative (CRI). The primary goal of the CRI program was to provide funding to major cities and metropolitan areas aimed specifically at developing plans to respond to large-scale bioterrorism events by mass dispensing of antibiotic medications to jurisdictional populations within 48 hours (CDC, CRI facts). The initial phase of the program awarded funding to twenty-one pilot jurisdictions, one of which was the City of Chicago. In 2005, the program expanded to include an additional fifteen jurisdictions, bringing the national total of CRI sites to 36. A further expansion of the program in 2006 doubled the number of CRI sites, thus bringing the nationwide total of such sites to seventy-two.

The overwhelming challenge and caveat of the CRI program is that not only are jurisdictions required to develop mass prophylaxis plans, but plans must be fully operational and must also include both the DVC or POD (dispensing operations) and RSS (warehousing operations) components. And, as if that was not a large enough challenge, exercising of the plans must demonstrate the capacity to dispense to the jurisdiction's ENTIRE population within 48 hours of the decision to do so. For Chicago, this meant plans must ensure the ability to prophylax roughly three million residents within forty-eight hours. Since the large influx of funding to public health for emergency preparedness in 2002, the Chicago Department of Public Health (CDPH) had been developing and exercising plans for events requiring mass prophylaxis of city residents. However, prior to the implementation of CRI, those plans had not sought to do so in a restrictive timeframe. Time studies of dispensing operations had revealed the ability to dispense oral antibiotics at a rate of one hundred persons per hour. Due to the implementation of the CRI program, CDPH officials then realized that in order to achieve the CRI mission, the department would need to develop the capacity, including the training of staff, to activate fifty-five dispensing/vaccination centers (DVCs), all of which would have to run twelve simultaneous dispensing lines, with each line producing a throughput rate of 100 persons per hour. So, 100 persons per hour, per line in one DVC would result in the prophylaxis of 1,200 persons per hour per DVC. Further extrapolation of this figure confirms that with a rate of 1,200 persons per hour, the department would need to activate fifty-five DVC sites in order to provide prophylaxis to the full population of 3 million persons. Compounding the magnitude of this mission was the realization of the amount of *trained* staff that would be needed to be successful in this effort. Identification of minimal roles needed within each center and the necessity of twenty-four hour operations of each site throughout the forty-eight hour period yielded staff projections of over 6,000 staff per shift per day. With three shifts per day, the department would need over 18,000 staff per day to successfully achieve its goal. Even more staggering than the amount of staff needed, is the determination of how to train such a large number of staff to carry out their roles. Considering that the department had a staff body of about 1,200 persons at the time the CRI initiative was introduced, it was clearly evident that the staff would have to be secured from other city agencies and department. This effort is too large, and too complex, to employ the utilization of traditional face-to-face, lecture style training on a just-in-time basis to equip such a large number of workers with the skills necessary to fulfill the roles within a DVC. The department is in need of a creative mechanism that will provide an avenue for training large numbers of workers in a manner that is both cost-effective and ensures skill competency.

D. Assessment of Distance Education

Distance education or e-learning or distance learning, as it is sometimes called, can be defined as a teaching arrangement in which the student and teacher are separated from one another either by geography (location), time or a combination of the two. Distance education has been wildly popular in recent years and represents the most “rapidly growing aspect of education and training in the world” (Essex, Caliltay, 2001). In proposing the utilization of gaming or virtual world technology to train public health workers, the ability to evaluate worker learning and mastery is of the utmost importance. Mechanisms for capturing student data and tracking such data (to determine continued learning) must also be identified and incorporated into the game or simulation during the development process. Traditional teaching modalities (face-to-face lectures) offer a number of mechanisms for evaluating student learning. Body language, participation in oral discussion, quality of questions posed by students and student-teacher interactions all provide effective indicators of student learning (Hack, Tarouco, 2000). However, these mechanisms were previously non-existent in distance education scenarios. Fortunately, the evolution of networks;

computer technology; gaming and virtual world technology; as well as the Internet are changing the landscape of distance education assessment and evaluation (Hack, et al 2000).

When evaluating distance education, most evaluation systems “emphasize usability and reliability of the technology over the value of the instruction to the students” (Hallet, Essex, 2002). As online instruction continues to grow, both in popularity and student preference (due to convenience), so does the need for more substantive evaluation of value to students. Similarly, mechanisms for such evaluation will also become more necessary as institutions seek to evaluate and track the success of distance education programs and modalities. The level of accountability associated with the evaluation of distance education is tremendous and is generated from a number of different sources. As indicated by Hallet, et al:

- Instructors, administrators and other stakeholders in online learning want to know the value of their course and program offerings in terms of student satisfaction and student learning. This includes multiple factors such as student satisfaction with the learning process; appropriate level, pace, depth and breadth of instruction; accomplishment of intended online objectives; and areas in need of further instructional development.
- Because students taking distance education courses are primarily out in the workforce and facing real-world problems, demands, clients and supervisors, it is especially important that e-learning assessment activities address whether the learning that takes place is useful to the students. This includes applicability of the knowledge learned to real-world settings and problems.
- Administrators, technical support personnel and designers are also interested in measuring certain facts about distance education including performance, usability, reliability and compatibility with existing systems.

- Finally, institutions have accountability expectations as well, including cost benefit analyses of implementing and maintaining the technology, effects of distance learning efforts on institutional reputations and the data collection needs to assist in future institutional decision making.

These reasons all strengthen the argument for broad and efficient mechanisms for evaluating distance education technologies.

The work of Hallett, et al emphasizes the multiple stakeholders who hold an interest in the identification of effective mechanisms for evaluating distance education. In doing so, it is important to consider the multiple aspects that must be present in the evaluation mechanism. The evaluation system "should measure the success of the content, process and delivery of online instruction in terms of the individual student, the program or institution and the field in general" (Hallett, et al, 2000). The seemingly most widely accepted model for student learning is that developed by Don Kirkpatrick in 1975. Kirkpatrick's model implements four levels of evaluation, each of which is progressively extensive in nature and represents a cumulative approach to evaluation that can be used to provide in-depth information regarding the value of distance education programs (Hallett, et al, 2000). Kirkpatrick's four levels of evaluation include:

- Level 1 – Student Satisfaction
- Level 2 – Student Learning
- Level 3 – Transfer of Learning
- Level 4 – Return on Investment or Business / Academic Impact

Advances in simulation technology have created opportunities for evaluating student satisfaction and other measures of satisfaction with regards to distance education. This evaluation will focus on the first two levels of Kirkpatrick's model and therefore, will seek to provide information to address formative issues (Level 1) that can be utilized by CDPH and CADE staff to improve the instructional content and delivery of the game; and summative issues (Level 2) related to student "outcomes" or the degree of learning that took place as a result of participation in the game.

III. RESEARCH STRATEGY

A. Research Question

The movement to serious games as a training intervention is a new phenomenon and evaluation of such interventions are necessarily also in a relatively nascent state. The evaluation approach that will be taken here borrows liberally from the work on evaluation of distance or e-learning interventions, itself a still relatively immature field of inquiry. The two broad evaluation questions to be addressed are:

1. What are the perceptions of the end-users of the game?
2. How effective is the game in improving knowledge?

B. Research Design

The research design, as originally conceptualized, is illustrated below in Figure 1. A pool of participants, recruited from among the staff that would perform in the role of clinical coordinator in a DVC (i.e. physicians, nurses and clinical therapists) of the Chicago Department of Public Health, will be randomly assigned to one of three arms in the study: a Game intervention arm, an Other Intervention arm and an "empty" Control arm. Each group will be asked to complete both pre- and post-tests. Statistical comparisons between groups should therefore allow for an estimation of the effect of the intervention.

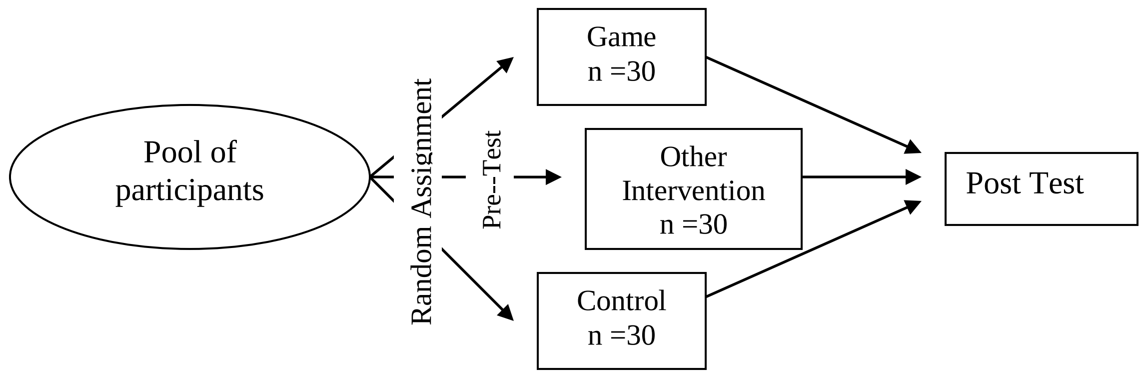

Figure 1: Research design

It is anticipated that this research design will allow for a test of the internal validity of the intervention or the degree of confidence one can have that the intervention will actually cause some evident effects. Although the same questions may be answered with only two groups, the Game Intervention and the Control arm, it is believed the inclusion of another intervention will strengthen the design. The Other Intervention will be modeled on what is the most common form of staff training, a face to face lecture about the topics related to conducting a DVC which is, in fact, how CDPH staff are traditionally trained about DVC roles. Thus, the inclusion of the Face-to-Face group will provide an opportunity to assess the relative effectiveness of the computer based intervention against the current practice. A “second iteration”, in which all participants will play the game a second time, will be included to ascertain whether repeated exposure to the simulation enhances learning.

C. <u>Data Analysis Plan</u>

Upon completion of the evaluation, both quantitative data and qualitative data will be collected. Quantitative data regarding improvement in worker knowledge after exposure to the game will be measured, utilizing posttest information in comparison to pretest information. Computer skills assessments will also be administered and the scores analyzed to determine what relationship computer skill level might have with the assessment results. The computer skills assessment will measure worker years of experience using computers, as well as years of experience with video games. Chi-square analysis will be conducted to determine if significant differences between the two groups exist. Qualitative data regarding worker satisfaction and confidence will be solicited from study participants. Workers will be asked to rate their experience with the game, particularly where it involves any anxiety or nervousness relating to the thought of the game or the fast paced nature of the game, which has been intentionally programmed in an effort to simulate the chaotic nature of a DVC.

D. The Two Publishable Papers

Upon completion of the evaluation study, two publishable papers will be produced for submission to peer-reviewed journal publications. The first of the papers will be framed as an editorial piece. This paper will be utilized to propose the idea of the use of simulation technology in public health training. Examples of successful use of gaming and simulation technology in other fields of inquiry will be presented and examined. As much as possible, statistical findings from other evaluative studies will be referenced and the proposal of similar studies for public health applicability will be introduced. The purpose of the second paper will be to provide information relevant to the evaluation of CDPH's DVC simulation game. The findings of the study will be presented, with the anticipation that such findings will answer the original study questions regarding user perception and knowledge improvement after exposure to the game interface. Together, it is anticipated that these two papers will 1) introduce public health practitioners to gaming and simulation technology, proposing applicability to public health based on evidence of success in other fields; and 2) demonstrate success of the game in improving worker knowledge among public health practitioners, with no prior gaming experience, playing the game. It is this second goal that holds the most relevance to emergency preparedness training. As federal requirements, for both planning and training, continue to increase and the magnitude of natural disasters become more and more devastating, the field is in desperate need of training modalities that can deliver training to large numbers of staff in a manner that is both cost-effective and non-resource intensive. The anticipated findings of the evaluation study have the potential to offer concrete evidence of a mechanism for training new to public health, but potentially monumental in its contributions to the field, particularly with regards to emergency preparedness capabilities.

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IV. Evaluating the POD Game: Using Simulation Technology to Train Workers in a Mass Dispensing Center

Abstract

In 2004, the Chicago Department of Public Health (CDPH) was funded by the Centers for Disease Control and Prevention's (CDC) Cities Readiness Initiative (CRI) to develop plans and other capacities that ensure mass prophylaxis to the jurisdiction's entire population can be accomplished within forty-eight hours of the decision to do so.[1] The addition of this time requirement added an additional level of complexity to the development of mass prophylaxis capability for funded jurisdictions. Mass prophylaxis dispensing is typically conducted within dispensing/vaccination centers (DVCs), commonly termed points of dispensing, or PODS. Within these centers, staff must perform tasks that differ from their daily tasks and duties, necessitating additional training and skill development for these roles. The large number of staff needed in Chicago to meet the forty-eight hour requirement necessitates the use of staff from other agencies in addition to those available from the Chicago Department of Public Health, adding to the need for additional training and competency development for these staff as well. Most importantly, the ability to provide mass prophylaxis services expeditiously translates into lives preserved and reduction in spread of disease, making more effective and efficient training for this capability a high priority for public health. Realizing that existing training mechanisms (traditional, face-to-face, just-in-time training) were insufficient for this mission, CDPH sought to identify a mechanism for providing training to staff that could facilitate worker competency during routine working hours, thus allowing for the use of drills and exercises to focus on speed and efficiency of skill. CDPH contracted with the University of Illinois at Chicago's Center for the Advancement of Distance

Education to develop a video game simulation of a functional POD in a mass dispensing scenario. Evaluation of the POD game yielded results indicating that simulation technology is a viable option for public health preparedness training.

Introduction

The POD Game is a computer-based simulation of an actual Dispensing and Vaccination Center (DVC), commonly referred to as a Point of Dispensing (POD), and is an example of what has been termed “serious game” technology. The purpose of a DVC or POD is to provide prophylaxis to the general public in the event of a large-scale emergency. The DVC simulation is designed to train staff to complete several different roles that are required to effectively implement a DVC. The focus of this evaluation was on one of those roles, the medical screener. The medical screener is the first point of contact for the public as they enter the DVC and as such is critical to maintaining proper organization within the DVC. The medical screener is responsible for triaging the members of the public and sending non-symptomatic patients to the Forms Review station and symptomatic patients to the Medical Evaluation station. In addition to asking a series of screening questions that ascertain where each person needs to be directed, the medical screener has key responsibilities related to maintaining the flow or through-put of individuals, notifying security staff of possible security risks, maintaining supplies and communicating with other DVC staff. The goal for the medical screener is to do this as effectively and efficiently as possible, as their performance impacts the overall flow through the additional stations within the DVC. Additionally, the medical screener role was the first build out to be completed. Success of worker skill development in this role would have larger implications regarding decisions to continue to dedicate funding to the development of simulations for other DVC roles.

The simulation interface is divided into four main areas: the video challenge, response options to that challenge, chain of command communication, and supply management. The video challenge presents the player with situations that they may encounter in their role that are likely to slow the line flow if improperly handled. The response options to that challenge are divided into customized responses (particular to that challenge) and standard questions, based on CDPH response protocol. Chain of command communication may be required when neither the customized responses nor the standard questions are appropriate (e.g., if the subject poses a security threat). Supply management is a persistent feature and is represented by supply icons with their levels indicated. The player must properly monitor these levels and make appropriate requests for new supplies (using chain of command communication) when needed. The player must negotiate all four areas of the interface with correct responses in proper sequence. Immediate, brief feedback is given for each action in the form of a pop-up window which indicates the correctness or incorrectness of the action with a few words of explanation. This visual feedback is accompanied by auditory feedback – a “ding” for correct responses and a “buzz” for incorrect responses. More comprehensive feedback, with explanations, is given in an “after action report” upon completion of game play. Normal game play is occasionally and randomly interrupted with a short pop-quiz which tests basic knowledge of DVC operations and public health knowledge related to a particular threat or CDPH’s response plan for the threat presented in the game (anthrax, in this instance of the game). Players can monitor the effectiveness of their responses through a dynamic graphing line chart at the top of the interface, which indicates the player’s throughput time (rate of persons processed per hour). This rate is calculated based on speed and correctness of responses.

The movement to serious games as a training intervention is a new phenomenon and evaluation of such interventions are necessarily also in a relatively nascent state. The evaluation approach taken here borrows liberally from the work on evaluation of distance or e-learning interventions, itself a still relatively immature field of inquiry. The two broad evaluation questions addressed are:

1. How effective is video game-based training in improving knowledge and decision-making?
2. Is video game-based training an appropriate and acceptable training format for public health workers?

Despite the broad nature of these research questions, we anticipated that the answers would be valuable to CDPH with regards to policy development and changes in organizational practice relative to training and education of staff. Because widespread acceptance of change to organizational practice depends heavily on worker attitudes and perceptions, it was important that this study capture those basic feelings and beliefs. Although policy changes should be data-driven and evidence-based, we believed that worker perceptions with this new training mechanism would also be important and that success of this novel training program would depend heavily on worker acceptance and level of comfort with the training modality.

Methods

The model for evaluation follows the work of Kirkpatrick (1975) which has been applied to what has been variously called distance learning, technology-mediated learning or e-learning projects. [2, 3, 4]

Kirkpatrick's four levels of evaluation include:

- Level 1- Student Satisfaction
- Level 2- Student Learning
- Level 3- Transfer of Learning
- Level 4- Return on Investment or Business / Academic Impact

This evaluation focuses on the first two levels and therefore, provides information to address formative issues (Level 1) that can be utilized to improve the instructional content and delivery of the game; and summative issues (Level 2) related to student "outcomes" or the degree of learning that took place as a result of participation in the game. Information to address Level 3 questions would require the production of an alternative context, such as a live simulation of the situation replicated in the game, to test participants' ability to transfer the learning to another situation and was beyond the scope of the current project, as are the level 4 questions of return on investment and academic impact.

To develop an appropriate evaluation approach, a review of materials regarding goals and objectives for the game were reviewed; a facilitated discussion was held with project staff to surface the appropriate goals for the evaluation; and a review of existing literature regarding validated items for evaluating satisfaction with distance or technology-mediated education was conducted.

Multiple methods were utilized to collect data for the evaluation. At Level 1, data was collected regarding participant satisfaction through a series of questions in a "course evaluation" format similar to what students complete at the end of a traditional educational course. The data collection tool included 14 items posed in a semantic differential format that asked respondents to rate their training relative to specific qualities (see Table 7 for these items). In addition, four items asked about the participants' confidence in performing several aspects of the DVC medical screener role. Other items focused on the participants' experience with the pre-game user training, the ease of playing the game, the usefulness of the Medical Screener Didactic Sheet, and whether or not the participants would ever play the game, recommend it to coworkers or like to use a multiplayer version of the game. This data collection occurred at the conclusion of the training intervention. Participants also responded to a set of questions to elicit their confidence in completing the DVC Medical Screener role after completing the training on a Likert-type scale from "Not at all" confident to "Very" confident.

Several data sources were utilized to assess student learning (Level 2). Participants completed pre- and post-tests consisting of knowledge items regarding issues and skills that are addressed by the game. The pre-post data allows for an estimate of the effect of the game on participants' knowledge and allows for comparison to non-participants (delineated below under *Research Design*). It was important to bear in mind the unique aspects of the *delivery* of the intervention (a serious game platform) and to craft a data collection strategy that allowed for a disaggregation of the effects due to what have been called "…situational factors, such as lack of familiarity with the method of interaction".[6] In this intervention, a participant's ability to navigate the computer screen, use a mouse and their general comfort with computers constitutes a source of variance in the participant's "outcomes". For example, the speed with which the participant "processes" the scenarios in the game is a function of a number of sources of variance including the participants' ability to make the right decision, the rapidity of their decision-making and their ability to multi-task, but also the participants' facility with the computer interface. Therefore we attempted to isolate the latter source of variance in order to increase the precision of the estimates of knowledge and skill improvement regardless of the participants' computer skills. A computer skills assessment, implemented just before starting the game, was developed to provide a quantitative measure of each participant's ability. The assessment asked the participant to rate their confidence in completing computer related tasks with varying levels of support (e.g. "Using a new software package if I had only the software manuals for reference"); indicate how many hours per week they spend using computers at work and at home; and their experience playing video games. The response to the computer confidence and use items were summed into a computer summary score and used in statistical analyses to control for the degree to which computer ability affected the outcomes of the game. Demographic characteristics of participants were not systematically collected as part of the evaluation. However, some participants had previously submitted this data to the Learning Management System (LMS) through which the game intervention was deployed. Therefore, limited information was available to assess the success of the randomization into groups.

Research Design

The research design, as originally conceptualized, is illustrated below in Figure 1. A pool of participants, recruited from among the staff that would perform in the role of Clinical Coordinator in a DVC (i.e. physicians, nurses and clinical therapists) of the Chicago Department of Public Health, was to be randomly assigned to one of three arms in the study: a Game intervention arm, an Other Intervention arm and an "empty" Control arm. Each group was to complete both the pre- and post-tests. Statistical comparisons between groups would therefore allow for an estimation of the effect of the intervention.

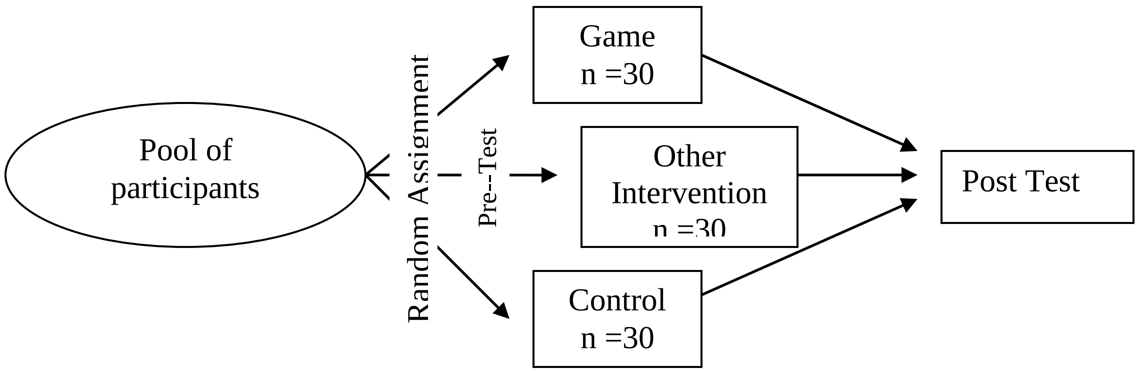

Figure 1: Research design

This research design allowed for a test of the internal validity of the intervention or the degree of confidence one can have that the intervention actually caused any evident effects. Although the same questions could have been answered with only two groups, the Game Intervention and the Control arm, the inclusion of another intervention strengthened the design. The Other Intervention was to be modeled on what is the most common form of staff training, a face-to-face lecture about the topics related to conducting a DVC which is, in fact, how CDPH staff are traditionally trained about DVC roles. Thus, the inclusion of the Face-to-Face group provided an opportunity to assess the relative effectiveness of the computer based intervention against the current practice. A “second iteration”, in which all participants played the game a second time, was included to ascertain whether repeated exposure to the simulation enhanced learning.

Challenges encountered in the execution of the evaluation study required some modifications to the original research design. All CDPH staff who were to be included in the evaluation were employees with clinical responsibilities within the public health clinics that are run by CDPH. These clinical responsibilities created challenges in scheduling time away from work for the CDPH staff that were recruited to participate in the evaluation. As a result, only one afternoon was available for the evaluation activities to take place. Space limitations in the available computer labs would not allow for 90 participants to complete the evaluation activities all in one afternoon. As a result, the Control Arm of the evaluation had to be eliminated in favor of the Other Intervention (face-to-face training) and Game Intervention groups. This decision was made since it was the more conservative approach, as participants receiving any training were more likely to improve their knowledge of a DVC than those receiving no training whatsoever. The decision also maintained the integrity of the comparison between the simulation and the current training method which the project staff felt was more relevant than the comparison of the simulation to a control group.

On the day of the evaluation, all recruited CDPH staff were asked to report to computer labs on the campus of the University of Illinois at Chicago for random assignment to the Game (n=35) and the Face-to-Face (n=30) lecture group. The participants chosen for the evaluation had not been previously exposed to the game. The groups were divided further into two small groups that were each led by proctors. All participants were guided through the Computer Skills Assessment and pre-test to measure their baseline knowledge of the medical screener role in a DVC. The Face-to-Face Training group was then relocated to a different classroom to attend a thirty-minute training session with a CDPH trainer, which was focused on teaching the role of a Medical Screener in a DVC. Members of the Game Group were given a one page role sheet describing the medical screener role in a DVC and then navigated through a brief training module on the online interface for the game. They were instructed to complete the game, which took approximately 15 minutes. After the trainings, both the Game Group and the Face-to-Face Training Group completed the post-test to measure their knowledge after the training, as well as the satisfaction survey. Due to time constraints on the day of the evaluation, only one of the subgroups of the Game Group (n=20) was given the opportunity to play the game a second time and take a second post-test, to evaluate whether increased exposure to the game resulted in a greater level of knowledge about the medical screener role in a DVC. None of the participants assigned to the Face-to-Face Group were able to play the game after the face-to-face training, as was initially planned.

Results

Participants

With regards to demographic information for the participants, the majority of participants were female; most had a bachelor's degree or above. Nurses were the single largest occupational group; all of the participants worked at CDPH. Participants had an average of just over 14 years of experience (median 11 years). There were no significant differences between the two groups on any of the demographic variables.

Knowledge

Both groups evidenced statistically significant improvement from the pre-test to the post-test. While the Face-to-Face group had a slightly higher post-test score than the Game Group (66% vs. 62%), the difference between the scores was not statistically significant. In other words, the two interventions resulted in approximately equivalent, statistically significant improvements in knowledge. A subset of the Game group played the game a second time and took a second post-test. The result was another statistically significant increase in knowledge from a mean of 60% correct on post A to 67% on post B. The second iteration of the game therefore, resulted in the

Game group participants achieving a mean that was slightly higher than that for the Face-to-Face group, though the difference was not statistically significant.

Table 1 provides the data regarding the 17 Face-to-Face participants who completed both the pre- and post-tests. A paired samples t test shows this increase to be statistically significant, $t(16) = 10.76$ $p < .001$. NOTE: Due to time constraints on test day (familial, secondary employment and academic obligations), several of the Face-to-Face participants were unable to complete the post-test, hence the lower N than at the start of the evaluation.

TABLE I

PRE AND POST DATA-FACE TO FACE GROUP

Face to Face Group	Mean	N	SD[1]	SEM[2]
Mean Correct Pre	.434	17	.09	.02
Mean Correct Post A	.663	17	.09	.02

1: Standard deviation
2: Standard error of the mean

Table 2 presents the analogous data for the Game group, again evidencing a statistically significant improvement, $t(33) = 9.43$, $p < .001$.

TABLE II

ANALAGOUS DATA-GAME GROUP

Game Group	Mean	N	SD[1]	SEM[2]
Mean Correct Pre	.429	34	.09	.02
Mean Correct Post A	.619	34	.15	.03

1: Standard deviation
2: Standard error of the mean

Table 3 presents the data for Post A and Post B for the Game group. The improvement was statistically significant, $t(19) = 2.41$, $p < .05$.

TABLE III

POST A AND POST B DATA-GAME GROUP

Game Group	Mean	N	SD[1]	SEM[2]
Mean Correct Post A	.604	20	.16	.04
Mean Correct Post B	.665	20	.19	.04

1: Standard deviation
2: Standard error of the mean

There were no statistically significant differences between the two groups on the summary measures from the Computer Skills Assessment. Scores for the total sample and the Game group separately were analyzed to determine what relationship computer skill level might have with the assessment results. Figures 2, 3 and 4 show the distribution of the two groups on the variables regarding amount of time using computers and experience with playing video games. The distributions are relatively similar although there are some differences at the upper end of the distributions for the variables regarding computer use at home and experience with video games, suggesting that the Game group might have had somewhat less experience in both areas. Chi-square analysis maintaining the original five levels of each of the variables showed no significant differences between the two groups. Collapsing the variables into two levels, high and low computer use and recent and not recent/never played computer games did not change the results of the chi-square analysis.

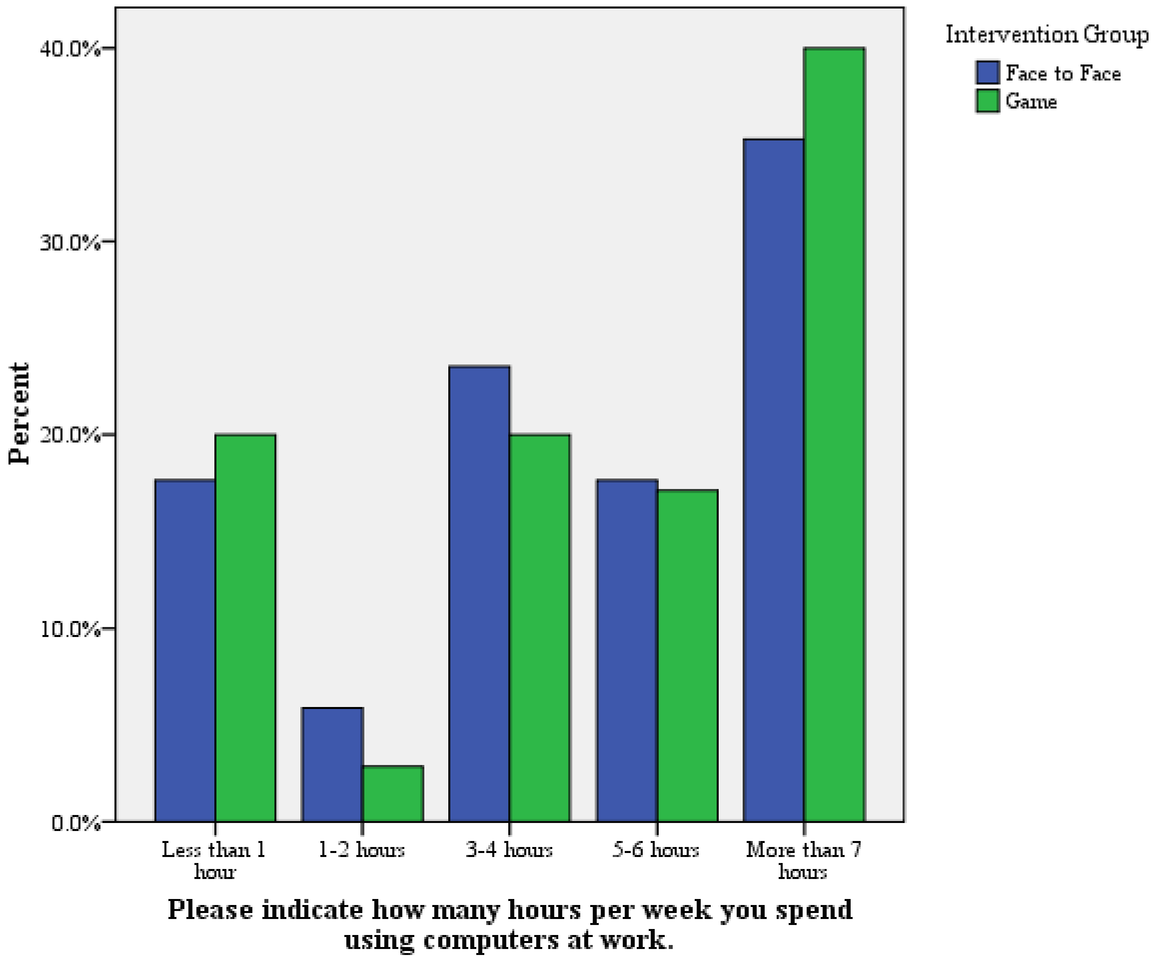

Figure 2: Hours per week using computer at work

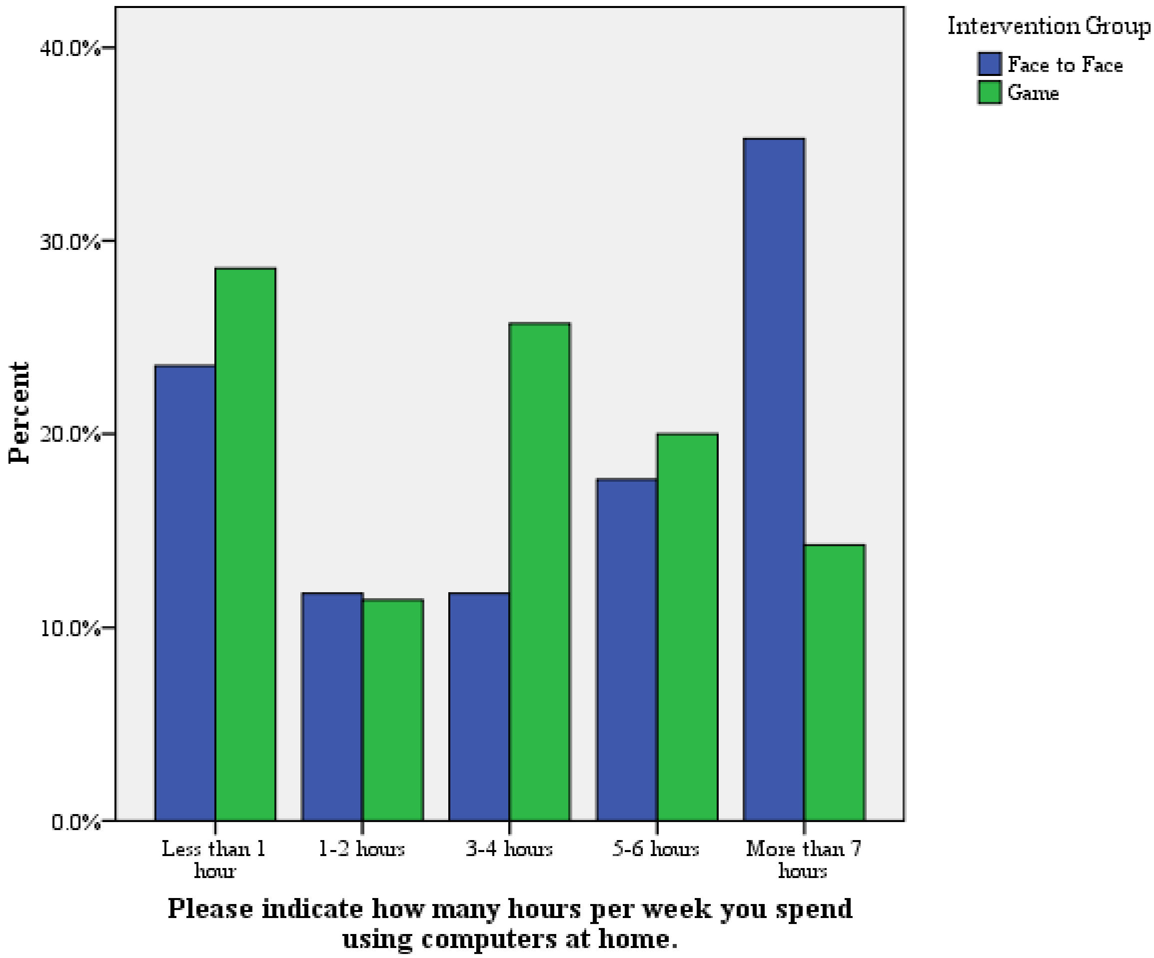

Figure 3: Hours per week using computer at home

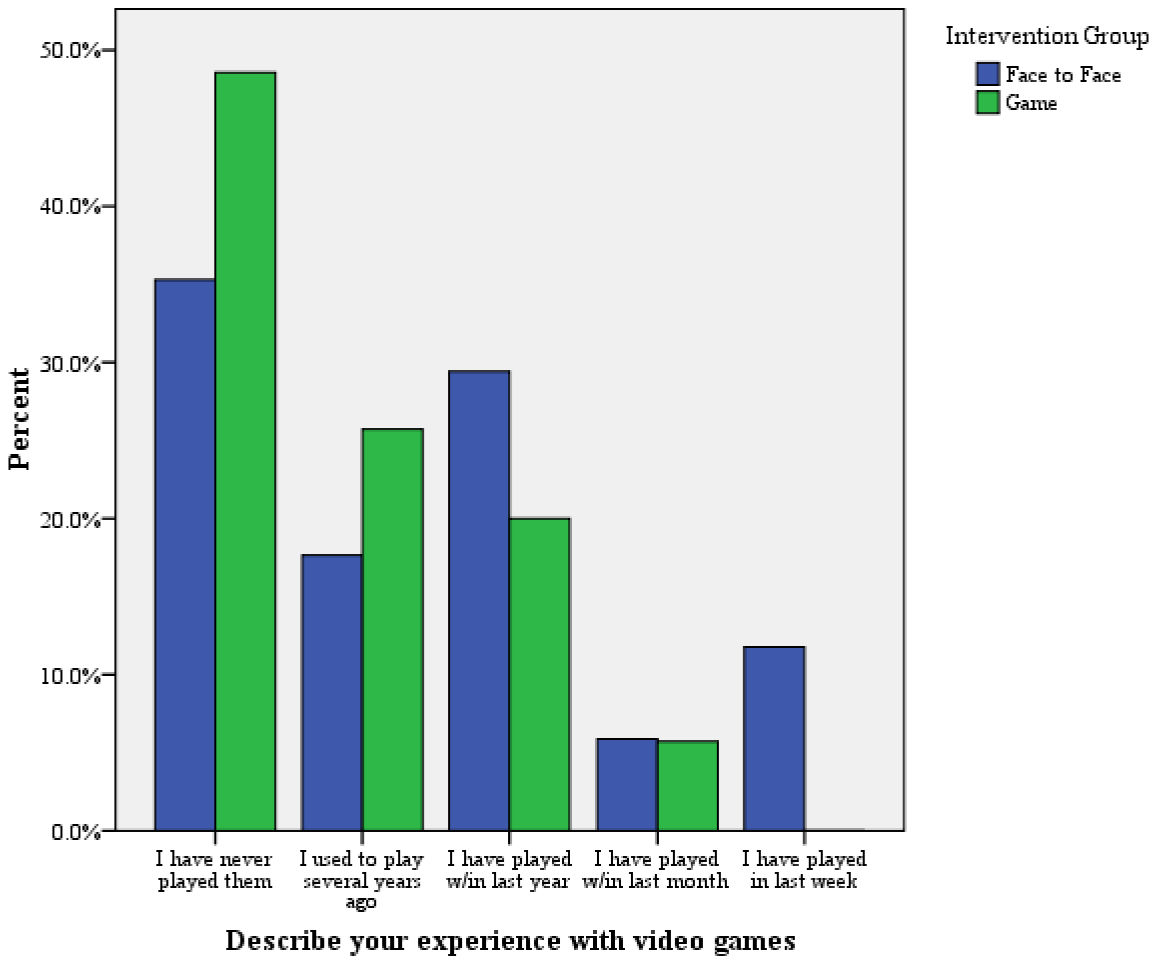

Figure 4: Description of experience with video games

Examination of the bivariate correlations between the pre-test scores, the post-test scores and the difference between those scores (post score minus pre score) and the computer summary score and years of experience variables revealed the relationships portrayed in Tables 4, 5 and 6. The years of experience variable was negatively correlated with all the assessment variables and significantly so with the post-test score for the total sample and for both the pre- and post- test scores for the game group. If one were to take the years of experience variable as a proxy for age one might wonder whether this pattern of negative relationships might be indicative of a lower level of computer ability for the older participants. A measure of this relationship is given by the correlation between the computer score and the years of experience variable. While the computer score variable was negatively correlated with the years of experience variable in the total sample and in the game group, these correlations did not reach statistical significance. When controlling for the computer summary score, the partial correlation between the years of experience variable and each of the three assessment scores was significant only for the post-test suggesting it was not computer ability but some other aspect of, or related to the years of experience variable that underlies this significant association (see Table 6).

TABLE IV

CORRELATIONS-TOTAL SAMPLE

		Mean Correct Pre	Mean Correct Post A	Post Mean Minus Pre Mean	Years of Experience	Education Level	Computer Summary Score
Mean Correct Pre	Pearson Correlation	1					
	Sig. (2-tailed)						
	N	65					
Mean Correct Post A	Pearson Correlation	.591**	1				
	Sig. (2-tailed)	.000					
	N	51	51				
Post Mean Minus Pre Mean	Pearson Correlation	-.125	.726**	1			
	Sig. (2-tailed)	.381	.000				
	N	51	51	51			
Years Of Experience	Pearson Correlation	-.209	-.396*	-.240	1		
	Sig. (2-tailed)	.168	.020	.171			
	N	45	34	34	45		
Computer Summary Score	Pearson Correlation	.182	.197	.135	-.139	.144	1
	Sig. (2-tailed)	.150	.169	.349	.361	.254	
	N	64	50	50	45	65	65

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

TABLE V

CORRELATIONS-GAME GROUP

		Mean Correct Pre	Mean Correct Post A	Post Mean Minus Pre Mean	Years of Experience	Education Level	Computer Summary Score
Mean Correct Pre	Pearson Correlation	1					
	Sig. (2-tailed)						
	N	35					
Mean Correct Post A	Pearson Correlation	.617**	1				
	Sig. (2-tailed)	.000					
	N	34	34				
Post Mean Minus Pre Mean	Pearson Correlation	-.007	.782**	1			
	Sig. (2-tailed)	.970	.000				
	N	34	34	34			
Years of Experience	Pearson Correlation	-.451*	-.455*	-.224	1		
	Sig. (2-tailed)	.027	.029	.303			
	N	24	23	23	24		
Computer Summary Score	Pearson Correlation	.090	.292	.285	-.185	.179	1
	Sig. (2-tailed)	.614	.099	.108	.386	.302	
	N	34	33	33	24	35	35

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

TABLE VI

PARTIAL CORRELATIONS-GAME GROUP

Control Variables			Mean Correct Pre	Mean Correct Post A	Post Mean Minus Pre Mean	Years of Experience
Computer Summary Score	Mean Correct Pre	Correlation	1			
		Sig. (2-tailed)				
		Df	0			
	Mean Correct Post A	Correlation	.595	1		
		Sig. (2-tailed)	.003			
		Df	20	0		
	Post Mean Minus Pre Mean	Correlation	-.086	.749	1	
		Sig. (2-tailed)	.702	.000		
		Df	20	20	0	
	Years of Experience	Correlation	-.405	-.423*	-.190	1
		Sig. (2-tailed)	.061	.050	.397	
		df	20	20	20	0

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Satisfaction/Confidence/Course Evaluation items

Table 7 provides the means for each of the satisfaction/course evaluation items by group, along with the probability value for a two tailed test for the significance of the difference between the group means. The Game group rated their experience more toward the anxiety-provoking and fast paced end of the continuum for each of those respective items (bolded). The face to face group had means slightly, though not significantly, higher for all the confidence items, however, the game group means were all 3.55 and above on scale of 1-5. While large majorities of both groups said they would play the game/take the training and recommend the game/training to others, these majorities were slightly larger in the game group.

TABLE VII

MEANS SCORE SATISFACTION/COURSE EVALUATION ITEMS

	Intervention Group	N	Mean	2 Tailed Significance for Difference
Game Qualities Items (scale 1-7)				
Useless to Useful	Game	31	5.39	.657
	Face to Face	17	5.18	
Difficult to Easy	Game	31	4.23	.272
	Face to Face	17	4.82	
Pleasant to Unpleasant	Game	31	3.39	.405
	Face to Face	17	3.00	.
Meaningless to Meaningful	Game	31	5.06	.539
	Face to Face	17	5.35	
Time Saving to Time Consuming	Game	31	3.71	.465
	Face to Face	17	3.35	
Efficient to Inefficient	Game	31	3.39	.561
	Face to Face	17	3.12	
Inappropriate to Appropriate	Game	31	4.77	.384
	Face to Face	17	5.18	
Rigid to Flexible	Game	31	4.06	.515
	Face to Face	17	4.35	
Stimulating to Boring	Game	31	2.65	.075
	Face to Face	17	3.47	
Creative to Unimaginative	Game	31	2.45	.053
	Face to Face	17	3.35	
Impersonal to Personal	Game	31	4.03	.956
	Face to Face	17	4.06	
Anxiety-provoking to Calming	Game	31	3.19	.001
	Face to Face	17	5.00	
Too Fast to Too Slow	Game	31	3.00	.018
	Face to Face	17	3.88	
Unclear to Clear	Game	31	4.00	.051
	Face to Face	17	5.00	.
Confidence Items (scale Not Confident 1-Very Confident 5)				
Confident to complete role	Game	31	3.61	.284
	Face to Face	17	3.94	
Confident to minimize distractions	Game	31	3.55	.053
	Face to Face	17	4.12	
Confident to respond to threats	Game	31	3.68	.364
	Face to Face	17	3.94	
Confidence before and after	Game	31	3.65	.321

MEANS SCORE… (continued)				
	Face to Face	17	3.94	
Game Specific Items* (scale 1-4)				
User training- Useful to Not useful	Game	31	2.03	.
Game in general- Easy to Hard to play	Game	31	2.42	
Medical Screener Didactic sheet- Useful to not useful	Game	31	1.94	
Additional items*- yes, no, maybe		Yes/Maybe	No	
Would you play game/take training again?	Game	87.1%	12.9%	
Would you recommend to coworkers?	Game	87.1%	12.9%	
Would you like multiplayer version?	Game	61.3%	38.7%	

* Participants in the face to face group did not answer these questions

Discussion

The results of this evaluation of a computer-based simulation to train staff for the role of a Medical Screener in a mass Dispensing and Vaccination Clinic show that this relatively brief, computer simulation is as effective in preparing staff as the current method of training, face-to-face lecture. This finding is particularly important due to the need to train staff who do not fulfill DVC roles on a day-to-day basis (CDPH staff), as well as staff who otherwise would not have experience in implementing a DVC (partner agency staff). In light of the 48-hour CRI requirement, this finding also indicates that utilizing the simulation technology can enable CDPH to train large numbers of staff to fulfill DVC roles. Participants generally had a favorable response to the simulation. Qualitative accounts taken from participants indicated that participants were pleased with the training modality and their interest during game play was maintained. Participants reported:

- "“Game is very practical and useful and an excellent teaching tool.”
- "“Very interesting...fun way to learn.”
- “Excellent. This game requires the screener to multitask during the situation.”
- “I thought this game would be easy, but it really required me to think critically about my decisions. Thanks.”
- “It was fun.”

Such qualitative insights from participants were important, due to departmental plans to change its training modalities to include simulation training. Worker perceptions and attitudes related to the game had larger policy and leadership implications, not only related to implementation of the new training modality for emergency preparedness across the department but also would factor into future decisions made with regards to application of future funding to continue the development of simulation technologies. Departmental leaders were clear in their goals to ensure a successful implementation of the revised training program and worker acceptance was deemed critical to achievement of those goals.

Lack of computer skills did not seem to impair participants’ ability to benefit from the intervention (another important finding), though this needs further investigation. Given the similar effectiveness of the simulation and the face-to-face training, the simulation may have great potential for delivering training in a very cost- and time- effective manner. For example, though there were significant costs to develop the simulation, the training can now be supplied literally at the flip of a switch. A version of the software could be developed that could be disseminated through CD's, over the internet, or loaded on to computers anywhere. Staff could play the game multiple times at their convenience which would provide a level of exposure to the training that would be difficult, if not impossible, to match with a face-to-face methodology. Future studies should address the return on investment question for this and other training simulations.

The evaluation has several notable strengths and raises some interesting hypotheses for future study. The participants in the evaluation are typical of the staff that is the target audience of the training, practitioners with experience in the field; although possibly minimal experience with response to large-scale emergencies, but with perhaps relatively little experience with computer use and video games. Despite the rather novel mode of delivery, the participants in the game group provided generally positive feedback about training, though they rated the game as somewhat more toward the "anxiety-provoking" end of a semantic differential scale that ranged from "anxiety-provoking" to "calming" and "too fast" on a scale that ranged from "too slow" through "too fast". While one might normally see this provocation of anxiety in a training experience as a negative, in this situation it might be that the game players actually were gaining a better understanding of the reality of a live DVC. An actual DVC is likely to be very hectic and a training that simulates that level of tumult is a more realistic training and might better prepare the trainee for the actual situation. If this hypothesis is correct, one might further surmise that the game players' confidence in their ability to complete the responsibilities of the Medical Screener role would be somewhat depressed relative to the Face-to-Face group but that may be as a result of a more realistic understanding of the nature of a live DVC. This is an issue that should be addressed in future investigations.

Several limitations in the study should be noted. The difficulties of doing evaluations with staff members of local health departments that are understaffed and generally under resourced are several. Pulling staff away from other duties and coordinating schedules for large numbers of individuals create numerous issues for this type of evaluation. In this case, the anticipated “empty” control had to be dropped and the randomization procedure had to be implemented on site the day of the training rather than ahead of time as planned. Fortunately, the randomization procedure seemed to work well as evidenced by the similar demographic distribution in the two groups and, even more clearly in the pre-test results for both groups. In addition, there was considerably more loss to follow-up in the Face-to-Face group relative to the Game group. This was probably as a result of logistical issues that required the Face-to-Face participants to move from one class room to another while the Game participants were able to stay in one room the entire time.

Conclusion

The mass Dispensing and Vaccination Center computer simulation shows great promise as a training tool to teach the responsibilities of the Medical Screener role. Our results show that the simulation was as effective as the more traditional face-to-face lecture modality and are suggestive that the simulation might actually be more effective in communicating the chaotic nature of a live DVC situation. These results are particularly important as the need for skill and capability development among workers becomes more relevant and necessary to public health response. Simulations have long been used as decision support tools in other disciplines, including the military where simulations aid in assisting soldiers to better perform their missions. [7] As federal requirements for both planning and training continue to increase and the magnitude of natural disasters become more devastating, public health is in desperate need of training modalities that can deliver training to large numbers of staff in a manner that is both cost-effective and non-resource intensive. We believe the findings of this evaluation suggest that simulation technologies are both applicable and effective for public health training needs.

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V. Harnessing 21st Century Simulation Technology in a 19th Century Public Health Agency

Introduction

Simulation technology offers realistic representations of real world situations. Used in various fields to train workers in replicated real world scenarios, simulation technology has been especially effective in training programs for both the military and healthcare arenas. This technology, however, has not previously been used as a public health training tool. The need to prepare for an ever increasing variety of threats and hazards challenges public health workforce training and preparedness efforts, calling for new and more effective tools to sufficiently train workers. “One part of preparing to act is training and rehearsal in an environment similar to what will be faced during a real emergency”.[1] This paper explores the use of simulation technology for public health training, as undertaken by a large, municipal health department and highlights the challenges that were encountered in the widespread deployment of simulation-based training.

Workforce Preparedness

The workforce is the keystone of the public health infrastructure and “the most essential element in our collective efforts in assuring the public’s health.”[2] Workforce development in public health has been widely studied yet agreed upon standards for measuring worker competence and improving worker skill-sets simply don’t exist. The difficulty with assessing workforce preparedness stems in part from the varied backgrounds of public health workers and an inadequate understanding as to how the intersections between formal education in public health and years of practical experience in the field contribute to and promote worker competence. Although more than 75% of the professional public health workforce lacks formal education in the field, public health workers acquire considerable skills, including those important for responding to emergencies, on the job.[3]

There have been several recent initiatives aimed at improving workforce competency. Government efforts, largely through the Centers for Disease Control (CDC), Health Resources Services Administration (HRSA) and the Office of the Assistant Secretary for Preparedness and Response (ASPR), fund state and local public health agencies and academic institutions for collaborative attempts to enhance workforce preparedness. The overall impact of these efforts is not clear, although there is widespread agreement that much remains to be done and that innovative approaches and new technologies are needed to ensure workforce preparedness. Acts of terrorism, emerging infections, rising rates of chronic diseases and other public health challenges will continue to occur and cannot be effectively mitigated without a strong public health infrastructure.[4] Emergency preparedness has led to an increased interest in the “employment, training and uses of workers who are prepared to respond to emergencies”.[5] However, without evidence-based methods for assessing and enhancing worker competence, it is difficult to determine who is prepared and who is not.

Public health workers, particularly emergency preparedness staff, acquire many of their skills through real-world experience. Response to natural disasters, such as floods, tornados and hurricanes provide opportunities for public health emergency preparedness (PHEP) staff to develop skills necessary to mitigate the effects of these disasters. Disease outbreaks, such as foodborne illnesses, meningococcal disease and influenza afford similar opportunities. During responses to these types of events, public health workers assess the extent of the emergency and make decisions necessary for effective response and mitigation. These decisions could involve resource deployment; restrictions on individuals or communities; utilization of skilled workers in specific areas of the disaster response; and command and control decisions, among others. Such actions are typically beyond the scope of day-to-day public health practice, creating the need for public health workers to practice these responses through exercises and drills. But, the stark reality of preparedness exercises is that during an exercise or drill, not every worker gets to “play”. Most capabilities tested during drills and exercises are those that public health workers do not typically perform on a day-to-day basis. Some capabilities, such as mass prophylaxis, require that workers not only develop the skills necessary to execute the mission but that they perform these skills with speed and efficiency. Real-world disasters and events offer the best opportunities for improving skill development, but these events can be few and far between. Public health practitioners now understand that the magnitude of training requirements, combined with the continuously cascading initiatives that bring with them additional training needs, creates difficulties and challenges that make meeting these requirements near impossible without the implementation of innovative approaches and technologies that provide a platform for training large numbers of workers in a manner that is both cost-effective and ensures skill competency.

Gaming/Simulation Technology

Video games are certainly not what they used to be. Originally developed for entertainment purposes, gaming technology has evolved significantly and is now being deployed extensively in many fields, including medicine/healthcare, the military, education and aviation, as a training tool using simulated real-world scenarios.[6] This technology allows trainees to interact with colleagues and navigate challenges in 3-dimensional, simulated environments or scenarios where they can “role play, communicate, and interact in real-time via the Internet”.[7] Simulations can also “capture the dynamic relationships between a wide variety of objects and allow the humans using them to extend their faculties of analysis and extrapolation."[8] Gaming and virtual world technologies can be developed and adapted for both individual and team training needs, thereby allowing for a wide range of capability development within organizations. Assessments and/or knowledge tests can also be built into games, thereby allowing for supervisory review of worker performance post-training. This then provides supervisory personnel with evidence-based indicators of employee performance and easily identifiable mechanisms for determining gaps in employee learning, which can then can be used to determine continued training needs for individuals as well as groups of employees.

The Use of Simulation Technology in Chicago

The Chicago Department of Public Health (CDPH) uses simulation technology to train workers in their roles associated with the management and distribution of Strategic National Stockpile (SNS) assets. The Cities Readiness Initiative (CRI) requires SNS assets to be distributed within a 48-hour timeframe, a formidable challenge for local health departments such as CDPH serving large populations since the Department would not be able to meet these requirements using its own staff; staff from other city agencies and partner organizations would have to be engaged. The idea to explore simulation technology arose out of this need to train large numbers of workers from both CDPH and other agencies in the roles they would have to fulfill to meet the SNS/CRI mission and timeframes. Training and skill development for an overwhelmingly large number of workers did not lend itself to using traditional training mechanisms, so an alternative solution was needed. Leadership challenges were immediately apparent as employing new processes would alter the way the Department had traditionally conducted its training programs. A large degree of buy-in would be needed at multiple levels in order for this change to be successful.

Initially, a video game was developed to train workers on their roles within a dispensing center, or point of dispensing (POD). The initial role for the game was that of the medical screener, the first point of contact for the public and the role which sets the tone for flow throughout the other components of the dispensing center. An initial evaluation of the effectiveness of the game (for the medical screener role) was conducted and results showed that the game was as effective as traditional training modes with respect to achievement of learning objectives. In addition, video game delivery through the Internet via the CDPH Learning Management System (LMS), made the training accessible to a greater number of workers at any time of the day, thus eliminating the need to schedule and coordinate multiple face-to-face training sessions.

Based on this initial experience, CDPH expanded its use of simulation technology. The simulation technology is now used in CDPH's community health centers to train workers, both clinical and non-clinical, in the roles that they will fulfill during a mass dispensing effort. Workers engage in game "play" using the video game to learn the nuances of their role within a dispensing center. Subsequently, a mock dispensing center is set-up in the clinic so that workers are able to perform their roles in a simulated, real-world scenario. In addition to the medical screener role, the game now incorporates several other roles within a dispensing center, including forms review, dispensing, and the captain role (leadership role within the center). The dispensing role tests clinical skills of the player by requiring the evaluation of the weights, ages and pre-existing medical conditions of patients and the determination of the appropriate antibiotic medication to dispense based on that data. This module of the game also provides feedback to the clinician when their decision results in an adverse reaction due to the dispensing of the inappropriate medication.

CDPH has also developed training using the Virtual World Technology, Second Life. In these trainings, workers are portrayed with the use of avatars and must navigate themselves through real-world disaster scenarios, including appropriate set up of a POD, set-up and management of a Receiving, Staging, Storage (RSS) site, hospital evacuation, fatality management, HAZMAT scenarios, tent set-up (for area/field command) and alternate care site/field hospital set-up. These simulations place workers right into a disaster scenario and require them to manage the high-stress situations associated with mobilizing necessary resources and engaging in the logistical operations associated with ramping up to respond to a disaster event. Through the ASPR Hospital Preparedness Program, CDPH has also provided funding to select hospitals to utilize Second Life to develop disaster scenarios requiring hospital evacuation.

These technologies can serve as an intermediary between tabletop exercises (TTXs), discussion-based exercises where workers review plans and "discuss" what their actions would be during the response, and functional/full-scale exercises or real-world disasters/events, where workers physically engage in the appropriate response actions. They also provide public health workers with limitless exposure and access to the training. Workers can learn their roles fully in the training environment, which then alters the focus of full-scale and functional exercises to throughput or speed of performance rather than role-learning. The results of an evaluative study of simulation technology support this claim.[7] Heinrichs et al utilized simulation exercises to train pre-hospital (EMS) and in-hospital teams to conduct triage after a CBRNE (chemical, biological, radiological, nuclear, explosives) incident. In these exercises, emergency medical services (EMS) workers responded to the scene of a dirty bomb explosion where they found injured patients needing transport to hospital facilities for injuries sustained in the explosion. The subsequent portion of the exercise then tested in-hospital staff in the re-triaging of patients coming into the hospital, by ambulance, on foot or by car following the release of a Sarin gas attack on a commuter train. Once being placed into their scenarios, pre-hospital workers were then required to respond to the call, set up triage areas, perform the appropriate triaging of patients, place patients in ambulances and transport them to medical facilities. In-hospital workers began play at the point where patients began arriving at hospitals. They were required to review the triage status of incoming patients, perform any necessary reclassifications, and perform decontamination of patients. The results indicated that 69% of the volunteer subjects were not gamers, or persons who regularly play serious games. Additionally, 62% had no prior training in response to mass casualty CBRNE incidents. Sixty-two percent also reported that the session changed their feelings and attitudes about working as a member or leader of a team. Feelings of immersion into the scenario and increased confidence in their ability to respond to a CBRNE incident were also reported.

Reaction to the Technology in Chicago

The data and experiences noted in the Heinrichs study differ drastically from the results CDPH achieved via the evaluative study the department conducted to assess simulation technology developed for worker training. In the CDPH study, a pool of clinical staff (i.e. physicians, nurses and clinical therapists) was randomly assigned to one of two study groups. One group constituted the “game” group, or the participants exposed to the simulation game as the training mechanism, while the second group constituted the “other intervention” group, in which participants were exposed to a face-to-face training as the training mechanism. Each of the two groups participated in both pre and post-tests to generate data which would allow for the analysis of the effectiveness of the training intervention. Statistical results (quantitative) of the study indicated that both the game and face-to-face training resulted significantly in improved knowledge; however the difference between the scores was not statistically significant, indicating equal effectiveness. Subsequently, repeated exposure to the game interface resulted in more statistically significant increases in knowledge. Important to note as well is that nearly 50% of the game group had never played video games, while another 25% reported having played them several years prior. Perhaps more telling than the statistical data however, was the qualitative data and raw, honest feedback obtained from participants; the worker attitudes regarding the training. Participants generally had favorable responses to the game simulation. Participants reported that they liked the training, that it held their interest. More specific responses from participants included:

- "The game is very practical and useful and an excellent teaching tool."
- "Very interesting…fun way to learn."
- "Excellent…"

The leadership at CDPH was encouraged by this feedback and felt worker attitudes and perceptions surrounding the technology would be critical to the success of a larger effort to implement the technology Department-wide. However, worker attitudes and perception soon became the very factors that lead to the retardation of efforts toward widespread implementation of the technology. Once the evaluative study had concluded and broader implementation efforts began, many workers, workers other than those who were included in the study, expressed doubt and apprehension about the technology. There was hesitance, skepticism and in many cases, fear that the technology may reveal weaknesses and deficiencies in skill level. It is interesting to note that these concerns came from older staff; staff who lacked computer literacy; and in some cases, staff whose titles and responsibilities were at levels lower than the study participants. Excuses were abundant, complacency was obvious and value of the technology minimized, which left leadership to question whether additional investments in the technology were prudent.

While the response to the technology from CDPH staff was low, the response from hospital partners was overwhelmingly positive. CDPH had provided funding to select hospitals for development of virtual environments in the Virtual World Technology, Second Life. This technology enabled hospitals to replicate the hospital environment and have their staff practice hospital evacuation procedures. CDPH leaders found that hospital staff saw the value in the technology, in that it provided the ability to practice medical evacuation procedures without having to be concerned with actual patient safety issues. In comparing hospital worker response to the training and the knowledge of widespread simulation use in the military, CDPH leaders contemplated why resistance was so strong among public health workers when workers from other fields saw clear value and benefits in the technology. It didn't take much time for CDPH leaders to recognize that many public health workers still operate from the mindset that emergency preparedness is a fleeting concept; that the concept is more fallacy than fact. Such was true for many CDPH workers. In the military, terrorism is real, but for many in public health it is not. For hospital workers, particularly emergency department staff, trauma and emergent situations are daily facets of life. Even slight errors in operational procedures can translate into critical patient safety issues and the potential for loss of life. Therefore, opportunities to "practice" and "make mistakes" without jeopardizing human life are welcome in this environment. For CDPH, a less aggressive, more personable approach to training delivery began to emerge as a better strategy for greater acceptance and thus implementation of this technology.

Leadership Challenges/Policy Implications

Modifying longstanding organizational practices in a large bureaucratic agency does not come without its share of resistance by workers. New programs and initiatives can fail if worker support and buy-in is lacking, despite the existence of organizational champions who support the effort. It is for this reason that CDPH actively sought direct feedback from workers regarding their perception of the technology as a training tool. Workers reported feeling that they were generally pleased with the new training modality and that their interest during game play was maintained. Workers described the training as a fun, effective training tool and acknowledged that they were made to think critically during game play. This insight was critical to department leaders, who were contemplating whether or not to continue with this technology in order to include multiple role modules and integrate the technology into the agency's overall training repertoire.

The central challenge at CDPH with implementing this new technology was overcoming the organizational barrier that "this is how we've always done it" in reference to traditional training modalities. This challenge continues and agency-wide acceptance still has not been achieved, several years after the initial deployment of the technology. Similar to many public health agencies, CDPH has an aging workforce, some of whom are resistant to advances in technology. A significant subset of the CDPH workforce also has limited experience with computers and computer technology, which has slowed worker adaptation to the technology. In an effort to overcome this barrier, CDPH has provided trainings on basic computer skills; however this has not overcome resistance from these workers. Resistance to utilizing the technology takes several forms, including "I don't have time log in and play the game"; "my manager won't allow me; and "I don't understand the key board and how to log in". Some supervisors and managers contribute to the resistance because they have not required their staffs to log in and complete the training.

CDPH leadership has had to develop strategies for overcoming these barriers in order to complete implementation of this technology into the Department's training program. Initial complaints from the community health centers indicated that computer resources in the clinics were insufficient to allow workers to take the training. In response, computer kiosks were deployed to the clinics to provide access to game simulation, email and other technology. This deployment removed the excuses, but did not result in widespread utilization of the training. As a result, a hybrid, but more personal approach to training delivery using the gaming technology was introduced. Training unit staff visits CDPH community health centers to deliver dispensing center training. Role learning via the video game is built into the training, where employees must play the game before being allowed to proceed to the dispensing/vaccination portion of the training. This approach gives CDPH trainers and leaders better control in both general training and emergency response situations. If the game/technology is where the information is, the staff will go there to get it. Personal approaches and encouragement have worked well for some employees, but not all. Additional employee mandates were established in order to motivate employees; these mandates were tied to punitive measures such as disciplinary action or financial implications.

In the current climate of increasing demands and decreasing resources, approaches to public health emergency preparedness training needs to be strategic in nature. In 2005, when the Department of Homeland Security analyzed how it used training to achieve its organizational goals, it found strategic management of training to be effective in enabling the organization to achieve its goals, despite continuously limited resources.[10] This represents another valuable lesson that public health can learn from more traditional public safety partners. As a first responder, public health must prepare for responses to the hazards and threats most likely to occur within its community, much like police and fire officials prepare for incidents common within their professions. Because emergency response is not widely considered a part of daily public health responsibility, simulation technology can help prepare public health organizations and workers to appropriately respond to large-scale emergency events and in its employment, public health has the opportunity to look more strategically at development of training programs to meet and respond to emerging and re-emerging threats. Employment of a more strategic approach to training necessitates analysis of human resource needs and required skills, which can contribute to broader, more effective policy development with regards to approaches to emergency preparedness.

Agency-level strategic priorities are frequently driven by executive level leadership and may include input from staff, either via committee or “open comment” periods. An opportune time to introduce transformational change initiatives would be during “visioning” or strategic planning sessions when agency leaders are engaged in the evaluation of organizational functioning and progress and examining the direction in which the organizations need to go in the upcoming years. Often, transformational activities become the vehicles that enable the strategic plans and visions to take shape, as they become the basis for the development of new policy mandates and procedural enhancements that are aimed at helping the organization achieve its new strategic priorities.

At CDPH, a transformational change is underway within the organization with younger workers embracing the change, but older staff remains resistant despite efforts to demonstrate the usefulness and value of the new training modality. Public health agencies such as CDPH need to implement larger policy changes that support more streamlined, mandatory training programs across the agency. This will be necessary in order to foster the organizational culture shift necessary for complete adoption of the technology. A more computer savvy workforce is also necessary to further organizational acceptance of the technology; this has implications for all public health agencies with regards to its hiring and recruitment efforts. Overall, public health agencies need strong leadership in support of workforce development with all training mandates supported by and enforced by the highest levels of the organization's executive level leadership. The integration of simulation technology at CDPH represented an innovative approach to workforce preparedness with vast benefits. However, the widespread implementation of this new training modality depended too heavily on worker perception and acceptance; a bottom-up approach. Other public health agencies considering simulation technology can avoid this pitfall by approaching new innovations from a top-down approach. Training must be developed in accordance with the agency's strategic goals and would ensure worker preparedness across the organization for any type of response involving the agency. Strategic approaches to workforce development create worker preparedness on a departmental level vs. a programmatic level. In doing so, emergency preparedness trainings would be mandatory and the training curriculum would employ the use of preparedness strategies that would help mitigate all hazards and vulnerabilities that the organization might encounter. This type of approach would decrease competition with excuses and eliminate the siloed approach to training, which currently exists within many public health agencies. This is how true transformational change within a large, bureaucratic agency is driven and implemented. While worker perception and acceptance are important, it is clear that the policy mandates must come from executive level leadership within the agency, despite competing priorities that seek to push this issue farther down the list of agency priorities.

Conclusion

Evidence-based mechanisms for assessing worker preparedness in public health are still very much needed. The varied backgrounds of public health workers and uncertainty as to how the relationship between formal education and practical experience in the field contributes to worker preparedness remains unknown and further complicates this issue. As threats to the public's health continue to increase, solutions to the worker preparedness issue are necessary and long overdue. Simulation technology is an option that can be a viable one for public health as public health leaders seek cost-effective solutions to its problems of infrastructure/capacity development. Simulation technology replicates real-world scenarios and enables workers to develop a wide-range of capabilities, both individual and team-based. An added bonus to simulation technology is the functionality it possesses to allow for evidence-based indicators of employee performance.

A large percentage of the public health workforce acquires skills on the job, particularly those skills important to emergency response. So, simulation technology shows great potential as a new tool for public health workforce development. Experience with game simulation adoption as a training tool in other sectors can lead to standards in the field. It is highly speculative to think this will happen in public health, however with the Institute of Medicine's identification of simulation technology as a research priority for public health[11]; this becomes increasingly possible. CDPH sought to use this technology and subsequent technological advances to move its training program forward into the 21st century. Complacency and lack of willingness to change has retarded these efforts; however the agency remains committed to improving processes from the back office to the front lines of response that will eventually move training needs to the top of the priority list. "These tools and techniques are becoming more socially acceptable, even socially desirable, as the people who experienced games as children become the next generation of leaders in business, government and the military."[6] With ever increasing expectations and rapidly evolving technologies, it is time for public health to get into the game.

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APPENDICES

APPENDIX A: Pre and Post Test Knowledge Items

The following questions refer to the role of a medical screener in a Dispensing and Vaccination Center (DVC) during an emergency. Please choose the best answer for each question. If you do not know the answer to a question, please choose your best guess.

1. In your role as a medical screener, if someone is having a hard time walking, what should you do?
   A. Contact On-Site Coordinator and request a wheelchair.
   B. Locate an On-Site Volunteer to help locate a wheelchair.
   C. Call your Captain and ask for assistance.
   D. Ask the person to sit down at your station and rest while you continue serving people in your line.

2. How long should it take to get medications to all people in Chicago?
   A. 12 hours
   B. 24 hours
   C. 48 hours
   D. within a week

3. When working at a DVC, you should receive your vaccination.
   A. Before your shift
   B. After your shift
   C. During a break in your shift
   D. After the DVC closes.

4. When working at your station it is okay to

   A. Call your captain
   B. Call Security
   C. Call the On-Site Coordinator
   D. Ask your neighbor for help if needed
   E. All of the Above

5. Your goal at the DVC is to have a rate of …
   A. 1600 people per hour or faster
   B. 1200 people per hour or faster
   C. 800 people per hour or faster
   D. 1000 or less to insure quality of service.

6. If a non-English speaking person comes to you for help, you should?
   A. Try to get them to understand you by speaking slow and pointing.
   B. Call the On-Site translator.
   C. Call your Captain
   D. Send them to Medical Evaluation.

APPENDIX A (continued)

7. If you need to go to the bathroom, you should?
   A. Hold it, until your break
   B. Call your Captain
   C. Ask your neighbor to cover your station while you go.
   D. Tell the next person in line that you will be right back and go use the restrooms.

8. If a person has questions about Anthrax you should:
   A. Answer them to the best of your ability.
   B. Refer the person to the medical handout
   C. Be polite and start asking the basic screener questions.
   D. Call your Captain

9. To speed the line up its okay for the Medical Screener to…
   A. Resist calling your captain and try to handle events on your own.
   B. Handle groups of people at the same time versus one at a time.
   C. Ask for assistance from your captain when needed.
   D. Quickly review forms and look for simple errors.

10. A woman tells you that she has no drug allergies but is concerned about her prescriptions causing a conflict with the drugs being dispensed. What do you do?
   A. Call the Clinical Coordinator
   B. Send the woman to Medical Evaluation
   C. Tell her to check her medical handout
   D. Call your captain to find out if there is a drug interaction

11. If you are working at your station and notice that the last person you helped left their cell phone at your station, you should:
   A. Quickly find the person to give the phone back
   B. Hit re-dial and tell the person on the line that you have her friend's phone
   C. Call Security
   D. Call your Captain

12. A man in your line claims to be OK, but shows symptoms of infection. What do you do?
   A. Call your captain
   B. Send him to Medical Evaluation
   C. Use your medical background to further evaluate his condition
   D. Tell him to check his medical handout.

13. The DVC is responding to a threat of anthrax exposure. A man walks by your line on his way to Medical Evaluation who appears to have a runny nose and is vigorously coughing. Some citizens in your line appear to be frightened. What do you do?
   A. Call security to quarantine the man

B. Assure the people in line that anthrax is not contagious
C. Send the people in line to Medical Evaluation – they might have been infected
D. Call security to ensure the people in line stay calm

14. A young woman on crutches is becoming tired and requests assistance. What do you do?
A. Hold the line until she regains her strength
B. Request that she sit off to the side
C. Call your captain for assistance
D. Help her to the next station
E. Ask her the standard questions

15. Your notice you are running out of medical information handouts. What do you do?
A. Continue handing them out until they are gone – then offer the information verbally
B. Borrow extra handouts from another Medical Screener
C. Wait for your next break to get more
D. Inform your captain that your supplies are low and need to be refilled
E. Continue handing them out until On-Site Coordinator replenishes your supplies

16. Two men at the end of your line are arguing very loudly and may be about to fight. What do you do?
A. Attempt to calm the situation yourself
B. Continue processing people through the line
C. Call your captain and request security
D. Find a police officer

17. The primary responsibility of the medical screener is to:
A. Dispense medication
B. Calm people down and orient them to the DVC
C. Ask symptomatic patients questions
D. separate the symptomatic patients from the non-symptomatic patients
E. all of the above
F. none of the above

18. The basic series of screening questions consists of _______________ questions.
A. Two
B. Six
C. Three
D. Ten

19. A patient should be sent to the Medical Screening Station:
A. If she answers yes to *all* the screening questions
B. If she answers yes to *any* of the screening questions

APPENDIX A (continued)

C. If she answers no to *all* the screening questions
D. If she answers no to *any* of the screening questions
E. None of the above

20. As the Medical Screener it is important to:
A. Send all patients to the Medical Evaluation Station
B. Send as few patients as possible to the Medical Evaluation Station
C. Send all patients to the Forms Distribution Area
D. Ask every person every screening question
E. All of the above
F. None of the above

21. If you feel a patient is agitated and may become violent, you should:
A. Send them immediately to the Medical Screening Station
B. Find a security officer ASAP
C. Ask them to wait until they feel more calm
D. Call the Station Captain
E. None of the above

22. At a Dispensing and Vaccination Center you are always required to…
A. Pass out surgical masks
B. Wear a surgical mask
C. Wash your hands and/or wear latex gloves.
D. Dispense a surgical mask to people that appear to be symptomatic
E. None of the above

23. In performing the Medical Screener role it is important that:
A. Every person gets all their questions answered
B. Every person is sent to the Medical Evaluation Station
C. Every person is sent to the Forms Distribution Area
D. You make sure that the forms are filled out properly
E. People get moved through the line as quickly as possible.
F. All of the above

24. A woman approaches you in line, looking at your suspiciously. She looks both ways and asks in a whisper "Is all of this information confidential? I'm concerned about sharing my personal business?"
What is the sequence of actions you should take next?
A. Explain to her that the information will be kept confidential, then ask her the standard questions and send her to Forms Review if she answers "No" to all of questions
B. Tell her to check her medical handout, then ask her the standard questions and send her to the Forms Review if she answers "Yes" to all of the questions

APPENDIX A (continued)

C. Explain to her that the information will be kept confidential, then ask her the standard questions and send her to Forms Review if she answers “No” to only one of the questions
D. Tell her to check her medical handout, then ask her the standard questions and send her to Medical Evaluation if she answers “No” to all of the questions.
E. None of the above

25. An older man approaches with a crazed look in his eyes. He says, “Help me, will ya? I was there, ya know. I was in the danger zone.” What is the sequence of actions you would take next?
A. Call your captain for assistance
B. Ask him the standard questions and send him to Forms Review if he says “No” to all of them
C. Send the man directly to Medical Evaluation
D. Ask him the standard questions and send him to Medical Evaluation if answers “Yes” to all of them
E. Call security

26. You are the medical screener for a DVC during an Anthrax event. A young, angry woman approaches and asks “Why do you have sick people in line with the rest of us?” What is the sequence of actions you would take next?
A. Tell her that you are in the process of screening out contagious people from the line and that she will be okay.
B. Calm her down and offer her a surgical mask.
C. Send her to Medical Evaluation so that she can discuss her medical concerns.
D. None of the above

APPENDIX B. Course Evaluation (Post Only Items)

Please consider your experience learning about the Medical Screener role in a DVC and rate the various qualities listed below by ***circling one number***.

Circle One Number

Useless	1	2	3	4	5	6	7	Useful
Difficult	1	2	3	4	5	6	7	Easy
Pleasant	1	2	3	4	5	6	7	Unpleasant
Meaningless	1	2	3	4	5	6	7	Meaningful
Time saving	1	2	3	4	5	6	7	Time consuming
Efficient	1	2	3	4	5	6	7	Inefficient
Inappropriate	1	2	3	4	5	6	7	Appropriate
Rigid	1	2	3	4	5	6	7	Flexible
Stimulating	1	2	3	4	5	6	7	Boring
Creative	1	2	3	4	5	6	7	Unimaginative
Impersonal	1	2	3	4	5	6	7	Personal
Anxiety-provoking	1	2	3	4	5	6	7	Calming
Too fast	1	2	3	4	5	6	7	Too slow
Unclear	1	2	3	4	5	6	7	Clear

Please rank your confidence in completing the responsibilities of the DVC Medical Screener.

I feel: (**circle one**)

Not confident at all	Not very confident	Not Sure	A little confident	Very confident
1	2	3	4	5

Please rank your confidence in minimizing distractions and moving people through the line at the DVC, as you perform the role of a Medical Screener.

Not confident at all	Not very confident	Not Sure	A little confident	Very confident
1	2	3	4	5

Please rank your confidence in responding to threatening situations that may come up while you are performing the role of a Medical Screener at a DVC

Not confident at all	Not very confident	Not Sure	A little confident	Very confident
1	2	3	4	5

APPENDIX B (continued)

Please consider your confidence in completing the responsibilities of the DVC Medical Screener before and after the training and answer the following question:

After the training I feel (**circle one**)

A lot less confident	A little less confident	About the same	A little more confident	Much more confident
1	2	3	4	5

Additional questions:

1. When you made a mistake as a medical screener would you….
   A. Keep the feedback as is
   B. Like to see what the correct actions were right away.
   C. Like to see the case close so that you could move on
   D. Like to have the correct response brighten up and all incorrect responses fade out.

2. General feel of the game is…
   A. Easy to use
   B. Confusing to use but then got easier as I used it
   C. Easy to use but cumbersome to make choices.
   D. Hard and confusing to use

3. I found that the user training before the game was
   A. Very clear and helped me use the interface.
   B. Not very useful because I could figure it out on my own.
   C. Not very helpful and confused me more.
   D. Was very useful but I could not remember it during the game.

4. I found the Didactic sheet was
   A. Very clear and helped teach me about the screener role.
   B. Not very useful because I could figure it out on my own.
   C. Not very helpful and confused me more.
   D. Was very useful but I could not remember it during the game.

5. Would you ever play this game again?
   A. Yes
   B. No
   C. Maybe

APPENDIX B (continued)

6. Would you recommend this game to your co-workers?
   A. Yes
   B. No

7. Would you like to see a multiplayer version of this game where you could play with co-workers?
   A. Yes, that would be fun and would help teach me my role more thoroughly.
   B. Yes, that would be fun but not really teach me more for this role.
   C. No, I don’t think its needed.
   D. No, it would make things more complicated for me.

APPENDIX C: Detailed Responses to Assessment of Confidence with New Software Packages

Often in our jobs we are told about software packages that are available to make work easier. For the following questions, imagine that you were given a new software package for some aspect of your work. It doesn't matter specifically what this software package does, only that it is intended to make your job easier and that you have never used it before. The following questions ask you to indicate whether you could use this unfamiliar software package under a variety of conditions. For each of the conditions, please indicate your level of confidence using the software by choosing a number 1 through 7.

I could complete the job using the software package:*

	1=Not At All Confident	2	3	4=Moderately Confident	5	6	7=Totally Confident
...if there was no one around to tell me what to do							
...if I had never used a package like it before							
...if I had only the software manuals for reference							
...if I had seen someone else using it before trying it myself							
...if I could call someone for help if I got stuck							
...if someone else had helped me get started							
…if I had a lot of time to complete the job for which the software was provided							
...if I had just the built-in help facility for assistance							
...if someone showed me how to 5do it first							
…if I had used similar packages before this one to do the same job							

APPENDIX C (continued)

	Computer Use at Work (*Hours/week*)	Computer Use at Home (*Hours/week*)
Less than 1 hour		
1-2 hours		
3-4 hours		
5-6 hours		
7 or more hours		

Operating System Used at Work	
OS X	
Windows	
Don't Know	

Experience with Video Games	
I have never played them.	
I used to play them several years ago.	
I have played a video game within the last year.	
I have played a video game within the last month.	
I have played a video game within the last week.	

VITA

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UNIVERSITY EDUCATION

University of Illinois at Chicago, School of Public Health, Chicago, IL
Doctor of Public Health (DrPH), 2009
Public Health; Concentration in Leadership, Workforce Development, Emergency Preparedness planning and response
Thesis: "Evaluating the Effectiveness of Using Video Game Technology to Train Public Health Workers in Their Emergency Response Roles"

Benedictine University, Lisle, IL
Master of Public Health (MPH), 2001
Certificate in Health Care Administration, 2001
Certificate in Managed Care, 2001

Brandeis University, Waltham, MA
Bachelor of Arts (BA), 1998
Biology

EMPLOYMENT

Deputy Commissioner
Chicago Department of Public Health, Office of Public Health Preparedness and Emergency Response, Chicago, IL
2009 to present

Adjunct Professor
Benedictine University, Lisle, IL
2008 to present

Director of Planning, Research and Development
Chicago Department of Public Health, Office of Public Health Preparedness and Response, Chicago, IL
2005 to 2009

Graduate Teaching Assistant
University of Illinois at Chicago, School of Public Health, Chicago, IL
2004 to 2008

Health Alert Network (HAN) Program Manager
Chicago Department of Public Health, Office of Public Health Preparedness and Response, Chicago, IL 2004 to 2005

Bioterrorism Regional Coordinator
Chicago Center for Health Systems Development/ CDPH Bioterrorism Program, Chicago, IL
2002 to 2004

Program Manager
Thresholds Mothers' Project, Parenting Teens Program, Chicago, IL,
1999 to 2002

LANGUAGES

Spanish (reading and writing; novice)

MEMBERSHIPS/ PROFESSIONAL AFFILIATIONS

Member, American Public Health Association

Member, Advisory Board, Kaplan University School of Health Sciences

Secretary, Board of Directors, Muntu Dance Theater of Chicago

Chicago Chair, Chicago Metropolitan BioWatch Program's BioWatch Advisory Committee

Co-Chair, Northern Illinois Public Health Consortium's (NIPHC) Emergency Response Committee

Co-Chair, City of Chicago Regional Catastrophic Planning Team, Medical Subcommittee

Member, Association of State and Territorial Health Organization's (ASTHO) Director's of Public Health Preparedness (DPHP) Workgroup

Member, U.S Centers for Disease Control (CDC) PERFORMS External Advisory Workgroup

Member, ASTHO Performance Evaluation and Improvement Workgroup

Directly-funded cities representative, ASTHO DPHP Executive Committee

ACADEMIC HONORS AND AWARDS

Fellow, Howard Hughes Medical Institute, Brandeis University, 1993

PROFESSIONAL SERVICE (selected)

Incident Commander/Lead Preparedness Official, Chicago Response to the H1N1 Influenza A (Swine Origin) Outbreak, April – May 2009

Incident Commander/Exercise Participant, Chicago BioWatch Exercise, May 2009

Incident Commander/Exercise Participant, Fahrenheit 531—Chicago Hospital Medical Evacuation Exercise (full-scale), May 2009

Principal Investigator, CDC Public Health Emergency Preparedness Cooperative Agreement, January 2009—Present

Principal Investigator, Assistant Secretary for Preparedness and Response, Hospital Preparedness Program, January 2009--Present

Exercise Control Group Participant, Centers for Disease Control and Prevention, Pan Flu OPLAN Exercise, October 2008

Exercise Participant (Unified Command Group), United States Postal Service, Cardiss Collins Post Office, BDS Exercise, September 2008

Mentor, University of Illinois at Chicago, School of Public Health, Year 15, Mid-America Regional Public Health Leadership Institute, Chicago, IL, September 2006-September 2007

Exercise Planner and Participant, Chicago Department of Public Health/ Chicago Office of Emergency Management and Communication, Chicago, IL May 2006 – Statewide FLUEX Pandemic Influenza Exercise

Planner and Evaluator, Chicago Department of Public Health/ Chicago Office of Emergency Management and Communication Cities Readiness Initiative (CRI)/SNS Exercise, August 2005.

Evaluator, City of Chicago Strategic National Stockpile Tabletop Exercise, May 2005.

Evaluator, Cook County Department of Public Health, Pharmaceutical Dispensing Plan Training Exercise (Mass Prophylaxis Clinical Practices), April 2005.

Exercise Participant, Department of Justice, TOPOFF II Exercise, May 2003

PROFESSIONAL PRESENTATIONS (selected)

2009 U.S. Department of Homeland Security, National Biowatch Workshop, Biowatch Exercises Lessons Learned Panel, "Chicago Biowatch Exercise", August 2009

American Bar Association, Business Law Section, "Payments and Pandemic Influenza", August 2009

Illinois State Medical Society, "Pandemic Influenza Planning Update", May 2009

Chicago Public Safety Consortium, "Update of Federal Antiviral Guidance and Implications for Chicago", March 2009

CDC/NACCHO 2009 Public Health Preparedness Summit, "Comprehensive Emergency Management Planning: A Proactive Approach to Performance-Based Planning for Public Health", ***and*** "Local Health Department Collaboration to Form a Joint Special Needs Advisory Panel (SNAP)", February 2009

Presentation to Wuhan, China Emergency Preparedness Delegation "Public Health Emergency Preparedness in Chicago", November 2008

Society of Public Health Educators, "Evaluating the POD Game: "A Mass Dispensing Center Game", May 2008

American Public Health Association, "A Dispensing Center Game", November 2007

Tazewell County Health Department, Emergency Preparedness Summit, "Emergency Preparedness Planning: Why Prepare?", April 2007

Association of Nigerian Physicians in the Americas "Disaster Management and Emergency Preparedness: Creating an Effective Public Health Emergency Response System", July 2006

Chicago Property Owners Association, "Emergency Preparedness for Property Owners", June 2006

PROFESSIONAL DEVELOPMENT

Certifications, Classes and Workshops

Homeland Security Exercise and Evaluation Program (HSEEP) Training and Certification, December 2008

National Incident Management System (NIMS) Training, Trained in ICS-100, 200, 300, 400, 700, and 800

Wright College, Chicago, IL November 2007, Certified--Hazardous Waste Operations and Emergency Response (HAZWOPER) Training

Rand Corporation/Georgetown University, Washington, DC October 2006—Workshop and Panel Discussion, Regionalization in Local Public Health Systems: Variation in Rationale, Implementation and Impact on Public Health Preparedness

University of Illinois at Chicago, School of Public Health, Year 2 Fellow, Mid-America Advanced Executive Public Health Leadership Institute, Chicago, IL, October 2005 to December 2006.

National Interagency Civil-Military Institute, Argonne National Laboratory and Will County Health Department, Counter-Terrorism (Biological) Training Course, Argonne, IL, November 2004

State of Illinois, Illinois Terrorism Task Force, Unified Command Training Course, Chicago, IL, October 2004

Centers for Disease Control and Prevention, Strategic National Stockpile Program, Strategic National Stockpile Preparedness Course, Atlanta, GA, September 2003

University of Illinois at Chicago, School of Public Health, Year 12 Fellow, Mid-America Regional Public Health Leadership Institute, Chicago, IL, September 2003-September 2004

SCHOLARLY CONTRIBUTIONS

Books

Editorial support provided for the completion of:

Turnock, Bernard J. (March 2006), *Public Health Careers: Choices That Make a Difference.* Chicago, IL: Jones and Bartlett

Forthcoming Articles

Evaluating the Effectiveness of Using Video Game Technology to Train Public Health Workers in Their Emergency Response Roles

Harnessing 21st Century Simulation Technology in a 19th Century Public Health Agency