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Use of Interactive Multimedia HRA's: Three Studies

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Overview

About 400,000 individuals die prematurely each year from health problems attributable to a lack of sufficient exercise and high fat content in their diet (Healthy People 2000, 1989). About the same number of individuals dies prematurely each year because they use tobacco products (Glantz and Parmley, 1991). The economic costs of these health problems are significant and burdensome. The share of the Gross Domestic Product (GDP) going to medical services was 12 percent in 1990 (Healthy People 2000, 1989). Health costs to businesses have reached almost 45% of operating expenses (Farnham, 1989).

Many prominent health problems are lifestyle-related, and thus are potentially preventable through increased awareness, education, and behavior change. For example, the national campaigns to educate and encourage the public to reduce high fat content in diets, high blood cholesterol levels, hypertension, and increase exercise, resulted in a reduction in the incidence of coronary heart disease (CHD) in the 1980's (Healthy People 2000, 1989). Programs to reduce the number of adult smokers have experienced moderate success, despite the oppositional efforts of the tobacco industry which devotes almost $4,000,000,000 per year to encouraging smoking (Surgeon General Report, 1994).

While there are numerous studies indicating that health promotion programs in worksites can benefit employee health and productivity while reducing medical insurance costs and employee absenteeism (Anspaugh, Hunter, & Savage, 1996; Pelletier, 1991; 1993; 1996; Wilson, Holman, & Hammock, 1996), there are few large scale studies in clinic environments or with older adults (e.g., in a senior center environment). Because a small number of employees can account for a large percentage of medical costs (Kingery et al., 1994; Pelletier, 1996), even programs with modest intervention effects can be cost effective. Worksite research thus is a model for the potential value of health promotion programs in the general population.

Several recent reviews of worksite health research decry the lack of rigorous research designs (Pelletier, 1991; 1993; 1996), yet they also find suggestive evidence for positive interventions in the areas of nutrition and cholesterol (Glanz, Sorensen, & Farmer, 1996), weight control (Hennrikus & Jeffery, 1996), exercise (Shepard, 1996), tobacco cessation (Glasgow et al., 1993; Salina et al., 1994), hypertension (Baumann, 1989; Dubbert , 1995; Edward et al., 1994; Fielding et al., 1994; Jeffery et al., 1993), and stress (Bunce & West, 1996; Cervinka, 1993; Conti & Burton,1994; Elkin & Rosch, 1990; Karaki, 1991). A number of other studies point to the value of programs that offer multiple interventions (Heaney & Goetzel, 1997). For instance, individuals in high stress jobs tend to smoke more and exercise less (Green and Johnson, 1990). Emmons et al. (1994) found that 88% of smokers in their study had multiple CHD risk factors, and that dietary fat intake and a lack of exercise were higher among smokers than non-smokers.

In sum, we know from worksite research that health promotion programs can have an impact on CHD risk factors, but there is evidence that the problems are more generic. Risk factors tend to be lifestyle related. What is needed to address this issue are health promotion programs in multiple venues for different populations, not just for employees at worksites. The challenge is to make the individual aware of his or her risk factors, to motivate that individual to reduce those risks, and to provide individuals who are willing to attempt change with effective support to modify the risks.

Interactive multimedia (IMM) technology - the marriage of video, graphics, and computers, - offers a promising new tool for health promotion programs. Automated health risk appraisal

(HRA) systems can be developed that can identify health risks and quickly provide a personalized video-based report that explains the HRA results and recommends specific behavior changes to modify the most prominent risk factors. This has always been the promise of HRA's – that information about personal risk factors would be enough to cause the at-risk individual to take action to lower those risks. But while some research shows the potential of HRA's (Edington, Yen, & Braunstein, 1998), the promise has been largely unrealized. While HRA's are designed to inform users about modifiable health risks, knowledge alone may not generate behavior change (Biglan & Hayes, 1996; Herbert, 1996). HRA's, by definition, are an assessment tool that provides risk information based on the user's input (Alexander, & Peterson, 1998). However, Consumer Information Processing Theory suggests that to effect genuine lifestyle change additional follow-up is needed beyond that of a printout of generic messages (Stiles, 1996). Face-to-face counseling to develop a behavior change plan has been shown to be effective (Anderson & Staufacker, 1996; Kellerman, Felts, & Chenier, 1992), but prohibitive staffing requirements have health educators searching for more cost-effective solutions. Use of the video and branching capabilities of interactive multi-media (IMM) technology appear to be attractive methods for delivery of an automated, personalized follow-up that mimics a one-on-one counseling session.

In the research reported here, we describe the development of three separate prototype IMM-HRA behavior-change education systems designed for use in clinics, worksites, and senior centers. The projects were funded respectively by the National Heart, Lung, Blood, Institute, the National Institute of Nursing Research, and the National Institute on Aging. Built to combine user-friendly, cutting-edge technology with a proven HRA and efficacious behavior change strategies, these kiosk systems identified risk factors and delivered video-based messages suggesting specific behavior change strategies tailored to the individual user.

Programmatic approach

The Healthier People Network (HPN) HRA, v 4.0, was selected for use in this program because it employs the programmatic approach originally developed by the CDC and later enhanced by the Carter Center at Emory University. (In consultation with Dr. Edwin Hutchins, Director of HPN, we simplified the instrument for touch-screen use, and added elder-specific items related to quality of life issues for the older-adult HRA.) All three IMM-HRA's produced a personalized video-based report that targeted modifiable mortality and morbidity risk factors. Health behavior change messages included: "Quit Smoking," "Control your blood pressure," "Lower your cholesterol," Lose weight," "Drink less alcohol, " "Don't ride with drinkers," "Always use your seat belts," and "Reduce your driving speed."

The system utilized a touch screen for user responses to the HRA questions, and for making choices during the IMM report. The system presented different message-sets depending on the user's combination of risk factors, good habits, and choices during the report presentation. Users with risk factors were presented only their four highest risks (e.g. "You need to control your blood pressure;"). Each risk factor was accompanied by specific behavior change recommendations to reduce the risk level (e.g. "take your medications daily" if the user reported have a prescription for blood pressure medicine, or "Get more exercise" if the user reported inadequate exercise). The user was then encouraged to hear specific testimonial messages about how to deal with each risk factor, and to commit to one or more of the recommended behavior changes as part of a personal "Change Plan." Later in the program, the user was advised of personal risks that could be minimized by preventative care (e.g. breast cancer) or monitoring (e.g. diabetes). Finally, the user was congratulated for any identified good habits. Before leaving, the user received a printout that specified the appropriate recommended behaviors to change, the user's own Change Plan, and reinforcement for any good habits reported. The printout also provided information about the user's relative body weight, recommended preventive care, and about HRA's in general.

Methods

This paper reports on three studies. Each is a replication of the use of a touch-screen IMM HRA kiosk system in a different context. In Study 1, the system was tested in the waiting room of a medium size medical clinic, Study 2 took place at a worksite, and Study 3 was conducted at a Senior Center.

Each study was conducted using a non-randomized pretest-post test design. Subjects signed an informed consent, completed a questionnaire before and after using the system, and then were interviewed about their reactions. Questionnaire items addressed risk perception, self-efficacy, intention, and stage of change (Prochaska & DiClemente, 1983). The results were analyzed using SPSS, and are presented here using one-tailed tests, consistent with the belief that the intervention would not negatively effect the outcome measures. Effect size, which can be an informative statistic regarding intervention program effects, was calculated from the data for each risk factor. Cohen[3] (p. 24) defines a small effect size as d=.20, a medium effect size as d=.50, and a large effect size as d=.80.

Study 1: Clinic-based HRA.

This program was tailored to Caucasian females under 40 years of age. A total of 42 Caucasian females used the HRA kiosk system in the waiting room of the Family Practice section of a medical clinic. Subjects averaged 29.5 years of age (sd = 6.6). A total of 10 were clinic staff, eight were patients referred by their physician, and 24 were patient-volunteers who walked by or were attracted by flyers in the clinic. As a group, they averaged five feet five inches tall and weighed 175 lbs (sd=44.6). Fifty-one percent of the subjects were married or living with a partner, 51.4% had children, and 41.9% worked full time. A total of 16.3% did not finish high school, 30.2% graduated from high school, 34.9% completed some college, 7% graduated from college, and 11.4% had a graduate or professional degree.

Study 2: Worksite-based HRA:

Study 2 was tailored for Caucasian female employees under 40 years of age, to be used in a worksite environment. As such, the system was designed as a repeat visit system, including the ability to refer users to other IMM interventions at subsequent visits. Employees recruited from the staff of a small regional hospital (n=1500) tested the program. Participants completed a "hard copy" Informed Consent. The pretest and post test questionnaires were presented on the touch screen system.

A total of 37 Caucasian female employees under 40 years of age used the worksite HRA kiosk system. They averaged 33.8 years of age (sd = 4.8), five foot, one inch tall (sd= .02) and weighed 157 lbs (sd=43.75). A total of 68% of the subjects were married or living with a partner, 60% had children, and 81% worked full-time. Nineteen percent stopped attending school after high school, 36% completed some college, an additional 28% graduated from college, and another 17% had a graduate or professional degree.

Study 3: Senior Center based HRA:

This study was designed to investigate the behavioral impact of an HRA system tailored for Caucasian females over 65 years of age. In addition to the usual health-risk prevention topics, the HRA also contained questions about issues that might influence "quality of life" (e.g. morbidity factors such as social isolation, accident prevention, nutrition, medication use). Additionally, program users had access to 43 "Age Pages," articles developed by the National Institute on Aging to provide information regarding aging issues.

A total of 42 older adult females tested the HRA kiosk system at a senior center. They averaged 71.5 years of age (sd= 4.8), five feet three inches tall, and they weighed 150 lbs. (sd=25.5). Subjects were recruited at a senior health fair or they volunteered after having seen flyers or hearing about the project from friends. Of the subjects, 16.7% had not finished high school, 30.2% graduated from high school, 30.2% completed some college, 9.3% graduated from college, and 11.6% had a graduate or professional degree.

Results and Discussion

For each of these studies the primary research question was "Did the HRA program influence subjects' risk perception, behavioral intention, self-efficacy, and stage of change in those health areas in which they had personal risk?" Not every subject would be expected to have each of the risk behaviors addressed by the HRA; thus, the HRA program was not expected to change health risk measures for blood pressure or smoking if the user didn't have high blood pressure or did not smoke. Similarly, users only viewed the components of the program related to the risks identified in their HRA report. Consequently, the results below report only for those subjects with the specified risk factors.

Study 1: Clinic-based HRA.

Risk factors. As shown in Table 1, risk perception was significantly increased for eight of the nine risk categories assessed. The "driving and drinking" item was not asked in this part of the instrument. The "riding with a drinker" item appeared to be influenced by a ceiling effect caused by a high pretest average mean of 6.4 on a 7 point scale. Thus, the subjects already perceived the risks of driving with drinkers and the score had little room to improve.

Behavioral intention was significantly increased for five of the ten risk categories assessed. "Drinking and driving" (pretest: x=6.4) and "safety belts" (pretest: x=6.8) showed positive trends, but appeared to have been limited by ceiling effects. "Control your blood pressure" and "Lower your cholesterol" showed no change in intention, although the cholesterol showed a weak trend (p=.17).

Self-efficacy showed positive change in five of the nine risk categories assessed and positive trends in three others. Only "riding with a drinker" was non-significant, and that item also was influenced by a ceiling effect (pretest: x= 6.7).

Five of seven stage of change measures showed significant positive movement. Only seat belt usage and alcohol consumption showed no stage movement. Seat belt safety appeared to be influenced by a ceiling effect (pre-test average = 9.3 on a scale of 10), possibly due to the seat belt law that is in effect in Oregon. Stage of change was not measured for "riding with a drinker," "drinking and driving" and "exercise".

The effect size calculations provide an estimate of the potential impact of the HRA program. In our analysis the mean effect size of the HRA program on risk perception were large, d=.75.

The mean effect size on intention was medium, d=.38. The mean effect size on self-efficacy was medium-large, d=.62. Finally, the effect size on stage of change was large, d=.82. These effect sizes translate to variance accounted for by the program (r-squared) as 12.3% of the variance in risk, 3.5% of the variance in intention, 8.8% of the variance in self-efficacy, and 14.4% of the variance in stage of change. Overall, these are notable effect sizes.

<u>User satisfaction.</u> The post test interview assessed user satisfaction. On a seven point scale, clinic-users found the HRA program to be useful (x=5.8) and were satisfied with it (x=6.1). They found it easy to use (x=6.95), would recommend it to a friend (x=6.1), and would use it again if it were available (x=6.2). The length of the program was "just right" (x=4.0). On a yes-no scale with Yes=1 and No=2, the subjects reported that the instructions were not confusing (x=1.8); it offered the choices they wanted (x=1.8); the topics applied to them (x=1.7); and the program didn't make them feel uncomfortable (x=1.95). About half the users indicated that there were topics that they would have wanted to know more about (x=1.5). Subjects spent about 7 minutes on the questionnaire portion of the program, and from five to 30 minutes in the video report phase, depending on their risks and the number of options they elected to view.

Study 2: Worksite-based HRA

<u>Risk factors.</u> These hospital-employed subjects reported very few risks. Only five employees received any risk messages at all, so the data from these subjects were analyzed. Despite this small subject sample, statistical analyses indicated significant program effects, on risk perception, behavioral intention, and self-efficacy (Table 2).

The reason for the small number of identified risks for the worksite population sampled in this study is unclear. It may be that our flyers and e-mail announcements only attracted the more medically educated employees in this health care facility, therefore this was a relatively "well" population. The subjects self-reporting may also be influenced by reactive effects due to the evaluation being conducted in an office in the cardiac rehabilitation wing of the building.

The effect size calculations provide an estimate of the potential impact of the worksite HRA program. In our analysis the effect size of the HRA program on risk perception were very large, d=1.44. The effect size on intention was extremely large, d=4.14. The effect size on self-efficacy was medium-large, d=.67. Finally, the effect size on stage of change was also very large, d=1.27. These effect sizes translate to variance accounted for by the program (r-squared) as 34.5% of the variance in risk, 80% of the variance in intention, 10.5% of the variance in self-efficacy, and 29% of the variance in stage of change.

<u>User satisfaction.</u> On a seven-point scale, employee-users found the HRA program to be moderately-to-very useful (x=5.5) and were very satisfied with it (x=5.9). They found it easy to use (x=6.4), were very likely to recommend it to a friend (x=5.9), and were moderately-to-very likely to use it again if it were available at their worksite (x=5.8). The length of the program was "just right" (x=4.0). On a yes-no scale with Yes=1 and No=2, the subjects reported that the instructions were not confusing (x=1.8); it offered the choices they wanted (x=1.8); the topics applied to them (x=1.7); and the program didn't make them feel uncomfortable (x=1.95). About half the users indicated that there were topics that they would have wanted to know more about (x=1.5). One item in the interview assessed the employees' most likely time of use during the work day. A total of 67.5% of the respondents indicated that they would use the system either "during lunch" (40.5%) or during afternoon breaks (27.5%).

Return visits. Of the 37 users, 33 (89%) used the on-screen calendar to set a return date to view linked IMM intervention programs. After only a single reminder message (if requested), a total of 23 employees (62%) came back for the second appointment which was scheduled during a three-day “window of availability” five to seven days after the first visit. Two additional subjects called and canceled their return visit because of unexpected work requirements that precluded visits during the few open slots remaining in the “window of availability.” These results are particularly noteworthy, because the returning subjects generally were not returning in response to their specific HRA risks, but to view other IMM health behavior change interventions on the kiosk system. A total of 14 subjects returned to see the intervention on reducing dietary fat intake, two subjects used the smoking cessation intervention, seven used the exercise “mini-intervention,” and another subject found two slots in the window of availability, so she was able to use both the diet and the exercise intervention.

Study 3: Senior-center based HRA:

Risk factors. Unfortunately for the research, the older adult subjects participating in this study also reported very few risks. In order to have confidence in the evaluation of the effects of the program, we limited the analysis of program effects to those risks identified as present in at least 10 subjects (i.e., a minimum sample size of 10). There were five risk behaviors that were reported by 10 or more subjects: Body weight, driving speed, cholesterol, blood pressure, and exercise. The analyses of these five risk behaviors are reported in Table 3. Given the limited sample sizes in these comparisons, the effect size calculations may be an especially informative statistic regarding program effects on these risk factors. As shown in Table 3, nine of the 20 pretest-to-post test comparisons indicate medium or large program effects. Four of the comparisons achieve statistical significance ($p<.03$) even with the small sample sizes, and seven additional comparisons approach statistical significance ($p <.08 - .15$).

Risk perception showed positive trends ($p=.12-.15$) for body weight, cholesterol, and exercise. With the exception of driving speed, effect sizes ranged from small-medium (body weight) to medium-large (exercise).

Behavioral Intentions were significant for body weight and driving speed, and the trend was positive for exercise ($p=.15$). Effect sizes ranged from small (blood pressure) to large (driving speed).

Self-efficacy was significantly improved for body weight and cholesterol. Effect sizes ranged from small (driving speed) to very large for cholesterol ($d=1.09$).

Stage of change showed positive trends for driving speed, blood pressure, and exercise ($p= .08-.15$). Effect sizes were small–medium for four risk factors, but were very large for blood pressure ($d=1.21$).

In sum, even with very limited sample sizes, the effects of the program were consistent across all five risk behaviors, reaching statistical significance on at least one outcome measure for three of the five risk behaviors. In addition, the program demonstrated quite large effects on at least one outcome measure for two risk behaviors, as well as small-medium effect sizes on the others.

User satisfaction. The post test interview measured user satisfaction. On a seven point scale with seven being positive, older adult users found the HRA program to be useful ($x=4.9$) and were satisfied with it ($x=5.8$). They found it easy to use ($x=6.8$), would recommend it to a friend ($x=5.8$), and would use it again if it were available ($x=5.2$). These older adult users rated on-screen text messages as easy to read ($x=6.6$), and the audio as easily heard ($x=6.6$). On a yes-no scale with “no” scored as a “2, ” the subjects reported that the instructions were not confusing (x=1.81), that the program didn’t make them feel uncomfortable (x=1.95), that it did not cause them to have concerns about their privacy (x=1.98), and that they were not frustrated when wanting to follow their desired programmatic pathway (x=1.79). Using the program was neither physically (x=1.7) nor emotionally (x=1.6) tiring. More than half of the subjects felt that there were parts of the program that did not apply to them (x=1.42), usually because they felt that they were already actively trying to do at least some of the recommended strategies and simply had not yet achieved mastery (e.g. lose weight, lower cholesterol). Qualitative measurements indicated that it took subjects about 15 minutes to complete the questionnaire portion of the program (which had additional quality of life items added to the standard HRA), and from five to 30 minutes to complete the video report phase, depending on their risks and number of options they chose to view.

These results are of additional interest because of the concern that older adults might react negatively to computers, programs, or technology with which they were not familiar. Our approach to this issue was to hide the computer, keyboard and mouse so only the touchscreen monitor was visible. From the user’s point of view the touchscreen monitor became a responsive television which would not threaten individuals who might be intimidated by technology. The program was advertised as being “like a personal TV program.”

Summary

This paper reports on the evaluation of several prototype interactive multimedia health risk appraisals. They were somewhat unique in that program users, prior to receiving the usual summary risk-message printout, received a video-based report. Additionally, the report was focused on behavior change for a limited number of risks, rather than on a comprehensive assessment of individual risk factors.

The programs were tested in a clinic, a worksite, and at a senior center. The evaluations, although limited in scope and not designed as randomized trials, showed strong and consistent intervention effects. Stage of change, risk perception, behavioral intention, and self-efficacy showed significant changes. Effect sizes were usually in the moderate to strong range with a few very strong effects. All the programs were well received by the users. These results, especially in light of the impressive effect sizes, suggest that interactive multimedia programs may be a cost-effective and important component of future health promotion activities.

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Table 1. Study 1: Clinic Based HRA Results of Paired t-test Analyses for At-Risk Subjects

Risk Category	# of Ss	Risk Perception		Behavior Intention		Self Efficacy		Stage of Change	
		p-value	Effect Size	p-value	Effect Size	p-value	Effect Size	p-value	Effect Size
Smoking	14	.003	1.45	.054	.66	.030	.78	.050	.65
Blood Pressure	13	.032	.10	n/s	.09	.082	.58	.046	1.60
Cholesterol	13	.059	.68	n/s	0	.006	1.2	.003	1.56
Body Weight	34	.001	.84	.003	.76	.001	1.19	.008	.69
Exercise	28	.006	.73	.016	.63	.014	.65	---	--
Alcohol Consumption	21	.028	.64	n/s	.07	.102	.41	n/s	.29
Riding w/a Drinker	42	n/s		n/s		n/s		---	--
Driving & Drinking	40	---	--	.067	.36	---	--	---	--
Safety Belts	41	.007	.81	.103	.45	.042	.51	n/s	0
Driving Speed	34	.002	.78	.052	.41	.093	.33	.001	1.01

n/s = not significant.

--- = not asked.

Table 2. Study 2: Worksite HRA Results of Paired t-test Analyses for At-Risk Employees

Risk Category	# of Ss	Risk Perception		Behavior Intention		Self Efficacy		Stage of Change	
		p-value	Effect Size	p-value	Effect Size	p-value	Effect Size	p-value	Effect Size
Combined Risks	5	.045	1.44	.002	4.14	.24	1.27	.09	.67

Table 3. Study 3: Senior-Center Based HRA Results of Paired t-test Analyses for older adults

Risk Category	# of Ss	Risk Perception		Self Efficacy		Behavioral Intention		Stage of Change	
		p-value	Effect size	p-value	Effect size	p-value	Effect size	p-value	Effect size
Blood Pressure	15	n/s	.32	n/s	.43	n/s	.28	.08	1.21
Cholesterol	13	.12	.50	.01	1.09	n/s	.39	n/s	.27
Exercise	10	.15	.71	n/s	.52	.15	.49	.15	.60
Body Weight	27	.15	.30	.02	.61	.03	.55	n/s	.30
Driving Speed	17	n/s	0	n/s	.10	.01	.97	.09	.49

n/s = not significant.