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Original Paper

Using Sequential Email Messages to Promote Health Behaviors: Evidence of Feasibility and Reach in a Worksite Sample

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Abstract

Background: US adults report suboptimal physical activity and fruit and vegetable intake. Innovative strategies to promote healthy behaviors are needed. Employee health promotion programs have been associated with reductions in health risks but are labor-intensive and costly to implement. Email and Web-based worksite programs have the potential to reach a broad adult population and to provide a cost-effective approach to employee wellness programming.

Objective: To assess the feasibility of using sequential email messages to promote physical activity and increase fruit and vegetable intake among employed adults.

Methods: Employees at one worksite of a large insurance company in New York State were invited to participate. Interested workers provided written consent. After completing a baseline survey, participants received daily emails, Monday through Friday, for 26 weeks. The emails provided (a) succinct strategies to encourage physical activity or increase fruit and vegetable intake and (b) links to detailed Web-based information and tools. Program reach was assessed by the number of emails opened, measures of sustained participation over 6 months, and the number of health-related Web-links clicked.

Results: Of 960 employees, 388 (40%) consented to participate; of these, 345 (89%) completed the baseline health survey. After 6 months, 70% of the 345 participants had opened 50% or more of the daily emails. In addition, 75% of participants continued to open at least one email a week through week 26 of the study. Email opening rates did not vary by gender, age, income, education, ethnicity, or baseline health behavior.

Conclusions: The rate of enrollment and sustained participation document the feasibility, broad reach, employee acceptance, and potential value of using electronic communications for health promotion in the workplace.

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KEYWORDS

Health promotion; employee wellness; information technology in health care

Introduction

Does Email Have a Role in Worksite Health Promotion?

Employee health promotion programs have been associated with reductions in health risks. Pelletier [1] and Aldana [2]

reviewed 11 and 72 studies, respectively, and found consistent evidence that worksite health promotion programs were associated with reductions in health risks and costs. However, traditional worksite health programs are labor intensive and costly to implement. In contrast, email and Web-based programs have the potential to reach a broad employee population with minimal delivery costs after the initial message development.

By design, the Internet spans geographic and time differences, sustains relationships based on interests, and provides links between people and information. In addition, email and Web access is available 24 hours/day, 7 days/week, and information can be customized to serve the individual characteristics of the user [3]. These attributes may serve both the employer and the employee as program access is available across work shifts and into vacation and leisure time. In 2005, a total of 74% of US adults reported having Web access, including 66% with home access and 36% with work access [4]. As well, 41% of employers report that they are “likely” to use Web-based education as a component of a health care utilization management program, and an additional 47% reported they were “somewhat likely” [5]. Thus, worksite leadership is poised to adopt email and Web-based programming, so it is timely to evaluate the reach and effectiveness for use in employee health promotion.

Suboptimal Health Behaviors

Levels of physical activity and fruit and vegetable consumption are well below recommended guidelines and have remained substandard despite the health promotion efforts spurred by the Healthy People 2000 and 2010 initiatives. Specifically, 25% of Americans report no regular physical activity [6]. Between 1990 and 2004, the number of Americans who reported moderate levels of physical activity actually decreased from 23% to 15% in 2004. In a recent national survey, 85% of respondents reported fewer than 60 min/week of leisure time physical activity [7].

In addition to lack of physical activity, suboptimal diets contribute to the prevalence of overweight and obese adults: 77% of adults report diets that include less than the recommended daily intake of fruits, vegetables, and vitamins [8], and 55% report weights that categorize them as overweight, and the prevalence is increasing. Of all adults, 31% meet the definition of obesity, and this number is higher for women [9]. Recent analyses found employers spend an additional \$462 to \$2485 each year on medical expenditures and work absence for employees who are more than 30 pounds overweight [10]. Despite the costs associated with behavioral choices, less than 3% of health dollars are spent on public health efforts to improve health behaviors [11].

Methods

This preliminary study evaluated participation and attrition rates over a 6-month, email-based health promotion program and the characteristics of employees who sustained participation. This study was the first phase in a worksite intervention trial designed to assess health behavior change following differing eHealth delivery modes of health-promoting materials. The Institutional Review Boards from collaborating institutions approved all procedures.

Setting

This preliminary study was conducted at the main office of a large health insurance company in upstate New York. In August 2003, the worksite employed 960 full-time workers; an estimated 90% had computer access at their desks. For this study,

employees without desktop computers were offered daily access to a central computer in the employee lunchroom or could identify a personal email address at which to receive emails. The total employee population was 76% female, 90% white, with a mean age of 43 years. Distribution of income was as follows: 24% earned less than \$29999, 46% earned between \$30000 and \$49999, and 30% earned more than \$50000. The organization employed building maintenance, clerical, customer service, actuarial, sales, information technology, and health professionals.

Enrollment

The invitation to participate was initiated by an email from the company president to all employees, followed by announcements posted in employee elevators and a 5-minute presentation at the quarterly “all-employee” meeting. A series of nine midday onsite study enrollment sessions were scheduled across 3 weeks. Enrollment was held in the employee lunchroom for convenience. The employee health office distributed reminder emails on each enrollment day in order to encourage participation. After a consent form was signed, a unique research ID number was assigned to each employee for use with all study related documents. Participants provided their preferred email address and work telephone number on the consent form for use by the study team. Both full- and part-time employees were included because it was not necessary for the email to be read on the same day it was delivered.

Health Assessment

In order to evaluate employee characteristics associated with participation and to validate the survey to be used in the subsequent trial, all consenting employees in the preliminary study completed a baseline health assessment prior to the start of the email health promotion program. This included validated assessments of demographic variables, exercise (International Physical Activity Questionnaire [12]), fruit and vegetable consumption (Quick Food Scan from the National Cancer Institute [13]), antecedents of health behavior change [14], intention to change, health status (e.g., Short Form 12) [15], and health care utilization. The employer agreed to allow participants to complete the 30-minute assessment during work hours. Reminder emails prompted participants to complete the assessment within 7 days and to return it to confidential study bins in the worksite mailroom. The employee health office collected the forms daily for secure storage, and the study staff collected assessments each week.

Email Messages

Following completion of the baseline health assessment, employees received an email with an explanation of the health promotion program. The email address provided on the enrollment form was used for this contact. If the email was returned as “undeliverable,” a study coordinator telephoned the employee to verify participation and the email address. Approximately 5% of email addresses needed correction.

Daily health tips (129 total) were delivered from an established website (RealAge.com) Monday through Friday for 26 weeks, starting in October 2003. No marketing messages were included in study emails. Approximately 30% of emails addressed fruit

and vegetable intake, 47% addressed muscle strength and aerobic activity, and 23% addressed general healthy living. Tips were grouped by these topics and rotated throughout the 26-week period (i.e., week 1 addressed fruit and vegetable intake, week 2 addressed aerobic activity, and so forth). Each email emphasized the gains associated with healthy habits and included three components: (1) a specific diet or exercise tip, (2) an estimate of the number of “RealAge” years younger

associated with adopting the behavior [16], and (3) embedded links for self-monitoring tools and additional information (Figure 1). For example, the diet and nutrition emails included serving tips, recommended seasonal fruits, and Web links to recipes, personal calorie counters, and further nutrient information. Physical activity emails suggested alternative ways to incorporate exercise into daily routines, while Web links offered exercise planning and tracking tools.

Figure 1. Sample email health message

Made for Walking – Tip of the Day

If your joints aren't up to a body jarring jog, walking can still help you keep extra pounds off.

A recent study revealed that walking at a certain speed can burn just as many calories as jogging at the same speed. In one study, women who walked at least 5 miles per hour for 5 minutes burned as many calories as they did when jogging for 5 minutes at the same speed. Some women burned even more calories walking than they did jogging.

RealAge Benefit: A physical activity program that builds stamina, strength, and flexibility can make your RealAge as much as 8.1 years younger.

[Click here](#) to read more about this tip.

[Send this tip](#) to your friends and family.

Learn new moves with these [fitness videos](#).

Create your own personalized [RealAge Fitness Plan](#).

Measures of Participation

Process measures of program participation included (a) total number of emails opened, (b) sustained participation over 6 months (i.e., number of days on study and the frequency of opening ≥ 4 emails per week), and (c) the use of health-related Web links. To assess heterogeneity, measures of participation were evaluated by employee demographic characteristics such as gender, age, and education.

To facilitate the evaluation of employee participation by the study team, the RealAge server tracked the use of email messages and Web links. When a participant “clicked” to open an email or link, the RealAge server delivered an HTML version of the message. Thus, the server recorded only HTML-delivered messages as “open” messages. These were recorded by study participant and by date of message. If a participant previewed the email but did not “click” to open it, the email was not counted as open.

To calculate an open rate, the number of HTML-version messages was divided by the total number of emails sent. Open rates were associated with the date the message was *sent* and *not* by the date the employee opened the message. For example, an employee who was on vacation or who worked part-time could read all messages delivered during his or her absence on a single day, but the “open” label was attached to the date associated with each email. Three weeks after the close of the

6-month study period, data summarizing opened emails and Web links (by date and participant) were forwarded to study investigators in a spreadsheet. Participants were not aware that these use statistics were an outcome of the study.

The number of emails opened was calculated as the sum of all opened emails over the 6-month (26-week) study period (maximum of 129 messages). To assess sustained participation, the number of days on study was defined as the last date an email was opened minus the first date emails were sent (October 6, 2003). We also calculated the prevalence of opening 4 or 5 daily emails each week as a second measure of sustained, active participation.

Analysis

The analysis included the tabulation of frequencies, means, and standard deviations and the use of inferential statistics (*t* tests or one-way analysis of variance [ANOVA]) to assess differences in the measures of participation across demographic characteristics. All analyses were conducted in the Statistical Package for the Social Sciences (SPSS). Figures were constructed using DeltaGraph version 5.4.

Results

Enrollment

Of the 960 full-time employees, 388 (40%) signed consent forms and enrolled in the study. The baseline health survey was completed by 345 (88%) of the 388 employees who enrolled. Within the first week, 2 of the 345 employees informed study staff that they would be unable to continue in the study due to personal reasons. As shown in [Table 1](#), participating employees

were predominantly female (87%) and white (91%), with a mean age of 43.7 years ($SD = 8.7$). The majority of participants were married, 34% completed college or post-graduate work, 21% earned an annual salary less than \$29999, and over half earned less than \$39999. With the exception of the gender distribution, characteristics of participating employees did not differ from the total full-time employed population at this worksite—a greater proportion of females enrolled in the study than were employed at the worksite ([Table 1](#)).

Table 1. Baseline demographic characteristics of participants (n = 345)^{*} and total employee population at the worksite (n = 960)

| | Participants | | Total Employee Population |
|----------------------------|--------------|-----|---------------------------|
| | N | % | % |
| Gender | | | |
| Male [†] | 44 | 13 | 24 |
| Female | 299 | 87 | 76 |
| Age (years) | | | |
| 20–29 | 17 | 5 | 6 |
| 30–39 | 107 | 32 | 31 |
| 40–49 | 128 | 38 | 39 |
| 50–59 | 77 | 22 | 21 |
| 60–66 | 10 | 3 | 3 |
| Mean age (SD) | 43.7 | 8.7 | 43 |
| Median age | 43.3 | | NA |
| Ethnicity | | | |
| White | 309 | 91 | 90 |
| Black | 23 | 7 | 8 |
| Other | 7 | 2 | 2 |
| Marital Status | | | |
| Married/partner | 244 | 71 | 66 |
| Divorced/separated/widowed | 66 | 20 | NA |
| Never married | 33 | 9 | NA |
| Education | | | |
| High school | 87 | 25 | NA |
| Some college | 142 | 41 | NA |
| College graduate | 78 | 23 | NA |
| Postgraduate work | 37 | 11 | NA |
| Income (US \$) | | | |
| < 19999 | 4 | 1 | 2 |
| 20000–29999 | 63 | 20 | 22 |
| 30000–39999 | 104 | 32 | 26 |
| 40000–49999 | 68 | 21 | 20 |
| 50000–59999 | 44 | 13 | 13 |
| 60000–69999 | 17 | 5 | 6 |
| 70000–79999 | 8 | 2 | 2 |
| > 80000 | 19 | 6 | 9 |

^{*}Total numbers do not add to 345 within specific characteristics due to missing data.

[†] $P < 0.05$ for gender distribution in participant sample compared to total workforce.

NA = not available

Table 2. Participation measures at 6 months (n = 345)

| | N | % |
|--|------------------|-----|
| Number of Emails Opened* | | |
| None | 12 | 3 |
| 1–25 | 35 | 10 |
| 26–51 | 46 | 13 |
| 52–77 | 26 | 8 |
| 78–103 | 40 | 12 |
| 104–117 | 34 | 10 |
| 118–129 | 152 | 44 |
| Mean (SD), Median | 88.6 (43.8), 108 | |
| Number of Days on Study*† | | |
| None | 14 | 4 |
| 1–35 | 4 | 1 |
| 36–71 | 11 | 3 |
| 72–107 | 11 | 3 |
| 108–143 | 13 | 4 |
| 144–161 | 14 | 4 |
| 162–179 | 278 | 81 |
| Mean (SD), Median | 159 (44.9), 179 | |
| Number of RealAge Clicks for Additional Information* | | |
| None | 36 | 10 |
| 1–15 | 235 | 68 |
| 16–31 | 42 | 12 |
| 32–51 | 15 | 4 |
| 52–95 | 11 | 3 |
| 96–127 | 2 | < 1 |
| 128–160 | 4 | 1 |
| Mean (SD), Median | 13.5 (22.3), 6.0 | |
| Opened 4 or 5 Emails per Week | | |
| Never | 34 | 10 |
| 1–6 times | 55 | 16 |
| 7–12 times | 35 | 10 |
| 13–18 times | 28 | 8 |
| 19–24 times | 59 | 17 |
| 25–26 times | 134 | 39 |
| Mean (SD), Median | 16.5 (9.9), 21 | |

*“None” is part of the 1st quintile in measures 1 to 3; in addition, the most populated quintile in measures 1 to 3 has been split at the midpoint to provide more detail about the distribution (5th quintile in measures 1 and 2, 1st quintile in measure 3).

†Calculated as the last date an email was opened minus the first date emails were sent.

Participation

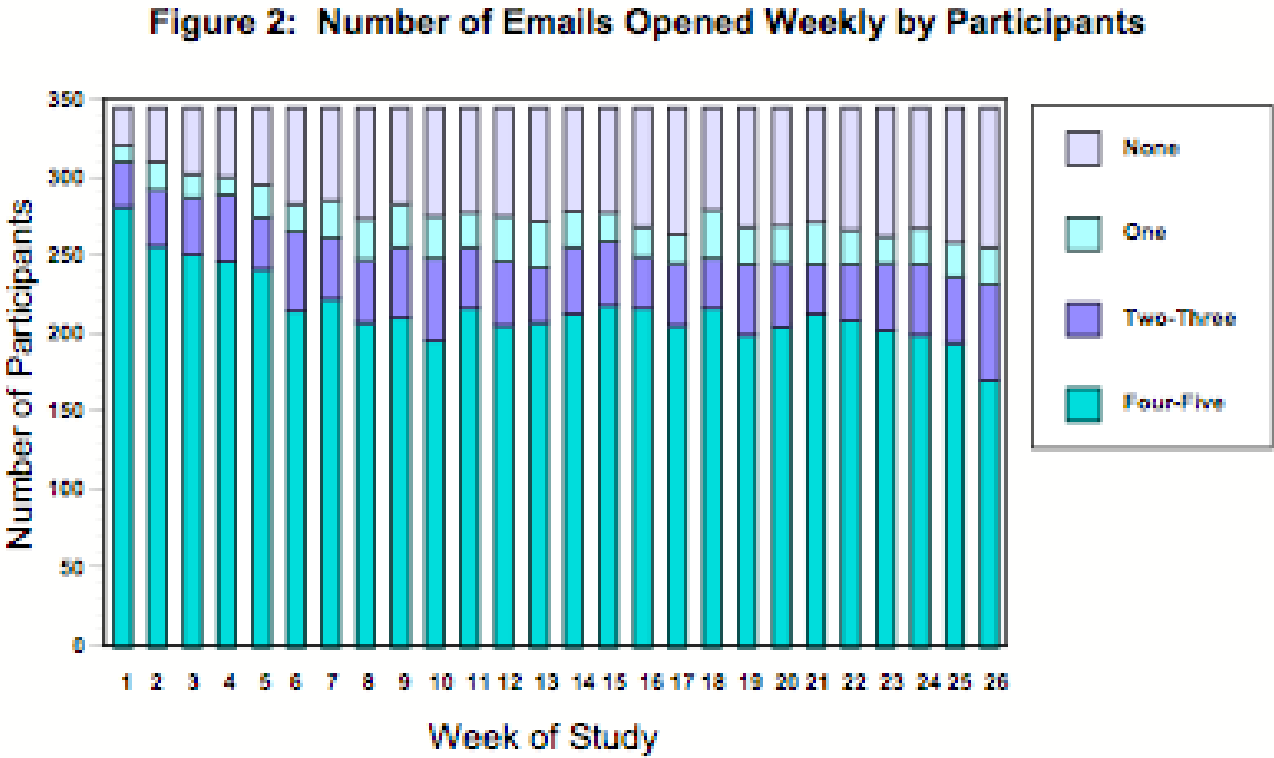
Of the study participants, 3% (n = 12) failed to open any of the 129 email messages, while an additional 5% (n = 16) opened 5 or fewer emails. The mean number of messages opened was

88.6 (SD = 43.8), and the median was 108 messages. More than 118 of the 129 messages were opened by 44% of participants (Table 2); 81% of the participants continued to open emails for 23 weeks or longer (≥ 162 days, Table 2), with more than 50% of them continuing to open emails throughout the 26-week study

period. Figure 2 details the number of emails opened weekly by participants. Although there was an initial decline in the number of participants opening 4 or 5 emails per week, the prevalence remained at approximately 60% from 6 weeks into the study until the 25th week.

The use of Web links for additional information was also collected. Approximately 90% of participants sought additional information at least once while enrolled in this study. The mean number of Web links used was 13.5 (SD = 22.3); the median was 6 (Table 2). For context, at least two Web links were embedded in each of the 129 daily messages, offering more than 250 possible Web links over the study course.

Figure 2. Number of Emails Opened Weekly by Participants



As shown in Table 3, seeking health information via Web links was more frequent among older participants, those with a high school degree, and those with an income of < \$40000 per year. Participation (as measured by the overall number of emails opened, the number of days on study, or the number of weeks when 4 or 5 emails were opened) did not differ by gender, age

group, ethnicity, marital status, education, or income (Table 3). Additionally, there were no differences in participation or in the number of clicks for additional information as a function of baseline fruit and vegetable intake or physical activity (Tables 4 and 5).

Table 3. Study participation at 6 months by baseline demographic characteristics*

| | Number of Emails Opened | | Number of Days on Study | | Number of Clicks for Additional Information | | Number of Weeks 4 or 5 Emails Opened | |
|-----------------------|-------------------------|------|-------------------------|------|---|------|--------------------------------------|------|
| | Mean | SD | Mean | SD | Mean | SD | Mean | SD |
| Gender | | | | | | | | |
| Male | 83.9 | 45.6 | 158.3 | 42.4 | 8.1 | 19.5 | 15.5 | 10.2 |
| Female | 89.1 | 43.6 | 159.4 | 45.5 | 14.3 | 22.7 | 16.6 | 9.9 |
| Age (years) | | | | | | | | |
| 20–29 | 96.2 | 41.5 | 155.4 | 47.8 | 6.0 [†] | 6.3 | 18.7 | 9.2 |
| 30–39 | 87.2 | 42.5 | 160.8 | 40.9 | 9.8 | 13.7 | 16.1 | 9.7 |
| 40–49 | 88.2 | 44.5 | 159.7 | 46.9 | 10.8 | 18.2 | 16.4 | 10.1 |
| 50–59 | 92.4 | 43.6 | 163.1 | 39.7 | 23.5 | 32.8 | 17.4 | 10.1 |
| 60–66 | 64.9 | 52.4 | 126.2 | 75.8 | 25.0 | 39.7 | 11.8 | 11.5 |
| Ethnicity | | | | | | | | |
| White | 90.2 | 42.5 | 160.9 | 42.6 | 13.5 | 22.1 | 16.8 | 9.8 |
| Non-white | 74.3 | 51.4 | 148.0 | 58.7 | 11.9 | 21.4 | 13.5 | 11.2 |
| Marital Status | | | | | | | | |
| Married/partner | 90.8 | 42.5 | 161.1 | 48.2 | 12.4 | 20.1 | 16.9 | 9.8 |
| Not married | 82.4 | 46.7 | 154.9 | 43.7 | 16.1 | 27.1 | 15.2 | 10.5 |
| Education | | | | | | | | |
| High school | 87.5 | 47.0 | 156.3 | 51.9 | 18.4 [†] | 27.3 | 16.5 | 10.6 |
| Some college | 92.2 | 41.7 | 159.5 | 43.2 | 14.7 | 24.4 | 17.4 | 9.5 |
| College degree | 88.7 | 43.5 | 159.4 | 44.4 | 8.3 | 13.2 | 16.6 | 9.8 |
| Post college | 76.6 | 44.0 | 166.1 | 35.5 | 8.1 | 9.7 | 13.1 | 10.3 |
| Income (US \$) | | | | | | | | |
| < 39999 | 90.3 | 43.9 | 156.5 | 48.5 | 17.0 [†] | 26.1 | 17.0 | 9.9 |
| 40000–79999 | 88.2 | 43.5 | 161.8 | 43.4 | 9.7 | 16.1 | 16.4 | 9.9 |
| > 80000 | 72.7 | 40.4 | 166.5 | 27.4 | 6.2 | 6.0 | 11.7 | 9.1 |

*Total number of messages sent = 129; total number of possible days on study = 179; total number of weeks emails sent = 26

[†] $P < 0.05$

Table 4. Study participation at 6 months by baseline stage-of-change and intention-to-change behaviors*

| | | Number of Emails Opened | | Number of Days on Study | | Number of Clicks for Additional Information | | Number of Weeks 4 or 5 Emails Opened | |
|--|-----|-------------------------|------|-------------------------|------|---|------|--------------------------------------|------|
| | N | Mean | SD | Mean | SD | Mean | SD | Mean | SD |
| Stage of Change | | | | | | | | | |
| Eating 5 daily servings of fruit/vegetables | | | | | | | | | |
| Yes, for > 6 months | 72 | 93.7 | 40.9 | 165.1 | 38.3 | 14.2 | 23.9 | 17.7 | 9.5 |
| Yes, for < 6 months | 22 | 86.2 | 47.1 | 145.6 | 55.9 | 21.1 | 22.9 | 16.1 | 10.4 |
| No, start in next 1 month | 131 | 88.7 | 43.5 | 160.6 | 43.2 | 12.4 | 21.8 | 16.6 | 9.9 |
| No, start in next 6 months | 69 | 83.6 | 45.9 | 153.0 | 51.3 | 14.3 | 23.9 | 15.3 | 10.6 |
| No, do not intend | 37 | 95.0 | 41.5 | 167.4 | 35.4 | 10.9 | 20.5 | 17.9 | 9.3 |
| Getting 30 minutes of daily physical activity | | | | | | | | | |
| Yes, for > 6 months | 71 | 91.4 | 41.8 | 162.5 | 40.7 | 16.2 | 26.7 | 17.0 | 9.6 |
| Yes, for < 6 months | 36 | 91.3 | 44.6 | 156.9 | 44.7 | 9.2 | 10.8 | 17.5 | 9.9 |
| No, start in next 1 month | 121 | 87.2 | 42.9 | 162.1 | 41.6 | 14.9 | 25.6 | 16.0 | 9.9 |
| No, start in next 6 months | 82 | 87.3 | 46.2 | 155.1 | 51.7 | 11.4 | 18.1 | 16.4 | 10.4 |
| No, do not intend | 26 | 83.2 | 49.2 | 150.0 | 55.4 | 8.9 | 8.8 | 15.5 | 10.9 |
| Intention to Change | | | | | | | | | |
| Eating 5 daily servings of fruit/vegetables | | | | | | | | | |
| Very unlikely | 44 | 92.2 | 44.7 | 162.1 | 40.6 | 8.7 | 8.9 | 17.5 | 9.9 |
| Somewhat unlikely | 76 | 84.9 | 44.7 | 158.6 | 46.9 | 15.5 | 26.7 | 15.6 | 10.1 |
| Somewhat likely | 147 | 87.5 | 44.9 | 155.2 | 48.8 | 11.9 | 17.7 | 16.4 | 10.1 |
| Very likely | 73 | 92.7 | 40.3 | 165.7 | 38.0 | 17.4 | 29.7 | 17.1 | 9.7 |
| Getting 30 minutes of daily physical activity | | | | | | | | | |
| Very unlikely | 39 | 89.1 | 46.5 | 156.9 | 51.8 | 13.2 | 18.2 | 16.5 | 10.6 |
| Somewhat unlikely | 70 | 88.2 | 46.8 | 155.6 | 49.4 | 8.7 | 12.6 | 16.7 | 10.2 |
| Somewhat likely | 149 | 91.8 | 41.1 | 162.9 | 38.6 | 14.0 | 20.2 | 17.2 | 9.6 |
| Very likely | 79 | 81.7 | 45.1 | 155.6 | 50.2 | 17.4 | 32.6 | 14.8 | 10.2 |

*Total number of messages sent = 129; total number of possible days on study = 179; total number of weeks emails sent = 26; $P > 0.05$ in all comparisons

Table 5. Study participation by baseline behaviors: servings of fruits and vegetables, and physical activity (n = 345)*

| | | Number of Emails Opened | | Number of Days on Study | | Number of Clicks for Additional Information | | Number of Weeks 4 or 5 Emails Opened | |
|--|-----|-------------------------|------|-------------------------|------|---|------|--------------------------------------|------|
| | N | Mean | SD | Mean | SD | Mean | SD | Mean | SD |
| Daily Servings of Fruits and Vegetables [†] | | | | | | | | | |
| < 2 | 111 | 84.9 | 44.3 | 160.1 | 43.2 | 11.9 | 22.3 | 15.8 | 10.0 |
| 3 or 4 | 102 | 86.6 | 45.7 | 157.3 | 46.2 | 11.4 | 18.7 | 15.9 | 10.3 |
| ≥ 5 | 122 | 93.7 | 41.2 | 160.6 | 44.9 | 15.6 | 22.1 | 17.6 | 9.6 |
| Physical Activity (days/week) | | | | | | | | | |
| Vigorous Activity | | | | | | | | | |
| None | 186 | 89.2 | 44.6 | 158.9 | 45.8 | 13.2 | 21.8 | 16.7 | 10.1 |
| 1–2 | 79 | 87.9 | 43.7 | 160.8 | 43.5 | 14.3 | 25.2 | 16.3 | 10.1 |
| 3–4 | 59 | 88.8 | 41.6 | 162.1 | 39.1 | 13.1 | 20.5 | 16.5 | 9.6 |
| 5–7 | 16 | 83.3 | 45.1 | 152.4 | 57.6 | 12.7 | 21.1 | 15.1 | 9.9 |
| Moderate Activity | | | | | | | | | |
| None | 123 | 88.7 | 45.3 | 155.8 | 50.9 | 12.8 | 23.7 | 16.8 | 10.1 |
| 1–2 | 117 | 87.2 | 45.5 | 157.4 | 46.4 | 12.2 | 19.1 | 16.2 | 10.3 |
| 3–4 | 54 | 84.0 | 42.9 | 163.9 | 37.9 | 13.4 | 24.8 | 15.0 | 9.9 |
| 5–7 | 44 | 94.9 | 36.1 | 169.4 | 26.3 | 18.4 | 23.9 | 17.6 | 8.8 |
| Walking 10 or more minutes per occasion | | | | | | | | | |
| None | 42 | 80.6 | 46.4 | 155.4 | 53.6 | 7.9 | 8.6 | 14.9 | 10.2 |
| 1–2 | 56 | 93.9 | 39.8 | 163.1 | 40.1 | 17.0 | 30.2 | 17.7 | 9.4 |
| 3–4 | 63 | 92.4 | 44.9 | 159.1 | 47.2 | 13.4 | 23.3 | 17.4 | 10.2 |
| 5–7 | 181 | 87.3 | 43.9 | 159.3 | 43.8 | 13.4 | 20.9 | 16.2 | 10.1 |

Note: Vigorous activity includes heavy lifting, digging, aerobics, fast bicycling, etc. Moderate activity includes bicycling at regular pace, carrying light loads, doubles tennis, etc.

*Total number of messages sent = 129; total number of possible days on study = 179; total number of weeks emails sent = 26; $P > 0.05$ in all comparisons

[†]10 outliers eliminated.

More than one third of employees at one large worksite who were enrolled in the study consistently opened health promotion emails throughout the 6-month intervention. Sustained participation was observed for both males and females, across all age groups, education levels, incomes, ethnic groups, and marital status categories. Moreover, participation did not vary by level of baseline health behaviors. The heterogeneity of participants with sustained email open rates supports both the reach and feasibility of an email health promotion program in the workplace.

Of the total workforce at the study worksite, 40% were enrolled in the study. Participants were representative of the total employee sociodemographic profile, with the exception that significantly more women enrolled. This observation is similar to other reports showing that women are more likely than men to participate in face-to-face health promotion programs [17,18]. Diverse age, education, and income levels were represented in the employee population. We defined a participant as an employee who completed both an informed consent and a 30-minute health assessment. It is possible that the completion of the lengthy baseline assessment may have discouraged further participation; that is, perhaps a larger proportion of employees

would have participated and used worksite health messages if the baseline assessment was not required. It is also possible that we attracted the more motivated employees who did not perceive the assessment as a barrier. However, the varied initial levels of healthy behaviors (i.e., fruit and vegetable intake and physical activity) and readiness-to-change categories (i.e., stage-of-change and intention-to-change) suggest that the email program engaged a heterogeneous employee population with regard to health behaviors and their hypothesized antecedents.

A limitation of traditional health promotion programs is that they attract primarily those who are already motivated to consider health behavior change. Similarly, the frequent users of Internet health websites are more health-oriented than the average population [19]. By using “electronic outreach,” the current email intervention reverses the traditional relationship with health promotion materials. Web-based information was delivered to participants at their desktop, in small, daily email tips, thus eliminating the need for the user to seek out health information, search the Web, or contact a health professional directly. Variation in self-reported health behaviors, stage of change, and intention to adopt health behaviors at the start of the intervention offers evidence that the email program included

less-motivated adults. Importantly, we did not detect variation in email use across stage of change or self-reported intention to change. These findings indicate the potential for eHealth promotion programs to reach adults with less than optimal behaviors.

In contrast to the sustained email open rate, fewer participants used the embedded Web links over time, and there was some variability in use by demographic characteristics. It is difficult to interpret these data; we speculate that perhaps people were not interested in general in the additional information (e.g., younger individuals did not feel themselves at risk for health issues), or they were not ready to seek out additional information. It is also possible that those with more education or income had other sources of available information. Alternately, the design and/or content of the Web links may not have appealed to our participants. Future research will need to investigate the factors that influence Web link use.

Longitudinal analyses demonstrated that about 75% of participants “actively” opened messages for 6 months; “actively” included opening a large number of emails or opening fewer emails overall, but continuing to open emails for at least 23 of the 26 weeks. These participants may represent different types of users, a topic worthy of further study. An initial decline in usage occurred from week 2 to 7 of the study. Subsequently, email use remained relatively constant through week 25. Decline in use over time may suggest that participants habituated to the intervention, consistent with the “law of attrition” [18], or that seasonal factors reduced participants’ time for messages. The first third of the study period included both the winter holidays and the business’ peak work season. Further research should evaluate the optimal email interval (e.g., daily vs. weekly) and intervention length in order to optimize employee engagement.

The email program participation rate compares favorably to the 30–40% rates reported for traditional health education and health

risk assessment programs [20–22]. However, the unique aspect of this program was the persistent, daily participation across 6 months, longer than a traditional health education program. As expected, this study’s participation rate exceeds the 10–17% rates reported in fitness programs requiring physical participation [20,22].

Successful email health promotion programs may be limited to worksites where regular personal computer access is an expectation. Service industry sites (e.g., financial, educational, marketing) may be particularly appropriate. Settings where Web access is limited or where employees share a computer station (e.g., hospitals, manufacturing plants) may not be easily included in this model. In the future, home email delivery could allow worksite health promotion programs to reach employee families and retirees, in addition to the current workforce.

Based on our findings, we encourage health promotion professionals, employers, and insurers to explore the use of email to deliver health promotion programs. Our results suggest that broad and diverse employee populations can be reached with this technology. The email program we studied sustained use over 26 weeks among varied employee demographic categories. Our ongoing research includes a randomized controlled trial to evaluate both reach and effectiveness (i.e., health behavior change) in a variety of worksite settings. Understanding both reach and effectiveness will allow us to calculate the true public health impact [23] of email and Web health promotion programs. The potential value of eHealth technology to improve active patient participation in health care through information and self-care tools has been well delineated [24,25]. Further research should evaluate message framing, email intervals, duration of intervention, and content of Web supports in order to optimize reach, effectiveness, and, ultimately, public health impact.

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Conflicts of Interest

Michael Roizen, MD, the Co-Principal Investigator of the study is also the founder and Chair of the Science Team of RealAge Inc. Dr. Roizen’s role in the study focused on the recruitment of worksites and serving as the primary interface with the RealAge technology group. Dr. Roizen did not participate in data analysis.

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Original Paper

A Case Analysis of INFOMED: The Cuban National Health Care Telecommunications Network and Portal

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Abstract

Background: The Internet and telecommunications technologies contribute to national health care system infrastructures and extend global health care services markets. The Cuban national health care system offers a model to show how a national information portal can contribute to system integration, including research, education, and service delivery as well as international trade in products and services.

Objective: The objectives of this paper are (1) to present the context of the Cuban national health care system since the revolution in 1959, (2) to identify virtual institutional infrastructures of the system associated with the Cuban National Health Care Telecommunications Network and Portal (INFOMED), and (3) to show how they contribute to Cuban trade in international health care service markets.

Methods: Qualitative case research methods were used to identify the integrated virtual infrastructure of INFOMED and to show how it reflects socialist ideology. Virtual institutional infrastructures include electronic medical and information services and the structure of national networks linking such services.

Results: Analysis of INFOMED infrastructures shows integration of health care information, research, and education as well as the interface between Cuban national information networks and the global Internet. System control mechanisms include horizontal integration and coordination through virtual institutions linked through INFOMED, and vertical control through the Ministry of Public Health and the government hierarchy. Telecommunications technology serves as a foundation for a dual market structure differentiating domestic services from international trade.

Conclusions: INFOMED is a model of interest for integrating health care information, research, education, and services. The virtual infrastructures linked through INFOMED support the diffusion of Cuban health care products and services in global markets. Transferability of this model is contingent upon ideology and interpretation of values such as individual intellectual property and confidentiality of individual health information. Future research should focus on examination of these issues and their consequences for global markets in health care.

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KEYWORDS

Case analysis; Cuban national health care system; INFOMED; ideology; virtual infrastructure; health care markets; globalization

Introduction

National health care systems are motivated by highly diverse ideologies giving rise to consumer-driven as well as social medicine models delivering widely varying quality of health

care. Health care is defined here as the preservation of mental and physical health by prevention or treatment of illness through services offered by the health professions [1]. A health care system is a dynamic set of interconnected individuals, institutions, organizations, and projects offering products and services in health care markets [2]. The boundaries of such

systems are increasingly difficult to identify. While many analyses, such as the annual reports of the World Health Organization (WHO), refer to national health care systems [3], diverse system boundaries may also be defined by overlapping corporate, professional, or other social entities.

Virtual infrastructures refer to (1) an environment characterized by overlapping distribution networks, systems brokerage functions, and the adoption of a software perspective emphasizing the devices and channels through which information is processed and distributed, as well as (2) a layer of abstraction between the computing, storage, and networking hardware and the software technologies that allow multiple operating systems to run on the same processor. This layer of abstraction leads to standardization and the support of legacy operating systems and applications on current hardware and software platforms. These infrastructures in turn are accessible through Internet websites and gateways designed to facilitate integrated use of the resources offered through virtual infrastructures. The adjective “virtual” thus describes any Web-based product, service, organization, or institution arising from the technical infrastructure defined above [4].

International trade in health care services and the globalization of national economies raise questions with regard to the emergence of institutional infrastructures in light of the deepening divide between the wealthiest industrialized nations and the developing world. Internet and telecommunications technologies are contributing to emergence of health care markets around the world. Research on economics and health care services has shown that national health care system performance is not directly related to gross national product (GNP) but rather is a function of variables describing rate of investment in public health as well as mechanisms for the equitable distribution of wealth [5-7]. Health care systems deliver widely differing services in terms of overall performance and per capita cost [3]. Thus, institutional and organizational configurations based on diverse ideologies are hypothesized to account for some of this variance. Ideology is the body of integrated assertions, theories, and aims that constitute a coherent sociopolitical system. Health care system ideology is expressed as the extent or manner of government and other stakeholders' involvement in the financing, administration, and regulation of health care [8,9]. Indicators of such involvement include investment in health care, oversight and control of health care services, as well as ownership and governance of the health care system.

Research on the association between ideology and health care system structures, processes, and performance remains inconclusive [10-16]. Recent qualitative case studies conducted in China [17], South Africa [18], and countries in transition from communism [19] present mixed results. Health standards in China have improved under communist rule, while the transition from communism in Russia and Eastern Europe has resulted in short-term regression in such standards with some signs of improvements to come in the future. The South African democracy has seen significant regression in health indicators due to factors related to the AIDS pandemic as well as the high rate of violence in the country. The conclusions of these studies suggest that a more detailed analysis of the configurations of

health care systems is required to understand dimensions affecting their internal coherence.

Consistent with Sen [5], Franco et al [11] found that democracy was more strongly associated with life expectancy, infant mortality, and maternal mortality than was GNP. Sen has pointed out that national health care system effectiveness measured on public health indicators such as life expectancy is not directly correlated with GNP, but rather that this relation is mediated through variables related to public investment in health care as well as mechanisms for the redistribution of wealth. This economic analysis is validated in the WHO's rankings [3] of the general effectiveness of national health care systems.

For example, in 2000, the general performance of the US health care system was ranked 37th by the WHO and the Cuban system was ranked 39th of 191 member countries [3], while total health care expenditure per capita was estimated (at 2002 international dollar rates) at \$5274 and \$236, respectively [20]. The level of expenditure in the United States, highest among member countries of the Organization for Economic Cooperation and Development (OECD), is not reflected in the health care system performance measured as life expectancy among OECD nations [21]. Despite resource constraints [22], the Cuban national health care system has achieved a significant level of health care quality and equity as measured by population health criteria—the highest life expectancy in the Caribbean region as well as the highest concentration of physicians in the world. According to the United Nations Development Program, there were estimated to be 591 physicians per 100000 population in 2004 [23].

The inconclusive evidence for the association between health care system effectiveness and ideology may be the result of the wide variety of descriptive as well as quantitative methods used in the studies and the lack of a systematic approach to meta-analysis. However, it is also important to consider the complexity of health care systems and the proposition that system performance may be better explained by the internal coherence of the system, including the fit between system configurations and market ideologies as well as their integration in global networks and their adaptability to rapidly changing political and economic environments.

Research Problem and Objectives

The Cuban strategy for an information society recognizes the critical importance of linkages among research activities and all economic sectors of activity, including health care. The accomplishment of this objective depends upon universal application of information technologies and development of national innovation systems and networks [24]. Extensive research has focused on the critical importance of proximate organization networks for knowledge creation and learning, particularly in health care and biotechnology [25-28]. This research has shown how diverse government, educational, research, and service entities contribute to effective research and development and service delivery. However, little research has examined specific institutional network configurations serving health care systems with the emerging roles of virtual infrastructures.

The Cuban system's perspective on health care integrates evidence-based practice as well as medical and social science criteria for evaluation of system performance [29,30]. Of pivotal concern in analysis of the Cuban case are the socialist ideological principles upon which technological and institutional infrastructures are founded [9,31,32]. These principles, particularly social welfare priorities of free and equal access to health care and education for all Cuban citizens, affect the social and ideological pattern of interaction between telecommunications technologies and institutional choices within the society. Social behavior and community participation shape technological development by a process reinforcing institutional structures as well as organizational adaptation [33,34]. In the centralized Cuban social medicine model, unique social control structures suggest that the role of technology is significantly different from that in the free health care market driven by consumer demand [35].

Information and telecommunications technologies are changing the configuration and modifying the definition of sustainable health care system performance. Pressures for collaboration, data sharing, and access to distributed resources increase the focus on the interconnection of services both within and across institutions. Thus, both technological trends and commercial pressures foster service decomposition and distribution through networks rather than host-centric systems [2]. The pattern of medical informatics system evolution can be traced across three generations from system creation at the enterprise or institutional level beginning in the 1960s, through integration of enterprise architectures in the 1980s, to horizontal linkage and coordination across contemporary system boundaries. Effective contemporary medical informatics systems encompass components of all three generations [36].

The Internet and telecommunications infrastructures contribute to control mechanisms of health care management systems [37] through electronic markets, hierarchies [38], and heterarchies [39-41]. Electronic hierarchies are electronic linkages controlled by a centralized managerial system, as in the model of social medicine, while electronic markets supported by Internet and telecommunications networks foster competition among multiple buyers and sellers [42,43]. Heterarchies are complex systems of diverse interdependent entities. Institutional networks contribute to market dynamics based on the creation and supply of products and services (push) [42]. The performance of health care markets is founded substantially on the linkages among research and service delivery institutions as well as business enterprises.

While the Cuban national health care system and INFOMED form a rich context for the study of an integrated socialist health care environment, little previous research has focused on the unique characteristics of these social structures.

The objectives of this paper are to present the context of the Cuban national health care system since the revolution in 1959, to identify the configuration of INFOMED and its virtual institutional infrastructures using a qualitative research methodology, and to describe how these infrastructures contribute to international health care services markets.

Ideological factors affecting the transferability of the Cuban model are considered.

Methods

Qualitative case analysis is a research methodology particularly appropriate to the study of the health care sector [44]. Technological innovation and economic globalization drive rapid changes rendering nomological model identification more elusive. Idiographic case research methods are thus useful for rich descriptive analysis and assessment of complex health care management systems within their social, economic, and cultural contexts [43-46]. Multiple sources of data were used in this study, including published studies and research reports well as the Internet sites of the health care institutions under study and their network configurations.

The holistic level of analysis includes the health care system and its virtual environment. Chronological ordering of information shows how telecommunications and Internet strategies unfolded in the socialist ideological context of the Cuban national health care system. Network structure is defined as a system or configuration of relations among traditional and virtual institutions on the Internet. Properties of these information structures include attributes of institutions as well as the nature of relations among them, such as hierarchy and centralization [47,48]. Network configurations arising from these properties reflect social and institutional patterns of information management and control [43]. Qualitative analysis identifies linkages among traditional and virtual institutions and serves as a basis for mapping their configuration. Particular attention is focused on institutional configurations and e-commerce in global health care service markets.

Results

Historical Context

Since the Cuban revolution in 1959, Fidel Castro and the country's leadership have pursued strategies to integrate national research and innovation policies through development of traditional institutions and, since 1990, virtual infrastructures [36,49-52].

- Development of a science base and infrastructure (1959-73): early transformation of the health care system and creation of integrated polyclinics (1963) to serve the Cuban population
- Elaboration of a centralized management model (1974-89): integration of information from various sources through institutional information architectures; introduction of community medicine (1974) and, subsequently (1984), the family doctor-and-nurse model
- Horizontal coordination and globalization through virtual infrastructures (1990-present): continued development of the Cuban social medicine model with emphasis on national infrastructure for institutional linkage of diverse sources of information and integration in international telecommunications infrastructures

In 1963, municipal polyclinics were first created to form the basic units of the Cuban health care system and to manage all

health care activities within their jurisdictions, including workplaces, schools, and childcare centers. These activities were the first programs of the current community-based health care model. In 1965, both the National Center for Scientific Research (Centro Nacional de Investigaciones Científicas) and the National Information Center for the Medical Sciences (Centro Nacional de Información de Ciencias Médicas de la República de Cuba, CNICM) were founded to serve the institutional needs of science with a priority on research in health care. The CNICM offered services for document distribution in Havana and throughout the country, as well as a system designed for the collection and analysis of information for health care evaluation. Coordination of these services contributed to universal access for all citizens as community-based social organizations encouraged participation in health-related activities such as vaccination, blood donation, and neighborhood clean-up efforts [53].

An evaluation of the municipal polyclinic model implemented in 1964 showed a lack of integration of health care activities across disciplines, persistence of curative over preventive priorities, lack of teaching and research opportunities in primary care, and inadequate coordination of polyclinic relations with hospitals and emergency rooms. Evaluation of this model led to the development of a new community medicine model. The system focus shifted at this phase from expressed morbidity to the preventive diagnosis of unexpressed morbidity by continuous assessment of risk factors associated with certain conditions, such as diabetes [53]. Continuous individual medical assessment and risk evaluation (dispensarización) transformed the earlier health care model and the activities of integrated municipal polyclinics [54]. In the period from 1971 to 1975, services for statistical analyses were integrated in the CNICM network [55].

Professors and medical residents increased their collaboration in polyclinic activities thus promoting opportunities for teaching and research in primary care. To further develop the focus on preventive medicine, a new holistic approach encompassing evaluation of social factors and preventive health care strategies was initiated in 1984 and later implemented throughout the country based on the *family doctor-and-nurse model* of medical practice. By 1984, CNICM had assumed the role of Cuban national coordinator for the Brazil-based Latin American and Caribbean Center for Information Sciences (BIREME), and preparations began to automate medical information services [55].

The information requirements of the Cuban national health care system continued to increase in complexity with the emergence of institutional networks and continuing emphasis on education and research. All of these factors contributed to further development of telecommunications infrastructures to support health care information, communication, and service delivery. These infrastructures reduced institutional health care costs in difficult economic conditions, including the collapse of the Soviet Union after 1989 as well as sanctions imposed by the US government [52,56,57]. INFOMED, the Cuban National Health Care Telecommunications Network and Information Portal (Red Telemática y Portal de Salud de Cuba), as well as academic telecommunications networks linking universities and research institutes became particularly critical to health care

workers' access to information. International organizations collaborated for the development of this network starting in 1992 when INFOMED was founded with the creation of the national network node in Havana. The United Nations Development Program, the WHO, the Pan-American Health Organization, and UNICEF made significant financial contributions to this effort [58]. The INFOMED network, later extended throughout the 14 Cuban provinces, made electronic access to important databases possible, including the US National Library of Medicine, the Cuban National Library of Medicine, and the growing collection of specialized Cuban medical journals such as ACIMED, the first Spanish language journal of medical informatics, founded in 1993 [55].

INFOMED developed collaborative projects with BIREME and offered training and assistance to other countries of the Caribbean and Latin American regions, such as Ecuador, Mexico, and Venezuela, where the Cuban health care model offers a reference for sustainable system development. The Virtual University project was inaugurated by the Ministry of Public Health in 1999 to improve continuing post-graduate medical training for more than 100000 Cuban health care professionals and to create an international center for post-graduate education in medicine and related disciplines [59]. These developments in the health care information system have contributed to the extension of the family doctor-and-nurse model of primary care, increased interdisciplinary integration of the activities of diverse health care actors, and emphasized continuous data collection, analysis, and dissemination throughout the system [60]. In 2002, INFOMED was awarded the Stockholm Challenge Prize in the health category for life-improving information technologies [61].

INFOMED and the Cuban National Health Care System

The current Cuban model integrates the family doctor-and-nurse model and a community-based health care strategy while emphasizing the social relationships among patients, families, and physicians specialized in comprehensive general medicine. More than 30000 family doctors, each usually assisted by a nurse, serve neighborhoods of approximately 150 families whom they know intimately [62]. Community and family participation throughout the system, as well as continuous individual medical assessment (dispensarización), link the collective and individual levels of health care [54]. While population-level data are analyzed for performance evaluation and policy making, individual patient histories are maintained in paper files and archives. A project has been formulated to create passive electronic archives of patient histories more than two years old on CD-ROM disks. Paper files are considered critical for the legal record of individual patient care [63,64]. Qualitative and quantitative data are required for interdisciplinary medical practice, administrative coordination, community participation, and health care system evaluation. A key characteristic of the model is participation of the family as a social unit with attention to social morbidity as well as family culture and environment [53,65].

The integrated INFOMED network and the Cuban Ministry of Public Health (Ministerio de Salud Pública, MINSAP) assure

both horizontal coordination and hierarchical control of the Cuban national health care system [56,57]. The hierarchical organization of MINSAP is comprised of 22 functional areas, including health statistics, hospitals, and ambulatory care, managed through the ministry and its board of directors as well as institutions at the national, provincial, and municipal community levels. At the municipal level, the people's assembly, basic work groups (grupos básicos de trabajo), and the family doctor contribute to local health care management [66]. Government, health care institutions, and mass organizations such as youth and women's groups are integrated in a distinctive social control system [35,67].

While MINSAP is largely responsible for hierarchical control, INFOMED is the vehicle for horizontal communication and coordination throughout the health care system. INFOMED also supports international collaboration and dissemination of information as well as the growing international trade in Cuban health care services. Specialized networks connect provincial information centers, research institutes, hospitals, and institutions of higher education. The virtual infrastructure maintained through INFOMED includes the Virtual Library (Biblioteca Virtual en Salud, BVS) and Virtual University (Universidad Virtual), the Health Information Observatory (Vigilancia en Salud), and key ministerial structures accessible through the portal as shown in the Figure.

The current mission of INFOMED is to develop an integrated telecommunications network for access and management of information and knowledge for improvement of clinical care, training, research, and health care management systems. Its mission is to improve the efficiency of the Cuban national health care system through development of an advanced electronic information infrastructure in order to foster communication and interaction between the international scientific community and Cuban health care workers, including clinicians, educators, administrators, professionals, and technicians [58]. Furthermore, INFOMED is designed to offer a virtual workspace and timely information access required for optimal performance without regard for physical location or the technical characteristics of work stations. Strategic objectives of the network include [58,68,69] the following:

- To facilitate electronic information access through the Virtual Health Library linked to provincial resources as well as regional and international databases available on the Internet
- To create an infrastructure of technical, organizational, and human resources for sustainable growth of INFOMED
- To facilitate continuing education for health care professionals through the Virtual University
- To maintain a continuous health information observatory through the National Office for Analysis of Health Care Trends
- To develop specialized telemedicine networks for services consistent with levels of telecommunications infrastructure throughout the country
- To support communication and create a virtual workspace linking health care institutions within Cuba and outside the country

- To develop software and implementation methods for projects designed according to the INFOMED model
- To promote Cuban scientific research and publication in the field of health information science

Technical personnel at both the national and provincial network nodes are specialized in network management, the Linux operating system [70], and system security. INFOMED experts create information products and services for the national health care system and assist regional information centers in the introduction of new information technologies. The telecommunications infrastructure of INFOMED consists of a national TCP/IP network for data transmission serving all entities of the national health care system. A public data transmission network links the national node and provincial nodes. INFOMED is connected to INFOCOM [71], the data transmission network of ETECSA, and CITMATEL [72], the Cuban Internet provider. INFOMED also possesses a national infrastructure connecting the medical science faculties of the 14 Cuban provinces for electronic messaging and access to electronic products and services. A telecommunications laboratory serves as a center to develop specialized expertise on computation, networks, website design, and information technology.

The Virtual Library integrates access to Cuban electronic publications in medicine and public health as well as important US, Latin American, and international publication initiatives. Medline and the US National Library of Medicine offer subscribed English language bibliographic databases while SCIELO, the Latin American Scientific Electronic Library Online, initiated in Brazil, offers medical journals by country of publication (Brazil, Chile, Cuba, Costa Rica, Spain, and Venezuela) in English, Spanish, and Portuguese. The INFOMED website offers a search tool, the reference locator for local, national, and international health information resources (Localizador de Recursos de Información de Salud) [73]. INFOMED also provides access to the Health Internetwork (HINARI), launched in September 2000 by the United Nations and the WHO to promote free institutional electronic access to medical publications in the developing world [74]. Thus, the Virtual Library integrates resources from the developed and developing world including the most advanced scientific research, accounts of medical experience in developing countries, and documentation of natural and traditional approaches to medicine.

The Virtual University is now part of the National Center for Medical Training through INFOMED and integrates all of the institutions of the Cuban national health care system, thus extending its institutional scope throughout the country [75]. This institution links the Cuban health care information and publication infrastructure with Cuban institutions for higher education, and it offers access to Cuban as well as international content such as the supercourse entitled Epidemiology, the Internet, and Global Health [76]. As part of the Virtual University, a Virtual Clinic offers expert consultation among the physicians and health care professionals associated with the University [77]. When authorized, consultations of particular pedagogical value are published for the benefit of other users of the clinic. The interactive design of the Virtual University

promotes an information market for shared expertise and learning serving the Cuban national health care system as well as external markets [74,75].

INFOMED also serves evidence-based practice of medical specialties. An example is the Cuban Pediatric Surgery National Network (Red Nacional de Cirugía Pediátrica). The Cuban Ministry of Public Health designated the lead network institution, the Pediatric Teaching Hospital Octavio de la Concepción de la Pedraja of Holguín, in 2001 [78]. The objectives of the network are to develop and support the specialty of pediatric surgery throughout the country, to make available high-quality research results for the practice of this specialty, and to link the resources of all the participating health care institutions across the country. Local area networks of hospitals are linked to integrated services in radiology, endocrinology, and neurophysiology through the INFOMED

portal. Regional experts in pediatric surgery have been identified for participation in discussion lists. These experts may participate in treatment of cases through collaboration with designated specialists or through collective consultation and analysis. The network also offers linkages to international discussion lists on topics relevant to pediatric surgery.

When appropriate, the network makes possible expert intervention in real-time treatment. Evidence-based protocols for best practice are developed using virtual analysis as well as face-to-face discussion for approval. Key features of the system include its intensive use of human resources, software development, and website design [79], a specialized virtual library, and alliances with provincial universities and enterprises. This model is under evaluation to be extended to other medical specialties.

Figure 1. Institutional configuration of INFOMED and the virtual infrastructure of the Cuban national health care system



The Figure summarizes the configuration of INFOMED and the institutions of the Cuban national health care system. As discussed above, the primary virtual infrastructure includes INFOMED, the Virtual Library, and the Virtual University. Traditional political institutions such as provincial and municipal people's assemblies ensure hierarchical control linked to MINSAP. The traditional and virtual infrastructures suggest the isomorphism of state governance with health care administration and a high degree of human resource intensity as evidenced by the critical role of the family doctor. Hierarchical control is maintained through the human resources of traditional institutions while horizontal coordination and institutional integration is accomplished through the virtual infrastructure of INFOMED. This system continues to evolve as the important parallel dynamics of institutional decentralization and network integration converge [69].

Cuban International Trade in Health Care Services

The INFOMED infrastructure plays a key role in development of the Cuban contribution to international trade in health care services. Globalization of the health care sector is based on the decline in public sector expenditure, growing private health care enterprise, deregulation in insurance and telecommunications sectors, growing mobility of both consumers and health care service providers, and cross-border e-commerce for delivery of both health care products and services. There is also a high degree of variability in health care available across national health care systems. This variability affects consumer mobility as well as global patterns of international investment. The General Agreement on Trade in Services [80,81] suggests four modes of international trade in health services:

1. *Cross-border delivery* includes physical mail shipments of products or services such as lab analyses, pharmaceuticals, or clinical consultations as well as delivery through e-commerce channels or email.
2. *Consumption abroad* includes cross-border consumer mobility to obtain health care products or services.
3. *Commercial presence* refers to the establishment of health care entities and enterprises through foreign direct investment as well as diversification of international enterprises to extend commercial presence to other countries.
4. *Movement of health personnel* includes mobility of doctors, nurses, consultants, and administrative personnel to offer services across borders.

The Cuban national health care system contributes to health services trade in each of the four modes identified by the WHO. Cuban international trade in health services is made possible by its competitive research in specific areas of medicine and medical informatics, the quality of its traditional and virtual education and health care services, its high concentration of physicians and health care professionals, its health care information and telecommunications technologies, and the exportability of certain aspects of its social medicine model to industrialized as well as developing countries.

First, in the *cross-border service delivery* mode, Cuba continues to develop its considerable potential for electronic delivery of information, telemedical services, and medical education

primarily through INFOMED and specialized virtual infrastructures. The Cuban Virtual Library in collaboration with the Latin American and Caribbean Center on Health Sciences Information of the Pan American Health Organization and the Brazilian Virtual Library delivers an important information resource, much of which is freely accessible on the Internet. The Cuban collection of specialized medical journals presents the results of Cuban research and accounts of the Cuban health care system experience. Foreign authors are also invited to contribute articles to be published in Spanish, thus creating a controlled medical information market. The Virtual University offers Cuban [82] and international content through the Internet as well as a forum through the Virtual Clinic for expert consultation with physicians and health care professionals associated with the University [83].

Because of trade restrictions under the US embargo and other resource constraints, electronic trade in information and education is more highly developed than conventional cross-border trade. However, some publications as well as biotechnology and pharmaceutical products may be purchased as advertised online and delivered by regular mail services. Examples are products offered through Cuban research institutes [84] and represented on external websites such as the International Center for Scientific Research [85], a free public utility service based in France.

The second mode of health services trade, *consumption abroad*, is a very important component of Cuban international trade. Consumers from both industrialized and developing countries go to Cuba to receive health care services as well as training and education in disciplines related to medicine. High-quality health care is available at competitive prices, particularly innovative treatments for conditions for which care is unavailable in other countries, such as pigmentary retinopathy or vitiligo [86]. Again, Cuban research in medicine is the foundation of this international competitive advantage in offering certain very specialized care. Medical care is offered freely or under public subsidy to patients from certain countries with which Cuba maintains bilateral agreements on social security, while luxury services such as cosmetology are offered at US dollar rates, as well as combined health care and tourism packages for foreign clientele [87]. This trade in health care services is led by Cubanacán [88], the Cuban holding company dedicated to tourism, through SERVIMED, a specialized trading company founded in 1994. Sales of services to foreigners yielded revenues of US \$20 million dollars in 1996, increasing to US \$30 million in 1998 [86]. MINSAP projections estimate potential sales of such services at US \$60 million [89,90]. These services are advertised through the INFOMED Portal.

Also, in the consumption abroad mode, students receive training and education in medicine and related disciplines at Cuban educational institutions and specialized clinics presented online. While some students receive subsidized education, generally fees are paid in US dollars at very competitive rates, thus attracting students from all over the world and generating significant foreign exchange earnings [91]. Again, it is important to note that these students come from industrialized nations as well as developing countries. The Latin American School of Medical Science (Escuela Latinoamericana de Ciencias

Médicas) [92] was created in 1998 to respond to the regional shortage of trained physicians made apparent by hurricane Mitch. This school has trained as many as 6000 medical students from the Americas and Africa and even promotes applications from US citizens through SeattleCuba.org, an organization for friendship and cultural exchange between the people of Seattle, Washington and Cuba [93]. Scholarships are offered to students who agree to serve poor communities upon return to their own countries. Recently, scholarships for 500 students from the United States were set up with the objective of contributing to representation of ethnic and other communities that are underrepresented in the medical professions [94,95].

A final type of service trade in consumption abroad is the organization of international workshops, seminars, and conventions for both scholarly, educational, and commercial (eg, trade fairs) objectives related to health care. These events are advertised through INFOMED and attract participants from around the world, thus bringing significant foreign exchange revenues [96]. Research in health care is also a part of the Cuban Science and Technology Forum organized throughout the country to promote innovative solutions to problems in applied science. Although this event has in the past been restricted to Cuban institutions, recent efforts have focused on internationalizing the competition and publishing its results [97].

One of the objectives of the first international extension of the Science and Technology Forum, the Symposium on the Impact of Science and Technology on Cuban Health (El Simposium: Impacto de la Ciencia y la Innovación Tecnológica en la Salud Cubana) in 2000, was to attract joint international projects and foreign investment in the Cuban national health care system, thus encouraging the third mode of trade in health care services through some controlled foreign *commercial presence*. Foreign investment relevant to the health care system has contributed to its telecommunications infrastructures as well as availability of international information resources such as Medline.

Although the amount of investment in such activities cannot be reliably estimated, growing joint enterprises with foreign firms in medical research and biotechnology contribute significantly to research, development, and international marketing of new Cuban products [98,99]. Development of Cuban biotechnology is led by the Cuban Center for Genetic Engineering and Biotechnology (CIGB) [100] and the Western Havana Bio-Cluster of 52 specialized institutions [101]. The Cuban strategy in research and development in the field of biotechnology incorporates both physically proximate institutional clusters and virtual infrastructures [25,26,102]. The Western Havana Bio-Cluster offers a physical environment fostering inter-organizational exchange of research and ideas, while the CIGB promotes development of an extended network of collaborators through an Internet presence.

The CIGB Business Development Group negotiation policy for alliance agreements outlines conditions regarding scientific collaboration and business investment in research and development of new pharmaceuticals [103]. The CIGB has made its Isotopica software freely available to registered users as a Web application for research in the field of proteomics (the

study of the structure and functions of proteins) with the collaboration of the Japanese Institute for Protein Research of Osaka University [104]. This offering extends opportunities for research collaboration with partners in the developed as well as the developing world. Other institutions contributing to Cuban trade in biotechnology include the Finlay Institute [105] and the National Center for Scientific Research [106].

The fourth mode of trade, *movement of health personnel*, is also critical to Cuban foreign policy as well as international health care services trade. Cuba's high concentration of well-trained, relatively low-cost physicians and other health care professionals makes possible their mobilization in a strategy of assistance to developing countries experiencing shortages of such personnel. Cuba is one of several countries, including India, the Philippines, and Egypt, where education and training of health care personnel exceed country requirements. In the case of Cuba, these personnel contribute to disaster relief efforts and other services in developing countries [107]. While these activities for development assistance may bring limited revenues, they extend Cuban influence and leadership in the developing world. Cuban schools and clinics have also been opened to serve students and patients in some Latin American and African countries. For example, SERVIMED opened a Cuban hospital in Brazil with the participation of Brazilian investors to respond to local demand for treatment of skin disorders [108,109]. In the future, MINSAP will focus greater efforts to provide remunerated advisory and consultancy services in medicine, medical informatics, and health care system design and management [86].

Discussion

Analysis of Cuban international trade in health care services shows the importance of its telecommunications infrastructures and expertise in medical informatics for service promotion and delivery. Despite many political and economic challenges, Cuba has developed a significant presence in international health care services markets and collaborative activities with the developing countries of the Caribbean and Latin America. Of particular importance is the coherence between design of the system and the socialist ideological values of its institutions: the ethic of universal and free access to health care services as well as attention to the collective social and environmental dimensions of health [110]. The unique features of the Cuban model enhanced by INFOMED and virtual infrastructures include the following:

- A systems perspective integrating health care service delivery, research, information resources, and education
- Horizontal coordination and integration through INFOMED and telecommunications infrastructures with vertical control through MINSAP and government hierarchy
- Government and health care administration serving socialist ideology: social control and universal citizen access
- Emphasis on individual assessment and community health evaluation including physical and mental health dimensions
- Priority on holistic, preventive health care in the family context rather than in specialized health care institutions

- Emphasis on original research and innovation in medicine, medical informatics, health care management, and related disciplines
- Recognition of the importance of methodological considerations in elaboration of data collection and information systems
- Effective mobilization of information and telecommunications technologies to achieve horizontal and interdisciplinary integration of the health care system and to promote Cuban contributions to international health care services trade
- Dual health care service market structure with emphasis on open information markets in education, research, and practice supporting trade on international services markets through the Internet
- Through the Virtual University, strong emphasis on training and continuing education of highly qualified physicians and other health care personnel as well as their indoctrination with values supporting service for the collective good

The Cuban approach to health care could be characterized as “high tech-high touch,” integrating the family and community context in individual assessment and risk evaluation. Both the high concentration of health care professionals and the highly

developed telecommunications and information systems of INFOMED contribute to this strategy. In the Cuban ideology, health care is viewed as a social process and a responsibility distributed throughout all levels of society [111,112]. This model suggests some important questions with respect to the globalization of health care services markets. Cuba has developed a significant presence in that global market, but one of the risks is emergence of a dual standard of service differentiating health care reserved for Cuban citizens from services offered to patients remitting foreign currencies on international markets. This risk is associated with the difficulties of integrating systems based on diverse ideologies—socialism and capitalism—on a global level.

The transferability of the Cuban model to other national settings is contingent upon interpretation of values such as individual privacy and intellectual property [113]. Regulation of world trade in health care services has favored privatization of the sector, and the future of ideological diversity in the global economy is a topic of intense debate [80]. More extensive qualitative case analyses of complex health care systems will contribute to better understanding of ideological diversity and the role of telecommunications and virtual infrastructures in the integration of global health care markets.

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Conflicts of Interest

None declared.

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Abbreviations

AIDS: acquired immunodeficiency syndrome

BIREME: Brazil-based Latin American and Caribbean Center for Information Sciences

BVS: Biblioteca Virtual en Salud

CIGB: Cuban Center for Genetic Engineering and Biotechnology

CNICM: National Information Center for the Medical Sciences (Centro Nacional de Información de Ciencias Médicas de la República de Cuba)

GNP: gross national products

MINSAP: Cuban Ministry of Public Health (Ministerio de Salud Pública)

SCIELO: Latin American Scientific Electronic Library Online

WHO: World Health Organization

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Original Paper

What Is eHealth (6): Perspectives on the Evolution of eHealth Research

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Abstract

Background: The field of eHealth holds promise for supporting and enabling health behavior change and the prevention and management of chronic disease.

Objective: In order to establish areas of congruence and controversy among contributors to the early development, evaluation, and dissemination of eHealth applications, as well as the desire to inform an evaluation research funding agenda, 38 semistructured, qualitative interviews were conducted among stakeholders in eHealth between May 2002 and September 2003.

Methods: Participants were asked about their perspectives on the credibility, value, and future potential of information technology for health behavior change and chronic disease management. Interviews were coded and analyzed for emergent themes using qualitative methods.

Results: Consistent themes were identified across stakeholder groups, with slight differences in emphasis. These topics included the following: (1) consensus and standardization—most stakeholders expressed a strong desire for a more coordinated, rigorous effort to define and integrate the field; (2) evaluation methods and challenges—demonstrating outcomes is required to establish eHealth quality and efficacy, but stakeholders were not satisfied with the sensitivity, validity, and reliability of existing outcome measures; (3) quality, value, and future potential—the intersection between eHealth's potential cost-effectiveness, efficiency, and improved clinical status among users generated a high degree of interest; and (4) health disparities—many stakeholders contended that traditionally underserved populations will particularly benefit from eHealth applications, although others argued that the underserved are also disadvantaged in terms of access to technology.

Conclusions: Recommendations included the need for improvement and formalization of development and evaluation standards across private and public sectors, additional research on the technology needs and preferences of traditionally underserved populations, and long-term epidemiologic studies of the impact of eHealth on outcomes and cost-effectiveness.

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KEYWORDS

Health services research; outcome and process assessments (health care); behavioral medicine; health behavior; information dissemination; telemedicine

Introduction

The importance of chronic disease prevention and management becomes clear when the combined effects of the projected aging of the US population, the limited capacity of the existing health care system to support the increasing demands of an older population, and the continued rise in health care spending are

considered [1–5]. An emerging approach for reducing the burden of chronic disease involves engaging patients and consumers in health promotion activities (e.g., healthy eating and increased physical activity), which require sustained behavior change. Research has noted the significant role that prevention can play in reducing morbidity and mortality [6–9], and addressing risk behaviors can be an efficient way to prevent or manage chronic illness in populations. However, even in high-quality health

care settings, counseling and monitoring are time consuming and often impossible for clinicians to do in a rigorous, consistent way with all of their at-risk patients [10–13]. It is also important to note that traditionally underserved populations are the most likely to have multiple behavioral risk factors, and the least likely to have access to consistent, quality care [14,15].

eHealth is emerging as a promising vehicle to address the limited capacity of the health care system to provide health behavior change and chronic disease management interventions. For the purposes of this paper, eHealth is defined as the use of emerging interactive technologies (e.g., Internet, CD-ROMs, personal digital assistants, interactive television and voice response systems, computer kiosks, and mobile computing) to enable health improvement and health care services [16]. Though still at an early stage of development, the evidence base is growing for these types of technology-based interventions. eHealth programs offer the potential for enhanced reach, including traditionally underserved populations, at relatively low cost; scalability; time efficiency; and the capacity to provide tailoring and customization for individual patients and consumers. Despite these potential benefits, there are barriers to the full implementation of eHealth solutions, and the limitations of access, health and technology literacy, and quality measures must be addressed [17,18].

While no single entity or sector originated the idea of harnessing electronic communication technology to address health care issues, purchasers (e.g., health management organizations), physicians, other practitioners, health care delivery systems, patients (referred to in this paper as users), developers, and academics all bring unique perspectives to, and have sometimes divergent opinions about, maximizing eHealth's potential. In the realm of health behavior change and disease management, there had been an increasing call to explore research methodologies for eHealth evaluation research, how these technologies could be created and adapted to reach traditionally underserved populations, and the formation and implementation of standards for the assessment of interventions [19].

In 2002, The Robert Wood Johnson Foundation created the Health e-Technologies Initiative, a national program office focused on expanding the body of knowledge about the efficacy, cost-effectiveness, and overall quality of eHealth applications for health behavior change and chronic disease management. To establish a cohesive set of funding priorities, it was necessary for the Health e-Technologies Initiative to consider perspectives from a broad range of sectors, comparing areas of overlap and addressing controversies. A series of interviews was conducted among opinion leaders (stakeholders) in eHealth in order to assess the existing strengths and challenges in eHealth evaluation research for health behavior change and chronic disease management. Qualitative inquiry provided an opportunity for individuals who represented varied interests to "make their case," which, when aggregated with the perspectives of others, revealed a previously undocumented state of the field.

Methods

From May 2002 to September 2003, 38 qualitative interviews were conducted. Each discussion consisted of two interviewers

and between one and five participants. Participants were recruited by convenience sampling from designated sectors involved in the development, evaluation, dissemination, or use of eHealth technologies. Specifically, the recruited sample consisted of individuals in the following categories: established developers/researchers of interactive health communications (IHCs); opinion leaders in information technology; projects/programs that have implemented IHCs; health plan representatives; technology and health care futurists; physician organizations/provider groups; purchasers (public/private coalitions)/larger employers; consumer groups; data collectors; and pharmaceuticals. Participants were distributed throughout the United States, with 18 in the Northeastern region (Massachusetts, Rhode Island, New York), 7 in the Mid-Atlantic region (Washington, DC; Pennsylvania), 5 in the Midwest (Wisconsin, Idaho, Minnesota, Michigan, and Illinois), 6 in Western states (Oregon, California, Arizona), and 2 in the South (North Carolina and Missouri). Interviews were conducted in person whenever possible, but due to geographic limitations, one third of interviews were conducted by telephone.

The unit of analysis for this study was each interview session, rather than the individual respondents. A total of 9 interviews were conducted with developers and researchers, 7 with opinion leaders in information technology, 4 with projects and programs that use IHCs, 4 with health plan representatives, 4 with technology and health care futurists, 3 with physician organizations and provider groups, 2 with purchasers and larger employers, consumer groups, and data collectors, and 1 with a pharmaceutical company.

Participants consented to be audiotape recorded and received copies of their transcribed interviews to modify or edit, as necessary. Interviews lasted approximately 50 minutes. Participants were informed that their individual responses would remain confidential but would be aggregated for future qualitative data analysis and that quotes would not be attributed to individuals unless explicit written consent was obtained prior to doing so.

The following questions were asked:

- What is your current view of the credibility, quality, and validity of eHealth technology (defined how) for health behavior change and chronic disease management? In general, do you believe it is effective? Why or why not?
- Could you provide any examples of current eHealth programs for health behavior change and chronic disease management that you believe to be effective? How were these developed? How do these work? How do you know they're effective? How are they evaluated?
- How would you go about evaluating the cost-effectiveness and quality (defined how) of eHealth programs for health behavior change and chronic disease management? What measurements would you use (quality adjusted life years, economic metrics, satisfaction, other health outcomes, etc.)?
- What type of experimental methods would you use to evaluate programs for health behavior change and chronic disease management (controlled studies, quasi-experimental

studies, natural experiments, modeling, etc.)? Is there a gold standard? How is it achieved?

- What obstacles exist to effectively evaluating eHealth for health behavior change and chronic disease management? What could be done to overcome these?
- What are your perceptions about traditionally underserved populations and eHealth access? How do you define access (hardware, primary speaking/reading language, reading levels, basic knowledge of technical/computer training, etc.)? How can access be strengthened for these populations?

If the participants asked for a definition of eHealth, they were encouraged to offer their own definition, and their comments were not restricted solely to IHCs. A spectrum of individual,

community, and health care applications were discussed according to sector, but the line of inquiry focused primarily on issues of quality in the development and evaluation of IHCs geared toward health behavior change or chronic disease management due to the nature of the questions being asked.

Transcripts were read line-by-line and coded for primary categories using NVIVO qualitative analysis software (version 2.0, QSR International). Frequent or related categories were grouped and identified as second- or third-level codes. When necessary, tape-recorded interviews were revisited for clarification of the participant's tone and intended meaning. As relationships between codes became evident, themes began to emerge. [Table 1](#) provides an overview of the relative emphasis of topic area by stakeholder category.

Table 1. Areas of emphasis by stakeholder group (✓ means prominently addressed by the majority of interviews within indicated sector; -- means minimally addressed or not at all)*

| | Developers/ Researchers | Health Plan Representatives | Programs and Projects Using IHCs | Opinion Leaders of Technology in Health Care | Futurists | Physician Organizations/Provider Groups |
|---|-------------------------|-----------------------------|----------------------------------|--|-----------|---|
| Access to technology (health disparities) | ✓ | ✓ | ✓ | ✓ | | |
| Cost-effectiveness | ✓ | ✓ | | ✓ | | |
| Process measures | ✓ | | | | ✓ | ✓ |
| Outcome measures | ✓ | ✓ | | ✓ | | |
| Utility (eHealth quality and value) | ✓ | ✓ | | ✓ | | |
| Funding for evaluation (obstacle to evaluation) | | ✓ | ✓ | | | |
| Market pressures (eHealth quality and value) | | ✓ | ✓ | | | |
| Infrastructure | | | | ✓ | | ✓ |
| Utilization rates and patterns | ✓ | ✓ | | | | |
| Credibility among opinion leaders | | | ✓ | | | ✓ |
| Funding for dissemination (obstacle to dissemination) | | | ✓ | | | ✓ |
| Reimbursement incentives | | | | ✓ | | ✓ |
| Translation from research to practice | -- | -- | -- | | -- | -- |
| Patient-provider tension | -- | -- | | -- | -- | -- |
| Privacy concerns | -- | -- | -- | -- | | |
| Reliability (evaluation approaches) | -- | -- | | -- | | -- |
| Generalizability | | -- | -- | | | -- |
| Credibility among providers | -- | | -- | | | -- |
| Liability | -- | -- | | -- | | |
| Consistency of care | | -- | -- | | -- | |
| Combined with standard care | | -- | -- | -- | | |

*Data collectors, purchasers, pharmaceuticals, and consumer group representatives excluded because of small sample size (≤ 2 interviews)

Results

Theme 1: Consensus and Standardization

There was universal frustration with the lack of comparability and standardization within the domain of eHealth. Stakeholders expressed a strong desire for a coordinated, rigorous effort to define and integrate the field. Researchers, as well as purchasers, need criteria for identifying quality information, sharing and comparing findings, and building upon current evidence in order to move eHealth forward. According to one stakeholder, “The most critical [challenge] is not working in isolation and certainly understanding what other people are doing in this arena. We...don’t want to reinvent the wheel.”

The dearth of consensus and standardization in development and evaluation activities often appeared implicitly in stakeholder discussions of other topics and themes cited throughout this paper; many of the challenges identified by stakeholders pointed toward the larger incongruities surrounding the field of eHealth. In order to standardize measures and ensure comparable results, an overarching paradigm must be well defined. Stakeholders were troubled by the broad, amorphous definitions of *eHealth* and *behavior modification*. At the time the interviews were conducted, professional organizations such as the Disease Management Association of America were beginning to issue guidelines and recommendations for determining the value of these interventions [20,21], and these efforts were highly valued by the researchers in this sample. More recent publications have continued to address the varying meanings of the word *eHealth* [22–26].

Theme 2: Evaluation Methods and Challenges

The stakeholders explained the relative importance, from their perspective, of refining process and outcome measures, determining the optimal study designs to capture these factors, and the relevance of the eHealth research environment to interactive applications already being disseminated in health care and commercial industry. Randomized controlled trials were regarded as the “gold standard” for evaluating application effectiveness, but stakeholders noted that eHealth presented unique challenges to this study design. These results align very closely with the issues raised in an editorial in this journal that was published shortly before the interviews were conducted. It is difficult to determine the degree to which this article, and any surrounding discussions in the literature, influenced the responses, particularly since no interviews occurred prior to its publication [27].

Process Measures

The stakeholders discussed the challenges associated with measuring usage, particularly traffic and utilization, using quantitative and qualitative methods. Process measures provide insight into influences on utilization and can explain associations between differential attrition and outcome status [28]. Identifying and accurately measuring variances within the length of delay that users experience when trying to access the Internet, the time a user spends on a page, which components of the program are used more than others, and the validity of responses to online questionnaires were examples of process measures

cited by the stakeholders. Additionally, stakeholders were concerned with more qualitative measures, such as how the user interpreted the information that was presented, the degree of comprehension, and the user’s level of engagement in the program. There was a concern expressed among stakeholders that if the delivery mechanisms are not well understood and validated, the outcome results will be difficult to interpret. Without process refinement, randomized controlled trial results may not be accurate and could threaten the credibility, perceived effectiveness, and, ultimately, the uptake of these technologies. Only researchers and developers commented on process measures in any level of detail and were mainly concerned that, from their perspective, quality design was not emphasized by funders and purchasers. “It’s not, ‘if you build it, they will come,’” noted one developer. Process measures help those designing interventions understand user interests and learning styles, which greatly impacts the program uptake and effectiveness. Users who are actively engaged in eHealth applications may benefit more than those who interact in a superficial way with the program. Developers and researchers expressed an interest in the education literature, particularly its research on methods of learning, in guiding the creation of applications that are appealing and relevant to users. Collaborations between educational researchers and eHealth developers may facilitate the construction of well-designed, effective instructional programs that can adapt to individual styles of learning.

A major criticism of current data collection methods was that they do not distinguish among usage behaviors. For example, if tracking reveals that a Web page is viewed for an extended period of time, it does not tell evaluators how long a user is interacting with the page, or if the user is even sitting at the computer. Furthermore, it is difficult to correlate navigation patterns with users’ cognitive factors related to behavior change, such as comprehension or interest in content. Commonly used measures (including hits, time on page, number of log-ins) all have disadvantages, and at the time of the interviews, no ideal measure or measures of usage had emerged as an optimal industry standard. While there was a sense of dissatisfaction with process measures, they were viewed as fundamentally important to building an effective intervention, and their role in development and evaluation should be as highly regarded as outcome measures.

Outcome Measures

Ultimately, the credibility and value of eHealth lies in its ability to demonstrate positive outcome effects. It was universally understood that funders and purchasers expect proof that an intervention is effective, although there was uncertainty as to what level of rigor was sufficient. It is difficult to determine quality outcome measures, especially when constrained by short follow-up periods. In lieu of long-term clinical outcomes (which require follow-up years later, and few studies have been performed on eHealth applications) or population-level measures of impact (i.e., a significant reduction in disease that can be attributed directly to an eHealth intervention, or a rigorous cost-effectiveness analysis), demonstrated behavior change was considered to be a good proxy measure and was considered a

more robust indicator of intervention success than reported improvements in knowledge and comprehension.

Evaluating behavioral components addressed by IHCs was considered to be a major challenge. Instruments that have been validated to measure behavior change have often not been validated for the evaluation of online interventions and therefore were considered too general. Qualitative, self-report, and Likert scales were named as helpful in obtaining certain types of information, but objective evidence of behavior change was preferred over self-reported measures or patient satisfaction ratings. As one participant pointed out, “Just because someone likes an intervention doesn’t mean it’s doing them any good.” That being said, user satisfaction is not irrelevant to the efficacy of an intervention because satisfaction with a program may influence utilization, which may impact eventual clinical outcomes.

The extent to which process and outcome are intertwined was a consistent theme among developers, researchers, and IT opinion leaders, but was also recognized by the other stakeholders as well. Patient, health plan, and physician representatives were particularly conscious of the importance of user satisfaction, which may reflect the proximity of these stakeholders to patients and their perceived quality of care from their doctors and health insurers.

Study Design

Time and expense were the most consistently, emphatically cited challenges to rigorous evaluation. Researchers and developers were particularly frustrated with the separateness of funding streams for development and evaluation activities. Stakeholders involved in research and development regarded the creation of an intervention and its evaluation to be a cyclical process; evaluation findings provide valuable feedback to

designers of the intervention, but funders’ priorities and limitations mandate the process to be more linear in nature. While accepting of the tension that often exists between what they want to discover and their obligations to fit within the parameters of a grant, researchers and developers find it more challenging to reconcile the choice they often face between allocating limited resources (time, money, personnel) to either development or evaluation. When required to choose, development is favored, with the rationale that it is pointless to evaluate poorly constructed interventions.

There are caveats to setting the minimum bar at the level of randomized controlled trials. If this design is considered to be the only acceptable methodology, there was concern that the rate of research will be too slow to keep up with development. “The research paradigm doesn’t match the context,” according to one stakeholder, and it was recommended that before attempting an randomized controlled trial, it is important to make certain that the technology and process measures are proven, even at a “lower level” than a randomized controlled trial. Without process refinement, randomized trial results may not be accurate, and stakeholders were concerned that questionable results may threaten the credibility of eHealth:

We can throw a lot of money at randomized trials that are the first thing out of the gate, and [a good number] of them will come up negative. And the whole idea of eHealth will be besmirched and perhaps inappropriately abandoned because we went into it too fast. [eHealth Researcher]

Alternative, potentially more practical methods include usability and case-control designs, which more easily align with implementation timelines. eHealth applications present unique methodological challenges, which are outlined in [Table 2](#).

Table 2. Methodological concerns in eHealth evaluation

| | |
|--|--|
| Selection Bias | Recruiting representative populations of interest is limited by users’ access and technological literacy. |
| Confounding and Effect Measure Modification | Controlling for unknown confounders (baseline severity of condition, comorbidity) is especially difficult when evaluating discrete eHealth interventions; quasi-experimental designs, case-control studies, and field trials may not accurately measure impact. |
| History | Health care and technology are in a constant state of rapid change, which may change participants’ experiences during the course of a trial or evaluation. |
| Attrition | If a large proportion of participants in the intervention group stop using the application, statistical power is reduced and results are biased toward the null. Differential attrition can occur across condition or across level of technological proficiency. |
| Contamination | As eHealth programs become more ubiquitous, it will be challenging to find an unexposed control population. |

Stakeholders were unable to propose solutions to major sampling challenges associated with Internet research:

By far and away, the biggest challenge for doing our kind of work on the Internet is to be able to get the kind of proactive recruitment rates that we’ve been able to do using other technologies. Talking with researchers, I know that that’s one of the major challenges to get adequate percentages of people participating. [eHealth Developer]

As with the development of mail and telephone surveys in previous decades, online surveys and recruitment strategies

need to be validated. It was difficult for researchers to define a general online population, and several felt that, while some response rates in eHealth research can appear to be strong, they were uncomfortable assuming these respondents were at all representative of the populations of interest (see “selection bias” in [Table 3](#)). For example, they highlighted the need to prevent multiple responses from a single user through internal filtering mechanisms, particularly when incentives were offered to survey participants. Determining the size and key characteristics of the sample population was not just of concern to researchers; one health plan purchaser noted that he/she “liked to see

denominators and see what percentage of eligibles have been using this in a given time period.” However, methods for accurately measuring these factors were not yet well developed at the time of the interviews.

The increasing presence of the Internet in the daily lives of individuals [29] may make it increasingly difficult to recruit controls who do not have some baseline exposure to similar eHealth programs, and to prevent contamination. If eHealth applications that resemble the one being evaluated exist elsewhere, there is a possibility that users may access these interventions independently, potentially receiving some “dose” of a similar intervention (particularly those that concern specific conditions or behaviors). Stakeholders commented on the importance of assessing research participants’ exposure to other eHealth applications at baseline and follow-up. Additionally, due to the stratification of information technology access along socioeconomic lines, evaluation results of eHealth applications may be particularly prone to bias if the sample does not accurately represent the target population:

There’s a feeling that the patients who are most likely to make use of Internet-based health care tools are the least likely, in many cases, to need it. So if you’re trying to show an effect in terms of chronic disease getting much better, the people who today have access to the tools and would use them are already doing fairly well. The chance of showing the effect is smaller because of that baseline being higher than the folks who are unconnected, don’t have access, [are] doing poorly, but possibly also lacking the motivation or the resources or the connections in various ways to give them access. [IT Opinion Leader]

Those whom eHealth applications may benefit most must be represented in sample selection. Stakeholders contended that these individuals might be those who have little or no access to other sources of care. If a sample is not representative of these users, but instead is made up of participants who, overall, have higher access (to health care, to eHealth tools, to healthy lifestyle choices and preventive care) due to higher socioeconomic status, researchers may encounter problems in demonstrating the effects of eHealth applications. Therefore, it is crucial that sampling methods continue to be refined and validated in order to accurately determine the efficacy of eHealth in the populations it has the potential to reach.

Perceived Credibility Among Purchasers and Users

Randomized controlled trials can limit an application’s time to market, and interest in dissemination should be balanced with the level of rigor expected of an evaluation. Creators of interventions felt intense pressure to develop products that are efficacious and usable from the beginning and are palatable to the public and physicians. However, stakeholders were aware that end users and some purchasers are not necessarily as concerned with evidence-based proof of effectiveness. As an IT opinion leader noted with chagrin, “The things that tend to lead people to trust a system are not the kinds of things that probably indicate the quality of a system.... People tend to believe in stuff that’s flashy, rather than in-depth.”

Theme 3: Quality, Value, and Future Potential

All stakeholders were concerned about the dearth of quality control or regulatory entities concerning eHealth, and many recommended a rating system to distinguish legitimate online sites from ones that are merely attractive or popular. “[I]t’s like the Wild West out there,” said a physician. “There are selected good resources. Connecting patients with the right resources is a huge challenge.” The stakeholders eschewed a free-market mentality when it came to users choosing IHCs as they would any other consumer product. As a component of health care, it was unanimously held that these applications should be tested and ranked in terms of quality in a similar fashion as other treatment regimens. The controversy concerned the identification of methodologies that are necessary and realistic to reconcile the demands of good science and consumer interest. Even with these concerns, the low cost, wide reach, potential for targeting audiences and tailoring to individuals, and interactivity of eHealth drove optimism for its future potential.

Information Acquisition and Continuity of Care

During its brief history, eHealth has often been used for different purposes by physicians and patients. Patients were using eHealth, especially the Internet, in order to obtain more health information than they typically had access to within their patient-physician relationship.

This enhanced information acquisition began to trigger a shift in the role of the patient and physician, the impact of which has yet to be fully established. Ideally, though, eHealth may empower the patient to more actively participate as a member of the health care team, but stakeholders believed that physicians are key to realizing this objective. Stakeholders noted that physicians might be concerned over the quality of information obtained by patients online and are uncertain about whether the patient-driven inquisitiveness it generates will result in burdensome workloads. In a potentially cyclical and ironic pattern, reluctance by physicians to respond to patients’ inquiries may fuel greater interest in online information sources; such reliance would further underscore the need for vetted online health information.

While the computer does not replace the physician, it can function as an aid, helping physicians gain a deeper understanding of current best practices in the context of individual patients. Optimally, health care should be continuous, and technology’s ability to bridge time and geography makes it well suited to a longitudinal approach to care. The coordination of care providers (be they lay or professional) requires teamwork and both synchronous and asynchronous communication, and physician group members and eHealth researchers alike recognized this as the ideal approach to chronic disease management. By empowering the patient and enhancing patient-physician (and physician-physician) communication, eHealth may enable a shift from the traditional model of the physician-patient relationship to what one stakeholder referred to as a “patient-health care interface,” where patients would move beyond simple information collection to becoming fully integrated members of their care team by improving, for example, disease self-management strategies.

While stakeholders could easily envision several dimensions in which health care and patients, particularly for behavior change and chronic disease management, could benefit from opportunities for rapid information exchange offered by eHealth applications, “no one holds the whole story,” said one participant, “and I don’t think that I have seen any situations in which [technology] is captured in any significant way that can really help providers make decisions, and to learn from one another on how they are approaching it, and come to a consorted plan that is really in alignment with what the patient’s goals are.” It is clear that more research is needed on the appropriate and efficacious use of technology in efforts to integrate care.

In addition to eHealth’s role in clinical settings, stakeholders contended that patients are inevitably going to use the Internet for a variety of activities, and participants recognized the value in capitalizing upon the existing interest and skill sets to bring relevant health information to patients. As one behavioral psychologist pointed out, most people seeking health information are in the early stages of behavior change (pre-contemplation or contemplation). eHealth is a less costly way of engaging them and “holding their hand” into the later stages and optimizing behavioral results.

Tailored eHealth Interventions

eHealth can differ from traditional, paper-based educational materials because of its ability to be customized according to user characteristics. While this was assumed by many stakeholders to have a greater potential to engage and encourage individuals toward behavior change than general information, this theory was somewhat controversial and stakeholders were not completely satisfied with the preliminary research that had been done comparing the efficacy of generic patient education with highly personalized or “tailored” materials. Additionally, achieving robust, comparable samples when measuring the efficacy of tailored interventions is challenging. Methodological concerns arise when evaluating the effectiveness of tailored messaging programs because, by definition, participants are not actually receiving exactly the same intervention. More advanced analysis strategies need to be applied in order to adequately accommodate this issue.

Tailoring requires considerable design and development work, and some stakeholders discussed the possibility that money spent on tailoring should, instead, be concentrated on widespread dissemination of untailored messages to achieve maximum population-level impact. In order to combine the presumed efficacy of tailoring with the desired reach of eHealth, it was suggested that tailored information also be applied to populations with similar characteristics, allowing interventions to effectively target high-risk groups. Targeting populations at greater risk of chronic disease is thought to result in long-term savings to the health care system. After an initial investment in development, eHealth has a relatively lower delivery cost than traditional methods and has significant potential if incorporated into the existing health care infrastructure.

Cost-Effectiveness

From a public health perspective, a return on investment was viewed as probable, since, according to one IT opinion leader,

“The cost of providing these services is much lower than the alternatives. Much lower. Even if it’s less effective, and I’m not sure it is less effective yet.” Analyses on cost-effectiveness were strongly urged, although stakeholders acknowledged that cost measures are extremely difficult to determine. Any approach to cost-effectiveness was seen as dependent upon proven positive outcomes; eHealth’s value is contingent upon it being lower in cost than standard care as well as being empirically proven to be effective.

Obstacles to Dissemination

The impact of eHealth on behavior change will be mitigated by environmental and infrastructure challenges, and this was acknowledged by all stakeholders. eHealth was not regarded as a “fix for the broken health care system” by any stakeholders; at most, said one stakeholder, the Internet can be a tool to help *systems* handle health care, but “it is not something that is going to fix health care all by itself.”

eHealth’s potential to maximize physicians’ limited time and contact with patients was highly regarded, although some were pessimistic about the degree to which physicians would embrace these technologies. For health care professionals, significant barriers to adoption exist at the point of care, including the financial costs of purchasing and installing systems, the disruption to office workflow, and the current lack of reimbursement for interacting with patients electronically via secure messaging/email or Web visits. Unless these issues can be resolved, adoption of eHealth solutions by physicians will be impacted negatively.

Interoperability is also an important aspect of eHealth. While researchers and developers were concerned with standardization of evaluation methodologies, stakeholders involved in the delivery of eHealth programs within health care identified an urgent need for standardized platforms to facilitate widespread use of the technology. As a leader of a program that has implemented IHCs, one stakeholder urged organizations to “move away from proprietary pieces, and work closer together for the greater good, and in some cases that means moving towards standards...simply to be able to get beyond the hurdle of technology or implementation or detail aspects, and get to the real goal which is stronger outcomes, better solutions, easier analysis.” It was believed that regulatory entities, as mentioned elsewhere in this article, could additionally help to manage inefficient connectivity and proprietary interests that prevent the effective interoperability of eHealth programs.

While eHealth was not purported to be the answer for all of the health care system’s woes, demographic shifts will eventually overload exclusively human-intensive interventions, since these systems are already understaffed and suffering from limited resources. “So it’s a bit of a paradox at the moment that it’s disorganized, research is of low quality, but the potential is fantastic,” according to an opinion leader in the use of eHealth technology for health care delivery systems. Going forward, several stakeholders recommended that, rather than focus on the development of new applications, the field of eHealth should concentrate on the stability, usability, and applicability of technologies within the existing infrastructure.

Theme 4: Health Disparities—eHealth as a Bridge or Another Hurdle?

There was a range of opinions about the ability of eHealth to reach populations without access to routine, traditional care. Stakeholders with a macro- or policy-oriented perspective (developers, researchers, IT opinion leaders) were confident that technology has the ability to surmount factors (e.g., reading literacy, distance and time constraints, language fluency) that contribute to limited access to health care. Additionally, eHealth applications have the ability to be tailored according to users' attributes. Race/ethnicity, age, and gender were often-cited dimensions, but more nuanced attributes (e.g., cultural and linguistic diversity within ethnic groups, or socioeconomic status) were not detailed in discussions about tailoring.

It was argued that technology, particularly computers, will become increasingly ubiquitous and affordable, as occurred with the widespread adoption of televisions and telephones in the 20th century. In some research studies, individuals from traditionally underserved populations have shown greater improvements in outcomes and higher degrees of interest than middle-class subjects [30].

[T]his is just an opinion, I can't defend this with data yet, but it just seems to me that increasingly the question is about rich and poor, regardless of ethnicity and regardless of race.... My own personal view of e-technologies and eHealth is that at some fundamental societal level, this is an act of democratization of information and that, overall, it's just incomprehensible to me that this would not help disadvantaged populations more than it helps advantaged populations.... It's almost certainly going to be a help, not a hindrance. [Stakeholder within a National Physician Organization]

All of us...have a huge responsibility and challenge in front of us to try to get people to think that eHealth is not a computer and a broadband connection and you've got to have wireless, and you've got to have this or that. In fact, it's just the opposite.... It's an enabling technology. [eHealth IT Opinion Leader]

Other participants, particularly those with day-to-day interactions with patients and health systems, had a more immediate, pragmatic set of concerns. While they did not discount the potential for well-designed technology to impact risk behaviors in individuals, they were skeptical that those who are traditionally underserved by the health care system will ever truly have equal access to state-of-the-art technology, and they are concerned about a disparity in technological literacy and aptitude:

I think in its current state, [eHealth] is probably widening the gap. I think that it has the potential to narrow the gap, but I don't think people have focused on that sufficiently.... I don't think that we are lessening this divide because the underserved are also underserved as far as their access and time to go on the Web. [Member of a Physician Organization/Provider Group]

Most stakeholders agreed that, once the issue of access to technology is resolved, eHealth has a great deal of promise for addressing health disparities. The operationalizability of the tools was not nearly as much a concern as access, because programs can be designed to accommodate low technological literacy and because underserved populations have demonstrated a high degree of interest in these technologies. The hotly debated topic was whether it was more cost-effective to invest limited health care dollars in eHealth as a means of reaching these populations, or to instead channel financial resources into publicly financed insurance systems like Medicaid. It was recommended that more research, especially qualitative studies, be dedicated to understanding exactly what underserved populations need in terms of access to health care and technology, as well as utilization abilities and patterns once access is achieved.

Discussion

Comparative State of eHealth

These stakeholder interviews covered many of the topic areas that have been outlined in the eHealth literature, including the need for an evidence base in eHealth and methodological issues associated with research in this field, challenges for implementation, and emerging trends and future directions [24]. While similar in scope, the emphasis of these interviews differs from previous stakeholder research conducted in the United Kingdom, which used similar methods and lines of inquiry. Jones et al [24] interviewed professionals with a high level of interest in eHealth (i.e., health care providers, academic eHealth researchers, developers), as well as policy makers. That study found that stakeholders called foremost for research on eHealth to demonstrate any cost-effectiveness and evidence of improved quality of life. Second on the list of concerns were topics related to the control and transmission of information (i.e., confidentiality and security). In contrast, the stakeholders in the United States spent more time discussing specific methodological challenges to development, research, and evaluation. While they overlapped with the stakeholders in the United Kingdom in their lengthy discussions of human factors and behavioral research to inform a larger eHealth research paradigm, US stakeholders gave slightly higher priority to evaluating existing technologies and applications. Stakeholders in both countries were mindful of the need for demonstrated effects on health outcomes. Notably, the role of eHealth in addressing disparities in access to health care achieved greater prominence in the United States than in the United Kingdom. This is likely due to differences in the administration of health care between the two countries: the United Kingdom's nationalized system, which is essentially free at point of service, creates a different set of circumstances compared to the mainly private, insurance-based health care model in the United States. This key difference could explain incongruent findings on other points as well: the stakeholders in the United States may find it more compelling to first address user-oriented concerns (i.e., defining measures for individually oriented applications, developing patient-centered technologies that address prevention and disease management to aid time- and resource-strapped physicians in patient care), while stakeholders in the United

Kingdom might find more benefit in ensuring systemic integrity and carefully evaluating whether eHealth applications help citizens to achieve greater quality of life in a way that is cost-effective to the nationalized system.

It is also possible that these differences are due to the several limitations that must be considered in the interpretation and presentation of these findings. First, the sample was not representative of the defined stakeholder categories due to the nonrandom selection of participants. Second, there were not an equal number of stakeholders in each category, although similar proportions were represented in this sample as in the United Kingdom stakeholder study discussed above. Perhaps most importantly, the focus of the interviews was skewed towards the interviewers' aims of informing a research agenda and funding priorities. The line of inquiry included several questions on evaluation methods, as the participants were chosen from a list of collaborators on an initiative that stressed the importance of evaluation. A larger, random sample with more candid, participant-led conversation may have elicited different opinions or levels of interest in evaluation and research methodology.

The primary goal of the stakeholder interviews, namely to establish a research agenda and funding priorities for the Health e-Technologies Initiative, was achieved successfully. Subsequent to these interviews, the Health e-Technologies Initiative funded 24 grants over the following two years, addressing many of the issues identified through the interview process. Descriptions of grantee research projects are maintained on the Initiative's website (<http://www.hetinitiative.org>). The results of these conversations were also helpful as the Initiative sought to promote evaluation standards and multidisciplinary collaboration among researchers. In addition, it has been valuable to examine these research findings on an aggregate, retrospective level in order to assess the progress that has been made in the field since 2002/03 toward building eHealth's credibility and future potential.

Clearly, advancements have been made. A recent study noted an 84% rise in the publication of articles from the period 1995–99 to 2000–04 that included the term *behavioral informatics*, one of the many phrases sometimes used interchangeably with *eHealth* [31]. As mentioned above, work continues on defining and clarifying the meaning of *eHealth*, not only to enhance communication between those who interact within this discipline [25], but also “to identify its place within the wider health informatics field, as part of a larger review of research and expert analysis pertaining to current evidence, best practice and future trends” [26].

Other markers point to expanding interest in eHealth evaluation research. The Health e-Technologies Initiative was the first national program of The Robert Wood Johnson Foundation with eHealth research as a core focus. The Initiative's 2002 call for proposals, designed to solicit a broad range of project ideas, generated 600 letters of intent. Even the more narrowly focused 2004 call for proposals drew 99 first-round applicants. In June of 2005, the National Cancer Institute, the National Institute of Mental Health, the National Institute on Drug Abuse, the National Library of Medicine, the Office of Behavioral and Social Science Research, the Office of Disease Prevention/NIH,

and the Health e-Technologies Initiative sponsored the first Critical Issues in eHealth Research Conference, which was attended by 400 participants from across North America.

As eHealth continues to be defined and its value and limitations are demonstrated, it will become increasingly important to standardize evaluation approaches and promote collaboration among sectors in order to achieve optimal dissemination and cost-effective, population-level improvements in health outcomes. While these interviews showed some degree of satisfaction and consensus in various realms within eHealth evaluation research, the stakeholders' collective insights and thoughts highlight the relative nascent stage of this work, and offer guidance as to areas of future exploration, which are outlined below.

Research and Policy Recommendations

The proposed research and policy recommendations for eHealth are summarized in the [Textbox](#). An evidence-based approach is key to achieving eHealth's future potential. In order to establish cohesive, standardized process and outcome measures, rigorous evaluation efforts must be made across both public and private sectors. Evaluation results should be widely disseminated to developers in order to establish industry standards. The uptake of eHealth by purchasers, as well as consumers, will be more likely if formal standards of quality and effectiveness are available to assist in informed decision making about available eHealth applications. In order to address concerns about users accessing misguided, erroneous, or inappropriate health information on the Internet, it is important to continue to define measures of quality and perceived credibility. These measures will inform the development of formal standards and accreditation mechanisms for IHCs, allow researchers to demonstrate the prevalence and risk presented by inaccurate websites, and provide guidance to practitioners and users as they navigate the Internet for health resources [32–35]. The emergence of convincing evidence of the effectiveness of eHealth programs will enable policy makers to include eHealth in ongoing efforts to refocus national programs such as Medicare and Medicaid on prevention and chronic disease management.

eHealth has the capacity to address health disparities among traditionally underserved populations due to its scalability, potential to target specific groups and conditions, and ability to be tailored and customized to culturally and linguistically diverse users [36,37]. It is strongly recommended that qualitative research and field trials be performed to understand the preferences and technological needs of underserved populations. While technology platforms that support eHealth are likely to become ubiquitous in the future, special attention should be paid to incorporating technology into environments where the underserved may access these services. Reducing health disparities is a major objective of Healthy People 2010 [38], and eHealth has the potential to help the nation achieve that policy imperative.

Inevitably, the infrastructure of health systems must be considered in efforts to broadly disseminate eHealth applications. The enthusiasm with which health care providers incorporate eHealth into routine care is contingent upon how

well technologies are integrated into the workflow of health care environments where work is too often constrained by reimbursement structures and lack of time [39,40]. In addition to human factors, technological interoperability must be ensured in order to facilitate the widespread use of eHealth across health systems and among physicians, users, and administrators [39,41]. Reimbursement incentives are also important to consider when proposing eHealth solutions that supplement or

replace standard care, as it is important to engage physicians in eHealth dissemination efforts. Opportunities exist in eHealth to link disparate members of the health care system with patients and their proxies in new ways, in order to achieve more consistent care [42]. These linkages may ultimately result in better patient health outcomes, which is an area that warrants further investigation when researching the efficacy and cost-effectiveness of eHealth applications [24].

Textbox 1. Research and policy recommendations

Recommended Areas for Future Research:

- Refinement of process and outcome measures
- Enhancement of sampling and recruitment strategies
- Efficacy of individual tailoring
- Effectiveness of targeting high-risk populations
- Long-term cohort studies on cost-effectiveness
- Appropriate use of technology for integrating health care
- Incentives for health care providers to incorporate eHealth applications into routine care
- Qualitative studies on the health and technology-related needs and preferences of underserved populations

Recommended Policy Priorities:

- Establish accreditation mechanisms to standardize, approve, and monitor the development of quality eHealth applications.
- Incorporate emerging technologies into environments occupied by traditionally underserved groups.
- Foster technological interoperability to promote eHealth connectivity.
- Implement evidence-based eHealth solutions to transform and enhance health care provision.

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Conflicts of Interest

None declared.

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Original Paper

Physicians' Use of Email With Patients: Factors Influencing Electronic Communication and Adherence to Best Practices

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Abstract

Background: With the public's increased use of the Internet, the use of email as a means of communication between patients and physicians will likely increase. Yet, despite evidence of increased interest by patients, email use by physicians for clinical care has been slow.

Objective: To examine the factors associated with physician-patient email, and report on the physicians' adherence to recognized guidelines for email communication.

Methods: Cross-sectional survey (March–May, 2005) of all primary care physicians (n = 10253), and a 25% stratified, random sample of all ambulatory clinical specialists (n = 3954) in the state of Florida. Physicians were surveyed on email use with patients, adherence to recognized guidelines, and demographics.

Results: The 4203 physicians completed the questionnaire (a 28.2% participation rate). Of these, 689 (16.6%) had personally used email to communicate with patients. Only 120 (2.9%) used email with patients frequently. In univariate analysis, email use correlated with physician age (decreased use: age > 61; $P = .014$), race (decreased use: Asian background; $P < .001$), medical training (increased use: family medicine, $P = .001$; or surgical specialty, $P = .007$; but not internal medicine, $P = .112$), practice size (> 50 physicians, $P < .001$), and geographic location (urban 17.2% vs. rural, 7.9%; $P < .001$). Multivariate modeling showed that only practice size greater than 50 (OR = 1.94; 95% CI = 1.01-3.79) and Asian-American race (OR = 0.26; 95% CI = 0.14-0.49) were related to email use with patients. Remarkably, only 46 physicians (6.7%) adhered to at least half of the 13 selected guidelines for email communication.

Conclusions: This large survey of physicians, practicing in ambulatory settings, shows only modest advances in the adoption of email communication, and little adherence to recognized guidelines for email correspondence. Further efforts are required to educate both patients and physicians on the advantages and limitations of email communication, and to remove fiscal and legal barriers to its adoption.

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KEYWORDS

Email; electronic records; health information technology; electronic communication

Introduction

The Institute of Medicine's vision for a high quality healthcare system includes the concept of patient-centeredness, which emphasizes the need to be responsive to patient preferences and needs [1]. Towards this goal, the use of email between

physicians and patients is recognized as enhancing communication [2-4] and is generally favored by many patients [4,5]. Moreover, with the public's increased use of the Internet, the use of email between physicians and patients will likely increase. Yet, physicians' adoption of email to communicate with patients has been relatively slow with only modest increases in adoption rates in recent years [6,7].

The current literature on the subject of physician-patient email is generally focused on somewhat limited populations or attributes. Work has been done, for example, on the experiences of early physician [2,8] or patient [9] email users, physician attitudes [10] and concerns [11] towards using this communication medium and the general benefits [2,3,12] of doctor-patient email. Early work has identified appropriate content for physician-patient email and has highlighted the medico-legal issues associated with this practice [13-15]. Published work has also examined the nature and regularity of email inquiries by patients [14] or their caregivers [16] with physicians [5]. Early studies have reported relatively low rates, generally between 6 [17] and 10 [5] percent, for physician-patient email. However, these previous statistics have typically been reported from surveys of patients and not necessarily of physician groups or practices. As a result, despite the increasing attention in the literature, few recent scholarly studies have comprehensively examined the frequency of physician-patient email use or the factors associated with this practice.

To help interested doctors benefit from email communication with patients, the American Medical Association (AMA) and the American Medical Informatics Association (AMIA) have adopted sets of guidelines for physicians [18,19]. It is unknown to what extent physicians comply with these best practice recommendations while emailing patients. The current paper specifically examines these issues directly by scientifically surveying a large sample of physicians in the state of Florida. In addition, it identifies numerous trends in mid-2005 that update previously identified developments in the use of physician-patient email.

Methods

Survey

As part of a statewide study of information technology (IT) use in the ambulatory setting, we surveyed 14921 physicians in Florida, using the State Department of Health's list of allopathic and osteopathic physicians with clear and active medical licenses. The survey (see [Multimedia Appendix 1](#)) included a series of questions regarding the use of email from the office. In addition, those who personally use email to communicate with patients were asked to indicate which guidelines from a list, if any, they required their patients and staff to use. The list, which included 13 questions, represented items from the AMIA [18] and AMA [19] communication guidelines developed to specifically advise physicians on the use of patient email.

The survey and a cover letter were sent in March, 2005, to all primary care physicians (general internists, pediatricians, family physicians, general practitioners and obstetricians/gynecologists) and a 25% stratified random sample of other specialists. Due to the nature of the study, we excluded those with a practice address outside of Florida and those who do not traditionally practice in the ambulatory setting (eg, radiologists, pathologists, anesthesiologists and emergency physicians). Each questionnaire

was tracked by a six digit identifying code. After four weeks, nonrespondents were mailed a second cover letter and questionnaire to reiterate our interest in their participation. Those physicians who indicated, by phone or mail, that they were no longer actively treating patients (ie, retirement, or other reasons) were excluded. Surveys returned after the initial mailing because of unknown or changed address were remailed when an updated address was obtained. Completed questionnaires were returned by physicians via business-reply paid postage. Data were entered into a computer database and subjected to verification and cross-check methodologies. For example, the first batch of entered data by each staff member was 100% verified to prevent data entry errors. Subsequently, a minimum of 10% of all surveys were verified. If problems were encountered in a batch, they were fixed and the proportion verified was increased. If any patterns of data entry errors were detected in a batch, verification of the field for all surveys was made. The protocol was approved by the institutional review board at Florida State University.

Statistical Analysis

The survey included demographic questions which enabled us to identify differences in the use of email by practice size, medical training, practice type, age, race, and gender. To examine practice size, we computed categories based on number of physicians practicing at a given location. Medical training (or "specialty") refers the area in which respondents said they spend the majority of their practice time in (ie, internal medicine, family medicine, pediatrics, and so on). Age was categorized by decade and included those less than 40 years, those aged 41-50, 51-60, and 61 or older.

To analyze the data, we first employed standard descriptive statistics and utilized chi-square analysis or Fisher's exact test (as appropriate) to identify significant differences among the independent variables of interest. Next, we utilized binary logistic regression models to compute adjusted odds ratios. In these models, independent and covariate predictors included medical training (primary care or other), practice size and type as well as physicians' age, race, and gender. Our dependent variable was email use with patients. In addition, using a similar model, we examined whether or not any of the predictors independently was related to adherence to the 13 communication guideline items described above. For this analysis, we collapsed all the medical specialties into primary care or other. Primary care was defined as family medicine, internal medicine, and pediatrics. All analyses were computed in SPSS version 13.0 and two-tailed significance was considered at the $P < .05$ level.

Results

A total of 4203 returned surveys were available for the current study. This represents a 28.2% participation rate. Demographic and practice characteristics of the respondents are shown in [Table 1](#). Overall, demographics of respondents did not differ from known characteristics of Florida physicians [20].

Table 1. Demographic and practice characteristics of responding physicians (n = 4203)

| | Results | |
|--|---------|-------------|
| Demographics of Respondents: | | |
| Age: Mean (range) | 50.64 | (30–86) |
| Gender: Male | 2479 | (75.9%) |
| Race/Ethnicity | | |
| Caucasian | 2875 | (68.4%) |
| Hispanic | 539 | (12.8%) |
| Asian | 433 | (10.3%) |
| African-American | 133 | (3.2%) |
| Other (or unknown) | 223 | (5.3%) |
| Practice Characteristics: | | |
| Mean years in current community | 14.4 | (< 1– 52) |
| Mean years since medical school graduation (range) | 21.4 | (< 1– > 65) |
| Specialty: * | | |
| Family Medicine | 756 | (18.3%) |
| Internal Medicine | 783 | (18.9%) |
| Pediatrics | 602 | (14.6%) |
| Obstetrics/Gynecology | 454 | (11.0%) |
| General Surgery | 42 | (1.0%) |
| Surgical Specialty | 393 | (9.5%) |
| Medical Specialty | 709 | (17.1%) |
| Other † | 397 | (9.6%) |
| Presence of an office computer | 4015 | (96.1%) |
| Presence of Internet access | 3812 | (96.5%) |
| High-speed access | 2848 | (85.3%) |
| Dial-up connection only | 404 | (12.2%) |

*Based on majority time spent in practice as reported by respondents.

† Includes all other specialties, and physicians primarily in administrative roles.

Physicians' Use of Email With Patients

Overall, 689 physicians (16.6%) indicated that they personally used email from their office to communicate with patients. A majority of these doctors reported doing so rarely (314; 45.6%) or occasionally (255; 37%), with only 120 (17.4%) physicians saying they frequently used email to communicate with their patients (at least once on half of all business days). These 120 doctors represented 2.9% of 4148 physicians who responded to the email question in the survey. Physicians who frequently sent email to patients did not differ demographically from those who sent email only rarely or occasionally, except, of note, all 120 physicians who stated they frequently emailed patients practiced in urban areas ($P = .048$ compared to rural).

Using email to communicate with patients was first assessed by physician age, race, medical training, practice size, and to urban geographic practice location using univariate analysis (see Table 2). For example, physicians in the oldest age category

(11.7% for those 61 years or older; $P = .014$) and those of Asian decent (7.2%) were least likely to engage in physician-patient email. Type of medical training also was related to email practices, in that family medicine doctors and surgical specialists were more likely to email patients than other groups. Although a significant difference was not noted between physicians who practice in single or multi-specialty practices, practice size itself was significantly related to the likelihood of email use. Groups of 50 or more physicians were significantly more likely (27.3%) to use email than those in smaller practices (14.5% to 22.7%; $P < .001$). Urban practice location was also significantly associated with physician-patient email use (17.2% vs. 7.9%; $P < .001$). Physicians who had high-speed Internet access (18.5% vs. 10.7%; $P < .001$), or indicated using an EHR system (25.4% vs. 13.9%; $P < .001$) were more likely to state that they sent email to patients.

When analyzed in a multivariate model, only two variables were noted to be statistically significant predictors for email use.

Physicians who practiced in groups of 50 or more were more likely than physicians in solo practice to communicate with patients via email (adjusted OR = 1.94; 95% CI = 1.01–3.79).

In addition, Asian-American respondents appeared to use email communication less commonly with patients than Caucasian physicians (adjusted OR = 0.26; 95% CI = 0.139–0.487).

Table 2. Number and percent of physicians who use email with patients in Florida (n = 689)

| | Number (percent) of physicians who use email with patients | | P-value * | Adjusted Odds Ratios (95% CI) | |
|---------------------------|--|--------|-------------------|-------------------------------|--------------|
| Total | 689 | (16.6) | | | |
| Age | | | | | |
| Less than 40 years old | 79 | (16.4) | | 1.00 | |
| 41-50 years | 197 | (17.6) | | 1.09 | (0.75–1.59) |
| 51-60 years | 168 | (18.2) | | 1.23 | (0.83–1.81) |
| 61 years or older | 56 | (11.7) | .014 | 0.69 | (0.42–1.12) |
| Gender | | | | | |
| Male | 410 | (16.7) | | 1.00 | |
| Female | 119 | (15.3) | .34 | 0.87 | (0.64–1.17) |
| Race | | | | | |
| Caucasian non-Hispanic | 522 | (18.3) | | 1.00 | |
| African-American or Black | 21 | (16.0) | | 1.24 | (0.66–2.34) |
| Hispanic | 78 | (14.6) | | 0.82 | (0.57–1.16) |
| Asian | 31 | (7.2) | | 0.26 | (0.14–0.49) |
| Other race or unknown | 37 | (17.7) | < .001 | 0.91 | (0.48–1.71) |
| Specialty | | | | | |
| Family Medicine | 154 | (20.6) | .001 [†] | ‡see note below | |
| Internal Medicine | 114 | (14.7) | .11 | | |
| Pediatrics | 86 | (14.5) | .14 | | |
| Obstetrics/Gynecology | 75 | (16.7) | .93 | | |
| General Surgery | 7 | (16.7) | .98 | | |
| Surgical Specialty | 83 | (21.4) | .007 | | |
| Medical Specialty | 113 | (16.0) | .67 | | |
| Other | 46 | (11.8) | .008 | | |
| Practice type | | | | | |
| Single specialty | 407 | (15.2) | | 1.00 | |
| Multi specialty | 81 | (18.0) | .12 | 1.07 | (0.73–1.58) |
| Practice size | | | | | |
| Solo practice | 176 | (14.5) | | 1.00 | |
| 2-9 physicians | 330 | (15.5) | | 1.01 | (0.70 –1.32) |
| 10-49 physicians | 87 | (22.7) | | 1.11 | (0.63–1.95) |
| 50 or more physicians | 56 | (27.3) | < .001 | 1.94 | (1.01–3.79) |

* Univariate P-values, calculated by chi square, compare trends between groups.

[†]P-values for each specialty represent the comparison of the given specialty with all other groups.

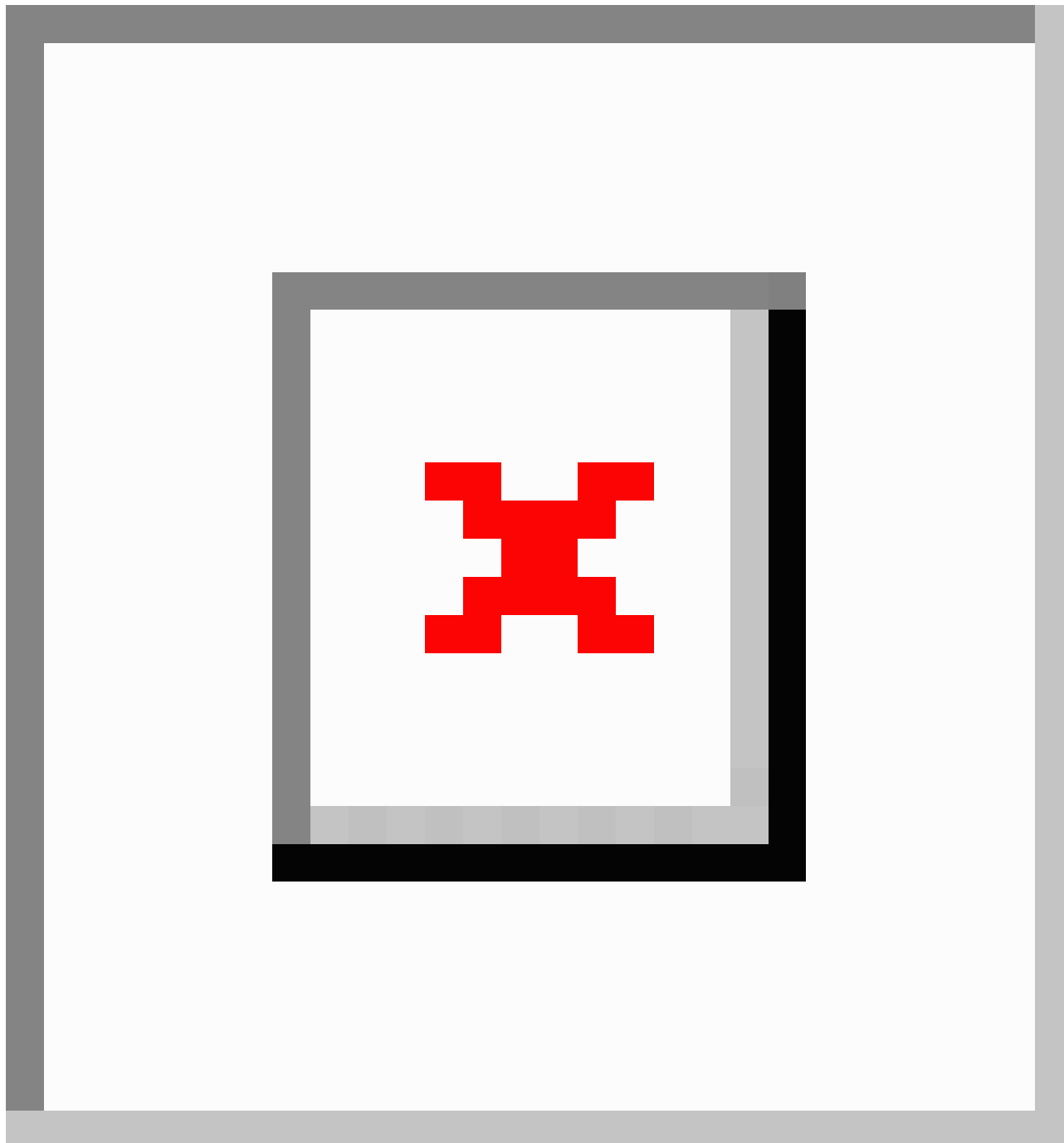
[‡] In multivariate analysis, we compared primary care physicians to other specialists; adjusted OR = 0.97 (0.77–1.24).

Of all physicians who did not currently use email with their patients, 13.4% indicated a future interest in doing so. An additional 52.8% expressed no desire to begin using email with patients and about one-third (33.8%) were undecided about future email use with patients.

National Physician-Patient Email Guidelines

Of the 689 respondents who indicated using email with patients, only seven doctors (1.6%) indicated requiring their patients to abide by *all* the selected guideline items (see [Figure 1](#)).

Figure 1. Number and percent of selected email guideline items being adhered to by physician practices in Florida (n = 689)



Furthermore, only 46 physicians (6.7%) required their patients to comply with at least half (7) of the 13 guideline items ([Table 3](#)). The most common practice, among less than half of respondents, was printing the email communication and placing it in the patient's chart (48%). The next most common practice, "informing patients about privacy issues with respect to email", occurred among 36.3% of respondents. Adherence to any one of the other individual guideline items was infrequent, occurring in less than 25% of physician responses. Physician-respondents

who stated that they frequently sent email to patients were more likely to adhere to 5 or more national guideline items (32.2% vs. 10.4%; $P < .001$). When analyzed by multivariate regression, physicians who were in primary care (adjusted OR = 1.95; 95% CI = 1.06–3.31) or in a practice of 50 or more physicians (adjusted OR = 8.07; 95% CI = 1.03–62.5) were more likely to follow 5 or more guideline items. Conversely, multivariate analysis of the group of physicians who followed less than 2

guideline items showed a significant negative correlation only with primary care (adjusted OR = 0.67; 95% CI = 0.48–0.98).

Table 3. Physicians' self-reported adherence to recommended guideline items when emailing patients

| Nationally Recommended Policies | No. of Physicians (n = 689) | Percent |
|--|-----------------------------|---------|
| Print email communication and place in-patients' charts | 331 | 48.0 |
| Inform patients about privacy issues with respect to email | 250 | 36.3 |
| When email messages become too lengthy, notify patients to come in to discuss or call them | 148 | 21.5 |
| Establish a turnaround time for messages | 111 | 16.1 |
| Request patients to put their names or identification numbers in the body of the message | 111 | 16.1 |
| Send a new message to inform patient of completion of request | 111 | 16.1 |
| Establish types of transactions | 110 | 16.0 |
| Explain to patients that their message should be concise | 70 | 10.2 |
| Remind patients when they do not adhere to guidelines | 55 | 8.0 |
| Develop archival and retrieval mechanisms | 57 | 8.3 |
| Instruct patients to put category of transaction in subject line of message | 48 | 7.0 |
| Configure automatic reply to acknowledge receipt of patients' messages | 42 | 6.1 |
| Request patients to use auto-reply features to acknowledge clinician's message | 28 | 4.1 |

Nonpatient Email

Among the physician-respondents, 2593 (63%) indicated the use of email from their office for communication with groups other than patients. Most commonly, they reported the use of email to communicate with friends or family members (74.2%), other doctors (63.8%), and for business-related communications (50.1%). Less common (though still more common than email to patients) was email to hospitals (29.2%) and pharmaceutical companies (20.5%). Lastly, 12.9% of physicians suggested emailing some "other" group besides those listed above.

Discussion

Patient-provider electronic mail has been previously defined as "computer-based communication between clinicians and patients within a contractual relationship in which the healthcare provider has taken on an explicit measure of responsibility for the client's care" [19]. As such, it is an important tool for physician communication with patients in both general [21,22] and specialized [23,24] areas of medical practice. Despite the improved communication potential from the use of physician-patient email, the number of physicians electing to do so is still low, even though broadband Internet access is very common. Our finding of over 85 percent of physicians having high-speed Internet access is consistent with other US-based surveys [25].

Yet, the present study, conducted in mid-2005, found that only 16.6% of physicians in Florida used email with patients, and only 2.9% of the overall respondents used it frequently. This latter number, derived from physicians' responses, suggests how rare email communication remains in clinical practice and is substantiated by studies showing the low number of patients who have ever sent email to a physician [5,26]. Although some patients do not yet have regular access to email [11], studies of

the general public show both an increasing access to email accounts [27] and a general interest in email communication with their physicians [5,12]. From the perspective of the diffusion theory, physician-patient email is only now beginning to traverse the uphill slope of the adoption curve [28]. Yet, the fact that physicians are regularly using email from their offices to communicate with virtually all other entities (except patients), indicates that barriers seem to be specifically *impeding email use with patients*.

These barriers have been identified previously [2,15,29] and appear to be due to several specific fiscal and legal causes. Even though most email communications are asynchronous in nature, physicians spend valuable time and resources responding to email messages from patients [8,30,31]. This represents an "opportunity cost" to some physicians, particularly if the email system in place does not replace other modes of communication such as telephone messages, postal letters, etc [2]. In addition, the purchase and maintenance of encryption software, required to achieve maximum privacy, adds expense to the practice [32]. Only recently have several pilot programs in the United States begun to reimburse physicians for the expenses associated with direct email consultation [33–35].

The pace of email communication to patients has also been slowed by concerns from physicians [30] and staff [36] over general liability and privacy stemming from the recent Health Information Portability and Accountability Act [37–39]. For the interested reader, several excellent reviews exist that discuss the numerous legal and policy implications of physician-patient email and electronic health record use [40–43]. For those interested in the policy issues related to unsolicited email from patients, a seminal study by Eysenbach and Diepen, which describes the policy implications, is recommended reading [44].

There may be a difference in perceptions between patients and physicians of the benefits accrued from the use of electronically

available information. For example, a survey of patient use of the Internet for health information suggested that patients perceive more benefits and fewer risks than their physicians do, when this mode of information gathering is utilized [45]. A further study of these perceived differences in email benefits/risks is warranted.

Another important observation from the current study is that the use of email with patients occurs most frequently among certain groups of physicians. In one of the few studies that reported demographic information of physicians who do, and do not, regularly email patients, Gaster et al found that female physicians, younger physicians, and university-based clinic physicians were proportionately more likely to use patient email [10]. Community-based physicians, who more often offer primary care, tended to use email less than university- or county-hospital based clinics. In the present study, both family medicine physicians and surgical specialists were more likely to email patients. We believe the percentage of surgical specialists using email may be higher because they tend to work in larger practices (which were also more likely to use email). Family medicine doctors also have a higher likelihood of email use in Florida. We hypothesize this may be due to an ongoing health information technology educational program actively being pursued by the Florida and American Academies of Family Physicians, respectively. Similar to findings by Gaster et al, we found less email communication by older physicians. We believe this trend will disappear as the current physician workforce ages and younger physicians, with a higher general comfort level with information technology, appear in the workforce.

As email communication differs from traditional, written medical communication between physicians and patients and among providers, guidelines for best practices have been developed. These guidelines have emanated from both the medical [19,46-48] and health informatics [18] professions, as well as experts in the bioethics [49,50] and legal [51,52] fields. In the current study, we chose to design our survey questions around the guidelines found in two large US medical and informatics organizations because of their breadth and general availability [18,19]. The AMIA released its guidelines in 1998, and the AMA [18,19], in 2000. Both of these sets of recommendations are available online for physicians to review and utilize.

One of the most important findings of the current study is that few physicians were routinely utilizing these guidelines for email communication with patients, despite their broad availability for several years. In this regard, the current study results are similar to those of Gaster and colleagues from a 2000-2001 survey of physician practices related to email use [10]. They found that 75% of physician-respondents never or

rarely obtained consent to communicate with patients by email, 66% never or rarely discussed confidentiality or security concerns and 58% never or rarely documented email in the patient record. Importantly, a separate study by White et al found that the majority of patients involved with regular physician email communication do follow guidelines when they are educated about their nature and importance [14]. The findings by White et al, done from the patient's perspective, coupled with the physician-oriented findings from our current study, suggest to us that the main barriers to guideline use may be more with the physician's initiation than with the patient's compliance.

The low rate of adherence to published physician-patient email guidelines may have several reasons. Among these reasons may be the lack of knowledge about the existence of guidelines by many practicing physicians; the lack of agreement with the guidelines (eg, not feeling that the guidelines are required in their particular practice), or an impracticality to their implementation. Unfortunately, the present study was not designed to determine reasons for not adhering to these recommended guidelines. However, given the results presented in the current study, the medical profession should consider further educating physicians about email communication, assess the barriers facing implementation, and better understand the practicality of utilizing the guidelines themselves.

We acknowledge that there are several important limitations of this study. First, we recognize that the survey response rate, although higher than comparable previous studies [22,53,54], may be a limitation. However, upon employing common methodologies used to detect bias, we failed to identify the presence of response bias. Second, as with other self-reported surveys, the study relies on the willingness and ability of participants to give accurate responses. Finally, because the purpose of the study was to identify the use of email by physicians in one state, the results of this study should be generalized to other geographic regions with caution.

To enhance email communication between physicians and patients, we believe that further work to educate both physicians and patients on the advantages and limitations of email correspondence is necessary. In addition, efforts are needed to deal with the fiscal barriers many physicians face in the regular use of email as a quality-enhancing tool in patient care. Although we are encouraged by recent efforts to reimburse physicians for email communication in several areas of the United States, most US physicians do not yet have access to these reimbursement programs. As these barriers are addressed in the United States, we believe email communication between physicians and patients will become better defined, better compensated and a resource for better clinical care of patients.

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Conflicts of Interest

None declared.

Multimedia Appendix 1

Survey of Physician Information Technology use in Florida, developed by the Florida State University College of Medicine. [\[PDF file, 68 KB - jmir_v8i1e2_app1.pdf\]](#)

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