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Contents

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Original Paper

Virtual Patient Technology: Engaging Primary Care in Quality Improvement Innovations

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Abstract

Background: Engaging health care staff in new quality improvement programs is challenging.

Objective: We developed 2 virtual patient (VP) avatars in the context of a clinic-level quality improvement program. We sought to determine differences in preferences for VPs and the perceived influence of interacting with the VP on clinical staff engagement with the quality improvement program.

Methods: Using a participatory design approach, we developed an older male smoker VP and a younger female smoker VP. The older male smoker was described as a patient with cardiovascular disease and was ethnically ambiguous. The female patient was younger and was worried about the impact of smoking on her pregnancy. Clinical staff were allowed to choose the VP they preferred, and the more they engaged with the VP, the more likely the VP was to quit smoking and become healthier. We deployed the VP within the context of a quality improvement program designed to encourage clinical staff to refer their patients who smoke to a patient-centered Web-assisted tobacco intervention. To evaluate the VPs, we used quantitative analyses using multivariate models of provider and practice characteristics and VP characteristic preference and analyses of a brief survey of positive deviants (clinical staff in practices with high rates of encouraging patients to use the quit smoking innovation).

Results: A total of 146 clinical staff from 76 primary care practices interacted with the VPs. Clinic staff included medical providers (35/146, 24.0%), nurse professionals (19/146, 13.0%), primary care technicians (5/146, 3.4%), managerial staff (67/146, 45.9%), and receptionists (20/146, 13.7%). Medical staff were mostly male, and other roles were mostly female. Medical providers (OR 0.031; CI 0.003-0.281; *P*=.002) and younger staff (OR 0.411; CI 0.177-0.952; *P*=.038) were less likely to choose the younger, female VP when controlling for all other characteristics. VP preference did not influence online patient referrals by staff. In high-performing practices that referred 20 or more smokers to the ePortal (13/76), the majority of clinic staff were motivated by or liked the virtual patient (20/26, 77%).

Conclusions: Medical providers are more likely motivated by VPs that are similar to their patient population, while nurses and other staff may prefer avatars that are more similar to them.

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KEYWORDS

virtual patients; interdisciplinary health teams; clinical staff engagement; environment design; health promotion; tobacco use cessation

Introduction

Engaging clinical staff in quality improvement interventions that promote clinical staff-patient discussions and referrals to health behavior change resources is key for health promotion, disease prevention, and disease management [1]. However, engaging staff is challenging. How do we activate clinical teams to adopt interventions that prescribe or introduce health promotion or health behavior activities to patients?

Interdisciplinary medical teams in the health care setting work collaboratively to provide comprehensive health services [2]. These teams commonly include medical providers, nurse professionals, patient care technicians, social workers [3], and increasingly include administrative staff for enhanced communication within and between clinical teams [4]. Increasingly, interventions are targeted to motivate clinical teams to engage patients in health-promoting behaviors [5]. Techniques to motivate physicians, nurses, and primary care staff to encourage patient health-promoting behaviors traditionally include reminders and performance feedback [6,7]. While these techniques are successful in the short term, they do not provide continuous reminders to cue behavior or sustainably engage providers for the long term. Clinical staff often do not see the outcomes of their health promotion activities on patients, potentially leading to a lack of positive feedback and reinforcement and lack of sustainability of quality improvement initiatives. Novel methods of engaging clinical staff in informatics innovations that support quality improvement could enhance the feeling that clinical staff are making an impact and improving the health of their patients.

Relational agents or avatars, digital and animated representations of people, are a newer form of engagement and motivation. Virtual patient (VP) avatars have been used to motivate healthy behaviors in patients, typically as patient coaches [8-11]. For example, a depression self-management intervention for young adults using virtual health care providers and virtual coaches significantly decreased depression symptoms [12]. The medical and nursing disciplines have used VPs to improve education on critical thinking [13,14]. To date, VPs have not been used in the practice setting to change provider behavior and encourage quality improvement initiatives. In this context, the avatar is present on staff computer screens as a continual cue to perform a behavior, such as counseling a patient to quit tobacco. The avatar intrinsically motivates staff to introduce patients to healthy behaviors, with the avatar's facial expression and narrative improving with greater amounts of positive staff behavior. However, these avatars have not been rigorously evaluated in the context of changing clinical practice patterns on the provider side. To evaluate the feasibility and potential for VPs in the clinical context, we developed and deployed 2 VPs within the context of a practice-level quality improvement program for smoking cessation.

This report describes the use of and reaction to the virtual patients (Bob and Susie) among the clinical staff of 87 primary care practices. In primary care, people in different staff roles usually have different technology preferences [15]. Thus, we were interested in the influence of staff role type on preferences for engaging with the VPs, as well as the influence of VP preference on clinical staff performing the activities in the smoking cessation quality improvement programs during a 3-month follow-up period. Our research objectives were to (1) determine VP preference by clinic staff role and primary care practice characteristics, (2) determine the influence of these characteristics and VP preference on clinical staff engagement with the quality improvement program (as described below, clinical staff were encouraged to refer patients to an online Web-assisted tobacco intervention as a part of the quality improvement program), and (3) explore perceived usefulness and motivation VP preference had on engagement and examine differences by staff role among practices with high levels of engagement in the quality improvement program (high patient referral rates). Examining the differences in technology use and preferences among primary care staff will enable further development of VP improvements that motivate staff to adopt and sustain quality improvement programs.

Methods

Study Description

The VP study was a prospective, observational study of physicians, nurses, and other primary care staff and their engagement with a longitudinal quality improvement study that used VPs to enhance engagement. The VPs were deployed in the context of a larger practice improvement program, the "Quality Improvement in Tobacco-Provider Referrals and Internet-Delivered Microsystem Optimization (QUIT-PRIMO)" trial [16]. The goal of QUIT-PRIMO was quality improvement in tobacco control, using a program assisted by a clinic-level ePortal to engage and remind the clinical staff of health care practices to recommend and refer their tobacco-smoking patients to a patient-level Web-assisted tobacco intervention. The results of the QUIT-PRIMO ePortal trial were previously reported [17]. The study was approved by the institutional review board, and the protocol was overseen by a data safety and monitoring board.

Clinic-Level ePortal Quality Improvement Program Overview

A total of 76 practices received the technology-assisted quality improvement program. The quality improvement program used a Web-based system (ePortal) to have practices enter their patient email addresses (with patient consent) and electronically refer patients to the patient-level Web-assisted tobacco intervention. After their visit, patients received up to 10 automated email reminders (personalized by the medical provider) to remind the smokers to participate in the Web-assisted tobacco intervention the clinic had recommended. The clinic-level ePortal quality improvement program resulted in nearly threefold greater patient participation (31%) than the rate in comparison practices using paper brochures to refer patients (11% patient participation in the Web-assisted tobacco intervention). Over 2000 patients were referred using the ePortal.

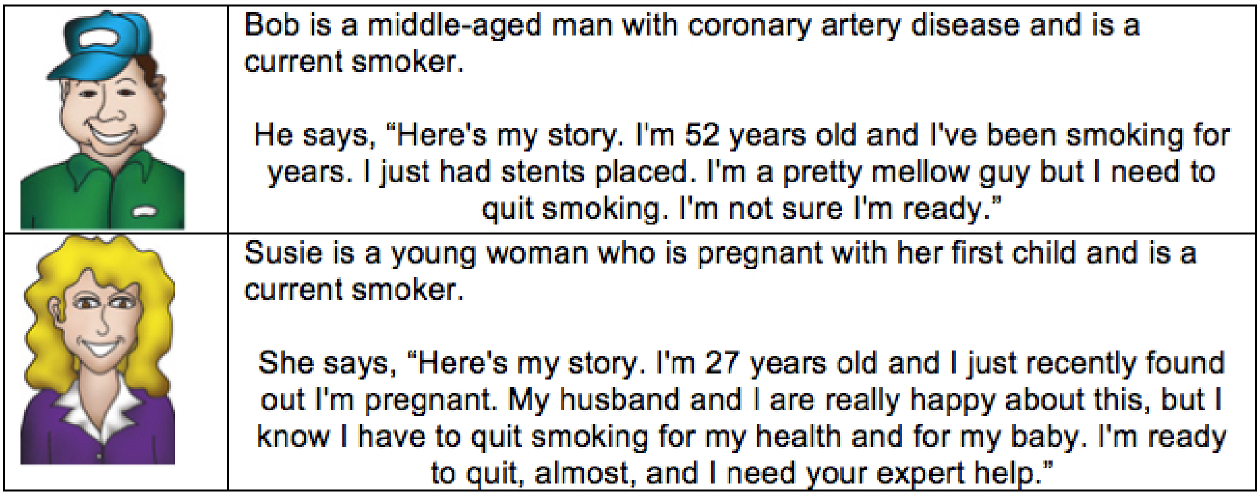
The ePortal home page included a VP. Each VP was created to assist the implementation of the quality improvement program (staff referrals of patients who are current smokers to the Web-assisted tobacco intervention). As described below, clinical staff were allowed to select their preferred VP. Data on participant selection of a VP character and referral rates were collected through the online database. Participants from clinics with a high referral rate (20 referrals or more) were targeted for an interview as a study of positive deviants, with questions pertaining to components of the QUIT-PRIMO trial including attitudes toward VPs.

Virtual Patient: Participatory Design Approach

We used a systematic participatory design process to create the VPs. A professional artist initially developed 6 VP characters that were pilot-tested with a group of health care providers and other clinical staff (N=8) at an academic primary care practice. The VPs were designed to motivate users by transforming their facial expression and narrative as more smokers were referred using the ePortal (Multimedia Appendix A). Based on feedback from clinical staff, 2 avatars were selected. These 2 avatars received positive qualitative comments from providers and staff, and no staff felt that these VPs were disliked. Although some other VPs were liked by some providers, they also received negative comments (like “not realistic” or “overly healthy” or “confusing” story). Providers stated that they selected the 2 characters because they most represented their patients and felt the artistic rendering was a good fit for patients’ stories. Providers also claimed to feel an empathetic connection to these 2 characters. See Figure 1 for a description of the two VPs (Bob and Susie) used in the ePortal quality improvement program.

The VPs were designed to change their story as the clinical staff used the ePortal. The more referrals of actual patients (meaning clinical staff entered the patient email address into the ePortal system so that the patient would receive follow-up reminders), the more the VP progressed through their own quitting tobacco story. There were 16 transformations of facial expression and/or verbal feedback in text form used for Bob and Susie. Multimedia Appendix 1 gives 5 examples each of Bob and Susie’s story as they progress through quitting related to the amount of referrals clinical staff enter online for their patients.

Figure 1. Virtual patient character description.



Recruitment

Each primary care practice participating in the quality improvement program was asked to identify 2 clinical staff to serve as implementation coordinators. These coordinators could include physicians, nurses, primary care technicians, secretaries, receptionists, and managers. These staff logged on to the ePortal quality improvement program where they received education about advising current smokers to quit and an online form that they could use to e-refer patients. They selected one of the VPs (Bob or Susie) to use for the course of the study.

Measures

Practices were recruited using mass mailing from a mailing list of practices until the sample size (76 practices) was achieved. During recruitment, practices completed a survey assessing practice-level characteristics, including region of the country. Clinical staff registering on the ePortal quality improvement program consented online and then completed an online survey that assessed clinic staff type, demographic information, and technology use. VP preference (Bob or Susie) was gathered when clinical staff registered in the online database (referasmoker.org). Documentation use of the ePortal by clinical staff was collected throughout the study on the online database. We interviewed staff of the practices who referred 20 or more smokers to the ePortal.

Several variables were constructed. Age was dichotomized on the 50th percentile for descriptive purposes. Categorical variables were recoded into dummy variables to better understand if any individual staff or practice characteristics affected VP preference. Dummy variables were created for staff role, practice type, practice region, and participant race for bivariate analyses with VP character choice. A total Web technology use score was calculated as the sum of 6 markers of Internet use collected at baseline (dichotomous variables for each function: using the Internet, searching for information, reading information, using email, using online social media, and input-based use). From this total score, a dichotomous variable of low or moderate technology use was constructed, with low use indicating 2 kinds of Web technology use or fewer and moderate use as 3 or more kinds. A categorical variable of referrals was created, including 3 categories: (1) no referrals,

(2) referrals under the set goal of 20 referrals, and (3) referrals meeting or exceeding the goal of 20 or more.

In addition to the quantitative data above, we conducted a follow-up qualitative study of positive deviants. Positive deviants are people who have more positive outcomes than others within the same context and resources available [18]. In this study, we defined positive deviants as clinical staff who had used the ePortal over 20 times to refer patients. Participating clinical staff within primary care practices that had overall referral rates higher than 20 were selected for interviews with both closed- and open-ended questions. A multiple choice question “How did you feel about the virtual patient?” with options of “It made me want to come back to website to refer patients,” “I liked it,” “I found it annoying,” “I wanted to skip over it,” and “other” was used to assess staff perceptions of VP technology usefulness. Subsequently, there was an opportunity to comment further in an open-ended way, and those who selected “other” were elicited for more information.

Statistical Analysis

Descriptive statistics were used for sample description. The impact of clinic staff roles on VP preference (Bob or Susie? Objective 1), VP influence on clinical staff use of the ePortal quality improvement program (Objective 2), and motivation to use the VP (Objective 3) were analyzed using the chi-square test due to their categorical nonparametric nature. For multivariable analyses, a survey analysis strategy (Stata svyset, StataCorp LLC) was used to account for the survey design sampling method of multiple clinical staff at each primary care site. Categorical variables were included in models as indicator variables. A logistic regression was performed to determine the influence of practice type characteristics (internal medicine or family practice, region of the country), professional characteristics (clinic staff role), and personal characteristics (age, gender, race) on VP selection (Objective 1). A logistic regression was performed to determine whether the number of e-referrals was influenced by VP selection or personal or practice type characteristics (Objective 2). Qualitative results were coded and summarized (Objective 3). Stata 12.1 (StataCorp LLC) software was used for all analyses, with *P* values of less than .05 considered significant.

Results

Characteristics of Primary Care Staff and Their Use of Technology

Table 1 provides characteristics for 146 primary care staff from 76 practices. Clinic staff included medical providers (35/146, 24.0%), nurse professionals (19/146, 13.0%), primary care technicians (5/146, 3.4%), receptionists (20/146, 13.7%), and managerial staff (67/146, 45.9%). The majority of the sample was female (121/146; 82.9%), with almost two-thirds of the medical providers being male (22/35; 62.8%) and almost all nonmedical providers female (108/111; 97.3%). Web technology use by primary care staff varied by staff role, with medical providers having the highest use of technology (mean 5.0, SD 1.2) and patient care technicians having the lowest (mean 3.2, SD 2.7) (Table 1).

Table 1. Clinic and staff characteristics.

Characteristics		Total (N=146) n (%)
Staff role		
	Medical providers[a]	35 (24.0)
	Nurse professionals[b]	19 (13.0)
	Patient care technician	5 (3.4)
	Receptionist/secretary	20 (13.7)
	Managerial staff	67 (45.9)
Practice type		
	Internal medicine	63 (43.2)
	Family medicine	81 (55.5)
	General practice	2 (1.4)
Practice region		
	Northeast	45 (30.8)
	Midwest	27 (18.5)
	West	32 (21.9)
	Southeast	42 (28.8)
Participant age		
	<35 years	59 (40.4)
	≥35 years	87 (59.6)
Participant gender		
	Male	25 (17.1)
	Female	121 (82.9)
Participant race		
	White	100 (68.5)
	Black	20 (13.7)
	Other race	26 (17.8)

[a]Medical providers include medical doctors, doctors of osteopathic medicine, and physician assistants.

[b]Nurse professionals include registered nurses, licensed practical nurses, and nurse practitioners.

Factors Associated with Virtual Patient Choice (Objective 1)

In these 76 primary care practices, 61% (89/146) of clinic staff chose Bob and 39% (57/146) chose Susie. All male clinic staff (providers, nurses, and other staff) selected the male VP, Bob, as their VP for the study (25/146). In bivariate analyses, medical provider role (*P*<.001) and clinical staff age greater than 35 (*P*<.001) were more likely to select the older, male VP than other participants (Table 2). These associations persisted in multivariable regression (Table 3). In multivariate analysis, medical providers were 96.9% less likely to choose Susie (odds ratio [OR] 0.031; CI 0.003-0.281; *P*=.002) than secretarial or managerial staff. In the same model, clinical staff older than 35 years were 58.9% less likely to select the young, female VP (OR 0.411; CI 0.177-0.952; *P*=.038), even when controlling for all other characteristics.

Table 2. Bivariate associations of virtual patient preference by clinical and demographic characteristics.

		Bob N=89 (61.0%) n (%)	Susie N=57 (39.0%) n (%)	*P* value[a]
Staff role				
	Medical providers	34 (97.1)	1 (2.9)	.000
	Nurse professionals	13 (68.4)	6 (31.6)	.475
	Patient care technician	4 (80.0)	1 (20.0)	.374
	Receptionist/secretary	8 (40.0)	12 (60.0)	.039
	Managerial and other staff	30 (44.8)	37 (55.2)	.000
Practice type				
	Internal medicine	49 (60.5)	32 (39.5)	.838
	Family medicine	39 (61.9)	24 (38.1)	.898
	General practice	1 (50.0)	1 (50.0)	.749
Practice region				
	Northeast	27 (60.0)	18 (40.0)	.874
	Midwest	17 (63.0)	10 (37.0)	.813
	West	19 (59.4)	13 (40.6)	.835
	Southeast	26 (61.9)	16 (38.1)	.882
Participant age				
	Age <35	24 (40.7)	35 (59.3)	.000
	Age ≥35	65 (74.1)	22 (25.3)	
Participant gender				
	Male	25 (100.0)	0 (0.0)	.000
	Female	64 (52.9)	57 (47.1)	
Participant race				
	White	69 (61.1)	44 (38.9)	.962
	Black	9 (45.0)	11 (55.0)	.115
	Other race	11 (84.6)	2 (15.4)	.067
Technology use				
	Low technology use	33 (54.1)	28 (45.9)	.150
	High technology use	56 (65.9)	29 (34.1)	

[a]*P* values express differences between categories using dummy variables.

Table 3. Virtual patient preference by clinical and demographic characteristics using multivariate analysis.

Characteristics		Model		
Variable (reference group)		Odds ratio	95% CI	*P* value
Staff role (managerial staff)				
	Medical providers	0.031	0.003-0.281	.002
	Nurse professionals	0.413	0.104-1.634	.205
	Patient care technician	0.219	0.006-7.411	.394
	Secretarial staff	1.164	0.349-3.879	.802
Practice type (family medicine)				
	Internal medicine	0.788	0.331-1.875	.585
	General practice	1.155	0.395-3.375	.790
Practice region (Northeast)				
	Midwest	0.998	0.289-3.441	.997
	West	0.786	0.264-2.340	.663
	Southeast	0.410	0.140-1.198	.102
Participant age (<35 years)				
	≥35 years	0.411	0.177-0.952	.038
Participant race (white)				
	Black	2.427	0.582-10.10	.220
	Other race	0.332	0.062-1.771	.194
Technology use				
	High technology use	0.937	0.403-2.181	.879
Constant		2.860	0.914-8.952	.071

Influence of Virtual Patient and Staff Characteristics on eReferrals (Objective 2)

Staff role, practice type, and race were significant in predicting referrals (Table 4, Model 2). Importantly, the VP character type was not significant in influencing e-referrals to an online tobacco cessation intervention (Table 4, Model 1), even when controlling for other staff and practice characteristics (Table 4, Model 2). Medical providers were 4 times more likely than clinic managers to refer smokers to the online tobacco cessation intervention (OR 4.319; CI 1.261-14.797; *P*=.020). Staff who work in internal medicine were more than twice as likely as those working in a family medicine clinic to refer patients (OR 2.215; CI 1.040-4.719; *P*=.040). Staff who were black were 72.3% less likely to refer patients than staff who were white (OR 0.279; CI 0.091-0.854; *P*=.026).

Table 4. Referrals to Web-assisted tobacco intervention by clinical and staff characteristics using multivariate analyses.

Variable (reference group)		Model 1 OR	Model 1 95% CI	Model 1 P value	Model 2 OR	Model 2 95% CI	Model 2 P value
Virtual patient (Bob)							
	Susie	1.072	0.562-2.045	.830	2.000	0.819-4.868	.127
Staff role (managerial staff)							
	Medical providers				4.319	1.261-14.797	.020
	Nurse professionals				1.417	0.433-4.641	.561
	Patient care technician				0.130	0.008-2.180	.154
	Secretarial staff				0.566	0.187-1.714	.310
Practice type (family medicine)							
	Internal medicine				2.215	1.040-4.719	.040
	General practice				1.000		
Practice region (Northeast)							
	Midwest				0.795	0.290-2.177	.652
	West				3.176	0.997-10.115	.051
	Southeast				2.241	0.818-6.138	.115
Participant age (<35 years)							
	≥35 years				0.790	0.314-1.990	.614
Participant race (white)							
	Black				0.279	0.091-0.854	.026
	Other race				1.191	0.345-4.111	.779
Technology use							
	High technology use				0.857	0.392-1.872	.696
Constant		1.282	0.832-1.975	.256	0.569	0.148-2.190	.408

Staff Perceptions of Virtual Patient Technology Usefulness (Objective 3)

In high-performing practices that referred 20 or more smokers to the ePortal (13/76), the majority of clinic staff reported they were motivated by or liked the VP (20/26, 77%). Two-thirds of secretarial staff were motivated by the VP to refer patients (4/6, 67%). While medical providers were less likely to agree they were motivated by the VP (2/7, 29%), most medical providers liked the VP (4/7, 57%) (Table 5). One medical provider found the VP annoying, but no clinical staff reported they wanted to skip over the VP. A total of 5 clinical staff selected "other" in response to the categorical VP impression question (5/26, 19%). These staff commented they had low personal e-referral experience (2/5), did not use the e-referral system (2/5), or "didn't notice" the VP (1/5).

Table 5. Motivation from and acceptability of the virtual patient by clinical staff role.

		VP[a] motivated e-referrals n (%)	Liked VP n (%)	VP did not motivate or did not like VP n (%)	Total n
Staff role					
	Medical providers	2 (29)	4 (57)	1 (14)	7
	Nurse professionals	1 (50)	1 (50)	0 (0)	2
	Patient care technician	0 (0)	0 (0)	1 (100)	1
	Secretarial staff	4 (67)	1 (17)	1 (17)	6
	Managerial and other staff	4 (40)	3 (30)	3 (30)	10
Total		11 (42)	9 (35)	6 (23)	26

[a]VP: virtual patient.

Discussion

In 76 clinical practices, we found strong differences in preference for VP by clinical staff role. Clinical staff in different roles have different technology preferences in technology innovations. For example, in a study of 9 information technology innovations for hospice use, researchers found that patients, physicians, nurses, managers, and others each preferred different innovation structures [15]. Thus, we were interested in the influence of staff role type on preferences for engaging with VPs and also in the influence of VPs on staff referrals to the Web-assisted tobacco intervention. We found distinct VP preferences mediated by clinical staff characteristics and positive impressions of VPs as agents to engage staff in quality improvement, although preference for individual VP did not influence participation in the quality improvement program. Below, we place these principal results into context.

Principal Findings

Staff Virtual Patient Preference (Objective 1)

In this study, the choice of VP varied based on staff role. Medical providers chose the VP that most fit their patient population, while administrative staff preferred the same-gender VP. This finding may indicate that medical providers are more likely motivated by VPs like their patient population, while other staff are more motivated by VPs that are similar to them. Health care providers have been shown to select VPs in virtual telemedicine to represent what characteristics patients are more likely to prefer or respond to, such as gender and race [19]. This phenomenon of selecting these characteristics to elicit a positive response by patients likely extends into motivating themselves to engage patients in health behavior change. Our findings extend this research into the realm of quality improvement.

Referrals to Web-Assisted Tobacco Intervention by Clinical and Staff Characteristics (Objective 2)

The VP avatars did not differ in influence of staff to refer patients to the Web-assisted tobacco intervention, controlling for all other clinic and staff characteristics. This is an important finding, as VP preference did not influence staff decisions to refer patients over other inherent characteristics of who they are and the clinical setting where they work. VPs' influence on provider performance needs further study. Developing and tailoring VPs to provider characteristics is in its infancy for motivational behavior.

Personal and practice characteristics were significant in predicting referrals to the Web-assisted tobacco intervention. Medical providers were the most likely to refer patients to an online intervention compared to other staff. Focusing on these staff members to increase referral rates needs to be examined. In addition, determining strategies in conjunction with VPs to encourage staff on the clinic team to use referrals should be explored. Different users have different needs during the implementation of innovations [20]. Further research to determine what VP characteristics appeal most to health care staff will assist in using this motivational technology to make an impact on health promotion efforts.

Perceptions of Virtual Patient Technology Usefulness (Objective 3)

Medical providers, nurses, and secretarial staff were more likely than technicians and managerial staff to find the VP useful and motivating for e-referrals. The differences in priorities among staff roles point to different technology preferences and needs during the implementation of innovations [20]. Familiarity with technology is known to influence clinical staff attitudes toward new technology use [21,22]. Technology use is higher among medical providers than administrative staff, which may indicate unfamiliarity and low use of the intervention. Our study of positive deviants also indicates those who were not motivated by the VP or did not like the VP were unfamiliar with the e-referral system and had low personal use of this technology. Therefore, a more thorough introduction to the VP and further training for clinical staff may create more positive perceptions of VP usefulness. To assist all staff members in participating in technology use, Das and colleagues recommend development of education and guidelines targeted to this group. Such guidelines can outline how to best communicate with and facilitate staff online use. This is a stepping stone toward building organizational infrastructure and incentives which can then facilitate Web technology use [23]. The differences in preference by clinical staff role point to the need for further research to determine characteristics that motivate each role for enhanced health promotion efforts.

Limitations

There were limitations to this study. This sample of primary care staff was primarily female. A majority of managerial, secretarial, and nursing staff were women. Overall, there was a low number of male participants, and no male nurses or secretaries were included, limiting the exploration of factors that influence male staff VP selection. However, these staff roles are known to have limited numbers of men. Both VPs in the medical setting were white, limiting the analysis of the influence of demographics on VP selection (aim 2). Finally, the subanalysis of staff perceptions of VP technology usefulness in high-referring practices included a relatively low number of participants, limiting the strength of findings on health care provider perceptions of usefulness (aim 3).

Comparison With Prior Work

Clinical staff often do not see the impact of their health promotion activities on their patients, which leads to a lack of positive feedback or reinforcement for these activities [16,24]. This phenomenon may contribute to a lower sustainability of quality improvement initiatives in the clinical setting. Novel methods of engaging clinical staff in activities that support health promotion have an opportunity to enhance provider feelings of impact on patient health. Similarly, performance feedback for initiatives has been reported to increase clinical staff pride in their personal or their practice's achievement [25]. The VP transformation to better health coordinated with the provider behavior transformation to increased smoker referrals is a visual form of performance feedback that taps into providers' intrinsic motivation of effective patient care.

VPs are a novel informatics innovation to intrinsically motivate clinical staff to change their behavior. A prevalent problem in the clinical setting is difficulty motivating clinical staff to incorporate a new task into their clinical workflow [26]. Solutions for motivation in health care have focused primarily on extrinsic sources, such as financial incentives, to change practice behaviors. These extrinsic incentives have crowded out intrinsic motivators, such as patient improvement. However, extrinsic incentives do not promote sustainability in practice change, as they commonly expire. Intrinsic motivation, the satisfaction of doing a job well with good outcomes as the reward, is just starting to be harnessed for provider change [27].

Motivational interviewing (MI) has been proposed to motivate health care providers to adopt evidence-based practices. As a tool to assist people in resolving ambivalence about change by incorporating principles that parallel Roger's diffusion of innovation theory [28], its purpose aligns with provider motivation to change a practice. MI has been used in webinars to implement an intervention [28]. Similarly, VPs could continue to be developed to incorporate principles of MI to enhance its effect on provider behavior. Verbal or written messages from VPs could incorporate elements of MI that could be used as a component for an effective strategy to change provider behavior.

A barrier to VP effectiveness or usefulness has been a lack of realism in both the context of clinical staff education and patient intervention [11,29,30]. Unrealistic visual components for patient assessment was a detracting factor in education and was a focused part of the study. Realistic features pertinent to the focus of the intervention would enhance the perceived usefulness of the VP. For example, if the focus of the VP intervention is on clinical staff or patient behavior, then the messages and responses of the VPs related to the behavior targeted for change need to be realistic. Our VPs are cartoon representations of patients that providers chose as realistic representations of patients in their practice setting. While we did not ask about perceived realism of the VPs to participants, none of the clinical staff reported a lack of realism as a criticism. Further development and testing of characters and messages for VPs to change behavior is needed in the strategy for clinical staff behavior change.

Conclusions

Clinical staff personal and professional characteristics influence VP character preferences and e-referral rates. Administrative staff selected the VP that was same-gender, while medical providers were more likely to select different-gender VPs. Clinical staff preferred VPs similar to their patients and administrative staff preferred staff similar to themselves, which may indicate the need for tailoring VPs according to staff role. VP character preference did not predict staff referrals to an online behavioral intervention in this study. However, high-referring primary care practice clinical staff reported they were motivated by VPs, indicating VPs as a potentially successful strategy for quality improvement programs in some practice settings. Therefore, further development of the VP characters and facilitative strategies need to be explored. Now that the feasibility of VPs in the context of quality improvement has been preliminarily tested, our future work will conduct randomized experiments to test the impact of the addition of VPs to traditional motivational components of quality improvement programs.

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Conflicts of Interest

None declared.

Multimedia Appendix 1

Virtual patient character transformation.

[PPTX File, 4MB - mededu_v3i1e3_app1.pptx]

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Abbreviations

MI: motivational interviewing
OR: odds ratio
QUIT-PRIMO: Quality Improvement in Tobacco-Provider Referrals and Internet-Delivered Microsystem Optimization
VP: virtual patient

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Original Paper

Simulated Conversations With Virtual Humans to Improve Patient-Provider Communication and Reduce Unnecessary Prescriptions for Antibiotics: A Repeated Measure Pilot Study

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Abstract

Background: Despite clear evidence that antibiotics do not cure viral infections, the problem of unnecessary prescribing of antibiotics in ambulatory care persists, and in some cases, prescribing patterns have increased. The overuse of antibiotics for treating viral infections has created numerous economic and clinical consequences including increased medical costs due to unnecessary hospitalizations, antibiotic resistance, disruption of gut bacteria, and obesity. Recent research has underscored the importance of collaborative patient-provider communication as a means to reduce the high rates of unnecessary prescriptions for antibiotics. However, most patients and providers do not feel prepared to engage in such challenging conversations.

Objectives: The aim of this pilot study was to assess the ability of a brief 15-min simulated role-play conversation with virtual humans to serve as a preliminary step to help health care providers and patients practice, and learn how to engage in effective conversations about antibiotics overuse.

Methods: A total of 69 participants (35 providers and 34 patients) completed the simulation once in one sitting. A pre-post repeated measures design was used to assess changes in patients' and providers' self-reported communication behaviors, activation, and preparedness, intention, and confidence to effectively communicate in the patient-provider encounter. Changes in patients' knowledge and beliefs regarding antibiotic use were also evaluated.

Results: Patients experienced a short-term positive improvement in beliefs about appropriate antibiotic use for infection ($F_{1,30}$=14.10, P=.001). Knowledge scores regarding the correct uses of antibiotics improved immediately postsimulation, but decreased at the 1-month follow-up ($F_{1,30}$=31.16, P<.001). There was no change in patient activation and shared decision-making (SDM) scores in the total sample of patients (P>.10) Patients with lower levels of activation exhibited positive, short-term benefits in increased intent and confidence to discuss their needs and ask questions in the clinic visit, positive attitudes regarding participation in SDM with their provider, and accurate beliefs about the use of antibiotics (P<.10). The results also suggest small immediate gains in providers' attitudes about SDM (mean change 0.20; $F_{1,33}$= 8.03, P=.01).

Conclusions: This pilot study provided preliminary evidence on the efficacy of the use of simulated conversations with virtual humans as a tool to improve patient-provider communication (ie, through increasing patient confidence to actively participate in the visit and physician attitudes about SDM) for engaging in conversations about antibiotic use. Future research should explore if repeated opportunities to use the 15-min simulation as well as providing users with several different conversations to practice with would result in sustained improvements in antibiotics beliefs and knowledge and communication behaviors over time. The results of this pilot study offered several opportunities to improve on the simulation in order to bolster communication skills and knowledge retention.

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KEYWORDS

simulation training; health communication; patient activation; motivational interviewing; decision making

Introduction

The economic and clinical consequences of antibiotic overuse are numerous and can lead to increased medical costs due to unnecessary hospitalizations [1], antibiotic resistance [2], disruption of gut bacteria [3], and more recently obesity [4]. Despite many individual and organizational efforts to address the unnecessary prescribing of antibiotics in ambulatory care, the problem persists, and in some cases, prescribing patterns have increased [5,6]. In fact, recent evidence shows that up to 30% of antibiotics were inappropriately prescribed in 2010-2011, with a majority of these prescriptions being given for sinusitis [7].

Patients and health care providers often express frustration engaging in conversations about challenging or sensitive topics such as the overuse of antibiotics for treating viral infections within the clinic encounter. A review of the evidence shows that most antibiotics for viral infections are not prescribed as the result of clinical evidence but rather given in response to patient demands or lack of training in the appropriate guidelines among health care providers [8,9]. However, findings from intervention studies suggest that the provision of treatment guidelines to physicians and patient education alone are insufficient for reducing unnecessary prescribing of antibiotics [10,11]. Rather, recent research has underscored the importance of incorporating collaborative, patient-centered communication, and SDM into the medical visit as a means to reduce the high rates of unnecessary prescriptions for antibiotics [12]. In 2012, the Choosing Wisely campaign was launched by the America Board of Internal Medicine (ABIM) Foundation, along with Consumer Reports and the Robert Wood Johnson Foundation (RWJF) in an effort to facilitate collaborative patient-provider communication aimed at reducing treatment overuse and waste [13]. Patient engagement, in particular, was regarded as one of the primary methods for reducing antibiotic overuse in the context of the Choosing Wisely campaign. The February 2013 issue of *Health Affairs* was entirely devoted to patient engagement practices and cited strong evidence that “patients who are more actively involved in their health care experience have better health outcomes and incur lower costs” [14]. Similarly, Greene and Hibbard [15] found that interventions that address individual levels of activation and build skills and confidence are effective in activating patients, thereby reducing cost and improving care quality and outcomes. Finally, sound communication in health care interventions and informatics has been shown to allow providers and patients to make sense of the information provided and make sustained changes [16,17].

Building on this evidence, this pilot study examined whether a 10-15 min simulated role-play conversation with a virtual human, one for providers and one for patients, can facilitate the development of collaborative communication skills, knowledge, and confidence of patients and providers to effectively manage conversations regarding overprescribing of antibiotics for viral infections. Specifically, we hypothesized that use of the simulation would result in improvements in (1) patients’ knowledge and attitudes toward antibiotic usage; (2) patient activation; (3) patients’ and providers’ attitudes toward and preference for SDM; (4) providers’ perception of patient engagement in their self-management; and (5) patients’ and providers’ confidence, preparedness, and behavioral intention to engage in conversations about antibiotics.

Methods

Participants

This pilot study used a single group repeated measures design. Patients were recruited from the Bellevue Ambulatory Care practice, a New York City-based public hospital-based primary care practice that serves predominately low-income minority patient populations. Patients were recruited through their previous participation in completed trials with one of the study authors at Bellevue Hospital. Patients were sent letters inviting them to participate in the study and a telephone number to call for more information. Study staff also called patients inviting them to participate. Patients were excluded from the study if they (1) were unable to give informed consent, (2) refused to participate, (3) were unable to speak and read in English, or (4) age <18 years. Primary care providers were affiliated with NYU Langone Medical Center, providing care across four health care facilities: Bellevue Hospital, Gouverneur Health, Veterans Affairs NY Harbor Health Care System’s New York Campus, and the NYU Faculty Group Practice. An email was sent to providers inviting them to participate in the study. All patients and providers provided written informed consent approved by the Institutional Review Board of New York University Langone Medical Center.

Description of the Patient-Provider Communication Simulation

The 15-min simulation was developed by Kognito in collaboration with a group of experts in motivational interviewing, patient engagement, medical education, and antibiotics. In addition, over 25 patients and providers provided feedback during the development phase before the beta version was piloted in this study.

For this study, both patients and health care providers engaged in a simulated conversation aimed at the overarching goal of improving collaborative patient-physician communication and SDM for antibiotic use. When patients accessed the simulation, they assume the role of Laura (the virtual patient) and engage in a conversation with Dr Wei (the virtual provider). Health care providers enter the simulation taking on the role of Dr Wei, who has to manage the conversation with the patient, Laura. At the beginning of the learning experience, participants view a brief movie that explains the backstory and their goals in the conversation. For example, participating providers are told that they will play the role of Dr Wei and conduct an office visit with Laura, a mom who has been coughing for a week and believes that antibiotics can help her get better quickly. Their goals in the conversation are to engage Laura in a conversation about her condition and health goals, and then to collaborate with her on a treatment plan that she understands and is motivated to follow all while expressing empathy, using plain language, checking understanding, and managing her repeating requests for antibiotics. Study patients who choose to play the role of the virtual patient are told that they will act as Laura in the conversation and decide what to say to the virtual physician, Dr Wei. Their goals in the conversation are to provide Dr Wei with a clear understanding of Laura's illness, ask Dr Wei questions so that they understand everything he says, learn about the proper use of antibiotics, and to work with Dr Wei on a plan they both are satisfied with (Figure 1).

At the end of the 15-min simulation, users view a brief movie where the virtual coach provides them with feedback on the decisions they made in the conversation. Then, they are provided with a performance dashboard that includes more detailed feedback on their performance. The information in the dashboard is based on the exact dialog decisions made by the learner during the conversation (Figure 2).

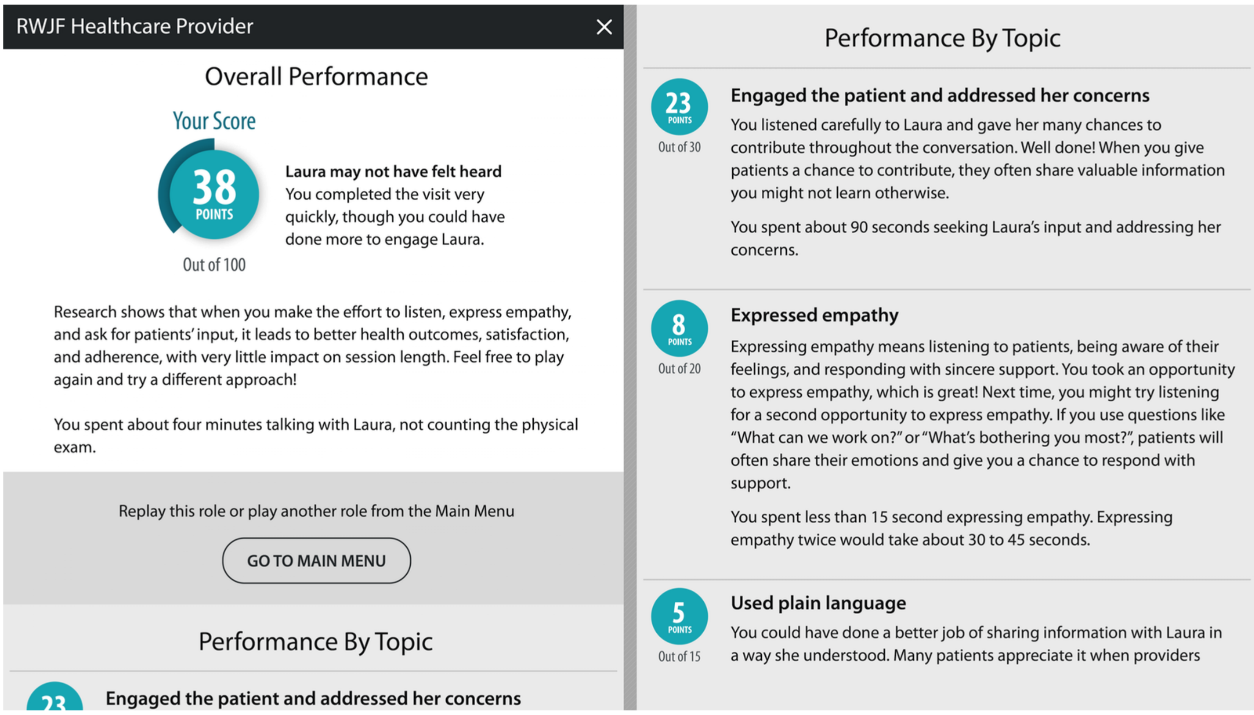
The simulation was designed using the Kognito Conversation Platform, an innovative group of development, delivery, application programming interface (API), data collection, and analytic technologies that integrates a behavior change model that employs the principles of neuroscience, social cognition, adult learning, applied game mechanics, and storytelling [18]. This learning model includes two parts: the first part is an instructional design component based on extensive research showing that skills are best learned when knowledge is actively constructed [19-23]. Learners are afforded multiple opportunities to actively make conversation decisions in a virtual environment where emphasis is placed on reducing extraneous cognitive load to create deeper and more meaningful unique pathways of experience on an individual level. The second part, the conversation component, involves integration of evidence-based communication strategies including motivational interviewing [24], mentalizing [25-27], empathy [28,29], empathic accuracy [30] (knowing what someone is feeling without feeling it yourself), and reappraisal strategy [31,32] (changing the way you interpret a situation). The conversation component is further augmented by aspects of social cognitive theory [33] for participants who are observing how the virtual characters interact and the consequences of those interactions in a contextually realistic environment, which can guide them in making real-life decisions.

In each simulation, a learner enters a risk-free practice environment, assumes a role (ie, health care provider, patient), and engages in a conversation with intelligent, fully animated, and emotionally responsive virtual characters that model human behavior. Virtual humans are coded to possess an individual personality and memory, and adapt their behaviors to the decisions of the learner throughout the conversation. Learners communicate with the virtual human by selecting from a dynamic menu of dialog options. Each option represents a specific conversation tactic based on communications skills that may be more or less effective or ineffective in accomplishing the learner's goal (see Figure 1). The simulation, including dialog options, was developed with input from nationally recognized subject matter experts and end users as part of a comprehensive iterative process involving every aspect of simulation development, ranging from accuracy of content, integration of motivational interviewing strategies and other communication tactics, engaging and realistic storylines, virtual character development, and verbal and nonverbal responses. Once the learner chooses a dialog option, they see their avatar "perform" the dialog, and then observe the verbal and nonverbal response of the virtual human. A new set of dialog options then appears based on the specific tactic selected. If learners select choices that include being critical, judgmental, or labeling, for example, they will lose some of their interlocutor's trust and willingness to talk openly. In these cases, a virtual coach provides personalized feedback and gives learners an opportunity to revise their choice. The virtual coach also provides feedback at the conclusion of the simulation based on the learner's performance as they relate to the study objectives.

The relationship between dialog decisions made by the learner and the response of the emotionally responsive virtual human is controlled by a set of mathematical behavioral models and algorithms specifically designed to simulate real interactions with "types" of people presenting particular personality traits or conditions (ie, cold or cough). The algorithms ensure that learners are repeatedly exposed to target conversations and behavioral patterns as a way to develop skills.

Figure 1. Dr Wei talking with his patient Laura.

Figure 2. Performance dashboard provided to users who played the role of the provider. RWJF: Robert Wood Johnson Foundation.



Study Measures

Self-report measures were administered at the baseline (presimulation), immediate postsimulation, and 1-month follow-up to participating patients and providers. The measures were designed to assess key aspects of patient-provider communication targeted in the simulation (ie, SDM), patient activation, patient antibiotic knowledge and beliefs, behavioral intentions, preparedness, and confidence to engage in challenging conversations, and satisfaction with the simulated encounter. In addition, exit interviews were conducted postsimulation to determine acceptability of the approach.

Antibiotics beliefs and knowledge was assessed for patients using a measure developed for medical students [34]. The knowledge items assessed the extent to which patients accurately understood the correct uses of antibiotics and the costs of using antibiotics (ie, antibiotics are effective at treating bacterial infections; Cronbach alpha=.59). Perceived belief items asked how much patients agreed or disagreed with commonly held attitudes regarding the use of antibiotics for infection (ie, I expect antibiotics when experiencing cold symptoms; I keep extra antibiotics at home for an emergency; *lower* scores indicate more accurate beliefs; Cronbach alpha=.75). Both scales were measured with a 4-point Likert scale (range: strongly disagree to strongly agree).

Patient activation was measured for patients with the *Patient Activation Measure (PAM)* developed by Hibbard et al [35,36]. The PAM assesses an individual's knowledge, skill, and confidence for managing one's own health and health care (Cronbach alpha=.89). In addition, the Clinician Support for Patient Activation Measure (CS-PAM) was used to assess clinician beliefs about the importance of patient participation in care (Cronbach alpha=.84) [37]. Both measures, each with 13 items were created using Rasch Analysis and produce a 0-100 score. The surveys were administered to participants (patients and providers, respectively) during the first in-person session (pre- and postsimulation) as well as during the 1-month follow-up session.

SDM was measured for patients and providers with the shared subscale from the *Patient-Provider Orientation Scale (PPOS)* [38,39]. This measure assessed the patient's and provider's attitudes about one another's role in the encounter as it applies to the decision-making process (ie, patients should be treated as if they were partners with the doctor, equal in power and status). Responses were given on a 4-point Likert scale (range: strongly disagree to strongly agree, with *lower* scores indicating a higher degree of SDM; Cronbach alpha=.78). Providers also completed the *SDM-Q-doc* [40,41], which assessed the extent to which providers perceive that they engage patients in the treatment decision-making process. Responses were given on a 4-point Likert scale (range: completely disagree to completely agree; Cronbach alpha=.85). These surveys were administered to participants (patients and providers) during the in-person session (pre- and postsimulation) and during the 1-month follow-up session.

Patient preferences for decision-making were assessed with the decision-making subscale from the *Medical Communication Competence Scale (MCCS)* using a 4-point Likert scale (range: strongly disagree to strongly agree; Cronbach alpha=.71) [42]. The subscale assessed the extent to which patients preferred medical visits to be doctor-centric (ie, important medical decisions about your health should be made by the doctor, not you) versus patient-centered. The survey was administered to patients during the in-person session (pre- and postsimulation) and during the 1-month follow-up session.

Confidence, preparedness, and behavioral intention to engage in challenging conversations was a measure developed for this project with the intention to assess the preliminary effect of using the simulation on patients' and providers' behaviors and attitudes in the patient-provider clinic visit (Cronbach alpha=.97). All three attitudinal constructs were drawn from psychological frameworks aimed at understanding goal driven behavior and predicting future outcomes. This includes Reasoned Action Theory [43], which posits that behavioral beliefs and subjective norms are the antecedents to behavioral intention which is the direct precedent to behavior, and Bandura's [44] integrative framework of personal efficacy or perceived behavior control where self-efficacy is both a direct and indirect predictor of behavior.

For patients, the preparedness items asked patients how prepared they felt to ask their doctor questions, express their concerns, and discuss treatment options as a result of using the simulation. The behavioral intent items asked patients to rate how likely they would ask questions in the clinic visit and give their doctor details about how their health is affecting them personally. The confidence items assessed patients' level of confidence to ask questions, express their concerns even when the doctor does not ask, and engage in discussions about different treatment options. *For providers*, the preparedness items asked providers to rate the extent to which they felt *other doctors* would be better prepared to seek patients' input, respond to patient emotion, have effective conversations about antibiotics, share information in a way patients understand, and invite patients to ask questions and participate in the conversation, as a result of the simulation. Behavioral intent items asked how likely other doctors would ask patients how their problems affects their everyday life and goals, engage in conversations about antibiotics, and invite patients to ask questions. Finally, the confidence items asked if doctors would be more confident to engage patients in conversations about their goals, respond to emotion, and have effective conversations about antibiotics. These questions were asked on a 4-point Likert scale (range: strongly disagree to strongly agree) immediately following the simulation and at the 1-month follow-up. In addition, providers were asked if the simulation influenced the way they work with patients in general and when speaking about antibiotics since completing the simulation 1 month ago.

Participant sociodemographics were measured at the baseline visit. Data on patients' age, gender, education level, insurance status, and health literacy level [45] were collected. Provider data included age, gender, occupation (ie, internist, family medicine provider, nurse practitioner), rank (ie, attending, resident), degree, mean years at clinic, and exposure to previous communication skills training.

Analysis

Descriptive statistics were generated for baseline patient and provider characteristics. Generalized Linear Models (GLM) using repeated measures analysis were used to analyze the pre-, post- and 1-month follow-up survey measures. Analyses were first run for the total sample and then repeated for the subset of participants, who were in the lower PAM levels at the baseline visit (presimulation) (PAM level 1 or 2; n=13). Independent *t* test was used to compare the study measures by provider rank (attending vs resident) at a single time point; GLM was used to compare scores across time using a time X rank interaction. Since this pilot study is exploratory, we used a *P* value <.1 to denote significant findings.

Results

Participant Characteristics

We recruited a total of 69 participants (35 providers and 34 patients); with a retention rate of 99% (68/69) (one patient was lost at follow-up). As shown in Table 1, approximately half of the patient sample was female (53%, 18/34), one-third had Medicaid (29%, 10/34), and the mean age was 57.6 years (standard deviation, SD 14.6). Two-thirds of patients reported having some college education or above (70%, 23/33) and a health literacy level equivalent to a high school degree (68%, 23/34). Approximately half of the provider sample was male (53%, 19/35), two-thirds were internists (63%, 22/35), and most had an MD (97%, 34/35), with a mean age of 40.34 years (SD 9.44). The average practice duration was 7.48 years (SD 6.53) at the clinic. Three-quarters of providers were attendings and the remaining one-quarter were residents. More than half (58%, 11/19) of the providers reported *some to quite a bit* previous exposure to training in communication skills (Table 1).

Patient Results

The Effect of the Simulation on Patients' Knowledge and Beliefs Regarding Antibiotic Use

At the presurvey assessment, the mean score on the beliefs subscale was 1.85 (range: 1-4; lower scores indicate more accurate beliefs). Immediately after completing the simulation, patients were significantly more likely to possess accurate beliefs about antibiotic use (mean change −0.11, P=.001). The improvement in accurate beliefs was maintained at the 1-month follow-up (mean 1.76; $F_{1,30}$=14.10, P<.001). The mean score on the knowledge subscale at the presurvey assessment was 3.01 (range: 1-4; higher scores indicate more accurate knowledge). Knowledge about antibiotics significantly improved postsimulation (mean 3.26, P<.001). However, knowledge scores significantly decreased from the post assessment to the 1-month follow-up (mean 3.08; $F_{1,30}$=31.16, P<.001).

The Effect of the Simulation on Patient Activation

The mean PAM score for the total patient sample was 63.60 (SD 15.39) at the presurvey assessment, 62.61 (SD 13.35) at the immediate postsurvey assessment, and 62.83 (SD 14.57) at the 1-month follow-up. Results of the repeated measures analysis showed no significant differences in PAM score across time ($F_{1,31}$=1.86, P=.18; Table 2).

The Effect of the Simulation on Patients' Perceptions of Shared Decision-Making

At the previsit assessment, patients not only tended to prefer their doctor make the final decisions about their care (mean 2.66, range 1-4; Table 2), but also believed that decision-making should be a collaborative process (mean 2.06, range 1-4; note: lower scores indicate a more collaborative encounter). Although not significant, patients reported an increased preference for being actively involved in the decision-making process with their doctor after completing the simulation and at the 1-month follow-up (mean change 0.19 and 0.17, respectively; $F_{1,31}$=1.94, P=.17). Attitudes about patients' role in decision-making did not change across time ($F_{1,28}$=1.86, P=.18).

The Effect of the Simulation on Patients' Level of Preparedness, Confidence, and Behavioral Intent to Actively Participate in a Clinic Encounter

After completing the simulation, patients reported feeling prepared to actively participate in a future medical visit with their provider (mean 3.35, range 1-4), which did not significantly change at the 1-month follow-up (P=.47). In addition, after completing the simulation, patients' agreed that they were more likely to ask questions in the clinic visit and give their doctor details about how their health is affecting them personally (mean 3.24, range 1-4), which was maintained at the 1-month follow-up (mean 3.31; P=.43). Finally, at both the post survey and 1-month follow-up, patients agreed that they felt more confident in their ability to ask questions, tell their provider how they are feeling, and work with their provider to make a treatment plan. There was no difference in scores across the time points (P=.12; Table 2).

Table 1. Participant characteristics.

Characteristics	Mean (SD[a]) or n (%)
Patient characteristics	
Age	57.62 (14.57)
Gender	
Male	16 (47)
Literacy levels	
7th to 8th grade	11 (32)
High school	23 (68)
Education level	
Less than high school	1 (3)
high school/GED[b]/technical	9 (27)
Some college	8 (24)
College degree	15 (46)
Patient insurance	
Private	9 (27)
Medicare	10 (29)
Medicaid	10 (29)
None	2 (6)
Other	3 (9)
Provider characteristics	
Age	40.34 (9.44)
Gender	
Male	19 (54)
Occupation	
Physician/family medicine	12 (34)
Physician/internal medicine	22 (63)
Nurse practitioner	1 (3)
Rank	
Attending	26 (74)
Resident	9 (26)
Degree	
MD[c]/DO[d]	34 (97)
NP[e]	1 (3)
Mean years at clinic	7.48 (6.53)
Provider communication skills training	
A little	8 (42)
Some	7 (37)
Quite a bit	4 (21)

[a]SD: standard deviation.
[b]GED: General Educational Development.
[c]MD: Doctor of Medicine.
[d]DO: Doctor of Osteopathy.
[e]NP: nurse practitioner.

Table 2. Comparisons of patient survey responses across all three time points.

Patient measures	Response range	Presimulation mean (SD[a])	Postsimulation mean (SD)	1-month follow-up mean (SD)	*F*	*P*
PAM[b] score	0-100	63.60 (15.39)	62.61 (13.35)	62.83 (14.57)	1.86	.18
Antibiotic beliefs	1-4[c]	1.85 (0.42)	1.74 (0.41)	1.76 (0.48)	14.10	.001
Antibiotic knowledge	1-4	3.01 (0.42)	3.26 (0.43)	3.08 (0.46)	31.16	<.001
Decision-making preference	1-4[c]	2.66 (0.73)	2.85 (0.73)	2.83 (0.78)	1.94	.17
Patient-provider orientation: shared power	1-4[c]	2.06 (0.44)	2.01 (0.40)	2.02 (0.41)	1.86	.18
Preparedness to act	1-4	-	3.35 (0.59)	3.25 (0.53)	0.74	.47
Behavioral intent	1-4	-	3.24 (0.57)	3.31 (0.52)	0.81	.43
Confidence to act	1-4	-	3.32 (0.61)	3.34 (0.57)	−1.62	.12

[a]SD: standard deviation.

[b]PAM: Patient Activation Measure.

[c]Lower scores indicate more accurate beliefs about antibiotics and shared power in the clinic encounter.

Subanalysis of Patients With Low PAM Scores

Results of the subanalysis showed that patients with low PAM scores demonstrated similar improvements in accurate beliefs regarding antibiotic use at the postsurvey (mean 2.04) and 1-month follow-up (mean 2.01; $F_{1,9}$=10.88, *P*=.01). Moreover, knowledge about antibiotics significantly improved postsimulation (mean 3.23) and then decreased at the 1-month follow-up (mean 2.89; F=28.53$_{1,10}$, *P*<.001). At the baseline (presimulation) assessment, patients in the lower PAM levels tended to prefer their doctor make the final decisions about their care at the previsit assessment (mean 2.58) as well as somewhat agree that patients and providers should be equal partners in the decision-making process (mean 2.40). After completing the simulation and at the 1-month follow-up, patients reported a significant improvement in attitudes about their role in decision-making ($F_{1,9}$=17.19, *P*=.002). Although patients' preference for being actively involved in the decision-making process with their provider improved across time (mean 2.69 [postsimulation] and 2.64 [1-month]), the change was not significant ($F_{1,10}$=0.45, *P*=.52). Similar to the total sample, patients in the low PAM levels did not exhibit changes in PAM scores across time (*P*=.58; Table 3).

Patients with low PAM scores also agreed that they felt better prepared to ask their doctor questions, express their concerns, and discuss treatment options after completing the simulation (mean 3.24) and at the 1-month follow-up (mean 3.33). There was no significant differences in the mean scores across time ($F_{1,6}$=−0.55, *P*=.60; Table 3). Similarly, these patients agreed that they were more likely to ask questions in the clinic visit and give their doctor details about how their health is affecting them personally (mean 3.25; range 1-4), which was increased significantly at the 1-month follow-up (mean 3.50; t_5=−2.24, *P*=.08). Finally, in terms of confidence to engage in the conversation, patients agreed that they felt more confident in their ability to ask questions at the post survey (mean 2.93), which significantly increased at the 1-month follow-up (mean 3.33; t_5=−2.34, *P*=.07; Table 3).

Table 3. Comparisons of low PAM patient survey responses across all three time points (n=13).

Patient measures	Response range	Presimulation mean (SD[a])	Postsimulation mean (SD)	1-month follow-up mean (SD)	*F*	*P*
PAM[b] score	0-100	39.00 (5.66)	40.90 (6.79)	40.90 (5.72)	0.32	.58
Antibiotic beliefs	1-4[c]	2.40 (0.20)	2.04 (0.27)	2.01 (0.44)	10.88	.01
Antibiotic knowledge	1-4	2.86 (0.25)	3.23 (0.39)	2.89 (0.23)	28.53	<.001
Decision-making preference	1-4	2.58 (0.49)	2.69 (0.48)	2.64 (0.71)	0.45	.52
Patient-provider orientation: shared power	1-4[c]	2.40 (0.20)	2.27 (0.16)	2.17 (0.30)	17.19	.002
Preparedness to act	1-4	-	3.24 (0.71)	3.33 (0.27)	−0.55	.60
Behavioral intent	1-4	-	3.25 (0.42)	3.50 (0.32)	−2.24	.08
Confidence to act	1-4	-	2.93 (0.52)	3.33 (0.50)	−2.34	.07

[a]SD: standard deviation.

[b]PAM: Patient Activation Measure.

[c]Lower scores indicate more accurate beliefs and shared power in the clinic encounter.

Provider Results

The Effect of the Simulation of Providers' Perception of Patient Engagement in Their Self-Management

Before engaging with the simulation, providers held high positive beliefs about patient's involvement in their self-management (mean 78.19, range 0-100). These ratings remained high (mean 76.47) immediately after completing the simulation as well as at the 1-month follow-up (mean 77.15). There were no significant differences across time ($F_{1,34}$=0.11, *P*=.74; Table 4).

The Effect of the Simulation on Providers' Level of Preparedness, Confidence, and Behavioral Intent to Effectively Communicate With Patients

Immediately after completing the simulation, participating providers felt that doctors would be better prepared to have an effective conversation with patients (mean 3.45), actively engage patients in the conversation (mean 3.48), and feel confident in their abilities to engage and respond to patients' biomedical and psychosocial concerns (mean 3.33). Similar to the postsimulation results, providers continued to agree that doctors would be better prepared, confident, and able to effectively engage in conversations about antibiotics, respond to patient emotion, and invite patients to be active participants in the medical encounter. All providers also felt doctors would be more prepared to have an effective conversation about antibiotics with patients (Table 4). There was no differences in scores across time for each of the measures (*P*>.10).

The Effect of the Simulation on Providers' Perceptions of Shared Decision-Making

Before completing the simulation, providers felt that they already engaged patients in the shared decision-making process (mean 3.24, range 1-4) and that decision-making process should be a collaborative process (mean 1.82, range 1-4; lower scores indicate more collaboration). Immediately after completing the simulation, there was a significant increase in providers' attitudes about patients' collaborative involvement in the shared decision-making process (mean 1.62, $F_{1,33}$=8.03, *P*=.01; Table 4). However, this score returned to the baseline level at the 1-month follow-up (mean 1.82). There was no change in providers' perceived use of shared decision-making skills with patients from the presurvey to 1-month follow-up ($F_{1,34}$=1.61, *P*=.21).

Table 4. Comparisons of provider survey responses across all three time points.

Provider measures	Response range	Presimulation mean (SD[a])	Postsimulation mean (SD)	1-month follow-up mean (SD)	*F*	*P*
CS-PAM[b]	1-100	78.19 (13.02)	76.47 (13.34)	77.15 (14.44)	0.11	.74
Shared decision-making	1-4	3.24 (0.38)	-	3.35 (0.38)	1.61	.21
Patient-provider orientation: shared power	1-4[c]	1.82 (0.37)	1.62 (0.32)	1.82 (0.39)	8.03	.01
Satisfaction	1-4	-	3.25 (0.28)	-	-	-
Preparedness to act	1-4	-	3.45 (0.50)	3.34 (0.44)	−0.36	.73
Behavioral intent	1-4	-	3.48 (0.47)	3.42 (0.44)	−0.84	.42
Confidence to act	1-4	-	3.33 (0.60)	3.31 (0.41)	−1.30	.22

[a]SD: standard deviation.

[b]CS-PAM: Clinician Support for Patient Activation Measure.

[c]Lower scores indicate shared power in the clinic encounter.

Findings by Provider Rank

In cross-sectional analysis, comparing the data by provider rank (resident vs attending), there were no significant differences between the groups before completing the simulation. At the 1-month follow-up, attendings were more likely to agree that patients should be actively involved in the shared decision-making process (mean 3.38 vs 3.28, *P*=.01), whereas residents were more likely to believe patients should play a shared role in the visit than attendings (mean 1.78 vs 1.83, *P*=.09). Results of the GLM showed no difference in scores by provider rank across time (*P*>.10).

Discussion

Principal Findings

This pilot study provided a unique opportunity to evaluate a brief 15-min simulated role-play conversation with a virtual patient or provider designed to promote effective communication and collaborative decision-making between health care providers and patients in order to improve intermediary health outcomes, including over-prescribing of antibiotics. Although there were not changes in activation scores for patients, the findings indicate that patients' experienced short-term positive benefit on beliefs about antibiotic use and a positive, albeit intermediate, impact on patients' knowledge about antibiotics. Patients with lower levels of activation, in particular, exhibited positive, short-term benefits in increased intent and confidence to discuss their needs and ask questions in the clinic visit and attitudes about engaging in shared decision-making with their provider. In particular, 79% of patients who saw their doctor after completing the simulation reported that it helped them in talking with their doctor. The results also suggest small immediate gains in providers' attitudes about shared decision-making. Providers also felt that doctors would be better prepared and confident to have collaborative conversations with patients as well as create an environment conducive to active patient involvement in the encounter after completing the simulation. In particular, 77% of providers reported that the simulation had a positive impact on the way they now communicate with patients, 65% indicated that it helped them have a conversation with a patient about antibiotics, and 94% said they intent to further invite patients to ask questions and participate.

These findings support the role of utilizing simulated role-play conversations with virtual humans for the purpose of improving communication and relational (ie, empathy) skills in a variety of domains. Specifically, previous research has identified needed skill frameworks, training, practices, and elements of effective relationships that can be integrated in digital interventions to improve social emotional and communication skills, and drive positive behaviors [46]. Virtual simulations such as those used in this study, offer the ability to explore situations that would be stressful in person in a controlled environment to enhance the training and evaluation of critical communication skills [47]. Moreover, simulated role-play conversations with virtual humans allow an opportunity for extensive repetitive practice with feedback without consequence to a real patient, allowing for mastery learning [48]. Given these advantages, there has been an increase in the use of simulated role-play conversations with virtual humans to improve patient and provider communication in medical education as well as clinical settings. For example, the MYSELF project was developed to train providers in the expression and recognition of emotions and interpersonal communication skills through the use of an emotionally expressive virtual patient [49]. Other computer-based programs have been developed to improve pharmacy students' motivational interviewing skills [50], medical students' history-taking and basic communication skills [51], and promote healthy behaviors in patients with low health literacy [52].

A strength of this study was the use of an evidence-based simulation that leveraged virtual humans to improve users' social emotional skills, empathy, motivational interviewing, and the use of sound communication tactics (ie, shared decision-making) that have been linked to sustained behavior change [53,54]. Moreover, the Kognito Conversations provide risk-free realistic role-plays that are sustainable and have high fidelity as opposed to face-to-face experiences, which are difficult to scale, expensive, and dependent on the skill and experience of each individual trainer and his or her knowledge of the population being trained. Finally, performing in front of others such as peers or instructors can increase the likelihood a trainee will feel embarrassment or social evaluative threat (ie, fear of being evaluated in a social setting) [55,56]. Both negative emotions in general and social evaluative threat in particular are known to impede cognitive performance [57-62]. Despite the many strengths of this approach, this pilot study offered several opportunities to improve on the simulation. For example, to mitigate the decline in knowledge experienced by patients at the 1-month follow-up visit, the final version of the simulation now includes a "teach-back" by the virtual doctor where learners are asked to explain in their own words why an antibiotic will not help a cold. The main points about antibiotic use are also now repeated within the simulation and in personalized feedback sessions through brief animated movies. To further improve communication skills, additional text was added to the performance dashboards, explaining the score the learner received in each area, and suggesting ways to do better in future visits. Changes were also made to draw learners' attention to the Coach Advice button.

Limitations

Several limitations of the study are worth noting. First, this was a single-group pre-post study. The lack of a control group limits our ability to attribute changes in participant's behavioral intentions, attitudes, and perceptions of communication exclusively to the simulation. Moreover, it is possible that increased awareness from completing the presimulation assessments diminished our ability to detect significant changes in the postsimulation assessments. However, the primary focus of this pilot study was to establish the preliminary efficacy of this approach and not statistical significance. Relatedly, changes in scores from postsimulation to the 1-month follow-up may reflect a decay effect over time and not long-term change. The knowledge gained from this project will be used to develop the evidence for a larger randomized control trial. Second, the small sample size prohibits making any statistical inference generalizations about the study measures reliability (ie, alpha scores) and requires replication in a larger sample. Third, since the primary focus of this study was the use of a tablet-based simulation, a selection bias may be present whereby patients with low levels of computer literacy or poor vision may be underrepresented. To mitigate this risk, we implemented several strategies to increase the generalizability of this approach to all patient populations including the use of audio for the dialog and ensuring that the text was written at or below a 6th-grade reading level. Moreover, only 20% of individuals (13 patients and 4 providers) contacted to participate in the study declined, of which there were no differences in demographics between participants and nonparticipants; the most common reason for both patients and providers was lack of time. Fourth, participants were only permitted one opportunity to practice a one 10-15 min role-play conversation. Normally users have unlimited opportunities to practice multiple different conversations within a single simulation as well as opportunities to engage in these practice over time. Another important limitation is that the study design neither allows for definitive conclusions about whether the simulation affected patients' actual level of engagement in their care nor whether shared decision-making as opposed to patient engagement was the primary communication strategy through which change occurred. Future studies should seek to disaggregate patient engagement from shared decision-making to elucidate the specific elements of communication that are associated with changes in patients' knowledge and beliefs about antibiotic use. Moreover, future research should determine which elements of shared decision-making (ie, adequate information-exchange, taking into account patients' values and preferences) are needed to improve patient outcomes. Preliminary results from this study suggest that patient-provider communication does not necessarily need to include patient participation in the final decision-making in order to be effective.

Finally, the external validity of our findings may be limited as a high percentage of the study participants (82%) were highly activated (as determined by PAM scores) at baseline (presimulation), even though the target audience for the simulation content was individuals with lower activation scores. This left little room for growth and could offer a plausible explanation for any nonsignificant findings. It is also plausible that the lack of significant findings was due to a baseline effect due to high levels of awareness about the problems with the overuse of antibiotics by patients and providers at the presimulation assessment.

In conclusion, this pilot study provided preliminary evidence on the efficacy of a simulation to improve patient-provider communication for engaging in collaborative conversations and decision-making on short-term improvements in patients' knowledge and beliefs about antibiotic use. Future research should examine whether repeated opportunities for patients to use the simulation and practice the skills being taught may lead to sustained improvements in knowledge, beliefs, and behaviors. Moreover, although providers of all levels derived some benefits from the simulation, residents and medical students may experience the greatest gains in improving their communication skills for challenging conversations and attitudes about patient-centered care.

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Authors' Contributions

AS acquired, analyzed, and interpreted data, and drafted the manuscript as well. GA acquired data and critically reviewed the manuscript. JH interpreted data and critically reviewed the manuscript. RG developed the simulation platform and contributed to all critical revisions of the manuscript.

Conflicts of Interest

Ron Goldman is a Co-Founder and CEO of Kognito. Glenn Albright is a Co-Founder and Director of Research at Kognito. Judith Hibbard is a consultant to and an equity stakeholder in Insignia Health.

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Abbreviations

ABIM: America Board of Internal Medicine
API: application programming interface
CS-PAM: Clinician Support for Patient Activation Measure
GLM: Generalized Linear Models
MCCS: Medical Communication Competence Scale
PAM: Patient Activation Measure
PPOS: Provider Orientation Scale
RWJF: Robert Wood Johnson Foundation
SD: standard deviation
SDM: shared decision-making

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Original Paper

The Coags Uncomplicated App: Fulfilling Educational Gaps Around Diagnosis and Laboratory Testing of Coagulation Disorders

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Abstract

Background: Patients with coagulation disorders may present to a variety of physician specialties; however, accurate and efficient diagnosis can be challenging for physicians not specialized in hematology, due to identified gaps in knowledge around appropriate laboratory assays and interpretation of test results. Coags Uncomplicated was developed to fill this unmet educational need by increasing practical knowledge of coagulation disorders among nonexpert physicians and other health care professionals (HCPs) in a point-of-care (POC) setting.

Objective: The aim of this study was to assess patterns of use of the mobile app Coags Uncomplicated, a tool designed to support education regarding accurate and efficient diagnosis of bleeding disorders.

Methods: App metrics were obtained by tracking registered user data. Additionally, a survey was distributed to registered users, to assess circumstances and frequency of use.

Results: The most common specialties of 7596 registered US users were hematology-oncology (n=1534, 20.19%), hematology (n=1014, 13.35%), and emergency medicine (n=1222, 16.09%); most identified as physicians (n=4082, 53.74%). Specialties accounting for the greatest numbers of screen views were hematology-oncology (99,390 views), hematology (47,808 views), emergency medicine (23,121 views), and internal medicine (22,586 views). The most common diagnostic endpoints reached were disseminated intravascular coagulation (DIC; 2713 times), liver disease effect (2108 times), and vitamin K deficiency (1584 times). Of 3424 users asked to take the survey, 262 responded (7.65%); most were physicians in direct clinical care (71%) and specialized in hematology-oncology (39%) or emergency medicine (21%). Most frequent use was reported by hematologists (69%, ≥6 times) and hematologists-oncologists (38%, ≥6 times). Most physicians (89.2%) reported using the app for patient-case-related education around appropriate use of laboratory tests in diagnostic evaluation. Physicians rated Lab Value Analyzer (mean 4.43) and Lab Test Algorithm (mean 4.46) tools highly on a 5-point "how helpful" scale and were likely to recommend the app to colleagues.

Conclusions: App use among physicians and other HCPs is consistent with value as a POC educational tool, which may facilitate differential diagnoses and appropriate early consultation with hematologists.

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KEYWORDS

blood coagulation disorders; smartphone; diagnosis; hematology; differential diagnosis

Introduction

Background

For many physicians who first encounter patients with severe bleeding symptoms, the potential contribution of an underlying bleeding disorder may often be overlooked. When presented with an acutely bleeding patient, the focus of many primary care physicians, physicians working in the emergency and hospital settings, and physician trainees is "where" rather than "why" the patient is bleeding, and how to best manage the symptoms at hand. Underlying bleeding disorders are perceived to be rare; however, approximately 1% of individuals in the United States have von Willebrand disease (VWD) [1,2], approximately 1 in 5000 males is born with hemophilia [3], and many individuals have iatrogenic bleeding problems from medications. Furthermore, obtaining a rapid and accurate bleeding disorder diagnosis is critical for understanding patients' long-term bleeding risks and management implications.

Bleeding disorders encompass a large number of unique conditions that require specialized knowledge and a stepwise strategy for accurate and efficient diagnosis, and they may be difficult for nonhematologists to diagnose. Many of these knowledge gaps were demonstrated through administration of a large survey to practicing physicians from various specialties, which presented a hypothetical case scenario of a patient with acquired hemophilia, a rare bleeding disorder [4]. Nonhematologists in this study were found to lack appropriate consideration of and response to bleeding symptoms and awareness of how to correctly interpret laboratory results as simple as an isolated prolonged activated partial thromboplastin time (aPTT) and to be hesitant in consulting with a hematologist once abnormal findings were identified. Furthermore, a particularly challenging task for nonhematologists is to understand the differential diagnostic considerations needed to distinguish among coagulation disorders with a similar set of bleeding patterns, such as qualitative platelet function disorders and VWD. Symptoms of platelet function disorders and VWD typically include nonspecific mucocutaneous bleeding symptoms such as epistaxis, menorrhagia (also called heavy menstrual bleeding), gingival bleeding, and easy bruising, which may present to physicians of a variety of specialties [5]. Physicians without expertise in hematology may stop evaluation after seeing a normal prothrombin time (PT), aPTT, and platelet count, rather than performing additional assessments needed to diagnose these disorders.

Coags Uncomplicated App

For physicians faced with acutely bleeding patients, education regarding specific laboratory tests, interpretation of results, and potentially applicable diagnoses may be valuable in supporting early referral and initiation of treatment. A potentially important tool to increase awareness of important diagnostic considerations is mobile technology, as mobile devices are emerging as a useful platform for health care professionals (HCPs) to quickly access medical information, including traditional sources such as medical textbooks, professional society guidelines, drug references, and institution-specific therapy standards, as well as Web-based tools and mobile phone apps [6]. The Coags Uncomplicated app is a freely available educational tool that was developed as a collaboration between nationally recognized hematologists, coagulation laboratory experts, and an industry partner (Novo Nordisk Health Care AG), and it provides targeted, case-based education around the differential diagnosis of bleeding disorders. The app consists of 5 separate tools: Lab Value Analyzer (users input laboratory values and receive a list of potential conditions for differential diagnosis, and can click through to view educational materials about each disorder), Lab Test Algorithm (a step-by-step guide on laboratory assays with educational information regarding the interpretation of test results and important caveats about variables which affect test results), Neonatal Module (normative laboratory value lookups and laboratory testing algorithms based on gestational age), Face a Case (a review of interesting cases for users to apply their knowledge), and Coag Challenge (a timed quiz in which users can compete for rankings).

Here, we present information regarding physician and other-HCP use of Coags Uncomplicated and assess its value as an educational tool. Data include results from a survey of Coags Uncomplicated users, as well as app tracking metrics with data collected from actual app use, to assess real-world patterns of use over time.

Methods

App Development

The concept for the initial gap assessment leading to the development of Coags Uncomplicated came from hematologist advisors in 2009 and was crystallized in a case study that became the focus of a quantitative Internet survey and subsequent qualitative interviews conducted in early 2010 [4]. The first generation app platform was developed in the fall of 2010 in an iterative, collaborative process involving external experts (CMK, EIP) and Novo Nordisk Inc (DLC) with additional medical support from an agency that built the app (Cline Davis & Mann Inc, Princeton, NJ, USA).

The initial focus of the app was on case scenarios presenting with abnormal PT or a PTT test results, for which published diagnostic algorithms could be adapted toward a primary care or first responder (nonspecialist) audience by eliminating common disorders earlier in the algorithm (eg, liver failure, disseminated intravascular coagulation [DIC], and vitamin K deficiency bleeding). This process identified 30 diseases for which educational content was developed and 26 coagulation laboratory tests associated with the diagnosis of these disorders. Content around all disorders and tests was referenced to 79 sources and comprised 270 app scrolling screens occupying 623 distinct screenshots. Important diagnostic caveats were included, and emphasis was placed on the need for expert consultation in the ultimate differential diagnosis. The app was launched in December 2010 (United States) and July 2011 (global), and included 4 separate tools: the Lab Test Algorithm (graphically described in Multimedia Appendices 1-3), Lab Value Analyzer, Face a Case, and Coags Challenge.

Following initial launch of the app, feedback from hematologists identified additional specific needs around (1) neonatal bleeding disorder differential diagnoses and challenges associated with gestational age-adjusted “normal” laboratory values and (2) VWD, platelet function disorders, and other disorders associated with normal PT and aPTT results and often normal platelet counts. Because these disorders were associated with fewer published algorithms and wider variability in diagnostic approaches, additional experts were engaged (MBC, RK) in developing the second-generation platform. The expanded scope of this platform included educational materials on a total of 66 diseases and 34 laboratory tests supported by 193 references and comprised 583 scrollable screens captured by 1733 screenshots. This version included the Neonatal Module as well as additional Lab Test Algorithms (see Multimedia Appendices 4-6).

App Tracking Metrics

In order to better understand the usage patterns of the app and to guide further content development, in the United States, registration was required before using the app. App tracking metrics describing patterns of use from the initial launch in December 2010 through February 2016 were obtained. Data include total numbers of screen views (by user specialty and by app tool) and the most frequent diagnostic endpoints reached. App users outside of the United States were not required to register.

Survey Data

Initial tracking metrics demonstrated greater use of the app by hematology and hematology-oncology specialists than by nonspecialists. To better understand whether specialist app use was primarily for education or teaching or for case-based education and whether app use differed between hematology specialists and nonspecialists, a Web-based survey was developed. Participants were recruited from a database of 3424 registered (US-based) app users who had downloaded the app (version 1.0 or 2.0), and they were screened to ensure that they had used the app at least once. Participants were required to be adults (at least 18 years of age), and they had to have completed the survey between October 1 and October 11, 2013. Survey questions provided an assessment of respondent demographics and frequency of app use (including use for education to support actual patient cases) and ratings of app helpfulness and likelihood to recommend the app. Helpfulness was rated on a 5-point scale from 1 to 5 with 5=very helpful. Likelihood to recommend the app was rated on a 5-point scale from 1=not at all to 5=very likely.

Results

App Tracking Metrics

As of February 2016, the most common specialties listed by 7596 registered users included hematology-oncology (n=1534, 20.19%), hematology (n=1014, 13.35%), and emergency medicine (n=1222, 16.09%; Table 1). A majority of users identified themselves as doctors of medicine (MDs; n=4082, 53.74%); other common degrees or positions were doctors of osteopathy (DOs; n=364, 4.79%), registered nurses (RNs; n=639, 8.41%), nurse practitioners (NPs; n=415, 5.46%), doctors of pharmacy (PharmDs; n=283, 3.73%), and physician assistants (PAs; n=224, 2.95%).

Numbers of screen views were largely consistent with rates of registered user specialties and degrees or positions, with highest numbers tracked to hematologists-oncologists and MDs, respectively. Screen views tracked by year were also consistent with user specialties; as of April 2015, the specialties accounting for the greatest numbers of screen views were hematology-oncology (99,390 views), hematology (47,808 views), emergency medicine (23,121 views), and internal medicine (22,586 views; Figure 1). More screen views were associated with the Lab Test Algorithm (69,232 views) and Coag Challenge (50,190 views) tools than with the Face a Case (44,682 views) and Lab Value Analyzer (40,466 views) tools (Figure 2). The most common diagnostic endpoints reached were DIC (2713 times), liver disease effect (2108 times), and vitamin K deficiency (1584 times; Figure 3). VWD was reached 62 times.

Survey Data

Of 3424 Coags Uncomplicated app users who were asked to take the survey, 262 responded (7.65%). Most respondents (71%) were physicians in direct clinical patient care (Table 2); the majority of these were specialized in hematology-oncology (39%) or emergency medicine (21%) and were board-certified (79%). Most physicians (64%) worked in a hospital-based practice setting, and 33% had an office-based practice setting. The average age of respondents was 46 years (range 23-83 years).

Table 1. Registered user composition and total screen views.

Specialty and degree or position	Registered users (N=7596) n (%)	Total screen views[a] n (%)
Specialty		
Hematology-oncology	1534 (20.19)	118,527 (28.20)
Hematology	1014 (13.35)	90,852 (21.62)
Emergency medicine	1222 (16.09)	47,312 (11.26)
>Internal medicine	543 (7.15)	24,769 (5.89)
Critical care	423 (5.57)	16,332 (3.89)
Pediatrics	260 (3.42)	10,682 (2.54)
Surgery	190 (2.50)	7356 (1.75)
Geriatrics	131 (1.72)	5368 (1.28)
Hospitalist	108 (1.42)	N/A[b]
Obstetrics/gynecology	79 (1.04)	2773 (0.66)
Other	1730 (22.78)	96,336 (22.92)
Unspecified	362 (4.77)	N/A
Degree or position		
Doctor of medicine	4082 (53.74)	221,484 (51.91)
Doctor of osteopathy	364 (4.79)	19,431 (4.55)
Registered nurse	639 (8.41)	28,771 (6.74)
Nurse practitioner	415 (5.46)	22,067 (5.17)
Doctor of pharmacy	283 (3.73)	19,332 (4.53)
Physician assistant	224 (2.95)	16,884 (3.96)
Social worker	12 (0.16)	N/A
Other	1569 (20.66)	98,702 (23.13)

[a]As of February 2016.

[b]N/A: not available.

Figure 1. Screen views by specialty.

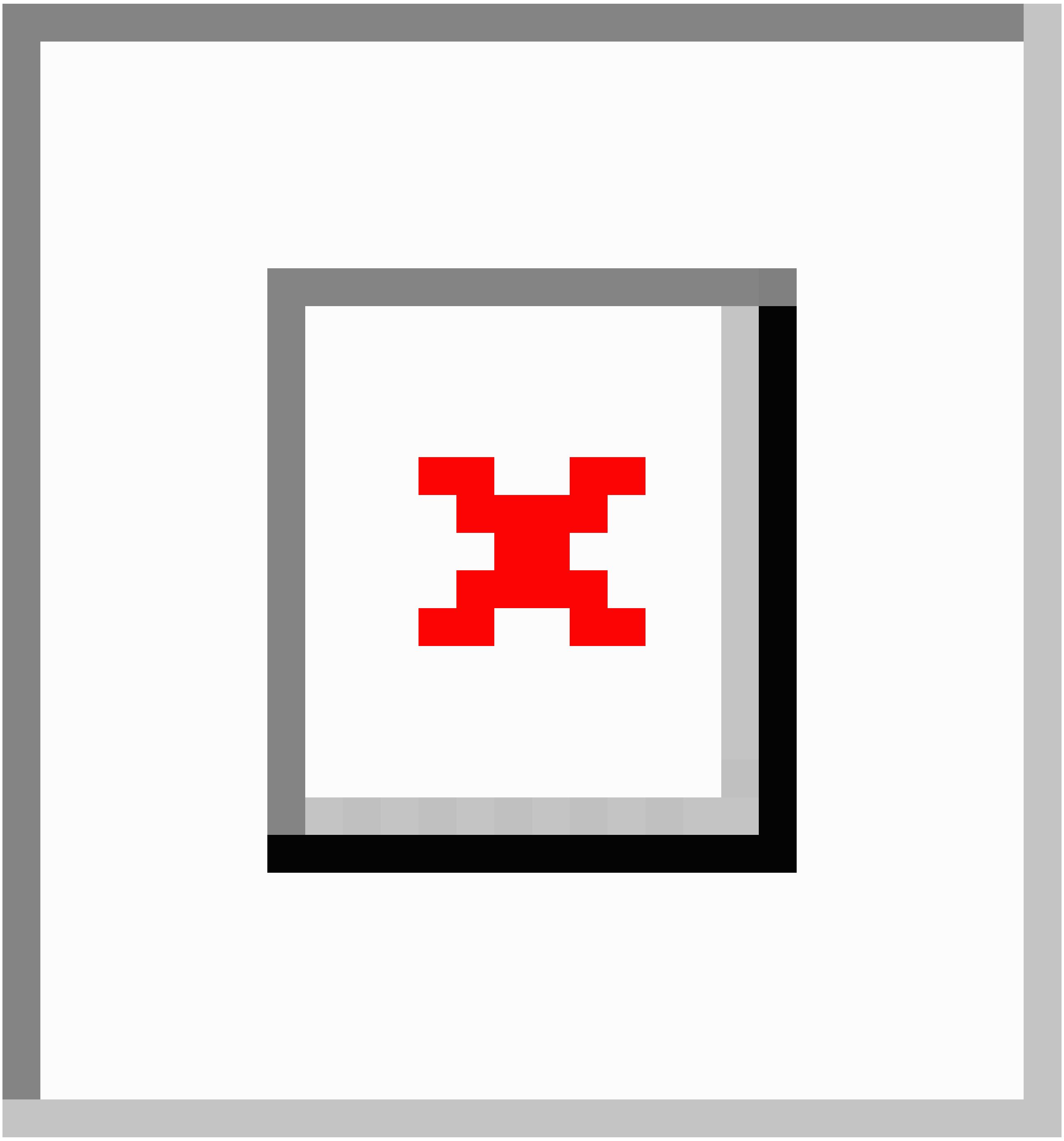
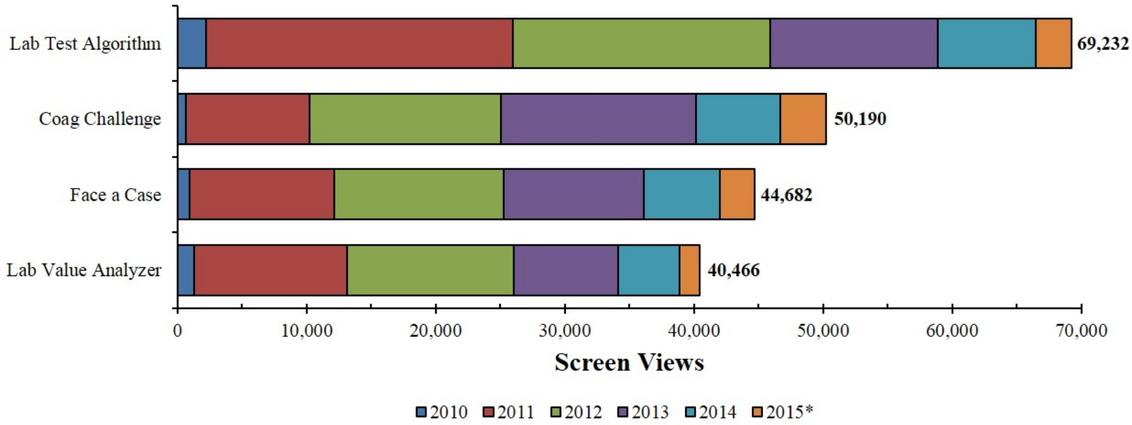
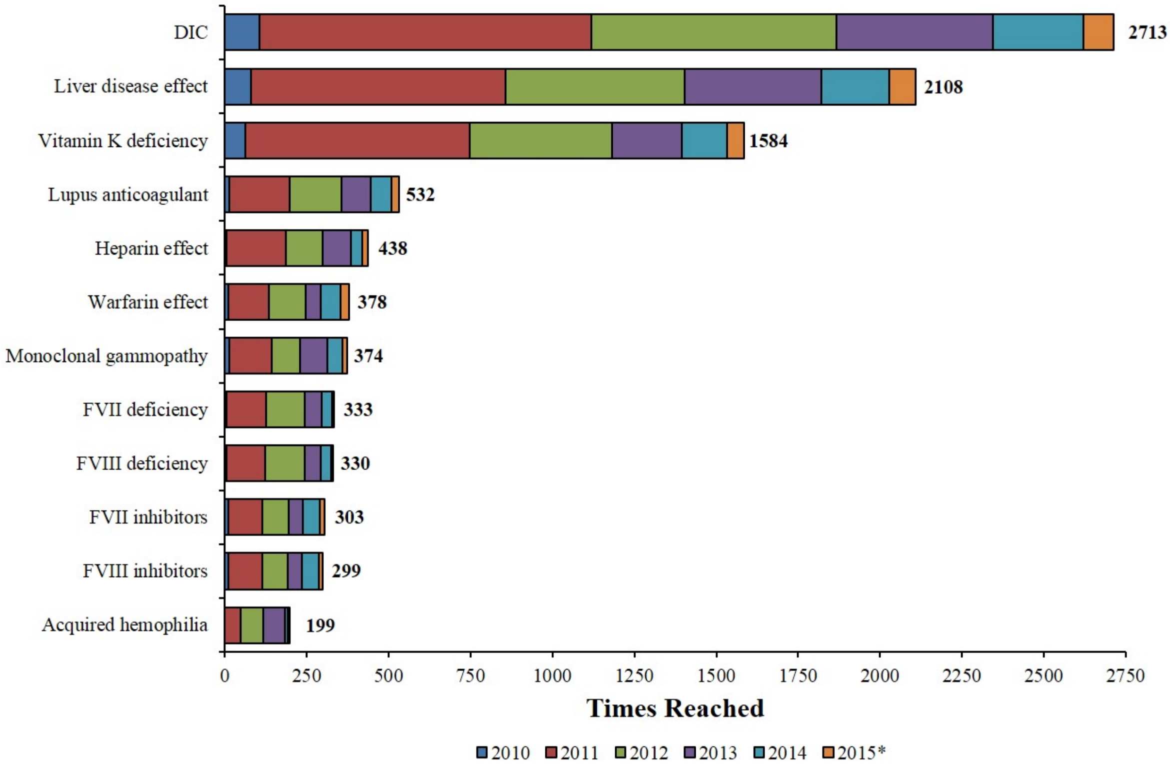


Figure 2. Screen views by app function.



*As of April 2015.

Figure 3. Most common diagnostic endpoints reached.



DIC, disseminated intravascular coagulation; FVII, factor VII; FVIII, factor VIII.
*As of April 2015.

Table 2. Survey respondent composition.

Position and physician specialty	Respondents (%) N=262
Position[a]	
Physician in direct patient care practice	71
Nurse	9
Academia/professor/instructor	7
Pharmacist	4
Physician assistant	4
Laboratory director	3
Pathologist	2
Medical director	2
Clinical researcher	2
Patient/parent/caregiver	2
Laboratory manager/supervisor	2
Blood bank manager/director	2
Physician specialty[b]	
Hematology-oncology	39
Emergency medicine	21
Hematology	7
Internal medicine	7
Critical care	6
Primary care	5
Hospitalist	3
Oncology	2
Pediatrics	2
Surgery	1
Obstetrics-gynecology	1

[a]Respondents could select multiple choices.

[b]Of physician respondents (n=185).

More than one-third of respondents (37%) reported using the app at least 6 times since downloading it, and some (6%) reported use of more than 50 times (Figure 4). Nearly all respondents had used the Lab Test Algorithm (95%) and Lab Value Analyzer (93%); majorities had also used the Face a Case (73%) and Coag Challenge (65%). The physician specialists reporting the most frequent app use were hematologists (69% used the app at least 6 times) and hematologists-oncologists (38% used the app at least 6 times).

A majority (89.2%) of physicians reported using the app for education related to actual patient cases (eg, point-of-care [POC] education). Among physicians who used the app for education in at least 1 actual patient-case-related instance, the most common circumstances of educational use were related to differential diagnosis (mean 6.35 cases per physician) and to review of educational materials on a disease to confirm a suspected diagnosis (mean 3.46 cases per physician; Table 3). The physician specialties reporting the highest rates of patient-case-related education using the app were hematology (mean 22.36 cases per physician), hematology-oncology (mean 14.06 cases per physician), and critical care (mean 14.00 cases per physician).

Physicians rated both the Lab Value Analyzer (mean 4.43) and Lab Test Algorithm (mean 4.46) tools highly on a 5-point “how helpful” scale (Table 4). On a 5-point scale of likeliness to recommend the app to a colleague or someone with interest in coagulation disorders, most respondents reported a likeliness of 4 (29%) or 5 (57%). Few respondents (7%) reported awareness of a similar app or electronic product.

Table 3. Physician use for education to support actual patient cases.

Physician use	Mean number of actual case situations per physician[a]
By circumstances of educational use	
To assist in making the diagnosis	6.35
To confirm a suspected diagnosis	3.46
As a teaching aid	1.37
For case management	0.94
When specialist not available	0.67
To decide whether to consult a specialist	0.60
By app function	
Lab Test Algorithm	7.15
Lab Value Analyzer	6.24
By physician specialty	
Hematology	22.36
Hematology/oncology	14.06
Critical care	14.00
Emergency medicine	12.57
Other specialties	10.80
Overall	13.39

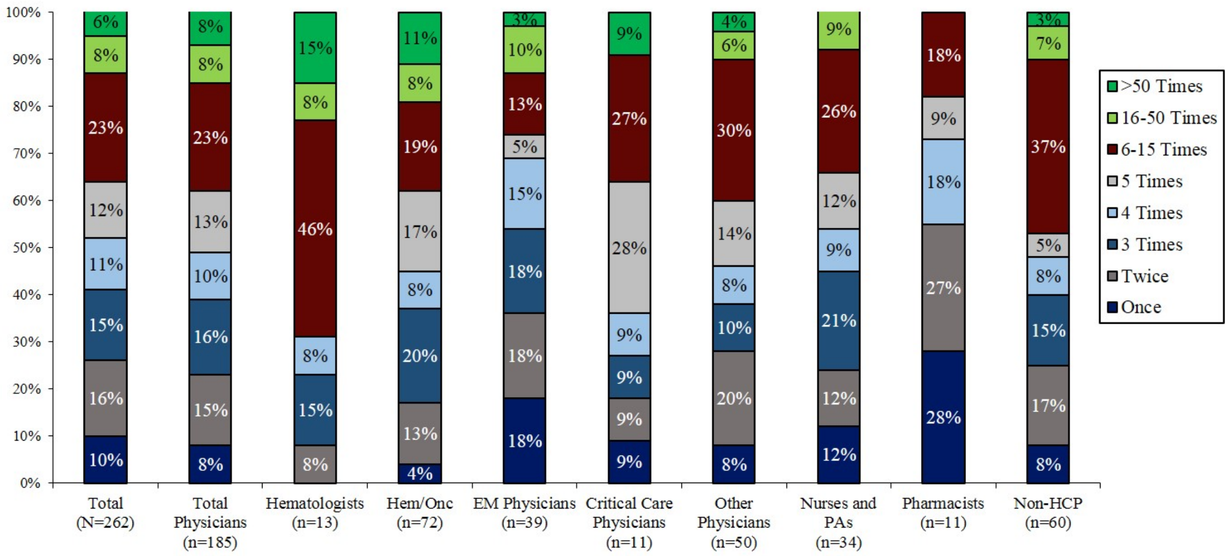
[a]Including only physicians who have used the app for patient-case-related POC education (n=165).

Table 4. Helpfulness ratings.

App tool	Mean "how helpful" rating[a]
Lab Value Analyzer	
All physicians	4.43
Hematologists	4.63
Hematologists-oncologists	4.36
Lab Test Algorithm	
All physicians	4.46
Hematologists	4.40
Hematologists-oncologists	4.40

[a]Rated on a 5-point scale, with 5=very helpful.

Figure 4. Frequency of app use since downloading.



EM, emergency medicine; Hem/Onc, hematologists/oncologists; HCP, health care professional; PAs, physician assistant.

Discussion

Principal Findings

The goal of developing Coags Uncomplicated was to address educational gaps around the appropriate sequence and interpretation of laboratory tests and to encourage referral to hematology specialists in cases of suspected bleeding disorders. To assess whether the app was reaching the target audience in the United States and whether the types of information sought matched relevant diagnoses and tests, user tracking data were collected and a survey of registered users was performed.

Results of these analyses demonstrated that hematologists and hematologists-oncologists account for the majority of app screen views and report the most frequent app use for POC education to support patient-case-related information about differential diagnostic considerations, disorders, or tests. Most nonhematologists may be less likely to gain awareness of the app and to encounter patients with coagulation disorders, although users specializing in emergency medicine also accounted for high numbers of registered users and screen views. Value of the app among nonhematologists is supported by high "helpfulness" ratings, which were similar between hematologists and physicians overall, and high rates of repeated use across specialties and HCP types.

Due to the high prevalence of use by specialists in hematology and hematology-oncology, who may have variable training and clinical practice experience in benign hematology (bleeding and clotting disorders, compared with malignant disorders), the survey was designed to explore the reasons why users were turning to Coags Uncomplicated, and to identify whether the app is being used more as an educational resource in clinical situations or as a teaching tool. Overall, survey data and app tracking metrics describe app use among physicians and other HCPs in a pattern consistent with value as a clinical POC educational tool. Reported use in patient-case-related circumstances to quickly review relevant educational materials about making a differential diagnosis, to review educational materials on a disease to confirm a suspected diagnosis, and as a teaching aid supports a practical value for filling unmet educational needs and suggests that use of the app may facilitate rapid and efficient differential diagnosis. A majority of physician app users reported using the app to support actual patient-case-related educational needs, suggesting high practical utility and less frequent use as a teaching tool. Additionally, most physician app users worked in a hospital-based practice setting, indicating that most frequent use may occur in the acute care setting.

Data obtained from the survey also assessed the tools that were used most frequently within the app. Whereas a large majority of survey respondents reported having used the Lab Value Analyzer (93%), this tool was associated with the lowest number of screen views. The Lab Value Analyzer was developed largely to help hematology-oncology specialists and those without easy access to specialists experienced in the interpretation of laboratory studies that may have been performed as part of a screening profile, and therefore infrequent use may suggest limited use for these purposes. This pattern of use is also consistent with lower use of the Lab Value Analyzer than the Lab Test Algorithm in actual patient cases, and suggests that the clinical value of the app may be highest in the early stages of diagnosis (before laboratory tests have been run). The Coag Challenge had the lowest rate of respondent use (65%), but the second highest number of screen views, suggesting high rates of repeated use among a subgroup of users who complete the whole challenge, supporting the value of competitive aspects to reinforce learning in adults.

The data regarding most common diagnostic endpoints reached seem to reflect preferential app use in cases of complex and acutely severe conditions that would be seen by those in an emergency room or hospital situation. For example, the most frequently reached endpoints, DIC, liver disease effect, and vitamin K deficiency, are each complex disorders that vary widely in bleeding symptoms [7-9]. Interestingly, VWD, the most common inherited bleeding disorder [10], is notably absent from the list of most common diagnostic endpoints reached. This infrequent use of the app to diagnose VWD may result from physicians' relative familiarity with diagnosing this disease, the standardized set of laboratory assessments used for VWD diagnosis, and the potential for VWD to present with relatively mild symptoms that may be observed outside of the acute care setting, resulting in infrequent presentations of severe bleeding associated with undiagnosed VWD [10].

Additional tools that may be considered for future versions of Coags Uncomplicated include use of bleeding scores or bleeding assessment tools (BATs) and standard workups for specific bleeding presentations. General diagnostic tools, such as the International Society on Thrombosis and Haemostasis BAT [11] and the Molecular and Clinical Markers for the Diagnosis and Management of Type 1 (MCMDM-1) VWD Bleeding Questionnaire [12], as well as symptom-specific tools such as the Epistaxis Scoring System [13] and the Menorrhagia-Specific Screening tool [14], are useful as screening tools, particularly for mild bleeding disorders. Additionally, standard protocols for assessing hemostatic parameters in patients presenting with specific symptoms, such as heavy menstrual bleeding or epistaxis, may be useful for physicians to ensure appropriate hemostatic evaluation.

Conclusions

An analysis of Coags Uncomplicated use among US physicians and other HCPs suggests value as a POC educational tool to support differential diagnosis of bleeding disorders. App tracking metrics and survey responses indicate most frequent use among hematologists, hematologists-oncologists, and emergency physicians, and frequent use for education to support actual patient-case-related circumstances. Patterns of use seem to suggest preferential use in cases of complex and acutely severe conditions, which may be encountered by physicians of various specialties. Because bleeding disorders may be challenging to diagnose for those who are not experienced in performing and interpreting advanced hematologic assessments, app use may facilitate efficient and accurate differential diagnoses, reduce delays to appropriate consultation with hematologists, reduce inappropriate use of therapeutic resources, and ultimately reduce mortality of bleeding patients.

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Conflicts of Interest

CMK has served on advisory boards for Baxalta, Bayer, Biogen, Genentech, Grifols, Novo Nordisk Inc, Octapharma, and Pfizer, and has received grant or research support from Bayer, Baxter, Novo Nordisk Inc, and Octapharma. EP's institution has received funding from the NIH NCI Cancer Center Support Grant P30 CA008748. MC is a paid consultant for Novo Nordisk Inc, and has received honoraria from Baxter, Bayer, Biogen Idec, and Pfizer. RK has received grant or research support from Baxter, Bayer, Biogen, Novo Nordisk Inc, and Octapharma and has served as a consultant for Baxter, Bayer, Biogen, BPL, Kedrion, Novo Nordisk Inc, and Pfizer. NH and DC are employees of Novo Nordisk Inc.

Multimedia Appendix 1

Lab Test Algorithm for abnormal prolonged aPTT (activated partial thromboplastin time) only.

[JPG File, 379KB - mededu_v3i1e6_app1.jpg]

Multimedia Appendix 2

Lab Test Algorithm for abnormal prolonged PT (prothrombin time) only.

[JPG File, 293KB - mededu_v3i1e6_app2.jpg]

Multimedia Appendix 3

Lab Test Algorithm for abnormal prolonged PT ( ) and aPTT (activated partial thromboplastin time).

[JPG File, 392KB - mededu_v3i1e6_app3.jpg]

Multimedia Appendix 4

Lab Test Algorithm for normal PT and aPTT (normal platelet count). aPTT: activated partial thromboplastin time. PT: prothrombin time.

[JPG File, 506KB - mededu_v3i1e6_app4.jpg]

Multimedia Appendix 5

Lab Test Algorithm for normal PT and aPTT (decreased platelet count). aPTT: activated partial thromboplastin time. PT: prothrombin time.

[JPG File, 622KB - mededu_v3i1e6_app5.jpg]

Multimedia Appendix 6

Lab Test Algorithm for normal PT and aPTT (increased platelet count). aPTT: activated partial thromboplastin time. PT: prothrombin time.

[JPG File, 163KB - mededu_v3i1e6_app6.jpg]

Multimedia Appendix 7

References supporting the diagnoses and laboratory tests included in Coags Uncomplicated.

[PDF File (Adobe PDF File), 30KB - mededu_v3i1e6_app7.pdf]

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Abbreviations

aPTT: activated partial thromboplastin time
BAT: bleeding assessment tool
DIC: disseminated intravascular coagulation

DO: doctor of osteopathy
HCP: health care professional
MCMDM-1: Molecular and Clinical Markers for the Diagnosis and Management of Type 1 [VWD Bleeding Questionnaire]
MD: doctor of medicine
N/A: not available
NP: nurse practitioner
PA: physician assistant
PharmD: doctor of pharmacy
POC: point-of-care
PT: prothrombin time
RN: registered nurse
VWD: von Willebrand disease

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Original Paper

Development and Assessment of an E-learning Course on Pediatric Cardiology Basics

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Abstract

Background: Early detection of congenital heart disease is a worldwide problem. This is more critical in developing countries, where shortage of professional specialists and structural health care problems are a constant. E-learning has the potential to improve capacity, by overcoming distance barriers and by its ability to adapt to the reduced time of health professionals.

Objective: The study aimed to develop an e-learning pediatric cardiology basics course and evaluate its pedagogical impact and user satisfaction.

Methods: The sample consisted of 62 health professionals, including doctors, nurses, and medical students, from 20 hospitals linked via a telemedicine network in Northeast Brazil. The course was developed using Moodle (Modular Object Oriented Dynamic Learning Environment; Moodle Pty Ltd, Perth, Australia) and contents adapted from a book on this topic. Pedagogical impact evaluation used a pre and posttest approach. User satisfaction was evaluated using Wang’s questionnaire.

Results: Pedagogical impact results revealed differences in knowledge assessment before and after the course (Z=−4.788; P<.001). Questionnaire results indicated high satisfaction values (Mean=87%; SD=12%; minimum=67%; maximum=100%). Course adherence was high (79%); however, the withdrawal exhibited a value of 39%, with the highest rate in the early chapters. Knowledge gain revealed significant differences according to the profession (X22=8.6; P=.01) and specialty (X22=8.4; P=.04). Time dedication to the course was significantly different between specialties (X22=8.2; P=.04).

Conclusions: The main contributions of this study are the creation of an asynchronous e-learning course on Moodle and the evaluation of its impact, confirming that e-learning is a viable tool to improve training in neonatal congenital heart diseases.

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KEYWORDS

distance learning; continuing medical education; pediatrics; cardiology; congenital heart defects

Introduction

Background

Managing congenital heart diseases is a worldwide problem [1]. Early detection through newborn screening can potentially improve the outcome of these diseases [2]. In newborns, congenital heart diseases can be detected by auscultation, pulse oximetry, radiography, catheterization, although transthoracic echocardiogram, a specialized form of ultrasound, is the elected exam for diagnosis [3,4]. Pediatric cardiologists usually perform this examination, but in developing countries there is shortage of professional specialists, which are often concentrated in larger urban centers, hindering the widespread population screening and causing a need for constant transferal of patients from the isolated regions to reference health centers [5].

Context

In response to these challenges, the Health Secretary of Paraíba, in Brazil established a pediatric cardiology network [6]—Rede de Cardiologia Pedia´trica (RCP)—in partnership with Círculo do Coração , a civil nonprofit organization from Recife, in order to create a neonatal screening program for the whole state of Paraíba and a hospital facility designed to manage patients. Of the 20 maternity centers covered by this network, only 7 had neonatal ICU beds. The remaining are level-1 district centers. In only one center, in the capital city of Joao Pessoa, there is a pediatric cardiologist available for echo and clinical diagnosis. No center performs cardiac surgery. This network provides perinatal and neonatal care in remote areas supervised by telemedicine; it was created due to the need to train local physicians and involve local professionals on screening, diagnosis, therapeutic treatment and management of congenital heart diseases in fetuses, newborns, and children of the public health system.

Echocardiography is used to diagnose congenital heart disease when either there is an abnormal clinical examination or an abnormal pulse oximetry. Abnormal pulse oximetry results are automatically noted on a database of the network, allowing the network to contact the clinic and request that they follow up any babies with abnormal test results. These active search protocols track the discharged neonates and ensure that abnormal findings are acted on.

Echo image acquisition and its interpretation is a combined process developed within this Web-based telemedicine network where trainees are constantly supervised by cardiologists. Not only the whole process is documented in the Web database system to track the apprentice's development, but also whenever needed, live interaction is called to adjust practical aspects. Initially, all echocardiograms needed to be performed with Web-based supervision by the pediatric cardiologist, as part of the neonatologists' training, but with time cardiologists would only be requested for direct Web-based supervision when pathological findings were suspected. As there are always new neonatologists being trained, this learning process and interaction between teams is a continuous cycle [7].

E-Learning for Health Care

With the increasing use of Internet information and communication technologies, e-learning has emerged as a widely accepted modality in medical education [8]. For its convenience and its potential for cost savings, it has become popular among the medical education community [9]. E-learning is known to offer learning opportunities where there is limited access to teaching in a specific field, either because of a lack of qualified or geographically distant teaching institution [10]. Therefore, e-learning can be a powerful tool to increase the capacity of health professionals in constricted contexts for neonatal echocardiography congenital heart disease screening. There is evidence in the literature that e-learning is a useful tool for overcoming barriers to health professionals training [10]. A review carried out by Frehywot et al on e-learning in medical education in resource-constrained LMICs suggests that e-learning may be effective for increasing capacity in rural settings, although evidence is still limited.

The convenience, the self-paced and learner-centered learning, and the creation of a global learning community, are some significant benefits of e-learning that have been discussed in many articles [8,10-24].

In medical contexts, e-learning program results such as efficiency and costeffectiveness have typically gone unreported [25]. In nonmedical contexts, there is evidence that e-learning can result in cost savings of up to 50% over traditional learning programs, due to reduced instructor training time, travel and labor costs, institutional infrastructure, and the possibility of expanding programs with new technologies [8,9,26].

Nowadays, there is an increasing demand for e-learning courses [27]. Many software platforms and learning management systems (LMS) are being used to support Web-based courses for online continuing medical education. Among the various LMS, there is Moodle (Modular Object Oriented Dynamic Learning Environment; Moodle Pty Ltd, Perth, Australia), a well-known platform that is considered one of the best open-source LMS, in what concerns user-friendliness and adaptivity [28]. Moodle allows the integration of a broad range of educational resources, activity modules, such as Forums, Wikis, and Databases, that build a rich collaborative community of learning around a subject matter depending on the learning goal. Moodle can also be used to deliver content to students (such as standard SCORM packages) and for learning assessment; it provides assignments or quizzes. As another advantage, its interface allows surfing through the contents intuitively [28,29]. The reason we decided to use Moodle in this study is because we had access to it in the Faculty of Medicine of the University of Porto that could host the Moodle course, and given its utility, we did not need to address the costly development of a new platform.

Objectives of the Study

In this context, as primary outcomes we aim to (1) develop an e-learning Pediatric Cardiology Basics Moodle course for nonspecialists and (2) evaluate its pedagogical impact and user satisfaction.

As secondary outcomes, we want to understand whether there are significant differences between different types of professionals undergoing the course and to measure the adherence to the course in this specific scenario.

Methods

The E-Learning Course Description

We chose to build a new course, as the few actual existing options are in English, and also associated with other institutions. The course was in Brazilian Portuguese, implemented on Moodle, hosted on the server at the Faculty of Medicine of the University of Porto, Portugal. The contents of the course were mainly based on the "Cardiologia para o Pediatra" book [30], which was used in this network to teach their professionals, and was written by a specialist Dra Sandra Mattos, stakeholder of the RCP network. This book follows a didactic approach, where the basic concepts for neonatal screening of congenital heart diseases are addressed, such as the current standard clinical protocols and guidelines to apply

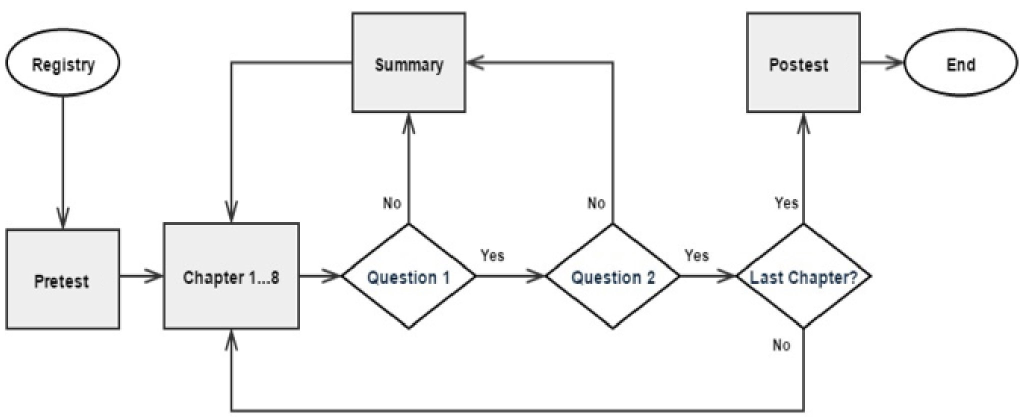
[31,32]; proposed by the American Association of Cardiology and the Association for European Paediatric and Congenital Cardiology, concepts of cardiac neonatal anatomy and physiology, how to obtain the ultrasound images, and for each anatomic window, which echocardiographic findings to expect and look for. The course was structured into 3 modules, with a total of 8 chapters (Table 1).

The content was presented using text, images, and videos. Diagnostic images and videos were collected directly from the RCP network at the Real Hospital Português in Recife, Brazil. A total of 22 images and 36 videos were used in this course, which were anonymized and illustrated examples of planes and imaging cuts, without any association with identifiable data from patients. Pediatric cardiology specialists from the cardiology and fetal medicine unit at Real Hospital Português reviewed all contents. Screenshots are presented in Figure 1.

Table 1. Description of the main contents contained in the intervention e-learning course.

Modules	Chapters	Contents
Foreknowledge	Cardiac neonatal anatomy	Internal configuration of the heart
	Physiology of neonatal circulation	Fetal circulation
	Physical ultrasound principles	Neonatal circulatory changes
		The ultrasound properties
		Transducers
		Echocardiography
Echocardiogram screening	How to obtain the ultrasound images	4-chamber image
	Different echocardiographic modalities	Left ventricle outflow track image
		Right ventricle outflow track image
		Pathologies to exclude in each image
		Bidimensional mode
		M mode
		Doppler mode
Pathologies	Identified pathologies in the 4-chamber image	Interventricular communication
	Identified pathologies in the outflow tracts image	Defect of atrioventricular septum
	Difficult to diagnose pathologies images in the neonatal period	Tricuspid atresia
		Ductus arteriosus
		Aortic stenosis
		Pulmonary stenosis
		Tetralogy of Fallot
		Transposition of the great vessels
		Truncus arteriosus
		Interatrial communication
		Coarctation of the aorta
		Total anomalous pulmonary venous drainage

Figure 1. Course flow diagram.



Recruitment and Implementation Strategy

Participants were recruited via an email disclosure within the RCP network platform with a brief description of the study, the link to the course, a tutorial for Moodle log, and the password for enrolment in the course. To access it, the learners should register on the Moodle website according to their personal information. Thus, website security was guaranteed through an authentication mechanism with username and password. After that, we had access to the participant's personal email given at the registry, and then we could do the follow-up of each participant by email.

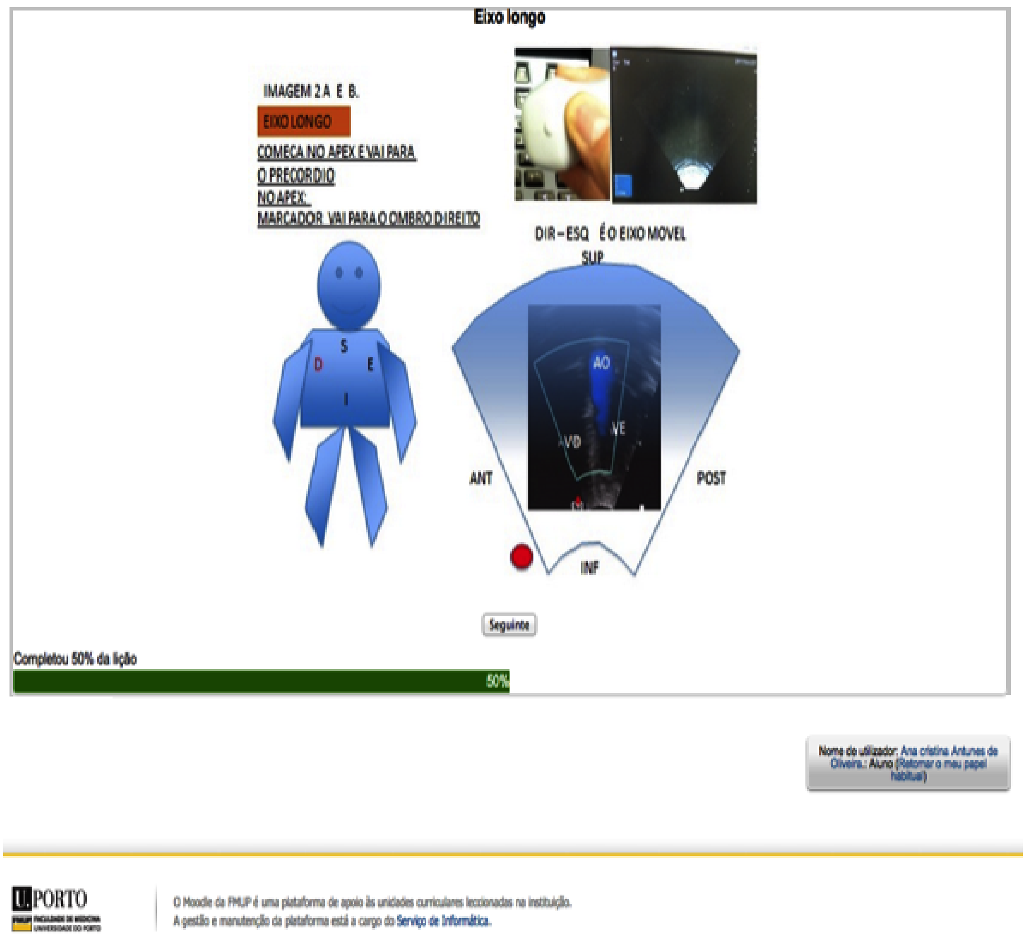
The course was created and revised between April 2014 and July 2014. We contacted the participants in September 2014, and those who registered to do the course first did the pretest and then had access to the asynchronous course, which was given until November 2014.

The course was built in a unidirectional way (Figure 2). First, the participants registered on the Moodle website. Then, a pretest of 16 questions was available during 20 min. After the answers submission, the first chapter was available. At the end of each chapter, a summary with the main key-points and a formative test of two multiple-choice questions for self-assessment was presented. These intermediate tests allowed immediate knowledge self-assessment. The next chapter would only be available if the user had given the correct answers. In case of error, the learner would be directed to a summary of the lecture, and then it was possible to go back to the previous lecture or repeat the assessment. At the end of these 8 chapters, a final summative assessment of 16 questions corresponding to the posttest was available during 20 min. After the final approval, a certificate was sent to the learners.

The learning activities chosen were lessons that corresponded to each chapter. We organized the content, images, and videos in different pages as it corresponds to different topics. The learner could control the lecture flow by pressing control buttons located at the end of that interface, moving forward or backwards, allowing the lecture to flow from the beginning to the end, page by page, managing his own learning process.

As the course was performed asynchronously, the learner could observe his evolution learning at any time during the course through a progress status bar that updates dynamically in order to manage his self-learning.

Figure 2. Screenshot of one of the echocardiographic views and schemes (left), and of one of the self-assessment tests (right) included in the e-learning course.



Evaluation Strategy

An important method of assessing educational training is a framework developed by Kirkpatrick [33,34], which focuses on 4 levels: reaction, learning, behavior, and results.

Numerous studies [16,21,35-42] have been carried out to assess the benefits of e-learning in medical education. Very often, evaluative education studies [38,43] rely solely on the reaction level and learning over the behavior and results levels [16,44,45].

Pre- and Postintervention Test

Concerning the learning assessment, the most common method described in literature is the pre- and posttesting self-controlled method, with multiple-choice test scores.

In this study, the participants were asked to do a pretest before taking the course and a posttest after completing the course. We used the same questions for pre and posttesting, so that we can guarantee the same level of difficulty and comparable results [46]. The test was structured with 16 different multiple-choice questions. They were all single-select questions and each question had 2-5 response options. The assessment questions were text-based to test knowledge based on the key ideas, learning outcomes, and objectives established for the course. In this test, a total of 2 questions were related to each of the course's 8 modules (Table 1), which were also the same end-of-chapter practice questions. The participants could only proceed to the next chapter after answering these end-of-chapter practice questions correctly. An expert on pediatric cardiology revised the questions making sure they were appropriate to the course content. To improve the authenticity of the answers by discouraging access to support materials, participants had only 20 min to complete the 16-question test, so a time controller and a progress bar were available. After that time, if they had not submitted, the answers would be automatically saved. At the end, the participants could see the test result, but not the correction, and they could not repeat the test. The technology we used to provide this evaluation tool was the Moodle lesson questions, a free Web-based office suite and data storage service.

User's Satisfaction Questionnaire

The reaction assessment is mostly done by questionnaires. One of the most cited questionnaires for assessing user satisfaction was developed by Wang [47]. Wang created an e-learning satisfaction model that consists of 26 items related to 4 qualities: content quality, learning interface quality, personalization quality, and learning community quality. However, the last 2 questions refer to global measurement in the context of end-user satisfaction, first developed by Doll in 1988 [48], and related to overall satisfaction and overall success. The measurement scale used was a 7-point Likert-type scale, with anchors ranging from "strongly disagree" to "strongly agree." Globally, this questionnaire was shown to have a reliability (Cronbach alpha) of .95 [47].

For our study, we used the questions related to content quality, learning interface quality, and personalization quality from Wang's questionnaire [47]. We did not use questions related to learning interaction quality, because the developed e-learning course was asynchronous. We used a Portuguese translated existing version from Wang's questionnaire [49]. The technology used to apply this evaluation instrument was the Moodle survey module. The satisfaction questionnaire became available to the participants who had taken the course after they did the postcourse.

Statistical Analysis

The purpose of the data analysis was to determine whether there was a significant difference between the test score before and after the course. We considered learning improvement as the ratio of the difference between scores and the preintervention score. The learning efficiency is the learning improvement per hour of the course.

Data analysis was performed by descriptive and inferential statistics, using the IBM SPSS Statistics software version 22.0.

According to the fulfillment of the criteria necessary to perform parametric hypothesis testing, it was concluded that the sample did not follow a normal distribution. Thus, we used the following nonparametric tests: Wilcoxon Signed-Rank test, Mann-Whitney U Test and Kruskall-Wallis H test. For all this statistical analysis, we considered a significance level of 5% [50].

Results

Summary

The target population in this study was the health care professionals—neonatologists, pediatricians, obstetricians, nurses, and internship medical students—who work in the RCP network. This convenience universe potentially includes a total of around 80 people. We obtained 78% (62/80) registrations. Concerning adherence (Figure 3), 79% (49/62) started the course. At the end, 61% of the participants (30/49) managed to complete the course and 39% (19/49) dropped out (Figure 4). See the percentage of participants who dropped by chapter (Figure 5). From the participants who had taken the course, 67% (20/30) responded to the satisfaction questionnaire.

Figure 3. Screenshot of one of the self-assessment tests included in the e-learning course.

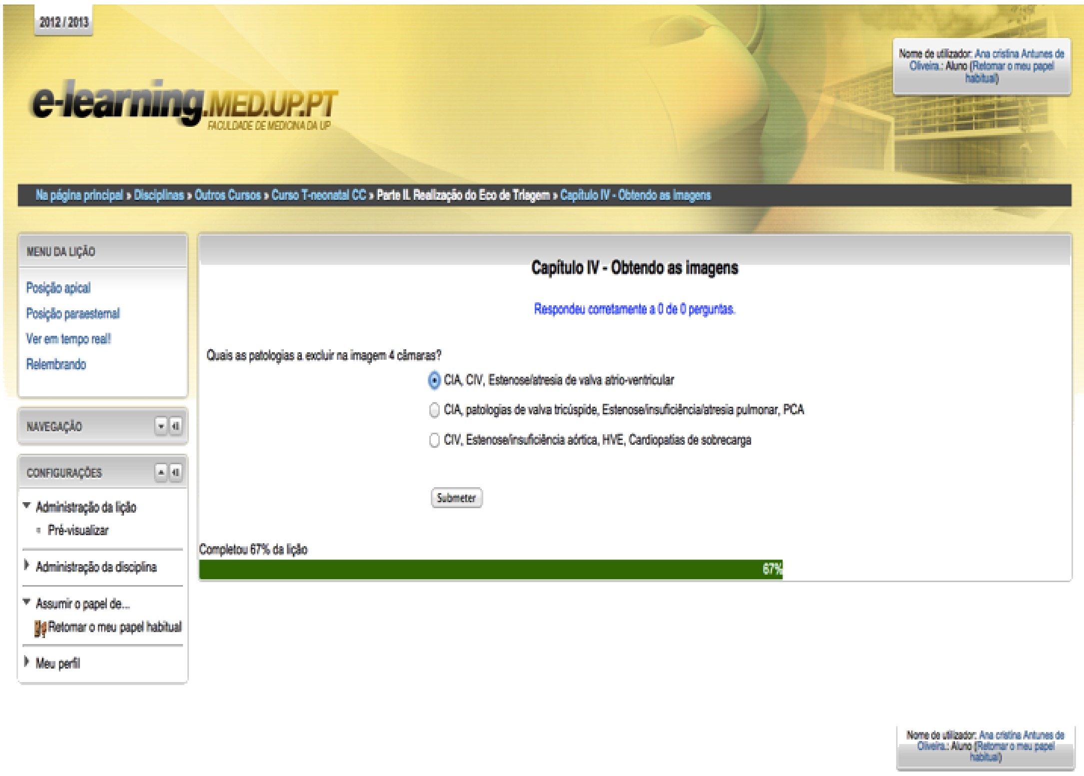


Figure 4. Participant flow diagram showing the enrolled sample and respective dropouts.

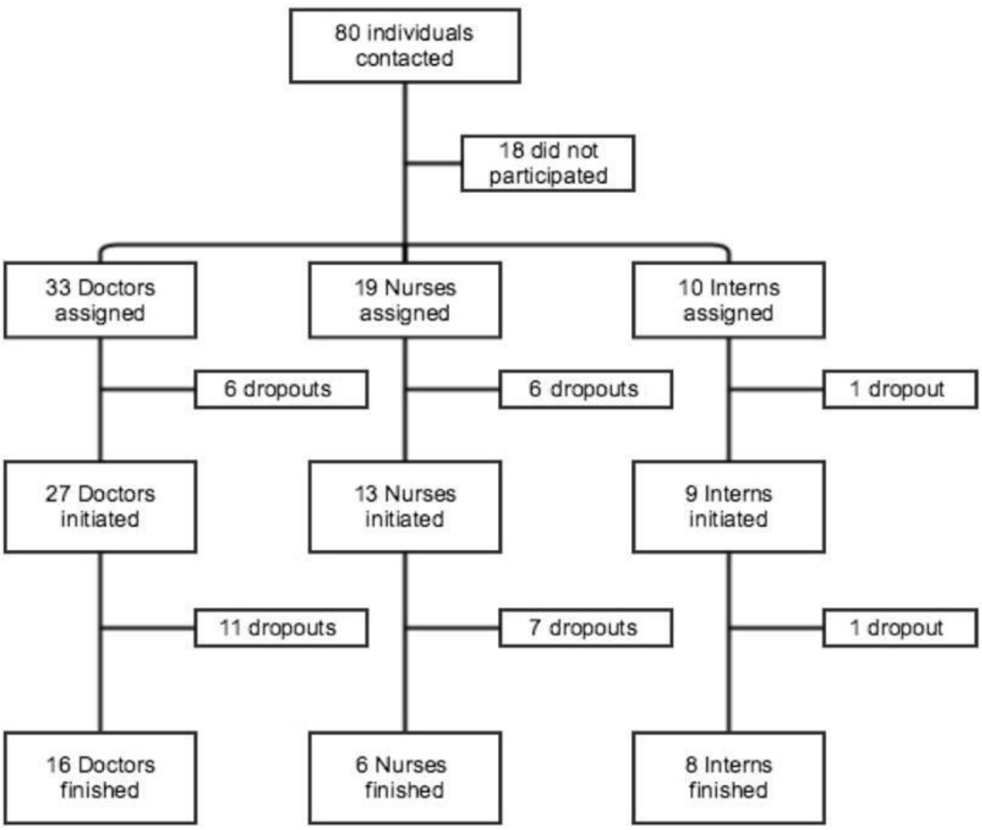
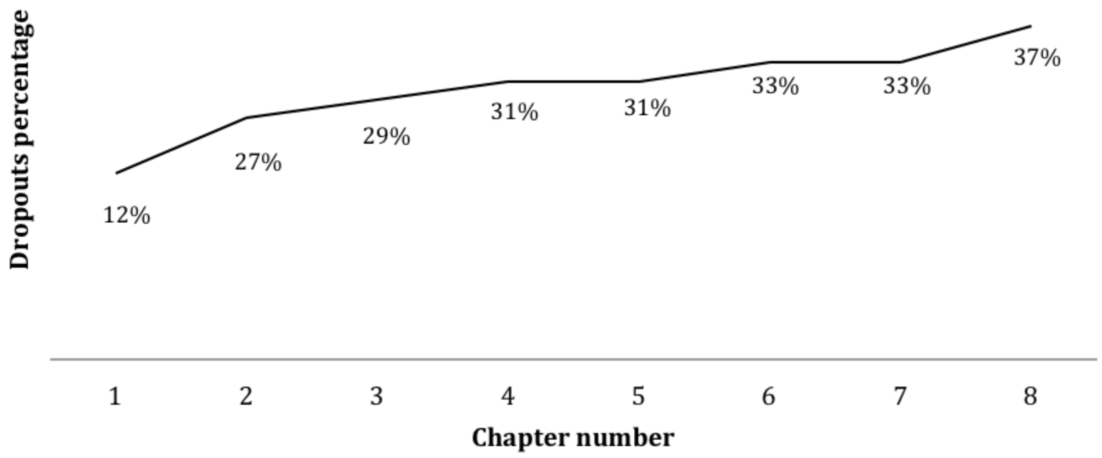


Figure 5. Percentage of participants who dropped by chapter.



Sample Description

The total sample consisted of 62 registered health care practitioners, including 49 female (79%) and 13 male elements (21%); 49 individuals started the course, including 39 female (80%) and 10 male elements (20%); and 30 participants completed the course, including 22 female (73%) and 8 male elements (27%; Table 2).

With regard to the registered participants, most are doctors (n=33; 53%) and mostly are of Neonatology (n=24; 39%) and Pediatrics (n=23; 37%) departments. This ratio remains the same for those participants who initiated the course (Table 3).

Regarding the state where they practice, 45 (73%) works in Paraíba and the other 17 (27%) in Pernambuco.

Pedagogical Impact

Regarding the pretest, 67% (n=20) passed (test score≥50%) and 33% (n=10) of participants failed (test score<50%). The test scores ranged between 0 and 100%. However, none of the participants failed to complete all the test items within the time limit. With respect to the posttest, 100% (n=30) of the participants passed.

The differences between the test scores before and after the course were all positive. There were no negative differences or equal scores before and after the course. A Wilcoxon signed-ranks test indicated that the median [Mdn (P25-P75)=94 (81-100)] posttest ranks were statistically significantly higher than the median [Mdn (P25-P75)=56 (38-69)] pretest ranks (*Z*=-4.788; *P*<.001).

Doing an intent-to-treat analysis by comparing the mean ranks (Mann-Whitney–U Test) of the score from the participants who did not do the course [Mdn (P25-P75)=50 (29-65); n=19] with those who did the course [Mdn (P25-P75)=94 (81-100); n=30], we found that test scores in those who did the course were statistically significantly higher than those who did not (*U*=21.500; *P*<.001).

Globally, the difference between the final and the initial scores can indicate the learning impact of the course [Mdn (P25-P75)=34 (19-50); n=30]. Moreover, the improvement in the results was related to what the participants already knew before the course [Mdn (P25-P75)=61 (36-114); n=30]. The efficiency was how much they improve per hour dedicated to the course [Mdn (P25-P75)=31 (12-80); n=30] (Figure 6). The maximum time dedicated to the course was 09 h 58 min and the minimum 25 min [Mdn (P25-P75)=01:47 (01:08-03:01); n=30].

We found the initial scores were statistically significantly different (X^2_2=13.8 *P*=.001) between professions (Table 4). Although nurses hadn't the highest final score, they were the ones who exhibited the highest difference between the scores, more than doubling it, but with less efficiency, as they also dedicated more time to the course. However, internship medical students had the highest learning efficiency, improving their knowledge per hour, as they dedicated much less time to the course than doctors and nurses. Predictably, doctors have lesser benefits from such an e-learning course. There were significant statistical differences in the improvement between professions (X^2_2=8.6; *P*=.01).

Table 2. Frequency and percentage of participants by gender.

Participants	Female, n (%)	Male, n (%)
Total sample (n=62)	49 (79)	13 (21)
Started the course (n=49)	39 (80)	10 (20)
Completed the course (n=30)	22 (73)	8(27)

Table 3. Frequency and percentage of participants by profession and specialty.

Participants		Assigned (n=62), n (%)	Initiated (n=49), n (%)	Concluded (n=30), n (%)
Profession				
	Doctors	33 (53)	27 (55)	16 (53)
	Internship medical students	10 (16)	9 (18)	8 (27)
	Nurses	19 (31)	13 (27)	6 (20)
Speciality				
	Neonatology	24 (39)	19 (39)	18 (60)
	Obstetrics	6 (10)	5 (10)	4 (13)
	Pediatric Cardiology	9 (14)	8 (16)	3 (10)
	Pediatrics	23 (37)	17 (35)	5 (17)

Table 4. Median and percentile Tukey's hinges (P25-P75) of the scores in study by profession.

Indicators	Doctors (n=16)	Internship medical students (n=8)	Nurses (n=6)	*P* value[a]
Initial score	63 (53-78)	50 (41-59)	40 (31-50)	.001
Final score	99 (88-100)	94 (81-94)	88 (81-100)	.24
Difference[b]	27 (13-44)	34 (28-44)	51 (31-63)	.13
Improvement (%)[c]	43 (16-89)	63 (55-91)	128 (63-200)	.09
Efficiency (%)/h[d]	15 (8-42)	76 (53-153)	26 (16-80)	.01
Dedication (hh:mm)	02:01 (01:32-03:06)	00:50 (00:37-01:06)	03:07 (02:09-03:54)	.45

[a]Kruskal-Wallis *H* test.

[b]Final score - initial score.

[c]([final score - initial score]/ initial score)*100.

[d]([final Score - Initial score]/ initial score)*100)/hour.

Concerning specialty (Table 5), the obstetricians were the ones who benefited the most, with the highest difference between the scores, the best improvement and efficiency (Figure 7), and were the most dedicated to the course. There were statistically significant differences in the improvement (X^2_2=8.4; *P*=.04) and in the course dedication (X^2_2=8.2; *P*=.04) between the different specialties.

Table 5. Median and percentile Tukey's hinges (P25-P75) of the scores in study by specialty.

Indicators	Neonatology (N=18)	Obstetrics (N=4)	Pediatric Cardiology (N=3)	Pediatrics (N=5)	*P* value[a]
Initial score	56 (44-63)	37 (25-46)	87 (68-87)	69 (69-81)	.06
Final score	91 (81-100)	88 (81-87)	100	98 (94-100)	.15
Difference[b]	38 (25-44)	60 (45-63)	13 (13-32)	13 (13-29)	.06
Improvement (%)[c]	61 (43-100)	170 (101-267)	15 (15-58)	18 (15-42)	.039
Efficiency (%)/h[d]	42 (20-78)	50 (18-117)	12 (10-50)	9 (7-16)	.28
Dedication (hh:mm)	01:39 (00:54-03:01)	03:12 (02:20-05:30)	01:20 (01:14-1:36)	01:35 (01:08-2:08)	.04

[a]Kruskal-Wallis *H* test.

[b]Final score-initial score.

[c]([final score-initial score]/ initial score)*100.

[d]([final score-initial score]/ initial score)*100)/hour.

Figure 6. Improvement (left) and learning efficiency (right) stratified by professional status.

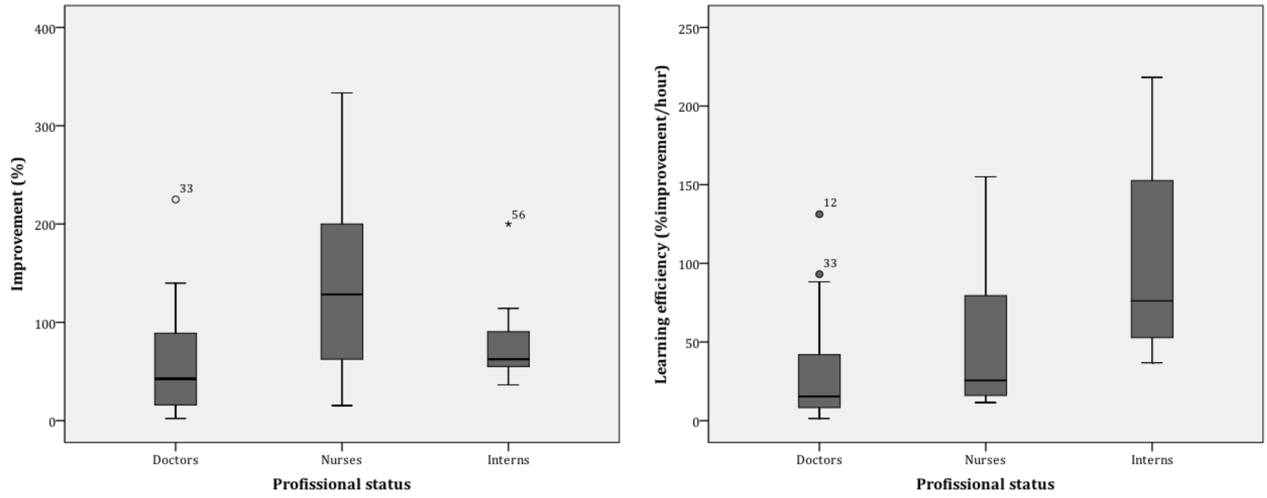
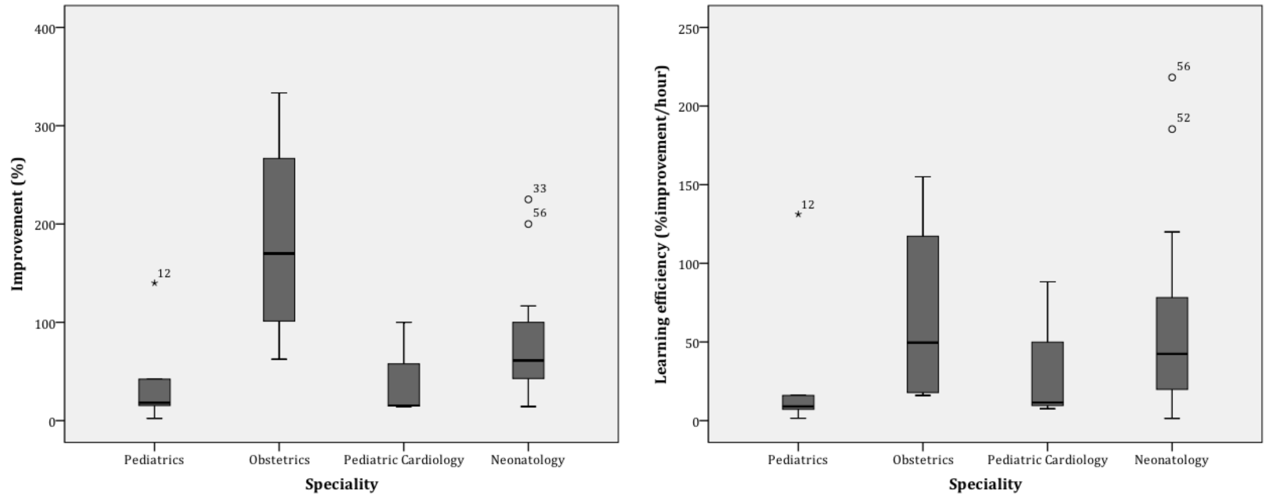


Figure 7. Improvement (left) and learning efficiency (right) stratified by specialty.



User Satisfaction

Only 20 (67%), out of the 30 participants who completed the course answered the satisfaction questionnaire. This was disappointing, showing that it was simpler to motivate these professionals to gain knowledge, than to contribute to a research study.

Globally, the satisfaction with the e-learning course was positive (μ=87%; σ=12%; minimum=67%; maximum=100%), whereas 6 (30%) learners were totally satisfied with the e-learning course. Regarding global measures (Q14 and Q15), 17 (88%) were satisfied and considered that the e-learning course was successful (6 and 7 points in the 7-point Likert-type scale). Considering content quality (Q1-Q4), 17 (88%) learners think that this course fits their needs, is useful, sufficient, and up to date.

About the learning interface quality (Q5-Q9), 15 (76%) learners found the e-learning course user-friendly, stable, making it easy to find contents needed. Concerning personalization quality (Q10-Q13), 16 (84%) participants think the e-learning course enables them to control the learning progress, to learn the content needed, to choose what to learn and record their learning progress and performance.

Within these 20 participants, all claim the necessity of continuing medical education (CME) and 18 (90%) said that they would like to do CME by e-learning systems, whereas the other 2 (10%) said that maybe they will be interested in CME by e-learning.

Discussion

Principal Findings

The first main result of this study was the development of an e-learning course for the neonatal screening of congenital heart diseases. Using a free open-access tool such as Moodle and adapting the pedagogical contents of a well-established book for teaching this subject did not require advanced programming skills and led to an effective e-learning course. Given our successful results, it is expectable that future e-learning courses that specifically use best practices for multimedia learning should have an even stronger impact.

The second principal outcome was the statistically significant results obtained in the used metrics of pedagogical impact, with quite interesting proportions of learning with just a few hours of training. These results meet the general literature reviews that identified e-learning as superior to noneducation intervention [45], or as having similar effects to traditional learning [51], and more effective when combined with traditional learning [29] (b-learning). Although, in some contexts, e-learning may not be an alternative for the traditional face-to-face learning method, it can always offer a contribution and be a complement, and a useful adjunct to traditional education [51,52].

When comparing professions, we confirmed that the background knowledge about pediatric cardiology varies by professional group. By the end of the course nurses were the ones who learned more, although they did not score the highest final score. The heterogeneity of time spent in learning was also perceived. Internship medical students had the highest learning efficiency, dedicating much less time to the course than doctors and nurses. Predictably, doctors have lesser benefits from such an e-learning course.

Concerning specialty, the obstetricians were the ones who improved their knowledge the most, with the highest difference between the scores, the best improvement and efficiency, and were the most dedicated to the course. There were statistically significant differences in the improvement and in the course dedication between the different specialties, in this case confirming that more time dedicated to the course does translate into higher knowledge gain.

The third principal result was the encouraging assessment of the user satisfaction questionnaire. However, a third of the students who completed the course did not complete this questionnaire. This might be an important consideration for future studies, with regard to the interest and motivation of the participants to answer satisfaction questionnaires.

Regarding the adherence to this study, although the number of participants can appear low, we must understand the context in which this course was applied. From a total of around 80 people who are fully engaged in their daily health care routine and who voluntarily accepted to participate and complete an 8-lesson course in their free time, we consider that 30 is a successful result that reflects the need and enthusiasm generated by the proposed initiative.

Limitations

Relevant limitations include the small sample size that affects the generalization of the results, and the limited implementation time, as the learners have their own agenda and priorities.

For the analysis, we had to use nonparametric tests because some of the variables did not follow a normal distribution and mainly because of the sample size. It would be definitely more interesting to use parametric methods to prove that there were significant differences before and after the course and the interactions between professions and specialty in a more robust manner, but for that possibility we would have to have a greater number of participants.

In addition, we have the impact of the exposure to the pretest and the end-of-chapter practice questions, which were identical to the ones that were used in the posttest. Although there was an expert validation of the test questions used before and after the course, the test was not assessed for its reliability or validity metrics.

The validity of the satisfaction assessment should be carefully considered, because we used a nonvalidated translation to a Portuguese version of the user satisfaction questionnaire, as it was not possible to find in the literature a Portuguese validated one for e-learning systems.

Another limitation of this work is the fact that the socioprofessional questionnaire was applied only at the end of the intervention. This situation limits our information about the description of our sample and other factors that could influence the adherence and learning process.

Concerning the evaluation strategy, we also faced the risk of a slight bias because we did not control if learners resorted to external sources in order to provide correct answers to the tests.

Conclusions

Globally, this study highlights the importance of training neonatologists and other health care professionals in the neonatal care units to screen for congenital heart disease. We consider the high rate of participation an important aspect of our study (78%), which reflects the great interest shown by these professionals to promote their professional skills. They took advantage of this learning opportunity, which confirms that these health care professionals are committed to responding to new challenges and evolving paradigms.

This study contributes to the Brazilian continuing training programs, as we did not find any similar course related to neonatal screening of congenital heart disease. It would be interesting to conduct additional assessments to demonstrate effective consolidation of knowledge gain. For future work, we also intend to assess the remaining levels of the Kirkpatrick framework, “behavior” and “results,” with respect to change in neonatal screening behavior and improved congenital heart disease detection. To do so, we plan to measure the number of telemedicine consultations conducted by the participants after the course and the number of congenital heart disease detected by them.

Our global results show that e-learning can provide statistically relevant knowledge gains in health care professionals in a neonatal screening context. We believe that this study underlines the importance of e-learning as a viable technology for training, especially in impoverished contexts. E-learning should be considered for continuing medical education in low- and middle-income countries, not only due to budget constraints, but also due to resource-constrained environments.

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All the authors have made a significant contribution to this manuscript and have approved the final paper, thus meeting the criteria for authorship. All those entitled to authorship are listed as authors.

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Conflicts of Interest

None declared.

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Abbreviations

CME: continuing medical education
LMS: learning management system
Moodle: Modular Object Oriented Dynamic Learning Environment

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Original Paper

Developing a Curriculum for Information and Communications Technology Use in Global Health Research and Training: A Qualitative Study Among Chinese Health Sciences Graduate Students

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Abstract

Background: Rapid development of information and communications technology (ICT) during the last decade has transformed biomedical and population-based research and has become an essential part of many types of research and educational programs. However, access to these ICT resources and the capacity to use them in global health research are often lacking in low- and middle-income country (LMIC) institutions.

Objective: The aim of our study was to assess the practical issues (ie, perceptions and learning needs) of ICT use among health sciences graduate students at 6 major medical universities of southern China.

Methods: Ten focus group discussions (FGDs) were conducted from December 2015 to March 2016, involving 74 health sciences graduate students studying at 6 major medical universities in southern China. The sampling method was opportunistic, accounting for the graduate program enrolled and the academic year. All FGDs were audio recorded and thematic content analysis was performed.

Results: Researchers had different views and arguments about the use of ICT which are summarized under six themes: (1) ICT use in routine research, (2) ICT-related training experiences, (3) understanding about the pros and cons of Web-based training, (4) attitudes toward the design of ICT training curriculum, (5) potential challenges to promoting ICT courses, and (6) related marketing strategies for ICT training curriculum. Many graduate students used ICT on a daily basis in their research to stay up-to-date on current development in their area of research or study or practice. The participants were very willing to participate in ICT courses that were relevant to their academic majors and would count credits. Suggestion for an ICT curriculum included (1) both organized training course or short lecture series, depending on the background and specialty of the students, (2) a mixture of lecture and Web-based activities, and (3) inclusion of topics that are career focused.

Conclusions: The findings of this study suggest that a need exists for a specialized curriculum related to ICT use in health research for health sciences graduate students in China. The results have important implications for the design and implementation of ICT-related educational program in China or other developing countries.

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KEYWORDS

information and communication technology; ICT; global health; research; training; China

Introduction

Background

Information and communications technology (ICT) can be defined as tools that facilitate communication and the processing and transformation of data by electronic means [1]. The application of ICT tools in research and training in the field of health sciences, including biomedical and population-based programs, has grown dramatically in recent years. ICT has transformed the way health care is delivered and health-related research is conducted. Meanwhile, more training programs to use ICT are delivered in developed and developing communities. The benefits of ICT use include [2]: (1) improve dissemination of public health information and facilitate public discourse around subjects that are major public health threats, (2) enable collaboration and cooperation among health workers, (3) support more effective health research and the dissemination and access to research findings, (4) improve the efficiency of health administration, and (5) improve the ability to monitor outbreaks and have effective management plans. During the last two decades, the use of ICT has contributed significantly in conducting biomedical and population-based research, improving health sector service provision and promoting health in many developed countries [3-8].

Information and Communications Technology

Within the health care context, information flow between health care providers and from health care providers to health consumers is crucial [9]. At the same time, global health research projects that are distributed across multiple countries encourage collaborations and networking for data sharing and new forms of research training. The use of ICT is crucial in expediting such global health initiatives [10], especially to address needs in the areas of health care and research, and training in low- and middle-income countries (LMICs) [11]. Building institutional capacity to create internal resources to accelerate ICT use in training and research programs is an important first step toward building global health research and training programs. However, in a developing country setting, the critical mass of professional and community users of ICTs in health generally has not yet been reached in many sectors, let alone the health sector [12]. It is in the developing world that ICTs can and should make the highest impact. This is because these populations probably require most of the benefits that are provided by the use of ICTs, such as ready access to needed clinical expertise to facilitate better diagnostic and therapeutic decisions, and ICT-based research expertise to carry out population-based or clinical research. The purpose of this study was to identify practical issues (ie, perceptions, learning needs) in developing an ICT curriculum to be used by graduate level researchers at major universities in southern China. We gathered information from graduate students, including masters and doctoral level research focused students, because they are the population who are currently engaged (or in the future will engage) in research and are in a good position to describe their perspective.

Methods

Sample and Settings

Participants were graduate students of health sciences programs (ie, population health or biomedicine) from the selected 6 major medical universities in southern China covering 4 provinces. These universities were Guangxi Medical University (GXMU), Guangxi University of Chinese Medicine (GXTCMU), Guilin Medical University (GLMU), Guangzhou Medical University (GZHMU), Kunming Medical University KMMU), and Fudan University (FDU).

Methods of Subject Recruitment

Participants were conveniently recruited during December 2015 to March 2016 in each of the participating universities. A liaison person who served as a senior researcher in each of the universities recruited subjects for focus group discussions. Selection criteria were as follows: (1) current graduate (masters or doctoral) student of any of the health sciences programs at the University who responded to our subject recruitment announcement within 1 week time frame and (2) willing to give consent to participate in the focus groups. Once we had reached our target sample size for the focus groups, we stopped recruiting.

Data Collection

A semi-structured FGD guide was developed with reference to the research team's earlier work [13,14] and pilot tested with 7 graduate students resulting in minor changes. All of the FGDs were conducted in Mandarin Chinese and audio recorded. The guide included questions on the following areas: major area of research, a definition of ICT, types of researchers who should study the application of ICT, whether ICT training is useful, past ICT-related training experiences, and pros and cons of Web-based courses. Interviewers were graduate students at the School of Public Health of Guangxi Medical University, and attended a 2-day training course designed for them. The training described the overall research projects, including logistical issues, recruitment process, familiarization with the FGD guide, and description of ICT and ICT-related research in areas of health sciences programs. The training also included a session on the ethical aspects of human subject research. Two interviewers worked as a team to collect data; one moderated the focus group and the other took detailed notes and also recorded the session with a digital voice recorder (after permission had been obtained from the participants). All focus groups were held in a private meeting room within the university and lasted for approximately 90 min. The sessions started with the moderator explaining the purpose of the group discussion and assuring confidentiality of the data collected for the research project. To compensate participants for their time, each participant was given a cash amount of RMB 50 (US $8). Written informed consent was obtained from each participant. The study was approved by the Ethics Committee of the Guangxi Medical University (No. IRB-SPH-2015: 009).

Analyses

The interviewers discussed and summarized the main content of each focus group and reviewed the notes taken immediately after the focus group. These debriefings were useful (1) to identify the most crucial themes and ideas and (2) to evaluate the demand for possible modification in the subsequent focus group. The audio recordings were reviewed and transcribed for each group during the translation of Chinese to English. Two members of the research team coded each transcript independently, with discrepancies resolved through consensus. The process of coding involved identifying central themes and highlighting these on the transcripts [15]. All additional notes taken during the course of focus group were examined to identify diversified themes presented in theses qualitative discussions. No specific software was used for the data analysis due to the small volume of the data. Rather, line-by-line coding, categorization, and theme extraction were used to conduct the content analysis [16].

Results

Participant Characteristics

A total of 10 FGDs were conducted involving 74 graduate students (Table 1).

Of the participants, 64% (48/74) were females and 53% (39/74) were first-year graduate students. Participants were affiliated with across the disciplines of population health or public health (42%, 31/74), clinical medicine (34%, 25/74), basic science (11%, 8/74), and others (13%, 10/74). The research background and areas of studies of the students varied across the university (Table 1).

The findings revealed the following 6 themes relating to the use of ICT: (1) ICT application in routine research, (2) ICT-related training experience, (3) understanding about pros and cons of Web-based training, (4) attitude toward the design of ICT training courses, (5) potential challenges to ICT course promotions, and (6) related marketing strategies for ICT training curriculum. These themes are described in the following section and supplemented by participants' statements on key themes provided in Table 2.

Information and Communications Technology (ICT) Application in Routine Research

Regarding ICT application in daily research, almost all (72/74) participants described the irreplaceable role of ICT to facilitate their academic work. They discussed using ICT for information seeking to data gathering to maintaining communication. For example, one of the participants mentioned:

> *It truly brings great convenience to scientific research, we track and get information about the latest findings in our field of research and pursue progress by searching scientific literature in the PubMed.*

Another graduate student said:

> *We are so addicted in it and cannot survive without technology. Computer andInternetuse have become part of student's daily life.For example, we use WeChat to share and seek information. We use texting,email with professional and even surfInternetand download papers with ICT.Ihave no idea where my experiment would go without the help of some specific technology.*

Use of ICT tools to check emails was common among the participants with about half (37/74) checking their emails daily and few (9/74) checking at least weekly.

Graduate students thought that ICT brings convenience to their research by synthesizing information and ensuring accuracy. One of the interviewees said:

> *Most of the ICT-related skills are easy to acquire and not that professional, I wonder whether there are some authoritative ICT skills can benefit our research.*

One of the students added:

> *The desire to acquire skills could drive us to take the initiatives of self-guided learning.*

ICT-Related Training Experiences

Less than half (43%, 32/74) of the participants took some training course relating to ICT. The following courses were mentioned very often: basic computer programming and R language, PPT-training (ie, how to make presentation in a scientific meeting or in the group), PubMed for searching scientific literature, Medical Statistics (a required course for most medical universities in China, Web-based course training such as CET-4 or CET-6 (an English test for Chinese college students), and the Party lecture (delivering basic theories of the Communist Party of China by lectures). Participants' willingness to attend professional ICT course varied across the universities. For example, all students of GLMU were willing to attend ICT course, whereas at GXMU about two-third (20 out of 32) and at FDU about one-third (3 out of 9) were willing to do so. A time constraint was the main reason for students' unwillingness to attend ICT courses. One student said:

> *I want to attend more courses on the application of ICT, but I may not have time to attend regularly...*

A participant added:

> *I did attend a ICT course when I was a freshman, but I forgot most of the details since lack of practice after class,butIsuppose the use of ICT can help a lot in my study.*

Understanding About the Pros and Cons of Web-Based Training

Students' impression about the idea of a Web-based course, in general, was mostly positive. Students thought that the access to varieties of lectures from prestigious universities including Ivy League schools would enrich their learning experience and professional knowledge. The flexibility and convenience along with abundant content were mentioned as the common advantages in the FGDs.

Several common disadvantages of Web-based courses were mentioned by students across the universities: lack of interactions, poor quality and out dated content, and the high price to attend the course. One graduate student mentioned:

> *Online course do possesses a large amount of advantages, for instance, it is time-saving and labor-saving,out of the restriction of location and time. But, sometimes,Iwas lost in thelargenumber of online courseavailable,Icannot select out the ones that were most useful to me and my professional development.*

Another student added:

> *Online course lacks face-to-facecommunicationswith teachers...alsoour confusion cannot be solved instantly.*

Table 1. Demographic characteristics of focus group discussion (FGD) participants (N=74).

Demographic characteristics	GXMU[a] (n=32)	GXTCMU[b] (n=12)	GLMU[c] (n=7)	GZHMU[d] (n=7)	KMMU[e] (n=7)	FDU[f] (n=9)
Focus group discussion date	November to December, 2015	March 25, 2016	March 21, 2016	May 20, 2016	April 19, 2016	March 28, 2016
Gender						
Male	11	9	0	4	1	1
Female	21	3	7	3	6	8
Age, mean (SD[g])	24.56 (1.50)	26.84 (3.74)	25.71 (0.49)	25.43 (2.94)	25.14 (1.21)	26.64 (0.67)
Public health	11	2	0	7	7	4
Clinical medicine	6	7	7	0	0	5
Basic science	6	2	0	0	0	0
Others (ie, nutrition, pharmacology)	9	1	0	0	0	0
Grade of study						
First-year graduate	18	10	0	4	4	3
Second-year graduate	8	2	7	3	2	3

[a]GXMU: Guangxi Medical University.
[b]GXTCMU: Guangxi University of Chinese Medicine.
[c]GLMU: Guilin Medical University.
[d]GZHMU: Guangzhou Medical University.
[e]KMMU: Kunming Medical University.
[f]FDU: Fudan University.
[g]SD: standard deviation.

Table 2. Typical statements made by participants by key themes.

Themes	Examples of typical statements made by the participants
Attitudes toward ICT[a]	A tool for learning knowledge; the development of software; the spread and promotion of technology as well as new information; supplementary means to improve the efficiency in the field of scientific research.
	A mean of sharing information and getting the newest information; the technology that offers convenience to all society members.
	A form similar to online-to-offline (O2O) pattern which was put forward by Jack Ma; information dissemination, storage, analysis, and transmission in the era of big data.
	Electronic equipment related to computer; offer help to scientific research and life with science and technology equipment to; tools for electronic information transmission.
	The category from daily email to literature retrieval and paper check in the field of graduate students' research topics; a perfect combination between communication and information technology.
	The way to get information from the Internet (statistical software, information retrieval, mobile phone app, Google Glass, Leonardo's Robot, and so on)
ICT application in routine research	Searching and reading electronic journal and papers (ie, PubMed); academic teleconference; translate the latest and updated foreign publications; online courses relevant to different research methods or educational programs to support professional development.
	Software in research, such as the software for monitoring and calculating the time of apoptosis; monitoring system about punching in and out in the laboratory.
	Patients' health data and information can be uploaded and stored to the hospital by using ICT; launch and feedback of questionnaires; long-distance diagnosis and treatment as well as teaching.
	Some apps relevant to the information of patients with AIDS[b]; the application of GIS[c] system in scientific research; fingerprint attendance, and so on.
	Mobile phone and email, GIS, WeChat subscription in the field of scientific research; relevant software about prediction of experimental results; e-learning; MED Analysis; online English course.
	Fitness app; operation robots; some large medical equipment for health care treatment.
Understanding about the pros and cons of Web-based training (advantages)	Convenient and out of the restriction of location and time.
	Contents are rich and could be learned repeatedly.
	It's possible for students to have online courses based on their own arrangements; promote resources sharing and academic exchanges.
	Online courses are helpful to improve educational equity.
	Online course are time-saving and labor-saving.
	Online courses are good for resources sharing with other academicians and professionals.
	Online courses are convenient and cheap.
	Course time could be arranged by individuals; some online courses could be downloaded based on individual interests.
Understanding about the pros and cons of Web-based training (disadvantages)	Ask interactive communication; not good for weak willpower learners as they easily got absent-minded.
	Some online-courses are expensive.
	Some free online courses are free of time limit, students are prone to become lazy.
	Lack of academic atmosphere; not possible to raise questions after a course.
	There are too many online courses and it is difficult to pick up appropriate courses.
	It's difficult for students to overcome their laziness and persist in learning all courses.
	Commercial advertisements are added in some online courses which direct users to nonrelevant sites.
	Students are interested in online courses at the beginning, but they lose their interests quickly due to the vagueness of courses and lack of professional answers to problems.

Themes	Examples of typical statements made by the participants
Attitudes toward the design of ICT training curriculum	Course contents should be authoritative and classified enough for different majors; the length of course time could be arranged individually based on students' interests.
	It's easy to learn lessons by exploring medical websites; it's better to have interactive questions and answers after classes; forms of ICT training courses should be flexible.
	It's better to have ICT training courses on the Internet; the time of an online ICT training course should not be over 20 min, whereas the time of a practice course could be extended appropriately.
	Traditional methods and theories should be combined with practices; ICT training courses would not be selected by students willingly if the conduct of ICT training courses is linked to students' academic degrees and credits because the effect of being forced to learn is always less satisfactory.
	The course time and main content even schedule totally depend on individual's choices.
	The courses with hands-on practices are more interesting; it's more important to introduce the approaches and solutions to solve problems than merely delivering theories.
Potential challenges to promoting ICT courses	Whether ICT or ICT training courses are relevant to difficult majors and can cater students' interest; to promote ICT training courses, we could deliver lectures for targeting potential students accurately.
	There will be competitions which come from the similar brand courses when promoting courses at the beginning.
	By giving gifts at the very beginning and showing the greatest benefit of the courses or the new technologies. Provide some demo courses and show feedback of user experience.
	Concerns about course's cost; the authority of the courses' contents.
	Due to the reliance on electronic technology, the loss of data would be irreparable if the system collapses.
	Some software are blocked due to copyright; people may consider to learn ICT only when it is needed because of the limit of time and energy; the quality of the electronic questionnaires cannot be confirmed.
Marketing strategies for ICT training curriculum	Take advantage of celebrity effect and employ the renowned professors to promote the course.
	Shows people the successful experience of previous course and ICT application in research.
	The titles of the courses should be understood easily and eye-catching to raise interest.
	By playing short videos about the course and explaining the benefits.

[a]ICT: information and communications technology.

[b]AIDS: acquired immunodeficiency syndrome.

[c]GIS: geographic information system.

Attitude Toward the Design of ICT Training Course

When asked about the design of ICT training courses, opinions differed across the universities. Some students were in favor of more organized training courses whereas some were in favor of short seminars or lectures. When asked about desired forms of teaching methods for ICT training course, one participant said:

> *It would be better if traditional teaching methods were combined with the modern method (ie, an online course), we would welcome some novel class formats such as workshop, new lecture-delivery methods, group discussions.*

Several students thought that the length of a course and the time required should be specified according to students' major and areas of research.

One of the participants mentioned:

> *If a course is useful for my major and research,Ifeel obliged to learn the course material again and again untilIhave acquired the skills being taught.*

When asked whether a course should be linked to a student' academic degree and credits, 68 out of 74 graduate students (92%, 68/74) were strongly against it. One of the students stressed:

> *ICT courses are always less satisfactorywhenbeing forced to learnin a formal classroom setting.*

One participant voiced concern:

> *Having access to a computer (desktop orlaptop)is a necessary step to using ICT, but some student who come from poorer backgrounds cannot afford buying a computer,Iguess this is the priority.*

Potential Challenges and Strategies for ICT Course Promotion

The participants in FGDs listed a series of unfavorable factors: whether the course is relevant and pertinent to each individual's majors, how the grading in the ICT course is linked to their overall academic grading, and best practice of other universities related to ICT courses.

For example, a student said:

> *Tied in heavily on daily schedule, we would think twice whether we accept an ICT course or not.*

Another student added:

> *If the ICT course is not relevant to my current research, Iwould definitely pass it, we are too busy to burden too many tasks.*

One of the participants doubted:

> *Is there rich evidence showing that the ICT made huge contribution to medical research than any other field?*

Apart from above statements, an ICT course's financial expenditure and time costs were also emphasized by 35 out of 74 participants (47%, 35/74) in the focus groups.

Marketing Approaches for ICT Courses

Few students (9 out of 74) suggested approaches to promote ICT courses, such as posting advertisements at university websites and employing professional experts to market the course. One graduate student suggested:

> *In order to promote ICT course among students, we could rely on various types of social media such as Wechat, Weibo (China's version of Twitter),and publicizing posters around the university campus.*

A participant stressed:

> *To the best of my knowledge, feedback from former student is the most useful way to popularize an ICTcourse,therefore engaging former students in the promotion of a new ICT course would be useful.*

Several students deemed that it is necessary to set some ICT course as a required course for graduate students. They said:

> *Some students won't spend time on any course unless they realized it is useful or the course is a required course.*

In addition, 12 out of 74 students (16%, 12/74) suggested providing demo classes to target students and offering free lectures for the entire school as ways to promote a new ICT course.

Discussion

Principal Findings

This study is among the first in China that explored the nature and need for ICT-related training for research focused graduate students at medical universities in China. This study informed us of the situation and level of implementation of ICT use-related training at these medical universities. Whereas the participants' understanding and attitudes varied from individuals to individuals, this documented important information about the nature of ICT training that would be applicable to graduate students engaged in biomedical or population-based research. Based on our findings, the usefulness of ICT for research focused graduate students lies in the ability to collect and analyze data, synthesize information from the Internet, and for use in teleconferencing. Participants identified some popular methods they had used on a daily basis in their research such as software used to identify information related to patients with chronic diseases, and geographic information systems (an information system that is used to input, store, retrieve, manipulate, analyze, and output geographically referenced data or geospatial data). Information sources included Wechat subscriptions and PubMed, which were used for identifying and tracking current and past research findings, conducting questionnaire-based surveys, and for analyzing experimental results. Early studies also reported that health-oriented social networking groups may represent a future for health care, medical practice, and medical research that is radically different from those used several decades ago [17,18].

Current advances in ICT that have been transforming our society have tremendous potential to improve health care in areas such as administrative and clinical care, consumer health, biomedical and health services research, financial transactions, professional education, and public health. The participants stressed their strong willingness to participate in highly specialized ICT courses related to their academic majors or the types of courses that would give them a better understanding of their research fields. In a study by Teresa et al [19], therapists used ICT for work management tasks and professional development. In addition, novel teaching methods (ie, workshops, group discussions) would seem to be more welcomed among graduate students if they are developed in a way that could stimulate and motivate the students as well as assist them in fostering sensible learning habits and efficient self-study methods.

Limited time and energy, value of an ICT course to individual's research, as well as financial implications are the main challenges to promoting an ICT curriculum. With the widespread use of the Internet, the new information age has brought us a great amount of convenience in that we are able to obtain enough information about many topics with only a few simple clicks. In this study, a considerable number of participants complained that they became confused, wasted time, and became distracted by an incredibly large quantity of information available when they searched on the Web. These results confirmed a previous finding that magnanimous information and a bewildering variety of Web links have occupied much of our time and energy [20,21]. Therefore, it is quite understandable that graduate students would think twice when a new curriculum or new course pops up and becomes available. Considerations such as how long would a course of study last and what are the fee standards involved will require considerable discussion. Novel ICT curriculum with highly specific and pertinent information related to their major would be more welcomed by already time-stressed graduate students in the health sciences field. Apart from what we discussed above, the copyright of specific software and cultural factors may also affect the promotion of ICT curricula [22-24].

Strengths and Limitations

The strengths of our study were not only the diverse range of respondents involved in the study in terms of specialty, gender, grade, work experience, and location (6 different cities in southern China), but also by the participation of research focused graduate students from different medical universities and health sciences schools that allowed us to gather varying views. One limitation was that all participants were recruited from only 6 cities in southern China, limiting our ability to generalize the findings to attendees in other areas of China. However, this study represents the first known qualitative study that focuses on the thoughts and attitudes of ICT use and ICT training among research focused graduate students studying in different areas of health sciences field in China. The findings should encourage more research in this area with the goal of promoting the development and use of ICT curriculum to promote health sciences research in LMICs.

Conclusions

This is the first qualitative study in China, which reflects the perceptions and needs of research focused health sciences graduate students toward ICT and its expanding use in biomedical and population-based research and training. The findings highlight the graduate students' demand for organized ICT curriculum along with the positive and negative aspects of currently available ICT tools (ie, Web-based education programs). Whereas a need exists for a nation-wide survey to better understand ICT use among graduate students engaged in health sciences research across medical universities throughout China, the current local findings provide some basis that could be used in the development of a training program or a model curriculum to be used by graduate students engaged in biomedical or population-based health research.

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Conflicts of Interest

None declared.

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Abbreviations

AIDS: acquired immunodeficiency syndrome
FDU: Fudan University
FGD: focus groups discussion
GIS: geographic information system
GLMU: Guilin Medical University
GXMU: Guangxi Medical University
GXTCMU: Guangxi University of Chinese Medicine
GZHMU: Guangzhou Medical University
ICT: information and communications technology
KMMU: Kunming Medical University
SD: standard deviation

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Original Paper

When Educational Material Is Delivered: A Mixed Methods Content Validation Study of the Information Assessment Method

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Abstract

Background: The Information Assessment Method (IAM) allows clinicians to report the cognitive impact, clinical relevance, intention to use, and expected patient health benefits associated with clinical information received by email. More than 15,000 Canadian physicians and pharmacists use the IAM in continuing education programs. In addition, information providers can use IAM ratings and feedback comments from clinicians to improve their products.

Objective: Our general objective was to validate the IAM questionnaire for the delivery of educational material (ecological and logical content validity). Our specific objectives were to measure the relevance and evaluate the representativeness of IAM items for assessing information received by email.

Methods: A 3-part mixed methods study was conducted (convergent design). In part 1 (quantitative longitudinal study), the relevance of IAM items was measured. Participants were 5596 physician members of the Canadian Medical Association who used the IAM. A total of 234,196 ratings were collected in 2012. The relevance of IAM items with respect to their main construct was calculated using descriptive statistics (relevance ratio R). In part 2 (qualitative descriptive study), the representativeness of IAM items was evaluated. A total of 15 family physicians completed semistructured face-to-face interviews. For each construct, we evaluated the representativeness of IAM items using a deductive-inductive thematic qualitative data analysis. In part 3 (mixing quantitative and qualitative parts), results from quantitative and qualitative analyses were reviewed, juxtaposed in a table, discussed with experts, and integrated. Thus, our final results are derived from the views of users (ecological content validation) and experts (logical content validation).

Results: Of the 23 IAM items, 21 were validated for content, while 2 were removed. In part 1 (quantitative results), 21 items were deemed relevant, while 2 items were deemed not relevant (R=4.86% [N=234,196] and R=3.04% [n=45,394], respectively). In part 2 (qualitative results), 22 items were deemed representative, while 1 item was not representative. In part 3 (mixing quantitative and qualitative results), the content validity of 21 items was confirmed, and the 2 nonrelevant items were excluded. A fully validated version was generated (IAM-v2014).

Conclusions: This study produced a content validated IAM questionnaire that is used by clinicians and information providers to assess the clinical information delivered in continuing education programs.

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KEYWORDS

validity and reliability; continuing education; Internet; electronic mail; physicians, family; knowledge translation; primary health care

Introduction

Theoretical Model and Development of the Information Assessment Method

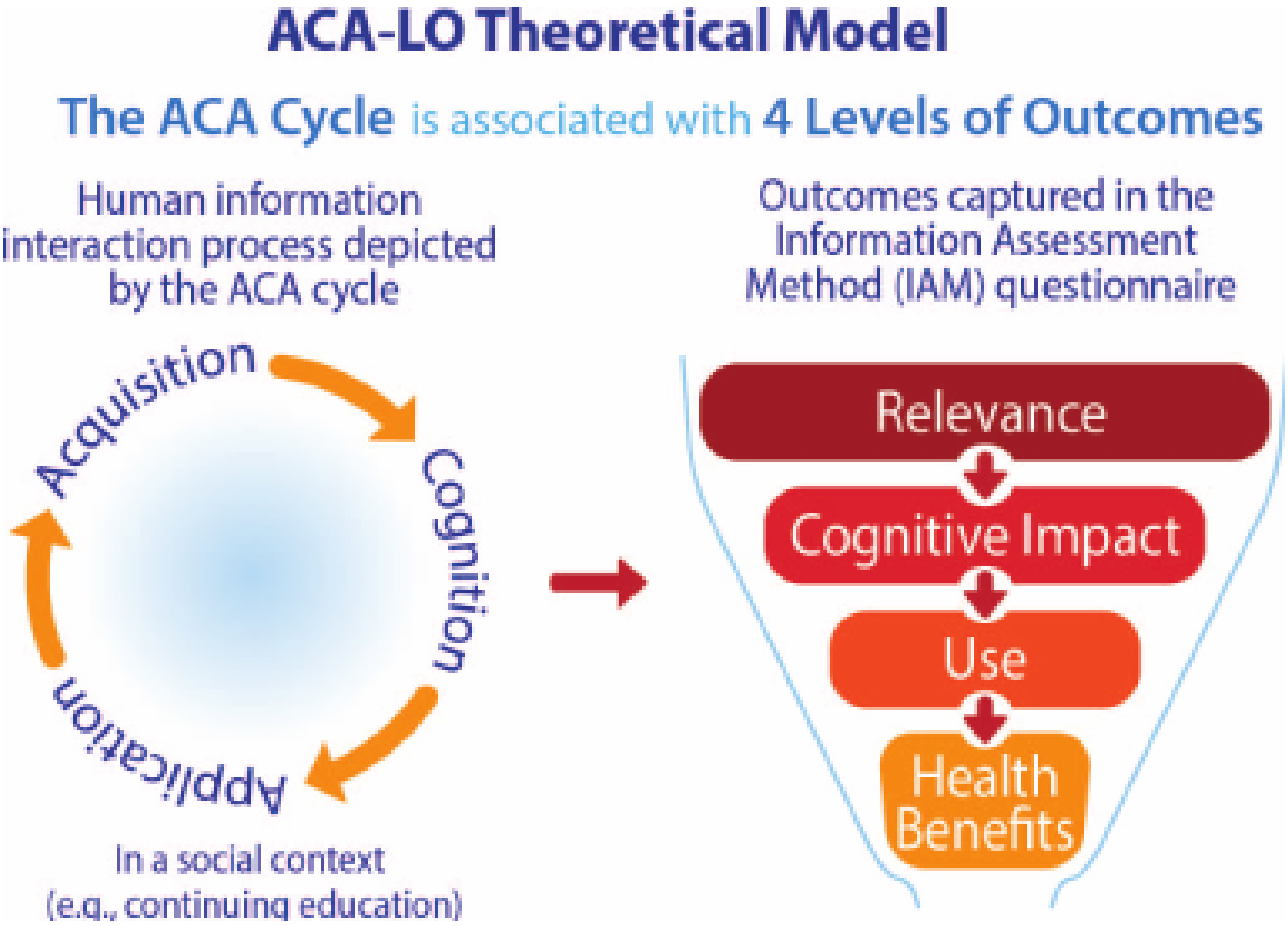
This paper reports the content validation of an original method for assessing the value of educational material delivered to the health professionals from their perspective. Numerous clinically relevant research studies are published daily; thus, it is impossible for health professionals to filter and absorb all this information. Educational programs strive to overcome this issue, through Web-based information resources and email alert services. In particular, clinical emailing channels deliver educational material to health professionals, such as a Daily POEM research synopsis (POEM stands for Patient-Oriented Evidence that Matters) or a Highlight (a weekly email with evidence-based treatment recommendation) [1-3]. As shown in an earlier article, family physicians perceive advantages from receiving educational material via email [4].

The purpose of this study was to validate a method for assessing the perceived value of information (educational material) delivered by email from the perspective of family physicians (information users). The Information Assessment Method (IAM) is used by more than 15,000 Canadian pharmacists and physicians as a continuing education tool for assessing (reflective learning) outcomes of information delivered in educational programs. The physicians described in this study participate in the longitudinal Daily POEMs program, sponsored by the Canadian Medical Association. This program is certified for continuing medical education credit by the College of Family Physicians of Canada and the Royal College of Physicians and Surgeons of Canada. For each completed IAM questionnaire (reflective learning activity), physicians earned credits. Then, we used the IAM ratings for this validation study. Saracevic and Kantor [5] defined the perceived value of information as an “Acquisition-Cognition-Application” process; subsequently, we linked this process to 4 levels of outcome of information in a theoretical model, which has been operationalized by the IAM questionnaire. Presented elsewhere, the ACA-LO (Acquisition Cognition Application – Levels of Outcome) model explains the “value” of information, that is, how information is valuable from the users’ viewpoint [6-8]. Health professionals subscribe to an alerting service and then acquire a passage of text (acquisition), which they read, understand, and integrate (cognition). Subsequently, they may use this newly understood and cognitively processed information for a specific patient (application). The corresponding subsequent 4 levels of outcomes are as follows: the situational relevance of the information (level 1), its cognitive impact (level 2), the use of this information (level 3), and subsequent health benefits (level 4; Figure 1).

The IAM is a systematic and comprehensive method to assess information from the perspective of the information users; different versions of the IAM questionnaire have been developed for and used by the public (patients and parents) and health professionals (nurses, pharmacists, and physicians) [1,2,7-13]. The IAM can help assess electronic knowledge resources in the context of the “pull” or the “push” of information. A “push-pull acquisition-cognition-application” of information conceptual framework has been published elsewhere [2,14]. On the one hand, “pull” refers to information-seeking behavior, such as a search for information in an electronic knowledge resource. “Push,” on the other hand, refers to information delivery and is currently used in multiple health domains such as continuing education, disease prevention, health education, medical treatment, and nutrition [1,10,15-19]. This is a type of passive acquisition of information such as email alerts.

With respect to the physicians’ evaluation of clinical information in a “push” context, the 2011 version of the IAM questionnaire (IAM-v2011) contained 23 items distributed on 4 constructs (derived from the 4 levels of outcomes): (1) the “cognitive impact” construct contains 6 items of positive impact and 4 items of negative impact (cognitive impact of information on clinicians), (2) the “clinical relevance” construct contains 3 items (relevance of information for a specific patient), (3) the “clinical use” construct contains 7 items (information use for a specific patient), and (4) the “health benefits” construct contains 3 items (expected health benefits for a specific patient; Multimedia Appendix 1). In a “push” context, clinical information will in some way impact a clinician’s continuing education in general (eg, learning something new about a medical intervention) but may not be necessarily relevant for a clinician’s specific patient (in contrast to the “pull” context where clinicians typically seek information for a situation linked to the care of a specific patient). Thus, we sequenced the IAM questions in a pragmatic order (rather than a theoretical order); as such, questions that operationalize the “cognitive impact” construct (level 2) were presented before questions regarding the “clinical relevance” construct (level 1). Hereafter, we follow this pragmatic order. Specifically, the IAM questionnaire has been refined iteratively since 2001 through literature reviews, qualitative, quantitative, and mixed methods research [20]. It allows information users, including professionals, to systematically report these outcomes for each piece of information such as one educational email. For example, in the context of lifelong learning, 13,444 family physician members of the College of Family Physicians of Canada used the IAM to stimulate reflective learning and earn continuing education credits between January 2010 and December 2014 [1]. This process allowed them to rate Highlights that are weekly treatment recommendations from a reference Web-based resource called RxTx. Along with ratings, participants provided constructive feedback to the information provider (the Canadian Pharmacists Association), which was then used to improve the information content of RxTx [21]. This paper addresses the following problem: the IAM has not been fully validated in the “push” context (for information delivery). Regarding the IAM-v2011 for the “push” context, items were developed in line with guidance from Haynes et al [22]. In previous work, we conducted discussions with experts, as well as literature reviews, qualitative, quantitative, and mixed methods research studies [1,2,9,11,21,23-27]. In this paper, we report an evaluation of the content validity of the IAM-v2011.

Figure 1. The Acquisition Cognition Application – Levels of Outcome (ACA-LO) theoretical model (reproduced by the permission of the American Board of Family Medicine) [3].



Literature Review

One important aspect of the content validation of an assessment tool such as the IAM questionnaire is to ensure that all aspects of the measure are covered [22]. Hence, we reviewed the literature (qualitative, quantitative, and mixed methods studies) about outcomes associated with educational email alerts. The included studies were (1) primary research studies, (2) on educational emails directed to physicians, (3) on outcomes of emails, and (4) reported in English. Specifically, we included the 5 research studies that were included in a 2010 review [2] and tracked research papers (up to March 2014) cited by or citing these studies and 3 literature reviews on educational emails (using the Scopus comprehensive bibliographic database). In addition, we conducted personal searches, for example, in Google Scholar. In total, 258 records were identified (146 from Scopus and 112 from personal searches). Full-text publications were retrieved and screened. A total of 13 studies were included [11,14,26-36]. The included studies had diverse designs: 6 quantitative descriptive studies, 2 randomized controlled trials, 2 qualitative research studies, 2 mixed methods research studies, and 1 quantitative prospective observational study. A thematic synthesis was conducted, and the findings are presented in Table 1. Regarding the outcomes of information constructs, (1) “cognitive impact” was reported in 9 studies, (2) “clinical relevance” was reported in 6 studies, (3) “clinical use” was reported in 8 studies, and (4) “health benefits” was reported in 5 studies. No other construct was reported. No instrument similar to the IAM was found in the literature. Our synthesis supported the 4 constructs covered in the IAM questionnaire, when educational emails are delivered to physicians. Therefore, this paper is aimed to evaluate the content validity of the IAM-v2011 from the perspective of physicians who use the IAM in the context of educational material delivered to physicians.

Table 1. Description of the included studies.

Author (year), study title, country	Study design, setting, participants, data collection, data analysis	Intervention	Relevant outcomes	Reported level of outcome
Cook et al (2013), Features of Effective Medical Knowledge Resources to Support Point of Care Learning: A Focus Group Study, Australia [32]	Design: qualitative study. Intervention and setting: 11 focus groups at an academic medical center. Participants: 50 primary care and subspecialist internal medicine and family physicians. Data analysis: comparative inductive thematic	Focus group interview	Features that influence users' selection of knowledge resources: (1) comprehensiveness, (2) search ability and brevity, (3) integration with clinical workflow, (4) credibility, (5) user familiarity, (6) capacity to identify a human expert, (7) reflection of local care processes, (8) optimization for the clinical question (eg, diagnosis, treatment options, drug side effect), and currency, and (9) ability to support patient education	Cognitive impact, information use, clinical relevance, health benefits
Ebell and Grad (2012), Top 20 Research Studies of 2011 for Primary Care Physicians, United States and Canada [31]	Design: a longitudinal Web-based summary of the most relevant, practice-changing POEMs[a] from 2011 as determined by Canadian raters using IAM-v2011.	Review	Based on IAM[b] user ratings, these 20 POEMs contain information that is most relevant for primary care physicians	Clinical relevance
Ebell and Grad (2013), Top 20 Research Studies of 2012 for Primary Care Physicians, United States and Canada [33]	Design: a longitudinal Web-based summary of the most relevant, practice-changing POEMs from 2012 as determined by Canadian raters using IAM-v2011.	Review	Based on IAM user ratings, these 20 POEMs contain information that has cognitive impact, is clinically relevant, is used, has health benefits for the patient, and is most relevant for primary care physicians	Clinical relevance
Galvao et al (2013), The Clinical Relevance of Information Index (CRII): Assessing the Relevance of Health Information to the Clinical Practice, Canada [27]	Design: a longitudinal Web-based study. Data collection: IAM rating of physicians in response to educational emails. CRII was applied to 4574 relevance assessments of 194 evidence synopses sent by email. Participants: 41 family physicians in 2008. Data analysis: descriptive statistical analysis.	Educational emails	The CRII is only weakly correlated with the number of citations received by a study and the level of evidence of the study. The CRII captures aspects of information not considered by other indices to be used by information providers, institutions, editors, as well as health and information professionals targeting knowledge translation.	Clinical relevance
Grad et al (2011), Do Family Physicians Retrieve Synopses of Clinical Research Previously Read as Email Alerts? Canada [14]	Design: mixed methods study. Participants: 41 family physicians. Settings: 9 different provinces of Canada. Intervention: IAM linked to POEM emails and searches in Essential Evidence Plus. Data collection: QUAN[c]: Pull, from PDA, Push, from IAM of POEMs. QUAL[d]: interview. Analysis: QUAN: descriptive statistics, QUAL: thematic.	Educational emails and face-to-face interviews	Family physicians purposefully retrieved a synopsis they had previously read as email. Factual knowledge from brief reading of email alerts of synopses may be simply forgotten. The ability of family physicians to remember synopses they previously read declined over time.	Cognitive impact

Author (year), study title, country	Study design, setting, participants, data collection, data analysis	Intervention	Relevant outcomes	Reported level of outcome
Law et al (2008), Facilitating Knowledge Transfer Through the McMaster PLUS REHAB Project: Linking Rehabilitation Practitioners to New and Relevant Research Findings, Canada [30]	Design: a longitudinal Web-based study. Setting: Mac-PLUS REHAB project, Canada. Participants: 1000 practicing occupational therapists and physiotherapists. Data collection: email alerts about new evidence tailored to the users' interest profile allow them to interact and submit feedback. Data analysis: descriptive statistical analysis.	Educational emails	PLUS REHAB: (1) helps occupational health professionals access and uptake of information, (2) speeds up the knowledge transfer process, (3) supports practice and knowledge sharing, (4) evaluates the effect of push-out technology on uptake and use of evidence-based knowledge, and (5) makes knowledge accessible by individualizing alerts, providing a credibly rated and trustworthy system of relevant articles and saving many valuable hours.	Cognitive impact, information use, clinical relevance
Leung et al (2010), A Reflective Learning Framework to Evaluate CME Effects on Practice Reflection, Canada [34]	Design: qualitative multiple case study. Participants: 473 practicing family physicians commented on research-based synopses after reading and rating them as an online (pull and push) CME learning activity. Data collection: these comments formed 2029 cases from which cognitive tasks were extracted. Data analysis: thematic analyses and cross-case analysis.	Internet (push) educational activities	Four cognitive processes and 12 cognitive tasks were supported. Reflective learning was defined as 4 interrelated cognitive processes: (1) interpretation, (2) validation, (3) generalization, and (4) change. Reflective learning performances of family physicians were evaluated.	Cognitive impact
McMullin and Singh (2006), A Single Email to Clinicians May Improve Short-Term Prescribing for People With Coronary Artery Disease and Raised LDL[e] Cholesterol, United States [29]	Design: randomized trial. Participants and settings: 14 US primary care physicians in academically affiliated practice. Data collection: physicians were blinded to group allocation. Intervention and data collection: intervention group received a single email, provided decision support, and facilitated "one-click" actions such as prescriptions, updating charts, and mailing out educational materials. Data analysis: descriptive statistical analysis.	Educational emails	The intervention group participants were more likely than controls to change their prescription. Median time to the first medication adjustment was earlier in the intervention group. LDL cholesterol levels for people with baseline levels greater than 130 mg/dL were significantly lower in the intervention group (119 vs 138.0 mg/dL). It took physicians less than 1 minute to process each email. A single email to primary care physicians could influence prescribing and may improve hyperlipidemia management in the short term.	Information use, health outcome
Pluye et al (2010), Evaluation of Email Alerts in Practice: Part 2 – Validation of the Information Assessment Method, Canada [26]	Design: mixed methods sequential explanatory. Data collection: a daily educational email was sent to 12,800 doctors. Participants: 1007 family doctors who submitted 61,493 ratings of "cognitive impact" (QUAN) and 46 doctors were interviewed (QUAL). Setting: Canada (QUAN), McGill academic setting (QUAL). Data analysis: descriptive statistical analysis (QUAN) and deductive thematic analysis (QUAL).	Educational emails and face-to-face interview	IAM contributes to: (1) research for systematically assessing and comparing the relevance, cognitive impact, use, and expected health outcomes associated with email alerts; (2) continuing professional development for documenting brief individual e-learning activities; and (3) two-way knowledge exchange between information providers and clinicians for improving email alerts.	Cognitive impact, clinical relevance, information use, health benefits

Author (year), study title, country	Study design, setting, participants, data collection, data analysis	Intervention	Relevant outcomes	Reported level of outcome
Pluye et al (2012), Feasibility of a Knowledge Translation CME Program: Courriels Cochrane, Canada [11]	Design: a longitudinal evaluation study. Data collection: participants received weekly emails with synopses of Cochrane reviews and rated them using the IAM. Participants: 985 French-speaking family physicians. Setting: Canada. Data analysis: statistical descriptive analysis	Educational emails and IAM questionnaire	Of 1109 completed questionnaires: 87.7% reported positive cognitive impact.75.3% reported the information was clinically relevant.53.7% reported that information use.51.3% of ratings contained reports of information use was associated with health benefits	Cognitive impact, clinical relevance, information use, health benefits
Schopf and Flytkjær (2012), Impact of Interactive Web-Based Education With Mobile and Email-Based Support of General Practitioners on Treatment and Referral Patterns of Patients with Atopic Dermatitis: Randomized Controlled Trial, Norway [36]	Design: randomized controlled trial. Participants: general practitioners, Norway. Intervention: a Web-based course on atopic dermatitis with guidance via email from specialists. Data collection: 46 physicians: 24 doctors were allocated to the intervention group and 22 doctors to the control group. Data analysis: descriptive statistical analysis.	Educational emails	There were no statistically significant differences in the duration of topical steroid treatment or number of treatment modalities between the groups. The lack of effect on the primary outcome may be due to attrition as 54% of the participants did not complete the course; 42% (10/24) of physicians sent at least one educational request via email. While 11% (8/73) of treatment reports in the intervention group were referred to a medical specialist (eg, dermatologist or pediatrician).	Information use, health benefit
Strayer et al (2010), Updating Clinical Knowledge: An Evaluation of Current Information Alerting Services, United States [28]	Design: Web-based study. Data collection: a 7-item checklist (push tools) based on evidence-based medicine was created and assessed for content validity and face validity. Participants: practicing clinicians, clinician researchers, and experts (n=7). Data analysis: descriptive statistics analysis	Educational emails information assessment tool	A checklist was created and can be used to reliably assess the quality of clinical information updating (push) tools. This tool will improve the application of basic evidence-based medicine principles to new medical information in order to increase their usefulness to clinicians.	Cognitive impact, information use
Wang et al (2009), The Cognitive Impact of Research Synopses on Physicians: A Prospective Observational Analysis of Evidence-Based Summaries Sent by Email, Canada [35]	Design: prospective observational study. Intervention and data collection: research synopses sent by email. Each synopsis was classified as either positive or negative based on physician-reported impacts. A total of 1960 Canadian physicians submitted 159,442 ratings on 193 synopses. Each synopsis was assessed on average by 826 physicians. Participants and setting: physicians, Canada. Data analysis: statistical analysis descriptive and logistic regression.		There were 28.3 negative ratings per research synopsis, 146.3 neutral, and 656.2 positive. Out of the 7 characteristics (number of characters, research design, study setting, number of types of patient populations studied, number of comparisons, number of outcomes, and number of results) analyzed, only the number of comparisons had a statistically significant influence on physician ratings. An increase in the number of comparisons or the number of results decreased the likelihood of a negative impact. Characteristics of the synopses appear to influence cognitive impact, and there might be lexical patterns specific to these factors.	Cognitive impact

[a]POEM: Patient-Oriented Evidence that Matters.

[b]IAM: Information Assessment Method.

[c]QUAN: quantitative.

[d]QUAL: qualitative.

[e]LDL: low-density lipoprotein.

Methods

Mixed Methods Design

We used a 3-part mixed methods convergent design (quantitative, qualitative, and mixing) [37,38]. In the quantitative part, the relevance of IAM-v2011 items was measured using data collected from a Web-based longitudinal study. In the qualitative part, we evaluated the representativeness of IAM-v2011 items and their relationship to the IAM constructs. Considering that ecological content validation is determined by the end users [39,40], the viewpoint of actual IAM users was needed, and participants were IAM users in the quantitative and qualitative parts of the validation study. In the mixing part, quantitative and qualitative results were integrated and discussed with experts.

We conducted an evaluation of the ecological and logical content validity of the IAM-v2011. Validity refers to whether a test measures what it is supposed to measure [41-44], and content validity is defined as “the degree to which elements of an assessment instrument are *relevant* to and *representative* of the targeted construct for a particular assessment purpose” [22]. The *relevance* of an assessment instrument refers to the appropriateness of its elements for the targeted construct and function of assessment. For example, the relevance of an item refers to the degree to which this item is likely to accomplish the goal implied by the construct. Relevance can be evaluated through quantitative methods. The *representativeness* of an assessment instrument refers to whether its elements cover all facets of the targeted constructs. For example, a representative item gives a good indication of what its construct is intended to measure. Representativeness can be evaluated through qualitative methods.

Content validity can be divided into (1) logical content validity in which a determination is left to experts and (2) ecological content validity in which the determination is obtained from the users [39]. Ecological validity is the degree to which the behaviors observed and recorded in a study reflect the behaviors that actually occur in natural settings [39]. Our general objective was to assess the logical and ecological content validity of IAM-v2011 for educational email alerts. In line with standard procedures for content validation of evaluation tools [22], our specific objectives were to measure the relevance and evaluate the representativeness of IAM-v2011 items for assessing information received via email alerts.

Part 1: Quantitative Longitudinal Study

A Web-based longitudinal study was conducted. We considered all 2012 IAM ratings submitted by physicians after reading a Daily POEM email alert [33]. Tailored to a primary care audience, Daily POEMs are synopses of original primary research or systematic reviews, selected after scanning and critically appraising studies published in 102 medical journals. A total of 270 Daily POEMs were emailed to physician members of the Canadian Medical Association in 2012. Participants were all physicians across Canada who subscribed voluntarily to receive Daily POEMs and rated at least one POEM in 2012 using the IAM-v2011 as a requirement to obtain continuing education credit. From 5596 physicians, we collected 234,196 IAM completed Web-based questionnaires (ratings) from January 1 to December 31, 2012. Regarding the data analysis, for each IAM-v2011 item of the construct, a ratio (R) was calculated using the formula shown in Figure 2.

Stated otherwise, for each construct or subconstruct, the relevance ratios of all items were calculated. For example, with regard to the item “I learned something new,” the relevance ratio R was calculated as follows. The number of completed questionnaires where this item was selected was divided by the total number of IAM questionnaires in which at least one item of the “Positive cognitive impact” construct was selected. In line with the standards for educational and psychological testing [45], validation is a joint responsibility of the developer and the knowledge user. IAM knowledge users (users of the results of the analysis of IAM ratings) are information providers (such as the Canadian Pharmacists Association, which produces the abovementioned Highlights) and appreciate the “Negative cognitive impact” items, which can detect issues with information content. Thus, negative cognitive impact items are rarely selected, but necessary, and the construct “cognitive impact” has been divided into 2 subconstructs: “positive” and “negative” cognitive impact. For example, with respect to the item “This information can be harmful,” the number of completed questionnaires where this item was selected was divided by the total number of questionnaires in which at least one item of the construct “Negative cognitive impact” was selected in order to calculate the value of R.

The results were interpreted as follows. In line with our prior content validation study in a “pull” context [46], the items were deemed relevant when R was 10% and above and irrelevant when R was less than 10%. With respect to the cutoff value of R to exclude items, there is no agreed upon criterion or universal cutoff to determine content validity [41,42].

Figure 2. Formula of the relevance ratio (R).

$$R = \frac{\text{The number of completed questionnaires where the item was selected}}{\text{Total number of questionnaires (where at least one item in that construct was selected)}}$$

Part 2: Qualitative Descriptive Study

A qualitative descriptive study was conducted [47] through semistructured face-to-face interviews with 15 family physicians (end users). The interviews started with general questions about educational email alerts and continuing medical education activities, to explore participants’ experiences; then, we asked specific questions on the representativeness of IAM-v2011 items.

Participants and Setting

An email invitation was sent to all physician members of the Department of Family Medicine at McGill University (n=269). Our eligibility criteria were (1) practicing family physician working in the greater Montréal area, (2) receiving educational email alerts, and (3) rating Daily POEMs or Highlights using the IAM. Of the 17 family physicians who volunteered, 15 were interviewed, while 2 were excluded (1 had no experience with the IAM-v2011 and 1 was not available).

Data Collection

Before each interview, participants received a brief lay summary of the study. For each IAM-v2011 item, participants were asked about its representativeness as follows: (1) the interviewer started by explaining each construct and the definition of that construct, (2) each participant was then asked to read the construct and its corresponding items on paper, and (3) for each construct, the participant was asked open-ended questions about the items and if they were suitable for that construct. For example, the interviewees were asked whether they would add, modify, or delete some items and the reasons behind their opinion. Although focus groups can be used in content validation studies [40], we decided to conduct individual interviews because we were interested mainly in individual experience and perception of the use of the IAM linked to educational emails. Interviews were recorded, reviewed, and transcribed on the same day of the interview. Our interview guide is available on request.

Data Analysis

We conducted hybrid deductive-inductive thematic analysis. This type of analysis consists of applying themes (theory-driven) and searching for themes that emerge because of their importance to the description of the phenomenon under study [48]. The inductive process involves the identification of emerging or new themes through "careful reading and re-reading of the data" [49]. We summarized and analyzed the interview transcripts. We assigned preliminary themes based on our ACA-LO theoretical model and the interview guide and then searched for themes that emerged. The coding process was conducted in 6 stages [50,51]: (1) developing a code manual, (2) testing the reliability of codes, (3) summarizing the data and identifying initial themes, (4) applying a template of codes for the meaningful themes, (5) connecting the codes in accordance with the process of discovering patterns in the data, and (6) corroborating and legitimating coded themes. The final results were discussed with 7 members of the Information Technology Primary Care Research Group (ITPCRG) who are experts in the IAM. For each construct, a table was created that contained themes collected from interviews. For each IAM item, we had 8 possibilities. There were 4 initial possibilities (4 deductive themes): (1) addition, (2) deletion, (3) modification of an item, and (4) no change. Then, 4 additional possibilities emerged (4 inductive themes): (1) merge two or more items, (2) merge two or more items and add a new element, (3) keep the main item and delete subitems, and (4) keep the main item and add a new subitem. An item was deemed representative of the corresponding construct when it was confirmed (modified or unchanged) or added (new item). An item was deemed not representative when participants suggested its deletion.

Part 3: Mixing Quantitative and Qualitative Parts

Qualitative and quantitative results were integrated and compared. Such a comparison of results has been recommended in reference books on mixed methods, specifically in primary care research [37,52]. The relevance and representativeness of IAM items were tabulated. Items of questionable relevance or representativeness were identified and discussed with ITPCRG members. IAM items with low relevance or those that were not representative were excluded. In addition, we reviewed and discussed the clarity and language of all items. A final decision regarding each item was achieved by consensus of ITPCRG members. For excluding items, priority was given to the quantitative data received from the 5596 physicians (relevance). The qualitative findings might have suggested new items (representativeness). In our study, qualitative findings supported the removal of 1 nonrelevant item and corroborated quantitative results but did not suggest any new item.

Ethical Approval

This study was conducted according to the ethical principles stated in the Declaration of Helsinki. Ethical approval was obtained from the McGill University Institutional Review Board. The Institutional Review Board provided ethical approval #A11-E25-05A for collecting and analyzing the quantitative data and #A06-E44-13A for the qualitative data collection and analysis.

Results

Results are presented according to the 3 parts of the mixed methods design.

Part 1: Quantitative Results

Of 23 items, 21 had an R value of greater than 10% (N=234,196). All 21 were kept for proposing a 2014 version of the IAM (IAM-v2014; in Table 2, all items except items 1 and 13). The remaining 2 items had an R value of less than 10% (in Table 2, see items 1 and 13). R was 4.86% (N=234,196) for item 1 of the construct "Positive cognitive impact" ("My practice will be changed and improved") and 3.04% (n=45,394) for item 13 of the construct "Information use" ("I did not know what to do, and I will use this information to manage this patient"). The final decision for items 1 and 13 was to exclude them.

Table 2. Relevance of the Information Assessment Method IAM-v2011 items.

Constructs and items[a]	Number of ratings[b]	Relevance ratio (R), %	Decision[c]
Positive cognitive impact (N=234,196)			
1. My practice is (will be) changed and improved.	11,380	4.86	Delete
2. I learned something new.	135,055	57.67	Keep
3. I am motivated to learn more.	51,763	22.10	Keep
4. This information confirmed I did (am doing) the right thing.	39,383	16.82	Keep
5. I am reassured.	43,835	18.72	Keep
6. I am reminded for something I already knew.	34,456	14.71	Keep
Negative cognitive impact (n=6742)			
7. I am dissatisfied.	4190	62.15	Keep
8. There is a problem with the presentation of this information.	1478	21.92	Keep
9. I disagree with the content of this information.	1289	19.12	Keep
10. This information is potentially harmful.	766	11.36	Keep
Information use (n=45,394)			
11. As a result of this information I will manage this patient differently.	10,460	23.04	Keep
12. I had several options for this patient, and I will use this information to justify a choice.	15,944	35.12	Keep
13. I did not know what to do, and I will use this information to manage this patient.	1378	3.04	Delete
14. I thought I knew what to do, and I used this information to be more certain about the management of the patient.	6752	14.87	Keep
15. I used this information to better understand a particular issue related to this patient.	7894	17.39	Keep
16. I will use this information in discussion with this patient, or with other health professionals about this patient.	18,135	39.95	Keep
17. I will use this information to persuade this patient, or to persuade other health professionals to make a change for this patient	5607	12.35	Keep
Expected health benefits (n=38,753)			
18. This information will help to improve this patient's health status, functioning or resilience (ie, ability to adapt to significant life stressors).	12,935	33.38	Keep
19. This information will help to prevent a disease or worsening of disease for this patient.	13,522	34.89	Keep
20. This information will help to avoid unnecessary or inappropriate treatment, diagnostic procedures, preventive interventions or a referral, for this patient.	20,474	52.83	Keep
Clinical relevance (n=234,193)			
21. Totally relevant	82,368	35.17	Keep
22. Partially relevant	85,227	36.39	Keep
23. Not relevant	66,500	28.40	Keep

[a]n refers to the number of completed questionnaires where at least one item of the same construct was selected.

[b]Number of ratings per item.

[c]Initial decision based on quantitative results.

Part 2: Qualitative Results

We interviewed 9 male and 6 female family physicians. A total of 9 participants were working in academic health science centers, while 6 were working in community-based private family medicine clinics. The participants' number of years in practice ranged from 9 to 38 years. A total of 5 participants indicated no particular clinical focus to their practice, while 10 expressed a special interest such as maternity and newborn care (n=3) or care of the elderly (n=3). We interviewed all participants in their offices. The participants were welcoming and cooperative. Of 15 interviewees, 11 gave ample time for the interview, while 4 seemed rushed. For each IAM-v2011 item, all interviewees answered all our questions about its relationship to its construct and whether they would add, modify, or delete it if they had the option to do so. Results of the qualitative part of the study are presented below (construct by construct) and summarized in Table 3.

Table 3. Representativeness of the Information Assessment Method IAM-v2011 items.

Constructs and items	Representative	Decision[a]
Positive cognitive impact		
1. My practice is (will be) changed and improved.	Yes	Keep
2. I learned something new.	Yes	Keep
3. I am motivated to learn more.	Yes	Keep
4. This information confirmed I did (am doing) the right thing.	Yes	Keep
5. I am reassured.	Yes	Keep
6. I am reminded of something I already knew.	Yes	Keep
Negative cognitive impact		
7. I am dissatisfied.	Yes	Keep
8. There is a problem with the presentation of this information.	Yes	Keep
9. I disagree with the content of this information.	Yes	Keep
10. This information is potentially harmful.	Yes	Keep
Information use		
11. As a result of this information I will manage this patient differently.	Yes	Keep
12. I had several options for this patient, and I will use this information to justify a choice.	Yes	Keep
13. I did not know what to do, and I will use this information to manage this patient.	No	Delete
14. I thought I knew what to do, and I used this information to be more certain about the management of this patient.	Yes	Keep
15. I used this information to better understand a particular issue related to this patient.	Yes	Keep
16. I will use this information in a discussion with this patient, or with other health professionals about this patient.	Yes	Keep
17. I will use this information to persuade this patient, or to persuade other health professionals to make a change for this patient.	Yes	Keep
Expected health benefits		
18. This information will help to improve this patient's health status, functioning or resilience (ie, ability to adapt to significant life stressors).	Yes	Keep
19. This information will help to prevent a disease or worsening of disease for this patient.	Yes	Keep
20. This information will help to avoid unnecessary or inappropriate treatment, diagnostic procedures, preventative interventions or a referral, for this patient.	Yes	Keep
Clinical relevance		
21. Totally relevant	Yes	Keep
22. Partially relevant	Yes	Keep
23. Not relevant	Yes	Keep

[a]Provisory decision based on qualitative results.

Construct "Cognitive Impact"

The 10 IAM-v2011 items associated with this construct were representative. For example, about the item "I am motivated to learn more" (item 3), one interviewee said, "I would like to modify this item to be more specific and to be 'I am motivated to learn more about this topic.'"

Construct "Clinical Relevance"

We asked specific questions about this construct, in particular the item "information partially relevant." Of 15 participants, 9 participants interpreted this item as follows: some information from a Daily POEM or a Highlight covers an aspect of a patient's condition, or the information does not exactly fit the patient's condition. A total of 4 participants said this item can be interpreted as either clinically relevant or not relevant. One participant interpreted this item as "information clinically relevant," while another participant interpreted it as "information clinically not relevant."

Construct "Information Use"

Of the 7 items associated with this construct, 6 were representative, while 1 item was not. By way of illustration, an interviewee said about the latter (item 13 "I did not know what to do, and I will use this information to manage this patient"): "I would like to delete this item as it is redundant."

Construct "Health Benefits"

All 3 items were representative.

Part 3: Mixing Quantitative and Qualitative Results

Results of quantitative and qualitative analyses were integrated. All IAM-v2011 items, their relevance, representativeness, and a final decision are presented in Table 4. Decision making involved discussions with ITPCRG members, after which 1 item with a low relevance ratio (item 1) and 1 nonrepresentative item with a low relevance ratio (item 13) were excluded from the IAM. With regard to the former item (representative with low relevance ratio), priority was given to the quantitative data (relevance) because it provided feedback from 5596 users. The 21 other items were deemed relevant and representative. There was no item with a high relevance ratio that was nonrepresentative. No new items were suggested from the qualitative data.

Table 4. Mixing quantitative and qualitative results.

Constructs and items	Quantitative results: relevance	Qualitative results: representativeness	Final decision
Positive cognitive impact			
1. My practice is (will be) changed and improved.	Delete	Keep	Delete
2. I learned something new.	Keep	Keep	Keep
3. I am motivated to learn more.	Keep	Keep	Keep
4. This information confirmed I did (am doing) the right thing.	Keep	Keep	Keep
5. I am reassured.	Keep	Keep	Keep
6. I am reminded for something I already knew.	Keep	Keep	Keep
Negative cognitive impact			
7. I am dissatisfied.	Keep	Keep	Keep
8. There is a problem with the presentation of this information.	Keep	Keep	Keep
9. I disagree with the content of this information.	Keep	Keep	Keep
10. This information is potentially harmful.	Keep	Keep	Keep
Information use			
11. As a result of this information I will manage this patient differently.	Keep	Keep	Keep
12. I had several options for this patient and I will use this information to justify a choice.	Keep	Keep	Keep
13. I did not know what to do, and I will use this information to manage this patient.	Delete	Delete	Delete
14. I thought I knew what to do, and I used this information to be more certain about the management of this patient.	Keep	Keep	Keep
15. I used this information to better understand a particular issue related to this patient.	Keep	Keep	Keep
16. I will use this information in a discussion with this patient or with other health professionals about this patient.	Keep	Keep	Keep
17. I will use this information to persuade this patient, or to persuade other health professionals to make a change for this patient.	Keep	Keep	Keep
Expected health benefits			
18. This information will help to improve this patient's health status, functioning or resilience (ie, ability to adapt to significant life stressors).	Keep	Keep	Keep
19. This information will help to prevent a disease or worsening of disease for this patient.	Keep	Keep	Keep
20. This information will help to avoid unnecessary or inappropriate treatment, diagnostic procedures, preventive interventions or a referral for this patient.	Keep	Keep	Keep
Clinical relevance			
21. Totally relevant	Keep	Keep	Keep
22. Partially relevant	Keep	Keep	Keep
23. Not relevant	Keep	Keep	Keep

Discussion

Principal Findings

These results have led us to produce a 21-item content validated version of the IAM for "push" technology, presented in Multimedia Appendix 2 (IAM-v2014). This work contributes to advance knowledge in continuing education, and continuing education tools, as there are no similar methods reported in the literature. Outside email alerts, our results can be applied to other Web-based means that deliver educational material, such as apps on mobile devices. For example, we have developed an app (called IAM Medical Guidelines) providing spaced education in a continuing medical education program on respiratory diseases. In such a program, the IAM questionnaire is used by clinicians to document reflective learning and earn continuing education credits.In addition, these results contribute to practice at 3 levels (user, provider, and researcher). First, at the level of the individual knowledge user, physicians can use a validated method to assess the clinical information delivered to them through educational email alerts. More than 15,000 Canadian family physicians and pharmacists are using the validated version of the IAM questionnaire to assess educational email alerts and earn continuing education credits in programs such as Daily POEMs and Highlights. During the calendar year of 2016, the IAM questionnaire (push version) was completed more than 400,000 times by physicians and pharmacists in Canada. To our knowledge, the IAM questionnaire is the most frequently used questionnaire in Canada, in the context of the continuing education of health professionals. Second, at the organizational knowledge provider level, the analysis of IAM-v2014 ratings can be based on a validated method. For example, information providers such as the Canadian Pharmacists Association are receiving validated feedback from their members. Third, using a validated questionnaire offers at least two other advantages: (1) researchers will save time and resources by avoiding the lengthy process of developing and validating their own instrument, and (2) new studies can compare their findings against those of other IAM-based studies.

Limitations of Our Study

The validation of the IAM as a whole is based on our prior work and a theoretical model, although we gathered quantitative and qualitative evidence for validating each construct and item. Future research may pursue the validation of the IAM as a whole, for example, using factor analysis. As mentioned in the standards for educational and psychological testing, validation can always be pursued [45]. With respect to the quantitative part of the study, as continuing education programs rely on the voluntary participation of physicians, we acknowledge a selection bias with respect to the participants. While our quantitative data sample comprised 234,196 IAM questionnaires completed by 5596 physicians, these participants were not representative of all Canadian physicians. For example, participants were more likely to be comfortable with information technology. With respect to the qualitative part, although focus groups are sufficient for content validation [40], we chose to conduct face-to-face interviews as it is typically difficult to arrange meetings with groups of physicians.

Our data regarding the expected patient health benefits of clinical information reflect the subjective views of health care professionals. For example, a limited number of studies report how using information from knowledge resources may have helped physicians to avoid unnecessary tests, treatments, or referral to specialist colleagues. Outside research conducted in computer laboratories using clinical scenarios, most of the studies share the limitation of self-report and do not objectively examine patient-related outcomes. With respect to the literature on continuing education in the health professions, basing study outcomes on self-report is typical. For instance, a scoping review examined the impact of physician self-audit programs [53]. None of the 6 observational studies included in the review objectively assessed outcomes. To the extent that self-report encourages socially desirable responses, the validity of study outcomes based on self-reported behavior and expected health benefits for patients can be questioned in future research.

Strengths of Our Study

Our content validation study followed the usual recommendations for developing psychometric and educational assessment tools [22,39]. In previous work, we reviewed information studies and developed a theoretical model, while in this study we gathered quantitative and qualitative evidence to support the use of the IAM in a specific context: the delivery of educational material. Content validation is typically a mixed methods research endeavor [37,38,54]. On the basis of the complementarity and synergy between qualitative and quantitative methods, mixed methods enhance validation studies by integrating quantitative and qualitative results on different aspects of the instruments. For example, focus groups provide qualitative evidence on relevance and representativeness of concepts [40], which are then tested using factor analysis (providing quantitative evidence on convergent and discriminant concepts).

Our validation study was based on Messick's definition of validity [42-44], which still informs the standards for educational and psychological testing [45]. Our mixed methods study assessed the content validity of the IAM. For each construct, we used quantitative methods to measure the relevance of IAM items and qualitative methods to evaluate their representativeness; then, we integrated the quantitative and qualitative results. In case of divergence, we gave more weight to quantitative results with respect to final decisions about "deleting" an item because the quantitative sample was large. In addition to the large sample in the quantitative part of the study, we interviewed 15 physician users of the IAM. This can be considered as a consultation with ecological experts (IAM users) [40]. The final steps in our data analysis and the draft of IAM-v2014 were discussed with ITPCRG members who are logical experts on assessing the value of clinical information. Expert panel discussion is a core component of content validation [22].

Conclusions

This study produced a content validated IAM questionnaire (IAM-v2014) that is used by clinicians and information providers to assess the clinical information delivered in continuing education programs. Research on how the quality of health care and the health of specific patients are associated with the delivery of educational content can use tools to accurately document clinical events at multiple points in time. One of the tools for researchers to conduct this type of work is our validated IAM questionnaire, coupled with data from electronic medical records. Finally, the IAM can facilitate a continuous interactional process between information providers who deliver "best" evidence (knowledge translation) and information users who assess this evidence (ratings) and submit constructive feedback; in turn, information providers may use this feedback from information users to optimize their evidence (thereby establishing two-way knowledge translation), which can be made available on the Internet for further retrieval [21]. Using the IAM, the delivery of research-based educational information can be enhanced by experience-based information from health professionals. For example, in addition to the IAM ratings, health professionals provide a substantial amount of free-text comments. These comments include constructive feedback such as suggestions for additional content, reservation or disagreement, suggestions to consider contradictory evidence, or a need for clarification of content. This two-way knowledge translation appears to be unique with regard to information management [55]. In line with the literature on relational marketing [56], being open to user feedback and handling such feedback can improve an educational resource and aid information providers in sustaining relationships with the users by valuing their expertise.

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Authors' Contributions

HB carried out this study. PP and RG supervised the work and contributed to all stages of the research. All authors participated in drafting the manuscript. All authors read and approved the final version of the manuscript.

Conflicts of Interest

None declared.

Multimedia Appendix 1

The 2011 version of the Information Assessment Method (IAM-v2011) in a "push" context.

[PDF File (Adobe PDF File), 196KB - mededu_v3i1e4_app1.pdf]

Multimedia Appendix 2

The 2014 version of the Information Assessment Method (IAM-v2014) in a "push" context.

[PDF File (Adobe PDF File), 116KB - mededu_v3i1e4_app2.pdf]

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Abbreviations

ACA-LO: Acquisition Cognition Application – Levels of Outcome
IAM: Information Assessment Method
ITPCRG: Information Technology Primary Care Research Group
POEM: Patient-Oriented Evidence that Matters

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Original Paper

Social Media in Health Science Education: An International Survey

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Abstract

Background: Social media is an asset that higher education students can use for an array of purposes. Studies have shown the merits of social media use in educational settings; however, its adoption in health science education has been slow, and the contributing reasons remain unclear.

Objective: This multidisciplinary study aimed to examine health science students' opinions on the use of social media in health science education and identify factors that may discourage its use.

Methods: Data were collected from the Universitas 21 "Use of social media in health education" survey, distributed electronically among the health science staff and students from 8 universities in 7 countries. The 1640 student respondents were grouped as users or nonusers based on their reported frequency of social media use in their education.

Results: Of the 1640 respondents, 1343 (81.89%) use social media in their education. Only 462 of the 1320 (35.00%) respondents have received specific social media training, and of those who have not, the majority (64.9%, 608/936) would like the opportunity. Users and nonusers reported the same 3 factors as the top barriers to their use of social media: uncertainty on policies, concerns about professionalism, and lack of support from the department. Nonusers reported all the barriers more frequently and almost half of nonusers reported not knowing how to incorporate social media into their learning. Among users, more than one fifth (20.5%, 50/243) of students who use social media "almost always" reported sharing clinical images without explicit permission.

Conclusions: Our global, interdisciplinary study demonstrates that a significant number of students across all health science disciplines self-reported sharing clinical images inappropriately, and thus request the need for policies and training specific to social media use in health science education.

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KEYWORDS

health education; health surveys; interdisciplinary studies; learning; professionalism; self report; social media; students; surveys and questionnaires; universities

Introduction

Social media facilitates information sharing, including usergenerated content, and has transformed the way we communicate. As of 2010, The Millennial Generation, individuals born between 1980 and 2000, comprised the major users of social media, with approximately 75% having a personal social networking page (eg, Facebook profile) and 61% perceiving sharing of personal data and images through social media as positive [1].

Health care professionals and health science students use social media as much as the general population [2] with approximately 90% of practicing doctors, nursing staff, and allied health care professionals having Facebook pages for personal or professional use [3]. Social media has implications in health science education due to patient and provider confidentiality; however, till date there is little instruction in the mainstream health science education to help students securely and appropriately engage with digital media [4,5], and wherever these guidelines are available, they have been mostly created by practicing health care professionals and academicians without the input of students and often lack definitions of professionalism as applied to online presence [6]. In recent years, a few studies incorporating the views of the broader health care provider community have come up with guidelines and frameworks that could help health science students and health care professionals to better embrace the positive aspects of social media in health care [4,7], although much needs to be done by universities and professional bodies in incorporating and providing these guidelines to students and professionals.

A recent survey among medical students showed that there is little consensus on what constitutes unprofessional behavior beyond the US Health Insurance Portability Act violations and students have felt that posting inappropriate material on personal social media sites was "unavoidable" [8,9]. Furthermore, studies have reported that students are unaware of ethical concerns posed by social media usage [10]; and even if students are aware of the importance of online professionalism, they do not feel it is relevant to them until they graduate and have an actual online professional identity [11]. Studies have also reported that students do not want or need formal policies for posting content online [9] and in fact, considered any enquiries into their social media use as "intrusive" and believed social media use to be too personal a topic for discussion [12]. Health science students struggle with the concepts associated with professionalism [13,14], and often fail to recognize the effect of their social media activities on future professional goals. In an age of growing social media influence and an increase in the perceived distrust of health care professionals by the public [15], it is important for schools to use an evidence-based approach to policy creation and to involve students in the process of the creation of these policies.

Although focus groups, surveys, and reviews of the literature have gathered usage information and perspectives from medical students and doctors [8,16,17], including a study that gathered information on health science students' media preferences and how often they use social media sites, and evaluated their responses to advertisements [18], no study to our knowledge, has examined the user profiles, attitudes, and perspectives of students from multiple disciplines and multiple cultures on the use of social media in health science education. Understanding the demographics and perceptions of students in different health science disciplines may be imperative to developing better student guidelines.

The purpose of this study was to examine the use of social media by students in health science education as well as the barriers to its use. By doing so, we can identify what could promote social media's use as an educational tool among health science students as well as how to improve its appropriate use.

Methods

The Universitas 21 Health Science Group (U21HSG) is a group of research-intensive universities committed to working together and pooling resources to conduct research in health science education. U21HSG conducted this large-scale, international study that involved 8 universities, which explored the user demographics, perceptions, and usage behaviors of dentistry, medical, nursing, pharmacy, physiotherapy, public health, and other allied health care students to social media use.

U21HSG developed an extensive survey to explore how social media is being used in health science education as well as educators' and students' opinions on it. The survey was trialled with students and faculty members within U21HSG first. Based on the feedback, we modified the survey and then distributed it subsequently in a more widespread approach. The results from the original trial were not included in our final analysis. The survey was first distributed among the members of the group as a trial. Feedback was received from the group, and the survey was modified accordingly before distribution. Prior to the distribution of the survey, an ethical approval was sought and granted from all 8 institutions. The Web-based survey was hosted using the FluidSurveys (SurveyMonkey) platform and was distributed among health science educators and students in the following 8 universities: Fudan University (China), Tecnologico de Monterrey (Mexico), University College Dublin (Ireland), University of British Columbia (Canada), University of Nottingham (United Kingdom), University of Birmingham (United Kingdom), Hong Kong University (Hong Kong), and the University of Melbourne (Australia). Responses to the survey were anonymous and were received between April and October 2014.

For the purpose of the survey, social media was described to participants as "a rapidly developing group of powerful and ubiquitous technologies and set of sociotechnical approaches for people to connect, support, and learn from each other. In other words, any online platform in which people communicate with each other, for example, Twitter, Facebook, YouTube, wikis, blogs, and so on."

Excluding educator responses left us with 2059 respondents, of which 419 either did not identify themselves as students or did not complete more than one question, and thus were excluded from the analysis. A total number of 1640 student responses were received and included in this analysis. The significance threshold set was 0.05 (*P*<.05 is significant).

Students who reported using social media in their education "never" or "rarely" were categorized as "nonusers," whereas those who reported using social media "sometimes," "often," or "almost always" were categorized as "users." Respondents were divided into these 2 groups to see if users and nonusers use social media differently or view social media use in health science education differently.

Results

Of the 1640 student respondents, 1343 (81.89%) were users and 297 (18.11%) were nonusers. Usage across the health science disciplines ranged from 63% in pharmacy to 91% in physiotherapy with the mean usage of 80% across all disciplines.

Table 1 exhibits the demographics of the respondents and the relationship between the demographic factors and the usage. There was a statistically significant difference between the mean age of users and nonusers (*P*=.003); however, there was no significant difference in the usage of social media between men and women (*P*>.99).

Table 1. Demographic characteristics of users and nonusers of social media.

Demographic characteristics	Users	Nonusers	Total	*P* value
Age in years, mean (SD)	n=1351 23.1 (4.74)	n=297 24.05 (5.68)	n=1648 23.25 (4.96)	.003
Gender, n (%)	n=1342	n=297	n=1639	>.99
Male	444 (81.9)	98 (18.1)	542 (33.07)	
Female	897 (81.84)	199 (18.16)	1096 (66.87)	
Nonbinary	1 (100)	0 (0)	1 (<0.1)	
University affiliation, n (%)	n=1505	n=296	n=1801	.001
Fudan University	55 (78)	16 (23)	71 (3.94)	
Tecnologico de Monterrey	491 (89.9)	55 (10.1)	546 (30.31)	
University College Dublin	336 (82.2)	73 (17.8)	409 (22.71)	
University of Birmingham	58 (78)	16 (22)	74 (4.11)	
University of British Columbia	52 (72)	20 (28)	72 (3.99)	
University of Hong Kong	83 (94)	5 (6)	88 (4.88)	
University of Melbourne	100 (86.9)	15 (13.1)	115 (6.38)	
University of Nottingham	330 (77.5)	96 (22.5)	426 (23.65)	

Among both users and nonusers, uncertainty on policies (51%, 68%, respectively), concerns about professionalism (46%, 57%), and lack of support from the department (39%, 57%) were the 3 biggest barriers to social media use. However, a much larger proportion of nonusers (47.0%, 119/253) did not understand how to incorporate it into their learning, compared with users (11.99%, 140/1167). Only 6.94% (80/1152) of the users failed to see the value of social media in education, compared with 29.8% (74/248) of nonusers (*P*<.001). Every barrier was more often reported by nonusers than users. The largest barrier among both groups was uncertainty on policy, which varied from institution to institution and ranged from 34% to 80%. The mean for all 8 global universities was 60%.

Factors that would encourage students to use social media in their education are shown in Figure 1. Departments had a big influence on students' social media use, as did peers. Evidence that social media use will enhance their learning would encourage users and nonusers alike to use social media.

Table 2 demonstrates that 858 of 1320 (65.00%) respondents did not receive training in social media policies and guidelines and that the majority of those who did not receive training would like to. The impact of social media training on students' confidence in using social media is also examined in Table 2.

Figure 1. Factors influencing social media use by health science students.

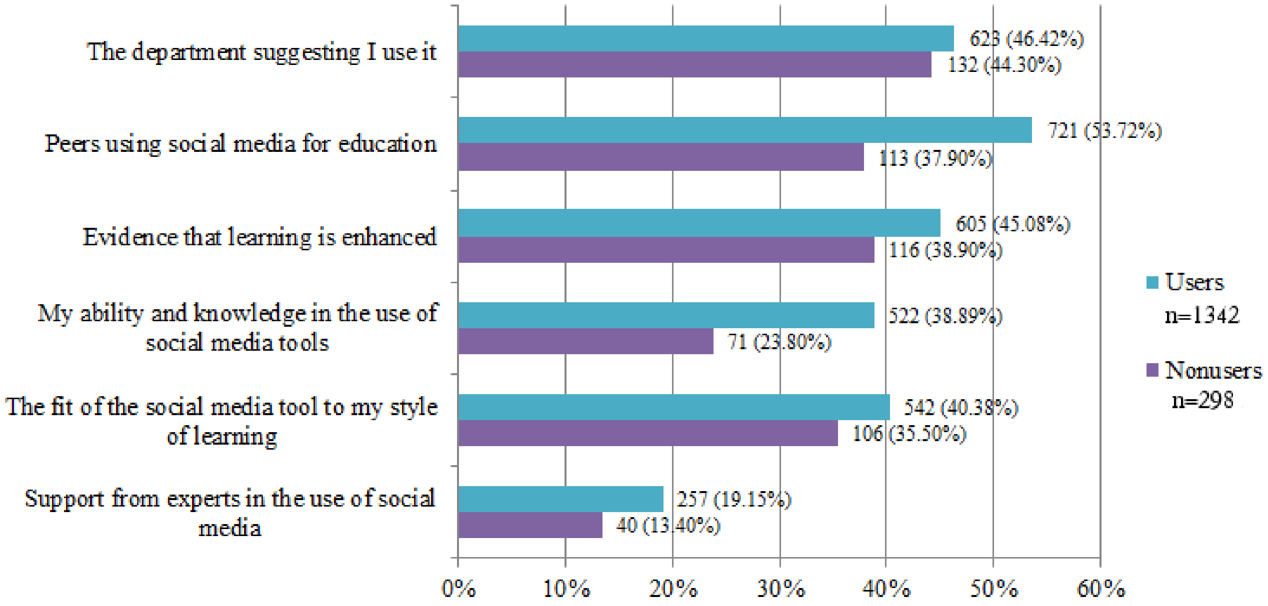

Table 2. Health science students' social media training.

Social media training	Users	Nonusers	Total
Training received on social media policy or guidelines from the faculty, n (%)	n=1091	n=229	n=1320
Yes	393 (36.02)	69 (30.1)	462 (35.00)
No	698 (63.98)	160 (69.9)	858 (65.00)
Would like to receive training on social media policy or guidelines, n (%)	n=762	n=174	n=936
Yes	511 (67.1)	94 (54.0)	608 (64.9)
No	251 (32.9)	82 (46.0)	328 (35.1)
Did training increase confidence?	n=418	n=75	n=493
It increased confidence	250 (60.1)	28 (37)	278 (56.4)
It didn't affect confidence	168 (39.9)	47 (63)	215 (43.6)

Figure 2 shows the rates of sharing of different items among users and nonusers without explicit permission. Nonusers had lower rates of inappropriate sharing in all categories than their user counterparts. Both groups most often shared opinions on work experiences. More than 10% of both users and nonusers have shared clinical images without explicit permission.

Social media nonusers had fewer reported breaches of confidentiality. Table 3 represents inappropriate sharing among users and nonusers and is broken down by their frequency of use. Those who used social media the most had the highest rate of inappropriate sharing of each category; however, nonusers did not always have the lowest rate.

Of the 174 respondents who had shared clinical images without permission, 50 (28.7%) either did not use security settings or did not know what their security settings were.

Figure 2. Inappropriate sharing of information by users and nonusers on social media.

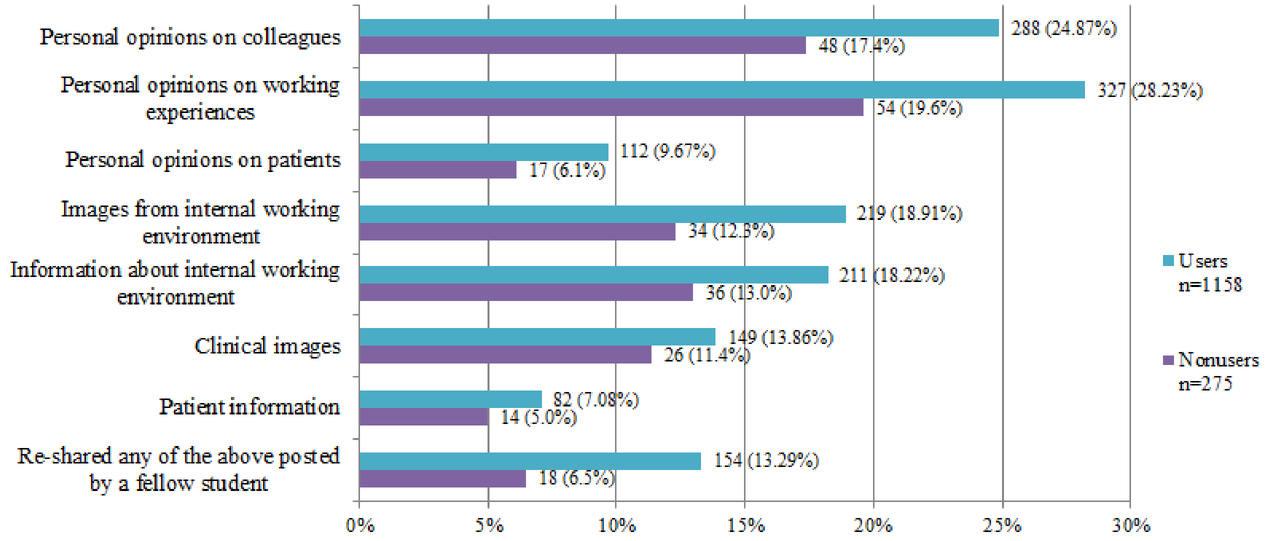

Table 3. Frequency of social media use and inappropriate sharing by health science students.

Information shared on social media	Nonusers n (%)	Sometimes n (%)	Often n (%)	Almost always n (%)
Patient information	82 (6)	29 (8)	25 (5)	29 (12)
Clinical images	26 (12)	44 (12)	55 (11)	50 (21)
Information about internal working environment	36 (16)	53 (15)	94 (19)	66 (28)
Images from working environment	34 (15)	54 (15)	89 (18)	78 (33)
Personal opinions on patients	17 (8)	39 (11)	42 (9)	31 (13)
Personal opinions on working experiences	54 (25)	85 (24)	154 (32)	92 (38)
Personal opinions on colleagues	49 (22)	75 (22)	129 (26)	86 (36)
Reshared any of the above posted by a fellow student	18 (8)	43 (12%)	55 (12)	56 (24)

Discussion

Principal Findings

As expected, most students (81.89% in total) from all health science disciplines were already using social media in their education. The biggest barriers to social media use among both users and nonusers were uncertainty on policies, concerns about professionalism, and lack of support from the department. All barriers were reported more frequently by nonusers than users. Not understanding how to incorporate social media into their learning is a barrier to almost half of the nonusers. Even a small portion of users reported not being sure of how to incorporate social media into their education. Having identified the 3 biggest barriers to health science students, institutions can understand the worries of their students and make guidelines and courses to help them become more comfortable with social media use.

Lack of support from the departments was one of the biggest barriers to social media use among users and nonusers alike and both groups identified that departments suggesting its use would influence their use of social media in their education. A similar study found that faculty reluctance was a barrier to social networking sites being used in third-level teaching [13]. Departments and faculty have a large influence on student's use of social media in their education. Educational institutions need to identify ways to increase the pedagogical value of social media to encourage usage while establishing clear guidelines to support positive and healthy use of social media.

The fact that most students who did not receive social media use training and reported that they would want it in the future is a positive sign. Kind et al reported that students did not want or need formal policies for posting content online; however, our findings suggest the opposite that students want formal policies for posting content on social media [4]. Perhaps, student needs have changed with the rise in social media use since the paper was published in 2010, and we only expect this trend to continue as social media continues to grow and integrate as a learning tool.

More than half of the users who received training on social media policy reported that it increased their confidence in using social media for educational purposes, implying that this training was beneficial for these students. Perhaps there is room for more research among those who did not find the training beneficial, so that training can be improved based on the feedback of students. It would also be important to provide nonusers with ways to incorporate social media into education to increase their usage. Having frequent users or faculty members showing good practices of social media use in education would be a good way to support nonusers for social media uptake.

Health science students have access to personal information about patients that must be kept confidential. This study shows that students across these 8 institutions distributed internationally share an alarming amount of inappropriate clinical information. The students who use social media the most reported a worrying amount of inappropriate sharing of clinical images. This figure (20.5%) substantiates one of the biggest concerns of social media use in health science education— confidentiality. Our findings suggest that appropriate training, policies, and guidelines be put in place to curb this. Students and faculty working together to ensure good practice and respect for patient privacy and confidentiality will play an important role in reducing the rate of inappropriate posting. Once social media is introduced with due care, it will be supported even by skeptics.

Conclusions

Although social media is being used for learning purposes by most health science students across the globe, many do so without appropriate training. Also, a high rate of inappropriate posting of content without explicit permission was self-reported, thereby jeopardizing patient confidentiality and the student-patient relationship. Meanwhile, students are receptive to training in social media use, and having faculty's support can facilitate increase in social media usage for enhancement of education. Faculty clearly has an important role to play in ensuring social media's safe use by students. Ideally, staff should integrate social media education and policies into curricula to ensure that students are making the most of these digital assets and are doing so with the least possible risk.

Our findings suggest that training programs to engage students in social media policy with clear benefits of social media in health science be made and implemented in institutions around the world. The training should include guidance on how and when to report a breach of the policy, along with consequences of breaking the rules. By implementing a training program, it is envisaged more students would not only be aware of and adhere to the policy but also know how social media can be used in an effective and safe manner for the ultimate benefit of patients.

Conflicts of Interest

None declared.

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Abbreviations

U21HSG: Universitas 21 Health Science Group

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Original Paper

Pediatric Residents' Perceptions of Potential Professionalism Violations on Social Media: A US National Survey

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Abstract

Background: The ubiquitous use of social media by physicians poses professionalism challenges. Regulatory bodies have disseminated guidelines related to physicians' use of social media.

Objective: This study had 2 objectives: (1) to understand what pediatric residents view as appropriate social media postings, and (2) to recognize the degree to which these residents are exposed to postings that violate social media professionalism guidelines.

Methods: We distributed an electronic survey to pediatric residents across the United States. The survey consisted of 5 postings from a hypothetical resident's personal Facebook page. The vignettes highlighted common scenarios that challenge published social media professionalism guidelines. We asked 2 questions for each vignette regarding (1) the resident's opinion of the posting's appropriateness, and (2) their frequency of viewing similar posts. We also elicited demographic data (age, sex, postgraduate year level), frequency of Facebook use, awareness of their institutional policies, and prior social media training.

Results: Of 1628 respondents, 1498 (92.01%) of the pediatric residents acknowledged having a Facebook account, of whom 888/1628 (54.55%) reported daily use and 346/1628 (21.25%) reported using Facebook a few times a week. Residents frequently viewed posts that violated professionalism standards, including use of derogatory remarks about patients (1756/3256, 53.93%) and, much less frequently, about attending physicians (114/1628, 7.00%). The majority of the residents properly identified these postings as inappropriate. Residents had frequently viewed a post similar to one showing physicians drinking alcoholic beverages while in professional attire or scrubs and were neutral on this post's appropriateness. Residents also reported a lack of knowledge about institutional policies on social media (651/1628, or 40.00%, were unaware of a policy; 204/1628, or 12.53%, said that no policy existed). A total of 372/1628 respondents (22.85%) stated that they had never received any structured training on social media professionalism.

Conclusions: Today's residents, like others of their generation, use social media sites to converse with peers without considering the implications for the profession. The frequent use of social media by learners needs to change the emphasis educators and regulatory bodies place on social media guidelines and teaching professionalism in the digital age.

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KEYWORDS

social media; professionalism; resident education; pediatrics; graduate medical education

Introduction

Physicians are using social networking sites with increasing frequency. Recent reviews of social media use by physicians indicate widespread use in medical education [1] and for personal and professional purposes [2-4]. A review of the characteristics of physicians using social media indicated a high use by those under 35 years old practicing internal medicine, pediatrics, obstetrics and gynecology, and family medicine [5].

Social media technology offers great educational benefits with its ability to reach a vast audience instantaneously. Patients and families are using social media to connect with health care providers and to seek medical advice.

At the same time, these advanced tools bring challenges to our profession in the form of ethical dilemmas regarding proper physician-patient relationships, privacy concerns, and the portrayal of physicians on the Internet.

Several reports [6] have highlighted these concerns by documenting breaches of professionalism by practicing physicians, prompting regulatory and professional organizations, such as the US Federation of State Medical Boards (FSMB), to develop and disseminate guidelines related to the use of social media by physicians [7-10].

Resident trainees are particularly at increased risk of the consequences of using social media. Some experts have reported concerns that the current generation of residents, who have been coined the "digital native generation" (born after 1980), will apply guidelines about online professionalism differently from the older digital "immigrant" generation [11].

In fact, a recent study reported that pediatric program directors find lapses in online professionalism by pediatric residents to be quite common, with over half of the program and associate program directors reporting inappropriate postings by residents in the past year [12]. Similar to the FSMB, medical schools have realized the need for social media educational guidance to trainees, noting online behaviors such as violations of patient privacy, use of profanity, depiction of intoxication, sexual suggestiveness, and communication about the medical profession or patients in a negative tone [13].

To date, most of the studies related to physicians' use of social media have largely focused on its use, and guidelines for helping physicians navigate the blurred lines. Previous research has elicited the opinions and concerns of US medical school deans, state medical boards, and pediatric clerkship directors and residency program directors regarding social media use by learners [12-15]. One recent study compared perceptions of pediatric residents with those of program directors using descriptors of online activity [16]. However, to our knowledge, none have directly surveyed trainees by using actual Facebook posts.

By conducting a national survey in the United States of all pediatric residents we sought to determine (1) residents' perspectives on appropriate social media postings, and (2) the degree to which residents are exposed to postings that violate regulatory and professional organization guidelines for social media use.

Methods

Recruitment

In March 2013, we distributed an electronic survey via SurveyMonkey (SurveyMonkey, San Mateo, CA, USA) to members of the American Academy of Pediatrics Section on Medical Students, Residents and Fellowship Trainees (AAP SOMSRFT) (now the Section on Pediatric Trainees). At the time of this study, approximately 98% of all pediatric residents were members of AAP SOMSRFT. For the purposes of this study, we used responses from the pediatric and medicine-pediatric residents only (N=9850). The survey site was open for 3 weeks from March 5 to March 25. No reminder emails were sent. The survey was voluntary, and we offered an incentive to complete the survey in the form of a chance to win a cash prize.

Survey Design

The survey consisted of 5 hypothetical postings from a resident's personal Facebook page (Facebook, Inc, Menlo Park, CA, USA). We based these vignettes on our observations of actual postings by residents from their institutions and mirrored the main criteria used by state medical boards to discipline physicians for unprofessional behavior [7]. Among the vignettes, 3 depict physicians' use of derogatory remarks about patients (vignettes 1 and 2) and about another physician (vignette 5); vignette 3 illustrates physicians wearing medical attire and consuming alcohol; vignette 4 addresses appropriate physician-patient boundaries (see Figure 1, Figure 2, Figure 3, Figure 4, and Figure 5). We tested the vignettes on a small focus group of early-career pediatric faculty at the primary author's institution, Louisiana State University Health Science Center, which included both social media users and those without social media accounts. We refined the vignettes based on feedback from the focus group. The vignettes do not encompass all areas discussed in published social media guidelines but were chosen as those most commonly encountered by trainees.

Using a Likert format, we asked 2 questions for each vignette regarding (1) the resident's opinion of the appropriateness of the posting, using a 5-point ordinal scale from "very inappropriate" to "very appropriate," and (2) the frequency with which the resident had viewed similar posts, using a 4-point incremental scale from "frequently" or "often" to "never," plus an additional "I have never used Facebook" option. We also elicited demographic data (age, sex, and postgraduate year), frequency of Facebook use, awareness of their institutional policies, and prior social media training.

Figure 1. Vignette 1, depicting physicians' use of derogatory remarks about patients. N/A: not applicable.

How appropriate?	Frequency	Percent
Very Inappropriate	433	26.6%
Inappropriate	844	51.8%
Neutral	276	17%
Appropriate	61	3.8%
Very Appropriate	14	0.9%

How frequently have you seen similar posts?	Frequency	Percent
Frequently	264	16.2%
Sometimes	708	43.5%
Rarely	378	23.2%
Never	195	12%
N/A I have never used Facebook	83	5.1%

Figure 2. Vignette 2, depicting a physician's use of derogatory remarks about patients. ER: emergency room; N/A: not applicable.

How appropriate?	Frequency	Percent
Very Inappropriate	767	47.1%
Inappropriate	642	39.4%
Neutral	158	9.7%
Appropriate	46	2.8%
Very Appropriate	15	0.9%

How frequently have you seen similar posts?	Frequency	Percent
Frequently	206	12.6%
Sometimes	578	35.5%
Rarely	458	28.1%
Never	299	18.4%
N/A I have never used Facebook	87	5.3%

Figure 3. Vignette 3, depicting physicians wearing medical attire and consuming alcohol. N/A: not applicable.

How appropriate?	Frequency	Percent
Very Inappropriate	134	8.2%
Inappropriate	353	21.7%
Neutral	691	42.4%
Appropriate	385	23.7%
Very Appropriate	65	4%

How frequently have you seen similar posts?	Frequency	Percent
Frequently	522	32.1%
Sometimes	663	40.7%
Rarely	241	14.8%
Never	121	7.4%
N/A I have never used Facebook	81	5%

Figure 4. Vignette 4, addressing appropriate physician-patient boundaries. N/A: not applicable.

How appropriate?	Frequency	Percent
Very Inappropriate	526	32.3%
Inappropriate	683	42%
Neutral	335	20.6%
Appropriate	74	4.6%
Very Appropriate	10	0.6%

How often have you seen this occur?	Frequency	Percent
Often	92	5.7%
Sometimes	322	19.8%
Rarely	507	31.1%
Never	626	38.5%
N/A I have never used Facebook	81	5%

Figure 5. Vignette 5, depicting a physician's use of derogatory remarks about another physician. N/A: not applicable.

How appropriate?	Frequency	Percent
Very Inappropriate	1217	74.8%
Inappropriate	366	22.5%
Neutral	35	2.2%
Appropriate	8	0.5%
Very Appropriate	2	0.1%

How frequently have you seen similar posts?	Frequency	Percent
Often	14	0.9%
Sometimes	100	6.1%
Rarely	403	24.8%
Never	1024	62.9%
N/A I have never used Facebook	87	5.3%

Analysis

We imported data from SurveyMonkey into Microsoft Excel 2007 (Microsoft Corporation, Redmond, WA, USA), in order to prepare the survey dataset for statistical and tabular analysis. The study dataset contained the responses of postgraduate years 1 through 4 training levels and chief residents. The data analysis was performed using Epi Info Version 7 (Centers for Disease Control and Prevention, Atlanta, GA, USA). We performed basic descriptive analyses of responses for each question and report the corresponding frequency for each question response.

The institutional review boards of the Louisiana State University Health Sciences Center, the University of Alabama School of Medicine, and the University of Arkansas for Medical Sciences approved this study as exempt from requiring participants' consent. Funding for this study was provided through a grant from the Louisiana State University Health Sciences Center New Orleans Academy for the Advancement of Educational Scholarship.

Results

Demographics

We received responses from 1628 pediatric residents (of 9850 surveyed; 16.53% participation rate). Of these, 92.01% (1498/1628) acknowledged having a Facebook account, of whom 888 (54.55%) reported daily use and 346 (21.25%) reported using Facebook a few times a week (Table 1).

Table 1. Frequency of Facebook use among 1628 pediatric residents.

Frequency	n	%
Daily	888	54.55%
A few of times a week	346	21.25%
A few times a month	130	7.99%
Rarely	145	8.91%
Never	119	7.31%

The total sample of 1628 residents included 1205 women (74.02%) and 423 men (25.98%). Mean age of the respondents using Facebook was 30 years (median 29 years; interquartile range 27-33 years). Mean age of the respondents who did not have a Facebook account was 31 years (median 30 years; interquartile range 25-37 years). Respondents were distributed throughout all postgraduate levels, with 554 (34.03%) in postgraduate year 1; 456 (28.01%) in year 2; 407 (25.00%) in year 3; and 211 (12.96%) in year 4 or chief residents.

Of note, there was no statistically significant difference in responses to the vignettes between Facebook users and non-Facebook users, nor was there a statistically significant difference between responses of various postgraduate year levels. Therefore, we report all responses in aggregate below.

Analysis

In vignettes 1 and 2 depicting physicians' use of derogatory remarks about patients (Figure 1, Figure 2) and about attending physicians (Figure 5), the majority of the residents properly identified these posting as inappropriate. However, the residents reported often seeing something similar (972/1628, 59.71% for vignette 1 and 784/1628, 48.16% for vignette 2 responding often and sometimes), but not vignette 5 (1427/1628, 87.65% rarely and never).

The third vignette (Figure 3) shows physicians drinking alcoholic beverages while in professional attire (scrubs). On this very often viewed posting (1215/1628, 74.63%), most residents were neutral (691/1628, 42.44%), with an even distribution toward appropriate and inappropriate.

In the fourth vignette (Figure 4), the resident accepts a friend request from a mother of a patient. The majority of residents recognized this as inappropriate (1209/1628, 74.26%) and as rarely or never seen (1133/1628, 69.59%).

We asked residents about their knowledge of the presence of social media policies at their institutions, pediatrics departments, or residency programs. Almost half of respondents (765/1628, 46.99%) said that their institution did have a policy. However, almost as many (651/1628, 39.99%) were unsure whether their institution, department, or program had a social media policy in place. Residents were also asked about any formal training on appropriate use of social media, and 418 respondents stated that they had never received any structured training on social media professionalism.

The most common method for training was in-person discussions by program leaders (n=706 responses), followed by formal lectures and discussions by hospital administration (n=458) or risk management personnel (n=402 responses). Simulation was the training experienced by a small group of the respondents (n=53). Other methods of training mentioned in free-text answers included prior training in medical school but not during residency, Web-based modules, and emails from superiors of the program's social media policy and about instances of inappropriate social media use. Another 2 comments indicated that training shouldn't be needed, as online professionalism is the "common sense of being an adult."

Discussion

Principal Findings

This study is, to our knowledge, the first to report a US national survey of pediatric residents' perspectives using simulated physicians' Facebook postings. Residents could identify some inappropriate content but reported being frequently exposed to unprofessional posts. Despite widely disseminated guidelines on the professional use of social media content, the data show that these professionalism standards are being violated as reported previously [12,16].

Residents did recognize the inappropriate scenarios as such in 4 of the 5 vignettes. The disconcerting exception is vignette 3, where 70% of residents were neutral about or comfortable with a post depicting physicians drinking alcohol while in medical attire. A recent study found that 40% of state medical boards would consider investigating a physician, with similar postings, for breaches of professional conduct [17]. While wearing scrubs when dining at a restaurant or bar is not necessarily a breach of professionalism, patients, colleagues, and the public may perceive the physician to be working while under the influence of alcohol. Residents, like many of the digital native generation, may not consider the future implications for career, professional standing, future job searches, etc, because Internet posts are "forever," leaving a digital footprint behind [18].

Regulatory groups discourage entering into an electronic "friendship" with patients (vignette 4) [6], and our study respondents recognized it as inappropriate, but to a lesser degree (around 70%) than published data on program directors' opinions (99% disapproval) [12]. Physicians should use the same guidelines in entering digital conversations as they would in real life and consider that shared personal information may cloud the typical boundary of the physician-patient relationship. Residents should continue to be educated on this issue, as patients may make these types of "friend" requests to an independent practitioner more frequently in an established, longer-term physician-patient relationship.

Residents' being exposed to unprofessional social media posts, as we report, may increase their propensity to model this behavior. Making disparaging comments about patients and other health care providers has no place in the dialogue of our profession and will undermine the public's respect. Physicians need to be cognizant that comments about patient experiences, as in vignettes 1 and 2, can be viewed as a breach of confidentiality, even if no personal identifiers are included, thus undermining the public's trust.

Our data show that a remarkably high percentage (92%) of responding residents use Facebook, with over 50% using it daily and another 20% using it at least once a week. This mirrors data from the general population, where 59% of adult respondents to a Centers for Disease Control and Prevention survey [5] and 74% of respondents to a Pew survey [19] reported use of social networking sites, with the highest rate being among 18- to 29-year-olds, the age group encompassing most medical residents. The prevalence of use of interactive Web technology by these learners underscores the need for social media education by medical educators, professional organizations, and regulatory groups. Education should not be limited to adherence to guidelines but should include what actions residents should take when they observe guidelines being violated by others [16]. Providing an anonymous, safe process for reporting, investigating, and addressing unprofessional behaviors online could lead to corrective actions being taken before state medical boards would intervene. Most medical schools have policies, guidelines, and processes for addressing professionalism at work. Those processes could be modified to include unprofessional behavior online.

Limitations and Benefits

There are several limitations to our study. Although a large number of residents responded to this survey, the results represent only 16.53% of all pediatric residents who are members of the AAP SOMSRFT. We attribute this to our inability to send reminder emails to nonresponders.

The study focused only on pediatric and medicine-pediatric residents. While the vignettes were not necessarily specific to pediatrics, the results may not be generalizable to all residents. The possibility that nonresponders were not Facebook users must be considered and could have skewed the results. In addition, physicians and health care professionals use other user-generated content sites, but we did not focus on these sites. Our questions were limited to 5 scenarios, which does not represent all potential violations that are enumerated by the FSMB social media guidelines. This self-reported study might also have been subject to recall bias.

This type of study has several benefits. As with case-based learning of medical diseases, the use of real posts would enhance the relevance to learners, stimulate greater discussion, and enhance the acceptability of teaching social media professionalism compared with simply providing a list of *do*'s and *don't*'s per published guidelines. Also, these results pinpointed generational and controversial areas, which can guide curriculum design. Due to the rapidly changing nature of the use of technology in medicine, follow-up studies would be useful to see whether lessons are learned and opinions evolve over time. Future studies may also compare learners of various levels versus attending physicians.

Conclusion

A high percentage of residents reported viewing and, in some instances, not recognizing unprofessional posts. This highlights the need for further education of residents about the potential hazards of online postings in order for the continued high standards of professional behaviors to be upheld by the next generation of physicians.

Conflicts of Interest

None declared.

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Abbreviations

AAP SOMSRFT: American Academy of Pediatrics Section on Medical Students, Residents and Fellowship Trainees
FSMB: Federation of State Medical Boards

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Original Paper

Continuing Professional Development via Social Media or Conference Attendance: A Cost Analysis

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Abstract

Background: Professional development is essential in the health disciplines. Knowing the cost and value of educational approaches informs decisions and choices about learning and teaching practices.

Objective: The primary aim of this study was to conduct a cost analysis of participation in continuing professional development via social media compared with live conference attendance.

Methods: Clinicians interested in musculoskeletal care were invited to participate in the study activities. Quantitative data were obtained from an anonymous electronic questionnaire.

Results: Of the 272 individuals invited to contribute data to this study, 150 clinicians predominantly from Australia, United States, United Kingdom, India, and Malaysia completed the outcome measures. Half of the respondents (78/150, 52.0%) believed that they would learn more with the live conference format. The median perceived participation costs for the live conference format was Aus $1596 (interquartile range, IQR 172.50-2852.00). The perceived cost of participation for equivalent content delivered via social media was Aus $15 (IQR 0.00-58.50). The majority of the clinicians (114/146, 78.1%, missing data n=4) indicated that they would pay for a subscription-based service, delivered by social media, to the median value of Aus $59.50.

Conclusions: Social media platforms are evolving into an acceptable and financially sustainable medium for the continued professional development of health professionals. When factoring in the reduced costs of participation and the reduced loss of employable hours from the perspective of the health service, professional development via social media has unique strengths that challenge the traditional live conference delivery format.

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KEYWORDS

social media; knowledge translation; continuing medical education

Introduction

Professional development is essential in the health disciplines. It allows the health workforce to maintain clinical currency, informed by emerging evidence, and supports best practice [1,2]. Best practice is continually changing and requires clinicians, researchers, and educators to be lifelong learners [3]. Certifying a minimum number of professional development hours is a requirement across many health disciplines for maintenance of ongoing registration to practice and to maintain best practice [4]. Together, these development activities support risk management and quality assurance activities within health care services [5,6].

Continuing professional development (CPD) can take many forms—from in-services and journal clubs, to courses and conferences, and Web-based activities. Each mode of engagement has its own unique strengths and weaknesses [7]. A journal club allows intimate discussion of a clinical issue, however it may be limited by the clinicians' abilities to critique and contextualize the evidence presented [8]. A conference provides access to breaking evidence from around the globe, supplemented by expert critiques; however, the time and financial costs of attendance may be prohibitive [7]. Web-based activities may provide cheaper avenues to emerging information and extend geographical and time-boundaries; however, limitations also exist with verifying the quality and credibility of the information source. Web-based mediums provide a nontraditional mode of social and professional engagement, with its own strengths and weaknesses based on the individual's perspective—connecting profiles and facilitating asynchronous conversation and information exchange [9], but foregoing the benefits of authentic live dialogue [10].

The majority of clinically relevant evidence does not survive the journey from researchers to clinicians at the point of care [3]. This remains true despite the significant resources being allocated to CPD and education. The evidence-to-practice gap is magnified by time pressures on clinicians, difficulties in searching and accessing the evidence, the challenge of assessing whether the evidence is applicable to a particular patient, and having the knowledge, skills, and resources to realize when and how to act upon that evidence [11].

Social media is designed to level information hierarchies, allowing the user to contribute directly to the sharing of information between individuals and communities of practice. Social media is now a mainstream information-sharing pathway, in part due to its speed, worldwide reach, and flexibility in access [12]. Maloney et al investigated the impact of social media on learning and translation to practice within the health disciplines [13]. This pre-post study of 199 clinicians across 4 continents provided practice points on evidenced-based tendon management, which were delivered only though social media. After the study, clinicians had more positive perceptions of social media for professional development, demonstrated an improvement in content knowledge, and reported intended management of patients that more closely aligned with current evidence [13]. Of all the participants, 80% (120/150) believed that social media would play a very significant role in the translation of evidence to practice. However, the participants also expressed caution in adopting a social media–led CPD environment, based primarily on concerns of trustworthiness of the evidence presented. These are valid concerns, as social media does not have the quality control mechanism of peer review. The strength of many social media platforms is that they are free and have open access, with the potential to reduce the cost of translating knowledge from researchers to clinicians.

Knowing the cost and value of educational approaches informs decisions and choices about learning and teaching practices [14]. It informs the sustainability of teaching approaches, and the efficiency and reach of workforce training development [15]. This is particularly relevant in times of health workforce shortages in rural and remote settings, and in times of budget restrictions within health services and education institutions. Despite the push for increased fiscal responsibility and accountability in health professional education, economic evaluations of cost and value remain uncommon [14-16].

Analyses of costs involved in CPD of clinicians can be conducted from many viewpoints. The provider incurs costs of delivering the content, participation costs are borne by the learner, and the health service has significant costs in the release and subsidy of staff to attend professional development activities [15]. Where health services are publicly funded, the cost is also borne by the taxpayer. Conferences have the largest opportunity cost for all stakeholders, primarily due to reduced capacity for health service provision with clinical staff attendance. There is currently no literature investigating the cost of participation in CPD delivered through social media to health professionals.

The primary aim of this component of the investigation was to analyze the opportunity costs of participation in CPD of the health disciplines via social media, compared with live conference attendance. The secondary aim was to investigate the acceptability of social media as a method for translating evidence to practice for clinicians, from the perspective of willingness-to-pay analysis of health professionals for a hypothetical social media professional development subscription.

Methods

Design

A cross-sectional design was undertaken to answer the research questions. Quantitative data were obtained from an anonymous electronic questionnaire. Ethics approval was obtained through the Monash University Human Research Ethics Committee (Approval number CF14/1372-2014000640).

Participants

This study was completed as one arm of a larger study investigating the potential role of social media for CPD and translational research. The detailed methods of this study are provided elsewhere [13]. In brief, this arm of the study invited participation from clinicians who were interested in musculoskeletal care. The invitation to participate was distributed via social media, as well as via email to the clinical affiliations of Monash University, Faculty of Medicine, Nursing and Health Sciences, Australia; Monash University Malaysia;

Warwick Medical School, University of Warwick, United Kingdom; and Swami Vivekanand National Institute of Rehabilitation Training and Research, India. The email contained a hyperlink for participants to accept the invitation to take part in the survey, as well as a link to decline to participate. If participants chose to decline, an option was available for them to volunteer their reason for not participating.

Of the clinicians, educators, and researchers who accepted the invitation, a filter was applied to reduce the potential participants to only those clinicians interested in musculoskeletal care (n=272), thereby aligning their field of interest with the scenarios presented in the study. No restrictions were made to the health discipline, age, or country of the participants. Undergraduate students were eligible to participate if they were actively engaged in the clinical practice phase of their education.

Outcomes

In the absence of a validated survey to obtain the required financial data for this population and context, a survey was developed by the research team including a tool to elicit willingness to pay for particular services using a stated preference approach [15]. The survey questions relating to the economic analyses are provided in Multimedia Appendix 1. The survey was designed to elicit the following themes:

1. Demographic data regarding age, country, and health discipline.
2. Perception of educational outcomes contrasting live conference attendance with social media–delivered professional development.
3. Participants' willingness to pay for any of the three options: a live conference format, social media–based format, and a live conference supplemented by a social media platform.
4. Participants' perceived costs of participation in live conference attendance, compared with a social media–based platform for the same information content.
5. The perceived number of effective employment work-hours lost through attending a live conference format, compared with a social media–based format.
6. Participants' willingness to pay for a hypothetical social media subscription that provides evidence and practice updates.

The "conference" scenario provided to contextualize the question to participants within the survey was as follows:

> *There is a conference being offered in the field of your area of clinical interest. It has leading local and international experts in the field to present their latest research, and discussions and panels on key issues in the field. The conference is two days duration, held on a Wednesday and Thursday, in Melbourne, Australia.*

Live conference attendance costs included conference fees, travel, accommodation, meals, and any other significant expenses anticipated by the respondent. Costs for attendance via social media included Internet access costs, along with any other significant costs anticipated by the respondent. A generic attendance fee price was set by first converting the respondent's answers to their willingness to pay to the same currency (Australian dollars) and then calculating the willingness to pay for each format.

The hypothetical subscription service was described to participants as being able to deliver 1 message per week of 150 characters, concerning updates in practice in the field of musculoskeletal care, for 48 weeks of the year, with a link to further source of information such as a journal article. To help contextualize a social media post of this nature, a screen-image of an example is provided in Figure 1 taken from the Twitter-based short course within another arm of this research [13].

All financial data contributed were converted to Australian dollars before computations were made. Currency conversion rates were taken from Xe.com, on October 20, 2014. Data were presented in summary format as median and IQR in Australian dollars. The average work-day length was taken at 7.25 hours.

Figure 1. A conceptual example of a Twitter-based short course for musculoskeletal practice.

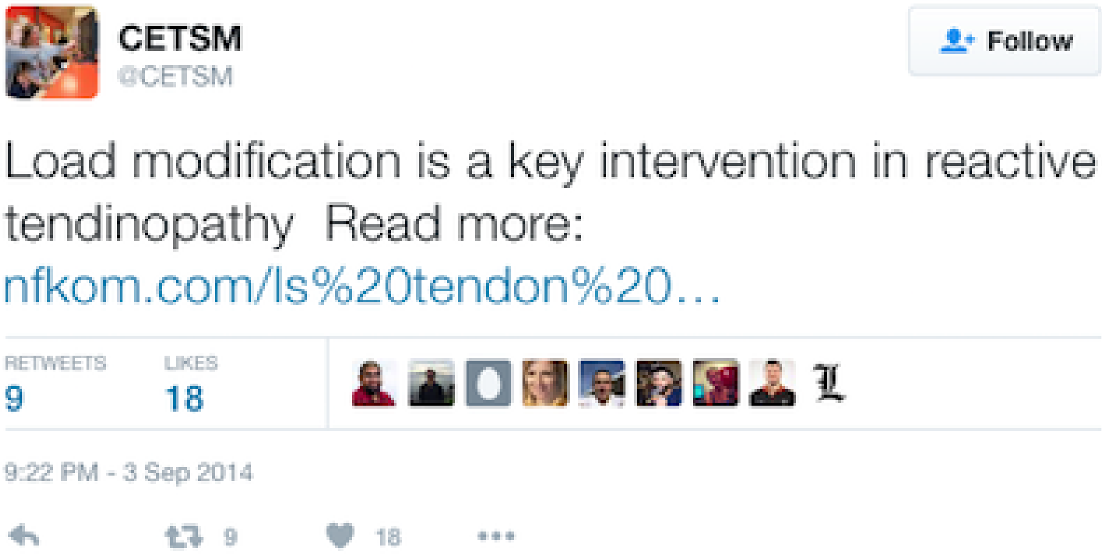

Table 1. Demographic data of the participants.

Descriptor		Participants n (%)
Country		
	Australia	59(39)
	United Kingdom	33 (22)
	India	12 (8)
	United States	17 (11)
	Malaysia	5 (3)
	Other[a]	24 (16)
Age (in years)		
	18-24	34 (22)
	25-34	68 (45)
	35-44	34 (22)
	45-54	10 (6)
	>54	4 (2)
Profession		
	Physiotherapy	117 (78.0)
	Medicine	19 (12)
	Osteopathy	3 (2)
	Podiatry	9 (6)
	Other	2 (1)

[a]The country category “other” is made up of any country that had less than three participants.

Results

Demographics

Of the 272 clinicians invited to contribute data to this study, 150 completed the study's outcome measures (150/272, 55.1%). Participant demographic details are represented in Table 1.

Subscription Value

The majority (114/146, 78.1%, missing data n=4) of respondents indicated that they were willing to pay for a social media subscription service targeting their area of professional development need. The hypothetical service delivered was 1 message per week of 150 characters, concerning updates in practice in the field of musculoskeletal care, for 48 weeks of the year, with a link to further source of information such as a journal article. The median price, reported for those who indicated they were willing to pay for a subscription, was Aus $59.50 (IQR 29.75-106.25, missing data n=18).

Willingness to Pay: Live Conference Versus Social Media

One-third of the respondents (50/150, 33%) felt that they would have the same educational outcomes whether the information was delivered within a live conference format, or via a social media–based format. Half of the respondents (78/150, 52%) believed that they would learn more with the live conference format, and the remaining 14% (22/150) felt that they would learn more from the social media–based format.

The respondents reported a willingness to pay for live conference registration in the order of Aus $342 (IQR 171.00-500.00, missing data n=18). Their willingness to pay for the social media–based equivalent was valued 68% less, at Aus $110.50 (IQR 50.00-200.00, missing data n=20). The live conference format supplemented by a social media platform was valued at an equivalent rate to the live conference only, at Aus $350.00 (IQR 156.00-500.00, missing data n=19).

The median perceived participation costs for the live conference format (not including registration) was Aus $1596 (IQR 172.50-2852.00, missing data n=19). The cost of participation for the social media–based equivalent is Aus $15 (IQR 0.00-58.50, missing data n=31). A subanalysis looking at Australian-based clinicians who would not need international travel to attend the base scenario conference (n=54), placed the median cost of participation for live conference attendance at Aus $122.50 (IQR 50.00-506.25).

Service Delivery Hours

Respondents indicated that they would need to access a median of 2.76 days of leave (20.00 hours, IQR 16.00-37.50, missing data n=17) to attend the mock conference presented in the base scenario. In contrast, the respondents reported that they would require just over one day of leave (7.75 hours, IQR 0.00-15.00, missing data n=26) to attend the social media–based equivalent.

Discussion

Principal Findings

The perceived costs of participation in CPD via social media, compared with live conference attendance, were far lower for the social media–based equivalent format, regardless of whether travel costs were included or excluded. Findings suggest that the potential savings in staff hours for a health service provider, releasing staff from clinical duties for attendance of CPD activities, were 12.25 hours per attendee. Interestingly, approximately half (72/150, 48%) of the respondents indicated that they believed they would learn either the same, or more, from the social media–based format than its live conference alternative.

Participants rated their willingness to pay for the social media–based format substantially lower than the live face-to-face alternative, indicating that it is of a lower perceived value. This may reflect the perception of lower costs to the education provider, which should be passed on to the consumer as a reduced registration fee [17]. This could be an accurate assumption by the respondents, given that one of the unique features of any education delivered by social media is its scalability. Unlike a live conference delivery format, social media incurs minimal variable costs with increased numbers of participation [15].

The majority of the clinicians indicated that they would pay for a subscription-based service, delivered by social media, to the value of Aus $59.50. This finding may indicate that there is an increasing readiness in the health professional sector for professional development delivered by social media, or perhaps opportunity for a sustainable business model for providing this service. However, an analysis of the barriers, risks, and rewards for such an activity was outside the scope of this study.

The overarching picture created by this research is not that social media provides equivalent educational benefit to conference presentations for less cost. There are a large number of tangible and intangible benefits to face-to-face conferences, such as networking opportunities, lengthy discussions, along with relaxation and creativity that comes from a change of work environment. Rather, this research provides important first steps scrutinizing the cost-effectiveness of our CPD activities, and the current degree of acceptability of social media as a medium for professional development.

Just as the methods of education are changing for undergraduate education, through simulation, social media, and other technology-enabled pedagogy, so it is in the professional development environment. It is interesting to consider that although didactic lectures are arguably the mode of delivery least supported by evidence to change practice and to generate discussion [18,19], when attending a conference on groundbreaking educational research, a didactic presentation is the most common format provided to the conference presenters. However, it may be that a change is looming in the conference-based learning environment also, with organizers beginning to harness the positives of live attendance, in conjunction with the benefits available from social media. An example is the Medicine 2.0 conference, the world congress of social media, mobile apps in health care and medicine, which was held in Maui, HI in 2014 [20]. This is a progressive conference, which encourages the use of social media by the audience, expanding the presenter's reach to interested observers, and facilitating discussion about the emerging evidence being presented. Socialization and networking is facilitated through QR codes available on each delegate's name tag. Scanning the tag of a new contact automatically links the two parties' social media profiles with the aim of fostering future collaborations. It is feasible that in the near future, a careful design of social media targeted to health professional education will be an acceptable alternative to live conference attendance, rather than simply being an important supplement to the conference's activities.

Limitations

There are a number of limitations that may affect the accuracy and generalizability of this study's findings. The mode of circulating the invitation to participate in this study included social media—and therefore could have created a selection bias toward participants who value social media more highly. The participants were spread across a wide geographic area, which may hide in-country differences; however, this is arguably quite authentic for any CPD provided via social media due to its ability to overcome geographic boundaries. Few who declined the invitation to participate in the study volunteered their reason for doing so, removing the ability to learn more about the nonparticipators and their potential impact on any selection bias. Another limitation is the narrow scope of the study, as it is focused only on the perceived economic costs of the different conference formats. As raised earlier, there are a number of personal or professional factors that may contribute to the participant's overall perceived benefit and final determination of value for the learning. Perhaps individual learning styles or confidence in navigating and engaging with Web-based technologies affect the feasibility of using social media for professional development. The same could be said for the perspective of the health service, with indirect benefits being obtained such as improved institutional profile. The findings are also influenced by who bears the cost for the education. Some learners would attend conferences through project funds, subsidized by their employers, or through their own salaries, with each variation potentially influencing the consideration of learners to attend CPD activities and the subsequent costs of participation. Likewise, the study did create the assumption that the individual, rather than their workplace, would provide the costs of accessing any social media–based education. As with all stated preference techniques used to elicit willingness to pay, there may be warm glow and part-whole [21] biases, leading to overestimation effects. With respect to warm glow bias, where an individual overestimates their values due to the satisfaction with the act of giving, it is unknown whether the respondents considered their willingness to pay as a form of obligatory compliance to society, as reflected by regulatory requirements for registration, rather than their personal development. Moreover, with respect to part-whole bias, it is unknown whether respondents see their willingness to pay as encapsulating the importance of continuous professional development in their own profession or the importance of CPD across all professions. Although the stated preference approach is commonplace, no validated questions existed to apply the approach specifically to the scenarios of this study—therefore, a customized survey was created.

Future Work

Further studies within this line of research may choose to evaluate the cost-benefit of a larger variety of CPD methods, with provision for measuring actual knowledge acquisition. The assumption of greater networking and professional socialization occurring via live event attendance in contrast to a purely Web-based format could also be revealing. Given that emerging research is showing evidence of social media being able to positively impact behavior change in the health disciplines [13,22], an alternate research direction could be to focus in on social media only, determining the value of different functional elements of the social media platform, and how the medium could be maximized for learning in the health disciplines or best integrated into traditional conference settings. Larger studies on this topic may also be well placed to investigate in-country and between-country differences, such as the influence of different pay structures and its effect on determining value.

Conclusions

Social media platforms are evolving into an acceptable and sustainable medium for the continued professional development of health professionals. In contrasting a 2-day live conference under the conditions of this study to equivalent content via social media, approximately half of the clinicians felt that they would learn the same, or more, via the social media–based format. When factoring in the significantly reduced costs of participation and the reduced loss of employable hours from the perspective of the health service, professional development via social media has unique strengths that may challenge the traditional live conference delivery format. Further evidence of the increasing role of social media in the translation of emerging evidence to clinical practice is highlighted in 78.1% (114/146) of the clinicians indicating their willingness to pay for a social media subscription, which would provide a weekly evidence-based practice point in their field of clinical interest. It is anticipated that professional development via social media will continue to offer viable and more cost-effective options than the more traditional methods currently available. Further investigations into CPD that include considerations of cost and value are important for ongoing improvement in the effectiveness and efficiency of our health workforce skills and training.

Conflicts of Interest

None declared.

Multimedia Appendix 1

Questionnaire.

[PDF File (Adobe PDF File), 32KB - mededu_v3i1e5_app1.pdf]

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Abbreviations

CPD: continuing professional development
IQR: interquartile range

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Original Paper

Erosion of Digital Professionalism During Medical Students' Core Clinical Clerkships

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Abstract

Background: The increased use of social media, cloud computing, and mobile devices has led to the emergence of guidelines and novel teaching efforts to guide students toward the appropriate use of technology. Despite this, violations of professional conduct are common.

Objective: We sought to explore professional behaviors specific to appropriate use of technology by looking at changes in third-year medical students' attitudes and behaviors at the beginning and conclusion of their clinical clerkships.

Methods: After formal teaching about digital professionalism, we administered a survey to medical students that described 35 technology-related behaviors and queried students about professionalism of the behavior (on a 5-point Likert scale), observation of others engaging in the behavior (yes or no), as well as personal participation in the behavior (yes or no). Students were resurveyed at the end of the academic year.

Results: Over the year, perceptions of what is considered acceptable behavior regarding privacy, data security, communications, and social media boundaries changed, despite formal teaching sessions to reinforce professional behavior. Furthermore, medical students who observed unprofessional behaviors were more likely to participate in such behaviors.

Conclusions: Although technology is a useful tool to enhance teaching and learning, our results reflect an erosion of professionalism related to information security that occurred despite medical school and hospital-based teaching sessions to promote digital professionalism. True alteration of trainee behavior will require a cultural shift that includes continual education, better role models, and frequent reminders for faculty, house staff, students, and staff.

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KEYWORDS

professionalism; health information systems; undergraduate medical education; social media; medical informatics

Introduction

The increasing use of social media, cloud computing, and mobile devices challenges medical schools and teaching hospitals to guide students toward the appropriate use of technology [1]. Medical school curricula addressing professionalism increasingly include a component on “digital professionalism,” discussing social media, physician identity, privacy, and protection of electronic protected health information (ePHI) [2-5].

Despite teaching efforts and the emergence of guidelines [6-9], violations of professional conduct in the digital realm are common [10]. Sixty percent of US medical schools report incidents of medical students posting unprofessional content online, including violations of patient confidentiality at 13% of schools [11]. Breaches in privacy can lead to severe legal consequences resulting in student suspensions and institutional fines. Data suggest that rising third-year students may not appreciate security risks stemming from use of mobile devices, placing patient data, the student, the medical school, and the hospital at risk [12].

In addition to formal instruction, studies show that components of the “hidden curriculum [13],” including informal interactions and observations of others, exert a profound effect on the unprofessional behaviors of medical students [14-16]. This influence likely extends to behaviors related to information security and patient privacy, although these components of professionalism have not been studied [17-19]. This study aimed to explore the influences of both formal and informal education during clinical clerkships on medical students’ professional behaviors specific to appropriate use of technology by examining changes in medical students’ attitudes and behaviors at the beginning and conclusion of their core clinical clerkships.

Methods

Study Design, Participants, and Setting

To assess the changes in medical student attitudes and behaviors about digital professionalism, we modeled the approach of Reddy et al [20], creating a survey listing behaviors and asking students to report whether they observed or participated in each behavior and to rate the behavior as either professional or unprofessional. We administered an anonymous survey to medical students at a large teaching hospital at the beginning and end of their third-year core clinical clerkships. We invited all students who were doing their hospital-based clinical clerkship year at our hospital during the academic year 2012-2013 to participate in the cohort. Participation was voluntary. The Institutional Review Board at the Beth Israel Deaconess Medical Center approved the study as exempt.

Survey Development

Our survey (Multimedia Appendix 1) consisted of 35 technology-related behaviors related to clinical clerkships. We chose the behaviors to represent domains of privacy, information security, communications, and social media, boundaries, and online tone. These behaviors captured elements of digital identity and perceptions of technology usage in professional settings as well. We chose these behaviors based on the collective experience of the study team in clinical informatics (BC, AM), medical ethics (SB), and clerkship education and leadership (DR). Not all behaviors were incontrovertibly unprofessional, and several were intentionally “gray areas.” We asked three questions per behavior. We asked students to report yes or no whether they (1) observed and (2) participated in each behavior. Then, students were asked to (3) rate each behavior on a Likert scale from 1 “Very Unprofessional” to 5 “Very Professional.”

Educational Sessions

Immediately before their initial clinical clerkship, all students received two 45-min educational sessions on digital professionalism (Multimedia Appendix 2). The first occurred for all rising clinical clerkship year students as part of a central orientation, and the second occurred the following day as part of hospital-specific orientation activities for the smaller cohort of students doing their principal clinical experience at our hospital. Two faculty members (AM, BC) developed and led both sessions to provide students with information and education regarding workplace professionalism related to technology. Sessions included background about relevant issues, best practices for information security, and case-based discussions of digital professionalism with an emphasis on professional behavior. The first session introduced three cases to illustrate concepts of digital identity, information security, and perceptions of technology use. We developed cases to illustrate basic principles rather than provide prescriptive instructions, given that it would not be possible to cover all scenarios that students would be likely to encounter. The second session, conducted at the hospital, allowed for interaction and question and answer sessions, as well as discussion of policies and procedures for information security.

Survey Administration

We administered the survey to students embarking on their clinical clerkships at our hospital (n=51) before the local session on digital professionalism; students had already attended the central session as described above. We surveyed students again at the end of their clerkship in April 2013. Data were maintained anonymously and without linking to protect student identity and facilitate truthful reporting.

Data Analysis

Responses were dichotomized to unprofessional (1,2) or professional (3,4,5), with neutral being considered professional for the purposes of analysis. Fisher test was used to determine significance of differences between pre- and post-clerkship surveys. All data were analyzed using SAS 9.3 (SAS Institute, Cary, NC). The primary outcome was participants’ change in opinions. Secondary outcomes included the observation of, and participation in, technology-related unprofessional behaviors.

In addition, for a subset of unprofessional behaviors where prevalence of participation was ≥30% (ie, medical record lookup outside of care and explicit instruction, use of third-party services with patient data, taking images of physical findings, conducting Web searches on patients), we analyzed post surveys to determine whether there was any correlation between observing behaviors and participating in behaviors. Where possible, we calculated relative risks (RR) and 95% CI.

We conducted a sensitivity analysis to determine how missing surveys would affect our results as not all students submitted end-of-the-year surveys, and we had avoided asking for linking information to preserve anonymity. This conservative analysis imputed answers for participants who did not return a post-clerkship survey, or who skipped a particular question, and biased responses toward the null.

Results

Survey Response

The response rates for the pre- and post-clerkship surveys were 96% (49/51) and 86% (42/49), respectively. Changes in perceptions regarding each behavior (pre- vs post-clerkship survey responses) and the post-clerkship observation and participation in each behavior are shown in Table 1.

Privacy

When asked post-clerkship whether a medical student should access the record of a patient not under his or her care without explicit instruction to do so, respondents were less likely to consider the behavior as unprofessional (98-71%, $P<.001$). In total, 46% of students reported observing others perform this behavior and 32% participated themselves. All students who participated in the behavior had observed the behavior.

Information Security

Fewer students perceived the use of third-party services (eg, Dropbox, Google Drive) for patient data to be unprofessional at the end of the year, reaching borderline statistical significance (94-80%, $P=.06$). The majority (58%) of students reported observing others use third party services (ie, online services not approved by the hospital and outside of the hospital firewall) and one-third reported doing so themselves (34%). All students who used these services observed the behavior in others. Fewer students considered the omission of passcode protection on personal devices as unprofessional (96-79%, $P=.02$), 26% observed others not doing so, and 8% did not do so themselves. Students who observed others not passcode protecting their devices were more likely to omit this protection as well, but this did not reach statistical significance. (RR=5.68, 95% CI 0.57-55.26).

Communications

By the end of their clinical clerkship year, students were less likely to consider ignoring pages from nurses to be unprofessional (100-82%, $P=.002$). Fifty percent of students reported observing this behavior, though none reported participating in the behavior. We did not see any significant differences among students before and after the clerkship in regard to ignoring emails or pages from colleagues, with most considering such behaviors to be unprofessional. However, those who participated in these behaviors were more likely to have observed others participating in them (RR=16, 95% CI 2.25-113.59). All students who answered phone calls or looked at mobile devices in patient rooms or on rounds had observed the behaviors in others.

Other behaviors that students considered significantly less unprofessional after their clerkship year included conducting Web searches on patients (“Googling” patients, 57-29%, $P=.01$), “friending” patients on online social networks (100-90%, $P=.04$), and using a mobile device for non–work-related matters while in a patient’s company (100-90%, $P=.04$). Students who observed others “Googling” patients were more likely to participate in the behavior themselves (RR=3.65; 95% CI 1.29-10.32). Students who “Googled” residents or attendings (faculty physicians) were more likely to have observed the behavior (RR=2.65, 95% CI 1.15-6.10; RR=2.27, 95% CI 0.96-5.34, respectively). All students who “friended” attendings had observed the behavior, and students who “friended” residents tended to have observed the behavior (RR=3.48, 95% CI 0.52-23.30). All students who reported using Facebook at work or watching non–work-related videos at the hospital had observed others doing the same.

Online Tone

Significantly fewer students considered the following types of online posts to be unprofessional: negative comments about patients (100-89%, $P=.03$), derogatory comments about nurses or hospital staff (100-89%, $P=.03$), and derogatory comments about residents or attendings (100-86%, $P=.01$). Students observed negative online comments about patients, residents, attendings, and nurses (prevalence ranging from 33- 42%), but denied participating in these behaviors (0%). Some students who observed inappropriate online behaviors from their colleagues, nurses, housestaff, and attendings (range=11.4-19%) did not give feedback about these behaviors. All students who observed others not giving feedback about inappropriate online behaviors reported not giving feedback themselves.

Sensitivity Analysis

Our conservative sensitivity analysis resulted in the loss of statistical significance for many results where we observed a change in perceptions over the course of a clinical year. Notable exceptions included looking up medical records of patients outside of ongoing patient care or formal educational context (98-71%, $P<.01$), and not returning a page from a nurse (100-86%, $P=.01$).

Table 1. Perceptions of professionalism of technology-related behaviors pre- and post-clerkship.

Behavior	Preclerkship		Postclerkship			Observation and participation	
	n Responded	n (%) Unprofessional	n Responded	n (%) Unprofessional	*P* value	n (%) Observed	n (%) Participated
Privacy							
Looking up the medical record of a patient who is not under your care without explicit instruction to do so	49	48 (98.0)	38	23 (60.5)	<.001	19 (46.3)	13 (31.7)
Taking a photo or video of a patient's physical findings	49	19 (38.8)	39	17 (43.6)	.67	34 (87.2)	13 (33.3)
Sharing a photo or video of a patient's physical findings	49	36 (73.5)	38	28 (73.7)	>.99	28 (71.8)	7 (17.9)
Security							
Saving work that contains patient data to a 3rd party service	49	46 (93.9)	39	31 (79.5)	.06	22 (57.9)	13 (34.2)
Not passcode protecting a personal device used for work	49	47 (95.9)	38	30 (78.9)	.02	10 (26.3)	3 (7.9)
Downloading non-work related programs onto a work computer	49	38 (77.6)	37	25 (67.6)	.33	7 (18.9)	4 (10.8)
Using a personal email address for professional communication	49	36 (73.5)	38	21 (55.3)	.11	22 (59.5)	15 (40.5)
Using a professional email address for personal communication	49	13 (26.5)	37	10 (27.0)	>.99	30 (83.3)	27 (75.0)
Communications							
Playing online games at work	48	45 (93.8)	40	31 (77.5)	.03	17 (43.6)	2 (5.1)
Not returning a page from a nurse	49	49 (100.0)	38	31 (81.6)	.002	19 (50.0)	0 (0.0)
Not returning a page from a colleague	49	49 (100.0)	37	34 (91.9)	.08	14 (36.8)	1 (2.6)
Not returning a phone call or page from a patient	49	48 (98.0)	36	34 (94.4)	.57	12 (31.6)	2 (5.3)
Not replying to an email requesting a response	49	48 (98.0)	39	34 (87.2)	.08	19 (50.0)	13 (35.1)
Not replying to an email from a professor that requests a response	49	45 (91.8)	37	34 (91.9)	>.99	9 (25.0)	6 (16.7)
Not replying to an email from a class administrator that requests a response	49	48 (98.0)	37	34 (91.9)	.31	12 (33.3)	9 (25.0)
Social media and professional boundaries							
Answering a mobile phone while in a patient's room	49	45 (91.8)	39	34 (87.2)	.50	31 (79.5)	2 (5.1)
Using a mobile device for non-work related matters while on rounds	49	46 (93.9)	40	35 (87.5)	.46	28 (71.8)	8 (20.5)
Using a mobile device for non-work related matters while in a patient's company	49	49 (100.0)	40	36 (90.0)	.04	17 (43.6)	1 (2.6)
Using Facebook at work	49	42 (85.7)	40	31 (77.5)	.41	35 (89.7)	15 (38.5)
Watching non-work related videos at work	49	39 (79.6)	40	28 (70.0)	.33	34 (87.2)	16 (41.0)
"Friending" a patient online	49	49 (100.0)	42	38 (90.5)	.04	2 (4.9)	0 (0.0)

Behavior	Preclerkship		Postclerkship			Observation and participation	
	n Responded	n (%) Unprofessional	n Responded	n (%) Unprofessional	*P* value	n (%) Observed	n (%) Participated
Accepting an "online friend request" from a patient	48	44 (91.7)	42	36 (85.7)	.51	2 (4.9)	0 (0.0)
"Googling" a patient	49	28 (57.1)	42	12 (28.6)	.01	26 (63.4)	22 (53.7)
"Friending" a resident online	49	5 (10.2)	39	7 (17.9)	.36	31 (77.5)	13 (32.5)
"Googling" a resident	48	7 (14.6)	40	6 (15.0)	>.99	28 (68.3)	26 (65.0)
"Friending" an attending online	49	24 (49.0)	41	18 (43.9)	.68	9 (22.0)	4 (9.8)
"Googling" a physician	49	0 (0.0)	42	5 (11.9)	.02	34 (82.9)	36 (87.8)
Online Tone							
Making negative comments about patients in online posts	49	49 (100.0)	37	33 (89.2)	.03	12 (33.3)	0 (0.0)
Making derogatory comments about nurses or hospital staff in online posts	49	49 (100.0)	37	33 (89.2)	.03	15 (41.7)	0 (0.0)
Making derogatory comments about residents or attendings in online posts	49	49 (100.0)	36	31 (86.1)	.01	13 (36.1)	0 (0.0)
Making derogatory comments about peers in online posts	49	48 (98.0)	37	33 (89.2)	.16	15 (41.7)	0 (0.0)
Accountability							
Not giving feedback to other students about inappropriate online behavior	49	36 (73.5)	36	21 (58.3)	.17	13 (36.1)	6 (16.7)
Not giving feedback to residents about inappropriate online behavior	49	31 (63.3)	36	17 (47.2)	.19	10 (27.8)	7 (19.4)
Not giving feedback to faculty about inappropriate online behavior	49	28 (57.1)	36	19 (52.8)	.83	9 (25.0)	4 (11.1)
Not giving feedback to nurses about inappropriate online behavior	49	29 (59.2)	36	17 (47.2)	.38	11 (30.6)	6 (16.7)

Discussion

Principal Findings

Clinical clerkships are a critical time in the formation of medical students' professional identities. Students constantly compare what they have been taught with what they see, and the influence of this "hidden curriculum" of medical school is thought to play an important role in the acculturation of students into the profession [13]. Our study, conducted after formal, interactive didactic sessions on the topic of digital professionalism, shows that students' definitions of unprofessional behaviors change over the course of their clinical clerkships. Furthermore, observation of unprofessional activities is correlated with participation in these behaviors. Our findings are consistent with prior studies that looked at professional and ethical development of medical students and also showed changing perceptions of and participation in unprofessional behaviors after clinical clerkships [14-16,20]. To our knowledge, however, ours is the first study assessing medical students' professional development in regard to digital professionalism.

Legal and Regulatory Risk

Students encounter new risks for unprofessional and unethical behaviors with the use of electronic medical records and social media; these risks are rarely discussed or taught explicitly. Unfortunately, several of the behaviors we assessed have critical legal and regulatory implications, exposing trainees and medical centers to substantial ethical, legal, and financial risk. Snooping in charts, for instance, violates the privacy rule of HIPAA (Health Insurance Portability and Accountability Act of 1996) and subjects the individual and institution to fines, along with a loss of patient trust; students may be dismissed from school at the first occurrence of such a violation. Allowing data to "leak" from secure environments onto third-party cloud servers violates the Security Rule of HIPAA; third-party services should not be used, unless they are sanctioned by the organization, encrypted, and have signed business associate agreements ensuring compliance with regulations.

Given that policy tends to lag behind technology, educators and hospital leadership need to proactively assess and monitor behaviors of their students, and assess risk and compliance with expectations and existing regulations. Medical educators must understand the basis for unprofessional behaviors and provide education, support, and resources to make it easy for medical students to act professionally and ethically, even in these pressured environments. Organizations are beginning to create agreements with cloud-based providers that do ensure the security and auditability of protected health information while meeting the needs of users. This development is encouraging that health care entities are making it easy for users, including students, to do the right thing all the time.

Ethical Considerations

Patients trust that medical providers, including students, will safeguard their information, upholding a central tenet of medical professionalism. Students also have an obligation to their patients and society to use their time in medical school most effectively to become competent clinicians. This sets up an ethical dilemma where a student feels that the use of a new but unsanctioned technology, like a third-party cloud service for preparing case presentations, outweighs the low but not negligible risk of a data breach. The law is clear in this case that data must be secured; in some cases, however, the law and policy are less clear.

Should students be allowed to look up the medical record of a patient not under their care for educational purposes? Electronic health records allow students the opportunity to see and follow different cases that they may not encounter on their own during medical school. Students may also follow patients longitudinally with the electronic health record, after their formal role in the patient's care has ended, to learn the outcome [21]. However, it is unlikely that all patients would consider their records to be open to all to view, even when coming to teaching hospitals. Others have written on this potential ethical dilemma [22-24]. Furthermore, it appears from other data that some students are accessing their previous patients' records for curiosity rather than more educationally related reasons. Our data show that, after their clerkship year, significantly fewer students felt it was unprofessional to look up medical records for patients not under their care, despite a nearly universal perception at the beginning; this suggests acculturation or normalization of the behavior occurs. Organizations and educational leaders should proactively discuss these dilemmas with their learners.

Teaching and Modeling Digital Professionalism

Recognizing digital professionalism as an important component of medical education will allow integration into the classroom, the clinic, and simulation-based training, with competencies that are tested throughout medical training. However, integration of digital professionalism training must be done in a manner that truly instills students with the tangible tools and resources they need to act professionally. Professionalism training for students, faculty, and staff must shift from abstract descriptions such as "keep data private" to behaviorally oriented definitions, such as "encrypt mobile devices." These definitions can be taught and refined as technology continues to evolve.

Although the introduction of a formal curriculum similar to the one we offer in our study may be a first step, our findings suggest that isolated sessions on professionalism are not sufficient to sustain perceptions and behaviors of professionalism [25]. Although we did not measure satisfaction with our sessions, students have generally considered these "on-doctoring" courses to be a frustrating, low-priority aspect of their training [26]. Furthermore, one-time educational sessions or written policies are not likely to sustainably promote professionalism. When Dawkins et al surveyed pediatric residents nationwide, the team found that residents viewed inappropriate social media postings not infrequently; more than half of the surveyed residents were unaware of social media policies despite nearly four-fifths of respondents having had some formal education around social media [27]. Taking a systems-level approach that goes beyond didactics and allows for professionalism training to be integrated more fully with clinical training may proactively promote proper behavior [17].

Changing the "Hidden Curriculum"

A critical step in improving students' performance and professional development is for faculty and staff to take a closer look at their own behaviors and expectations. Whereas the ultimate responsibility for unprofessional actions lies with the students themselves, faculty must hold themselves to a high standard. The more complex a setting and task, the bigger the discrepancy between what is explicitly taught in formal curricula and what is learned by students [26]. Until the culture of the hospitals and teams within which students function is changed, students will continue to receive conflicting messages on what is "ethical" and "professional." Acting in a professional manner in the digital age requires a constant reflection and assessment of one's tone and language and an active willingness to avoid electronic "shortcuts" that circumvent security. We found that students were more likely to engage in several unprofessional behaviors when they witnessed others doing so, emphasizing the need for deliberate change on the part of educators and entire hospital-based teams. Given the ease of taking such "shortcuts," the lack of immediate repercussions when unprofessional actions are taken digitally, and the prevalence of unprofessional behaviors on social media across groups and professions, a "do as I say, not as I do" approach is unlikely to inculcate students with the necessary tools for success.

Limitations

We conducted our study at a single site with a limited number of students. Our results may not be generalizable to other settings. We administered the survey anonymously to promote honest responses. However, this design limited our ability to perform paired analysis of pre- and post-clerkship surveys that might detect subtle differences. We performed a sensitivity analysis to conservatively account for missing responses. We did not formally pretest these questions with students and could not exclude differences in interpretation for some questions. However, questions from pre and posttest were kept identical with the same population, making it less likely to influence responses.

Conclusions

Although technology is a useful tool to enhance teaching and learning, the ethical dilemmas and legal ramifications of its potential misuse require enhanced attention to learners' beliefs and behaviors. True alteration of trainee behavior will require a cultural shift that includes continual education, better role models, and frequent reminders for faculty, house staff, students, and staff. Future studies should assess and compare various educational strategies for promoting professionalism.

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Conflicts of Interest

Dr Crotty serves on the Advisory Board of Buoy Inc.

Multimedia Appendix 1

Survey questions administered at the beginning and end of the clinical clerkship year.

[PDF File (Adobe PDF File), 17KB - mededu_v3i1e9_app1.pdf]

Multimedia Appendix 2

Curriculum delivered during educational sessions at the beginning of the clinical clerkship year.

[PDF File (Adobe PDF File), 56KB - mededu_v3i1e9_app2.pdf]

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Abbreviations

ePHI: electronic protected health information

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Original Paper

Simulation Training: Evaluating the Instructor's Contribution to a Wizard of Oz Simulator in Obstetrics and Gynecology Ultrasound Training

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Abstract

Background: Workplaces today demand graduates who are prepared with field-specific knowledge, advanced social skills, problem-solving skills, and integration capabilities. Meeting these goals with didactic learning (DL) is becoming increasingly difficult. Enhanced training methods that would better prepare tomorrow's graduates must be more engaging and game-like, such as feedback based e-learning or simulation-based training, while saving time. Empirical evidence regarding the effectiveness of advanced learning methods is lacking. Objective quantitative research comparing advanced training methods with DL is sparse.

Objectives: This quantitative study assessed the effectiveness of a computerized interactive simulator coupled with an instructor who monitored students' progress and provided Web-based immediate feedback.

Methods: A low-cost, globally accessible, telemedicine simulator, developed at the Technion—Israel Institute of Technology, Haifa, Israel—was used. A previous study in the field of interventional cardiology, evaluating the efficacy of the simulator to enhanced learning via knowledge exams, presented promising results of average scores varying from 94% after training and 54% before training (n=20) with $P<.001$. Two independent experiments involving obstetrics and gynecology (Ob-Gyn) physicians and senior ultrasound sonographers, with 32 subjects, were conducted using a new interactive concept of the WOZ (Wizard of OZ) simulator platform. The contribution of an instructor to learning outcomes was evaluated by comparing students' knowledge before and after each interactive instructor-led session as well as after fully automated e-learning in the field of Ob-Gyn. Results from objective knowledge tests were analyzed using hypothesis testing and model fitting.

Results: A significant advantage ($P=.01$) was found in favor of the WOZ training approach. Content type and training audience were not significant.

Conclusions: This study evaluated the contribution of an integrated teaching environment using a computerized interactive simulator, with an instructor providing immediate Web-based immediate feedback to trainees. Involvement of an instructor in the simulation-based training process provided better learning outcomes that varied training content and trainee populations did not affect the overall learning gains.

(JMIR Med Educ 2017;3(1):e8) doi:10.2196/mededu.6312

KEYWORDS

distance learning; feedback; simulation training; evaluation research

Introduction

Medical education is becoming increasingly challenging. Physicians must master an ever-expanding knowledge base; yet, they are constrained by a limited educational time frame. Didactic learning (DL) is no longer sufficient, hence interactive methods are needed. Thus, and in part due to the Internet, an alternative—Web-based educational—content has emerged [1]. Examples include flipped classroom [1,2], simulation-based training [3,4], and e-learning [5,6]. Although some of these methods have demonstrated encouraging results, others are still experimental and require a stronger evidence-based background [7,8]. Instructors still tend to perceive these methods as a demanding effort. Solid empirical evidence regarding the effectiveness of these novel teaching approaches is needed. Current publications lack objective quantitative evidence (knowledge test scores) for comparing various advanced training methods among themselves or with DL [5-7,9].

In addition to increase our knowledge base, cognitive learning can change our beliefs and the way we see and understand events. A major step in understanding the way people learn evolved in the late 1950s when the field of cognitive science emerged [10]. Cognitive science brought with it new experimental tools and methodologies that contributed to empirical and qualitative research. Novel approaches for enhanced teaching are emerging, yet a change in DL approaches has been implemented only minimally in schools. Many researchers believe that didactic teaching fails to prepare students for challenges they are likely to encounter in their professional lives. "Human competencies such as teamwork, cooperation, customer orientation, and entrepreneurial thinking are gaining more and more importance. However, didactic education and training concepts in universities and industries do not fulfill the new requirements" [9]. Moreover, accreditation institutions require graduates to communicate better, resolve engineering problems and be part of a multidisciplinary team [1].

e-learning is a powerful, cost-effective training tool. Although some have described it as boring and monotonous [6] when compared with DL and technology-assisted learning (TAL), it ranked as the most valuable training method [11]. A study that compared DL and TAL found that most participants (61%) preferred to attend the TAL courses. -learning was described as a cost effective, dynamic and interactive training method that brought new expertise to learners and reinforced existing training [11]. Additionally, e-learning is a platform with reusable materials, providing free and distance-learning to rural regions; yet, its effectiveness as a standalone solution is questioned [5]. The efficacy of e-learning is not yet known. One study attempted to evaluate the addition of interactivity to e-learning via interviews and questionnaires, comparing DL, e-learning, and mixed classes (e-learning combined with interactive class work). Students who attended the mixed classes reported the highest satisfaction. They reported that e-learning was more effective than classroom learning, yet it fell short on supplying social and teamwork skills that are relevant to the work environment [5].

To improve medical education and training, we developed a novel, low-cost, low-fidelity, accessible telemedicine simulator at the Technion—Israel Institute of Technology, Haifa, Israel—using a Wizard of Oz (WOZ) simulator. The WOZ is a well-established method for simulating the functionality and user experience in which a human operator, the Wizard, mediates the interaction. Using a human wizard to mimic certain operations of a potential system is particularly useful in situations where extensive engineering effort would otherwise be needed to explore the design possibilities offered by such operations [12].

The WOZ simulator features a remote instructor (the Wizard) in the training loop, controlling students' learning. This approach enables trainers to effectively detect learners' flawed mental models (misconceptions) and supply corrective immediate feedback during the training sessions [13]. Web-Based immediate, interactive human feedback provides immense advantages to enhanced learning [3,4,7,14-16]. Unlike traditional e-learning, the WOZ concept incorporates a two-way discussion, with immediate feedback, which can help improve the student's understanding [14]. Initial results regarding the usability and efficacy of the WOZ simulator in training interventional cardiologists, emergency medicine physicians, and medical students, are promising [3,4]. The WOZ simulator was invented following an unsuccessful attempt to develop a fully automated medical simulator at the Technion. The simulator failed because computers lack human intuition and human-like engagement that acknowledge complex and abstract questions [6]. The WOZ simulator could overcome these issues by returning the instructor (Wizard) to the training loop.

The WOZ simulator is a novel form of a low-fidelity, semiautomatic simulator designed to enhance medical education. It has been used to remotely train physicians in fields of emergency medicine, pediatrics, and interventional cardiology [3,4]. Promising results were noticed when training 20 interventional cardiologists on radiation protection. Knowledge improvement measured via knowledge exams before and after training showed a 40% improvement (94–54) with $P<.001$ [3].

The field of Obstetrics and Gynecology (Ob-Gyn) was chosen for this study due to its focus on knowledge-related tasks and diagnostic skills, such as US imagery interpretation. Fields that rely on knowledge-specific tasks and diagnostic skills better match the remote training, low-fidelity, instructor-led WOZ simulator platform.

Methods

Study Design

This prospective study was performed at the Simultech Center for Simulation in Medicine. The Center specializes in Ob-Gyn training. The WOZ simulator was accessed through a weblink (Figure 1). Training started by clicking the image of the patient in the upper left corner, which resulted in a pop-up displaying the patient's history and relevant case data. The first question appeared in the questions area when the pop-up was closed. Questions were open-ended or multiple-choice, in which case a list of possible answers was presented. The questions could include supporting media, such as images, videos, documents, or presentations (Figure 2). Open questions required a written explanation and multiple-choice questions required choosing the correct answer from the available options and clicking on the submit button.

In the automated e-learning mode, the follow-up question would immediately appear. In the WOZ mode, the instructor could proceed to the follow-up question or ask additional questions, send clarifying information, or skip some questions depending on the trainee's progress. After answering the final question, automated feedback would be presented to the trainee in the e-learning format, whereas in the WOZ format, the instructor would provide feedback in an open conversation.

Figure 1. User interface of the simulator—a multiple choice or open question interface.

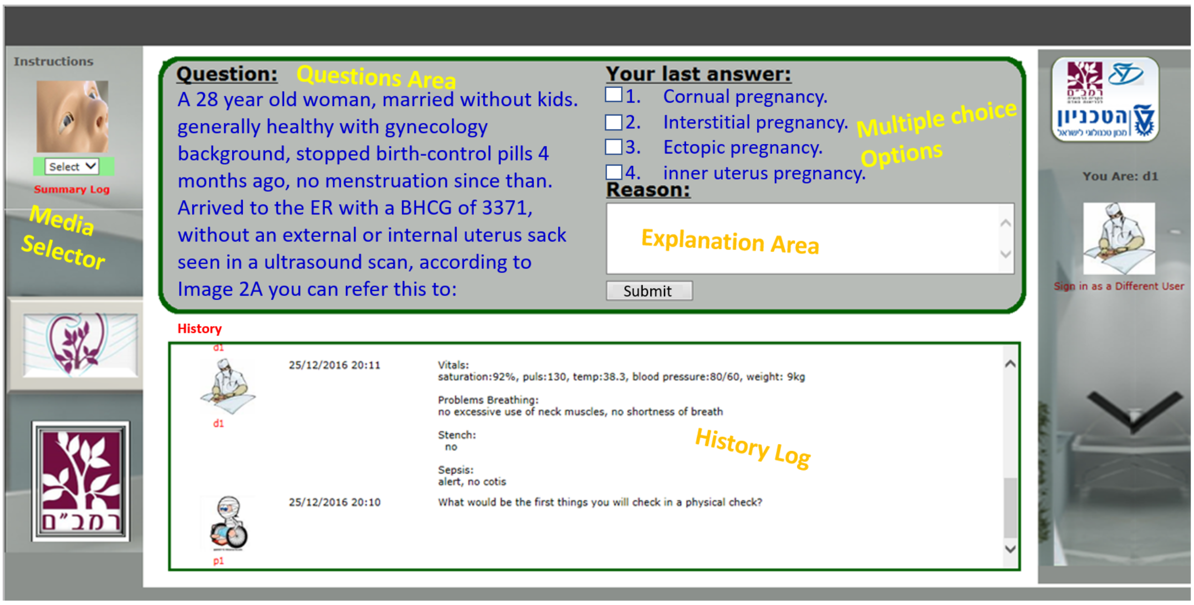
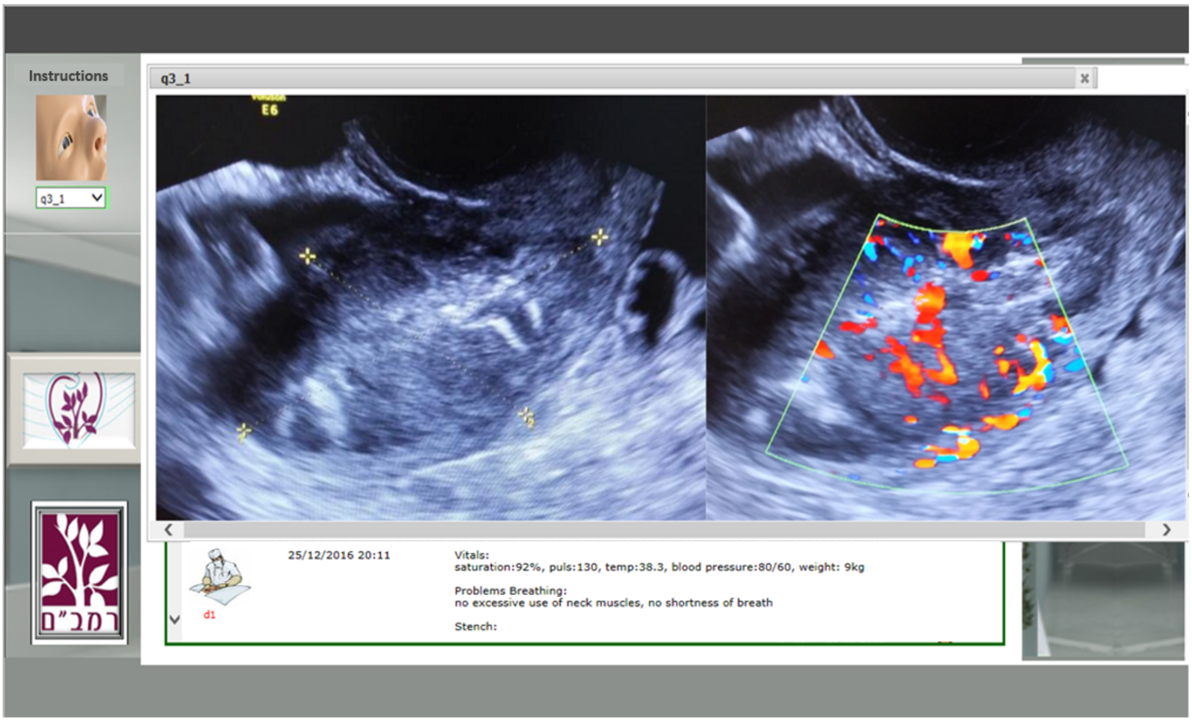


Figure 2. Simulator media display. Selecting a media option from the media drop-down displays a pop-up with the relevant image, lab results, or video.



Trainees

The design of our experiment required that there be a number of medical trainees sharing a similar medical knowledge background as well as qualified medical trainers. The Simultech Simulation Center satisfied these requirements. Integrating our WOZ simulator experiments into Simultech's training schedule was done in two different courses and included a total of 32 Ob-Gyn ultrasonography specialists.

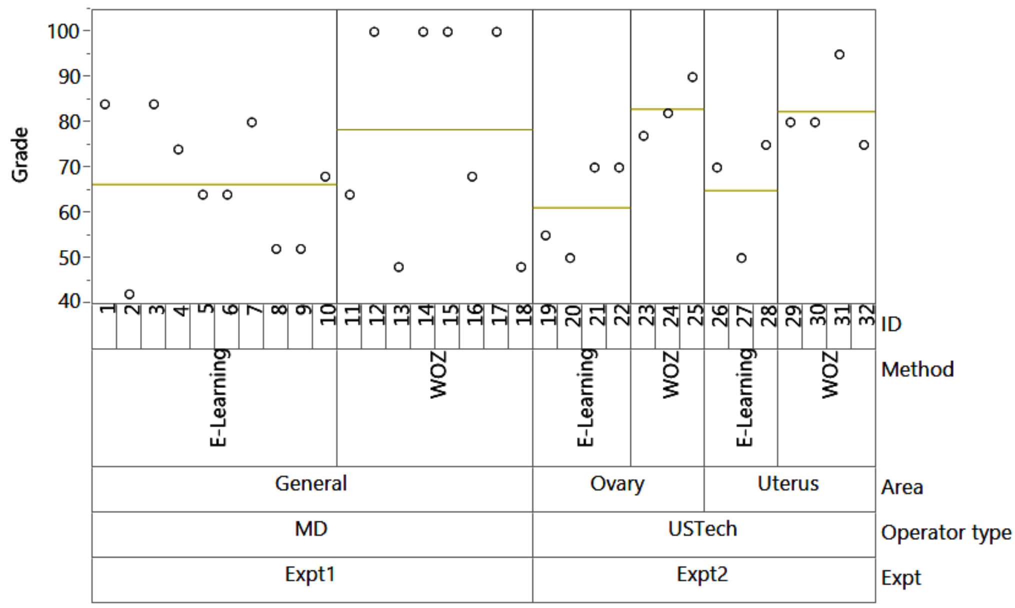
Population

The first experiment group consisted of 18 (12 men and 6 women) physicians who were participating in an Ob-Gyn ultrasound imaging fellowship program. The second experiment group included 14 women, who were senior ultrasound technicians with 5-20 years of experience.

Intervention Group

In the first experiment group, 8 random subjects went through the WOZ training session, whereas in the second experiment group 7 subjects (4 from the ovary subgroup and 3 from the uterus subgroup) were trained using the WOZ format. The interactive WOZ training session used the same case as the e-learning session, yet subjects received interactive, remote (sitting in a different room) Web-based immediate feedback from an instructor monitoring their progress (Figure 4). Case progress was controlled by the instructor based on expertise displayed by the student. Additionally, a final frontal feedback was presented and a posttraining knowledge exam was conducted.

Figure 3. Variability chart presenting the difference between block experiments 1 and 2 with medical subject area, and WOZ and e-learning.



Control Group

In the first experiment group, 10 random subjects went through the e-learning training session, whereas in the second experiment group, 7 subjects (3 from the ovary subgroup and 4 from the uterus subgroup) were trained using the e-learning format. e-learning sessions included self-paced training on the simulator and a post-session knowledge test. The self-paced training (a new question appeared immediately after the previous question was answered) included a set of questions, their supporting media and a self-assessment feedback table (questions, trainee's answers, and expected answers with detailed explanations) received at the end of the session. Case questions, their detailed answers and the knowledge test were developed and validated by Simultech instructors and the medical professionals supporting them. The validated medical case was uploaded to a local server, accessed by a local network at Simultech.

Materials

All evaluators were tested by a post-training, objective knowledge exam. All knowledge exams (1 for each of the 3 knowledge areas: general Ob-Gyn, uterus, and ovary) were validated by medical professionals from the Simultech Simulation Center and included 10 open questions that were evaluated and scored by professional medical supervisors.

Control groups (e-learning) from both experiments received an automated, self-assessment computerized case, where trainees answered a set of questions (Figure 1). Each e-learning session was followed by automated feedback, which presented trainees with the case questions, their answers, and the correct answers with detailed explanations. The intervention group (WOZ) received the same computerized case accompanied by a human trainer supplying Web-based immediate feedback and clarifications for each question and a final frontal debriefing at the end of each session.

Outcome Measure

The outcome measure evaluated in both experiments was knowledge gain based on the training received. Knowledge gain was evaluated using knowledge exams that were given to all subjects upon completion of their computerized training. According to the magnitude of difference between knowledge exam scores, the significance of instructors' contribution to the learning process can be deduced.

Training Development and Teaching

Before all training sessions, students were informed that the training was part of a research project. Due to a current change in Simultech's policy toward minimizing e-learning trainings, the experiment was divided into two sections: Training of Ob-Gyn physicians as part of a full-day training event and training senior US technicians as part of a continuing education program.

Training sessions for the first experiment (Ob-Gyn physicians) were conducted by professional instructors (Simultech's instructor team). They focused on supplying new techniques, knowledge reinforcement, and skill acquisition. Simultech's instructors are certified teachers with no medical background. Instructors study specific medical cases built by Simultech's medical professionals. The WOZ simulator training was scheduled to run once a week or every 2 weeks, depending on instructors' availability. Participants were randomly chosen to use the e-learning mode (control group) or the interactive WOZ mode (intervention group).

The second experiment included 14 of 23 (female) senior ultrasound technicians who attended a senior technicians' ultrasound course. The course included four meetings in 1 month. The course was attended by 23 senior ultrasound technicians (only 14 participated in the final experiment). A month after the course ended, a half-day training was added for students to practice and train with the WOZ simulator on cases designed by students during the course. Contrary to previous ultrasound senior technician courses that used DL during class time, this course included a homework assignment (building medical training case's questions). The homework required students to study a specific medical topic, whereas some of the class time was used to train, instruct, and facilitate team learning, using Simultech instructors as medical consultants.

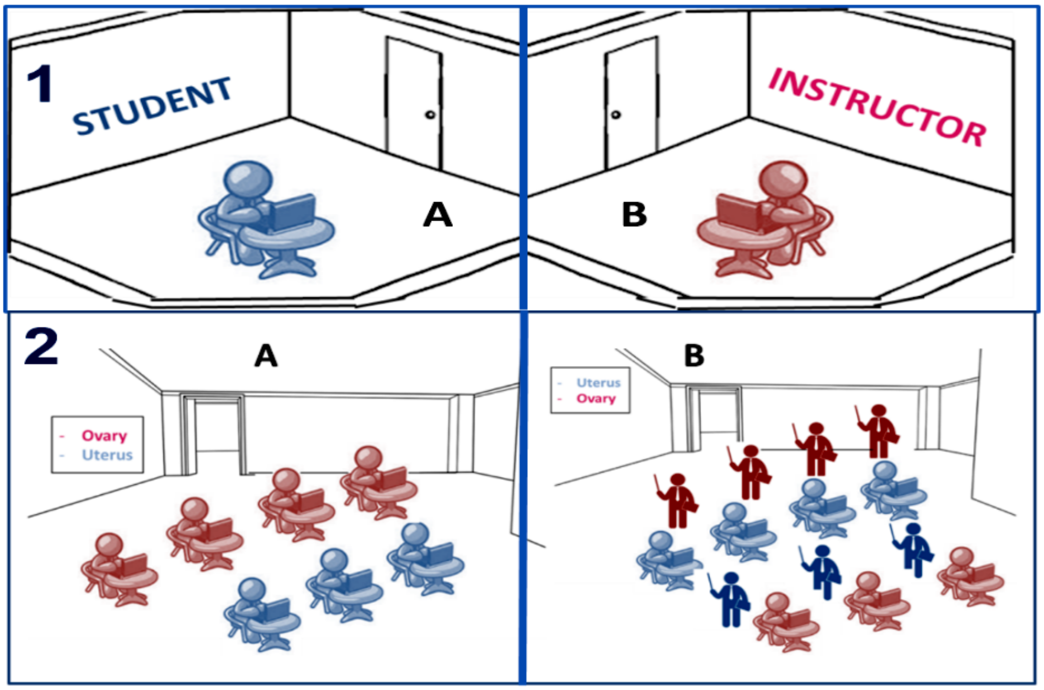
The WOZ simulator and the new exercise were presented to the ultrasound technicians at the first-class meeting. Students were divided into a uterus and an ovary subgroup and were asked to build a training case for the WOZ simulator that would include the following:

- A minimum of 10 training knowledge questions (multiple choice and open questions);
- Media to support the questions (images, video, lab results, patient's background);
- Detailed best practice answers with additional supporting media;
- A set of 10 open questions for an objective knowledge exam to be administered to each group after simulator training.

Additionally, students were informed that they would assume the role of instructors while training their peers on the WOZ simulator using their prebuilt training case. During the course, each student was responsible for developing one training question, its answer, and all supporting media, per his or her assigned topic of uterus or ovary. This assignment required each student to study a specific topic using written information, consult with the course staff and his or her medical coworkers. A team leader was chosen for each group to integrate all the questions into one training case that was validated by the Simultech training staff. Each group wrote a knowledge test of 10 open questions for each case. Several selected topics (questions built by students) that were not integrated into the simulator cases were presented as lectures at the end of the fourth meeting of the course.

The second experiment was held at Simultech a month after the first course ended. Fourteen students participated in the final simulator training (7 from each group). As illustrated in Figure 4, the training began with the e-learning session (control group), where 4 students from the uterus group trained on the ovary case and 3 students from the ovary group trained on the uterus case. After the first group of students finished their self-paced, self-assessed training, they received a written, open question, by topic (uterus or ovary), and a knowledge exam regarding the case they just completed. The second stage of the experiment included interactive WOZ training (intervention group) for the remaining 7 students, where 3 from the uterus group trained on the ovary case and 4 from the ovary group trained on the uterus case. This session included all 14 students, as the 7 students from the first stage instructed the 7 students from the second stage. Students undertaking the role of instructors assisted their classmates by clarifying questions and supplying Web-based immediate feedback. The same written knowledge tests (uterus and ovary) were given to the (WOZ and e-learning) subgroups after they completed the training session. Exams were evaluated and graded by an Ob-Gyn who guided the course from Clalit Healthcare Services.

Figure 4. (1:A) E-learning training mode—a fully automated case. The user interacts solely with a computer. (1:A+B). WOZ training mode: Students interact with a remote instructor receiving Web-based immediate feedback and support. (2:A) E-learning training class: students train on the simulator with no instructor support. (2:B) WOZ training class: students train on the simulator with an instructor (from the opposite group) leading, supporting and supplying Web-based immediate feedback during training.



Using the Simulator

The simulator used for training by the two groups, is a low-fidelity, Web-based application that was developed using Microsoft SharePoint 2010 technology. The simulator was used in previous studies and its efficacy as a training tool in various fields of medicine was evaluated [3,4]. For this study, minor changes were made to the simulator's user interface to enable a more e-learning like look and feel (Figure 1). The main advantage of using this platform was its dual mode support that can run the same case in fully automated e-learning mode and in interactive WOZ mode. The WOZ mode enabled the trainer to control a student's progress and supply Web-based immediate feedback to correct any misconceptions or errors [13].

Statistical Analysis

The JMP statistical package was used to compare the results of the knowledge tests taken after the completion of each training mode: e-learning and the interactive WOZ. The results for both experiments of 32 participants are displayed in Figure 3. A statistical model with the factors such as operator type (physicians/US senior technicians), method (WOZ/e-learning), and area (general, ovary, uterus) nested in "operator type" was fitted for both experiments together. Additionally, an equal variance exam was used to validate that both merged groups (operator type) shared the same variance (Tables 1 and 2). The level of statistical significance was set at 5%.

Table 1. Test for equal variance comparing both training experiments (difference of means).

Level			Mean absolute difference	Mean absolute difference
	Count	Standard deviation	Mean	Median
MD_General	18	19.65453	16.41975	16
Ultra sound physicians	14	13.54297	10.2449	9.92857

Table 2. Results by tests for equal variance performed.

Test	*F* ratio	Degrees of freedom	Degrees of freedom of denominator	*P* value
O'Brien (.5)	3.2068	1	30	.08
Brown-Forsythe	2.6479	1	30	.11
Levene	3.4262	1	30	.07
Bartlett	1.8723	1		.17
F Test 2-sides	2.1062	17	13	.18

Results

Evaluators

The first experiment included 18 medical, fellowship physicians who were randomly divided into two subgroups. The first subgroup included 10 e-learning trainees who scored an average of 64% (SD 13), and the second subgroup included 8 interactive (trainer-led) WOZ trainees who scored an average of 79% (SD 24).

The second experiment included 14 females, senior ultrasound technicians. They were randomly divided into 7 e-learning trainees who scored an average of 63% (SD 11) and 7 interactive trainees who scored an average of 83% (SD 7). Each training method was also subdivided based on the selected topic (uterus, ovary). The topic and its interaction with the training method were not significant relative to the grades scored.

Training Development and Teaching

The first sessions included Simultech instructors training Ob-Gyn physicians as part of a full-day training at Simultech. Trainees were randomly selected to perform the e-learning or the instructor-led WOZ session. The WOZ training included summarized verbal feedback at the end of the interactive case. Most of the WOZ training was done by one dedicated instructor. The knowledge test included general Ob-Gyn and US-related questions taken from previous cases built by Simultech's professional staff. This part of the training included 18 sessions, spanning more than 6 months.

The second training session lasted 1 day and took place a month after the four meetings of the course. Both training cases were built by course students, supported by Simultech's medical professionals and were uploaded to the WOZ Web server at the Technion. Training cases and their knowledge tests were divided into 2 knowledge areas (ovary and uterus). The WOZ training for all 7 trainees occurred in the same room with a trainer from the other group sitting behind each trainee. A knowledge exam consisting of 10 open questions was given after the computerized training and scored by an Ob-Gyn, physician an hour after all exams were submitted.

Training sessions lasted from 40 to 60 minutes. All participating students in both experiments completed 10 open questions in a written knowledge exam post-simulator training. All interactive WOZ sessions included 1 instructor training 1 trainee; yet, in previous studies we showed that 1 trainer can train 2 trainees or a small team [4].

Statistical Analysis

Before running the full model based on both experiments, a homogeneity of variance test was conducted (Tables 1 and 2). Results from this analysis validated that both experiments share the same variance.

A full model with the factors—operator type, method, area nested in operator—was fitted. All individual factors and interactions between method and operator type and between method and area were analyzed using the JMP statistical tool. A total of 32 observations were used from both experiments together (Figure 3 and Table 3). Results from this analysis showed that only the training method was significant with a *P* value of .01 (Table 3). Operator type (Physician or US technician) and content were both found to be insignificant in explaining the variance in exam scores.

Table 3. Analysis of variance table with statistical tests for the entire model.

Source	Nparm	DF	Sum of Squares	*F* Ratio	*P* value
Operator type	1	1	1.8399	0.0069	.93
Area (Operator type)	1	1	9.0536	0.0341	.86
Method	1	1	1948.0173	7.3445	.01[a]
Operator type X Method	1	1	109.598	0.4132	.53
Area X Method (Operator type)	1	1	15.4821	0.0584	.81

[a]significant at $P<.05$.

Discussion

Principal Findings

This study quantitatively evaluated the contribution of an instructor supplying Web-based immediate feedback to individuals using a computerized, interactive WOZ simulator. Previous research noted the lack of empirical and quantitative studies evaluating the efficacy of simulation-based training in shifting knowledge from opinion based to evidence based [7,8,16]. The addition of an instructor to learning outcomes was evaluated by comparing increases in subjects' knowledge after using a fully automated, e-learning case study and an interactive, instructor-led case study run on the same platform (WOZ simulator). Results indicated significant added value from the instructor's contribution, controlling learners' training progress and supplying Web-based immediate feedback.

Two experiments were conducted to evaluate the contribution of an instructor in a computerized simulated learning environment. They compared an interactive WOZ mode with a fully automated, e-learning mode. Research has revealed that e-learning should become more interactive to achieve better learning [5]. The first experiment tested a group of Ob-Gyn physicians. The second experiment evaluated senior, female ultrasound technicians. We used a cross-over training design (e-learning/instructor led) of the WOZ simulator to evaluate knowledge gained. Training included computer-based practice with (WOZ) and without an instructor (e-learning) and a knowledge test to evaluate training efficiency. We found that training supervised by an instructor who supplied immediate Web-based feedback increased learning outcomes (Table 3). The instructor helped trainees to understand the information better by clarifying Web-based, emphasizing relevant information, and resolving their errors and misconceptions [13].

The experiments were integrated to evaluate the overall contribution of the instructor (man in the loop) to the training process. The joint analysis indicated that the interactive WOZ training presented a significant advantage (*P* values of the method parameter =.0118) compared with the e-learning alternative. The impact of the training method on test grades was reinforced by the lack of statistical significance of the medical subject (area) and its interaction with the training method. Moreover, the experiment factor (operator type) and its interaction with the training method were not significant. This indicates that most of the variability in students' grades was due to the training method (WOZ vs e-learning).

In addition, a new teaching exercise of enhanced learning was added to the second experiment. The enhanced learning assignment required students (14 ultrasound technicians) to research a specific topic (uterus or ovary), build a WOZ simulator training case based on their research, and assume the role of the instructor and train their fellow classmates.

This exercise had very positive outcomes. Students and the management team described it as the most educational course Simultech had ever provided. Students training on the simulator described their experience as fun and educational, as was previously described by trainees using the WOZ simulator [3,4]. During the interactive WOZ sessions, students confronted their instructors (fellow classmates) on the quality of the case question and supplied feedback on the quality of the supporting media and the clarity of the question. This generated new discussions among students, and the management team was called to help sort out differences of opinion among the students. Furthermore, students and the management team mentioned that this exercise contributed dramatically to team building, increased motivation, and generated new working relations between technicians from different organizations.

Limitations

The study presented interesting insights regarding the contribution of instructors to a computerized training process, although there were several limitations. The study was conducted with limited access to trainees' personal and background data. It had a small sample size because ongoing courses at Simultech are constrained to a short timeframe with little flexibility to apply additional content. This study can contribute to the developing field of enhanced learning and can support continued research in this area.

The added value of Web-based immediate feedback and integrating an instructor to simulation-based training were introduced in the literature review [3,4,7,14,16] and in this study; yet training costs increase as well. Simultech's approach to reduce this overhead includes using trained instructors with no medical background who are directed by medical professionals. All training materials are developed by physicians. Additionally, students were responsible for building their own training and self-instruction units.

Conclusions

We conducted two independent experiments using a WOZ simulator to evaluate *quantitatively* the contribution of an instructor to learning with a computer-based WOZ simulator training. The results indicate the WOZ training was superior to automated e-learning. In one experiment, students were responsible for developing training materials and for training their peers. Researching and developing an educational unit contributed immensely to the overall student satisfaction. Additionally, this exercise initiated new discussions among students, improved team building, increased motivation, and created new work relations between technicians from various organizations. The results of this study present interesting insights in favor of interactive, instructor WOZ simulator training as compared with automated e-learning.

Conflicts of Interest

None declared.

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Abbreviations

DL: didactic learning
Ob-Gyn: Obstetrics and gynecology
TAL: technology-assisted learning
WOZ: Wizard of Oz

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