User-Based Evaluation of a Data-Driven Medical Education Platform

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Abstract. TrainCoMorb is an online data-driven training platform for medical students and residents who can practice recognizing comorbidities and their attributable risk for negative hospital outcomes. This is a subsequent cross-sectional evaluation study designed to examine four dimensions of the platform (navigation, usefulness, validity, features) and their association with external factors (age, experience in simulation systems, opinion about data-driven education). Eighteen medical residents participated in a scenario-based evaluation session and completed an online survey. The residents evaluated the four composite dimensions with scores between 3.77 and 4.15 (5-scale) and thought highly of data-driven medical education. Those more familiar with clinical simulation systems, and more positive about data-driven education, evaluated the "usefulness", "validity", and "features" dimensions with higher scores. TrainComorb is intended to be a supplementary tool for the education of future physicians, and this user-based evaluation study provided positive feedback that it could serve its intended scope.

Keywords. evaluation, health informatics, medical education, data-driven

1. Introduction

TrainCoMorb (Training with Comorbidities) is an online data-driven training platform for medical students and residents who can practice recognizing comorbidities and their attributable risk for negative outcomes. A comorbidity is the presence of one or more diseases co-occurring with a principal diagnosis (D_x) [1]. The authors of this study led the development of *TrainCoMorb,* which was completed in the year 2020 as a joint work between the College of Health Sciences and College of Medicine, at the Central Michigan University (CMU). With the use of *TrainCoMorb*, trainees (medical students and residents) can create scenarios of comorbidities in a computer assisted manner, to have at their disposal dynamically updated realistic snapshots of patient safety outcomes (hospital mortality, hospital acquired conditions) and the length of stay. The backend of the system is a relational database with 11 million inpatient records. The link to the app is: https://floating-caverns-75251.herokuapp.com. The system design and its clinical significance are explained in [2].

This present paper describes a subsequent study that was designed to evaluate the *TrainComorb* platform by the intended target audience (medical residents) and to examine several external factors associated with their perceptions about the platform.

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2. Methods

2.1. Survey design and deployment

The survey included 17 questions which explored the following dimensions: (i) System Navigation, (ii) Usefulness, (iii) Validity of information, (iv) System features. These are typical evaluation components that are examined in health informatics research [3] and in software evaluation [4]. The residents were also asked to provide their opinion about data-driven medical education. The questions used a 5-category Likert scale (Strongly Agree…Strongly Disagree). The survey also asked about the experience with use of computers, exposure with medical simulation systems, and their demographics.

After the study design protocol received approval by the Institutional Review Board, the director of Internal Medicine, Central Michigan University, made a formal invitation and eighteen internal medicine residents agreed to participate. Each resident was compensated with the amount $100 upon participation. The principal investigator of the study was not disclosed to the participants to avoid authority bias. After a 15-minute introduction of the platform, the residents were asked to complete four scenarios where they would create, step-by-step, patient comorbidity profiles (Table 1). Upon completion of the four scenarios, the participants were asked to follow a SurveyMonkey link and complete the evaluation survey.

2.2. Internal Validity and Statistical Analysis

To examine the internal validity of the four dimensions, Cronbach's Alpha statistic was used (Table 2). The separate questions that were designed to examine each dimension, were found to have an alpha score between 0.704 (navigation dimension) and 0.908 (features dimension). Finally, four questions were used to calculate the composite dimension 'Opinion about data driven medical education' (alpha = 0.84). The composite score of each new dimension was calculated as the mean value of the individual items. Since the sample size was relatively small, data analysis was conducted at the 90% of statistical significance. The analysis was completed with SPSS version 26 [5].

Table 1. Scenarios that the residents completed during the evaluation session

Scenario 1: Male patient, 75-79yrs, with a Principal D_x of Acute cerebrovascular disease [Submit]
Chronic Conditions: Essential Hypertension, Congestive Heart Failure [Submit]
Comorbidities: Diagnosed in hospital: None, Non-hospital acquired: Aspiration Pneumonitis [End]
Scenario 2: Female patient, 80-84yrs, with a Principal D_x of Multiple Myeloma [Submit]
Chronic Conditions: Chronic Kidney Disease [Submit]
Comorbidities: Diagnosed in hospital: Deficiency & other anemia, non-hospital acquired: Acute & unspecified renal failure [End]
Scenario 3: Female patient, <65yrs, with a Principal D_x of Cancer of Pancreas [Submit button]
Chronic Conditions: Essential Hypertension [Submit button]
Comorbidities: Diagnosed in hospital: Secondary malignancies non-hospital acquired: None [End]
Scenario 4: Male patient, 65-69yrs, with a Principal D_x of Septicemia [Submit]
Chronic Conditions: Diabetes mellitus with complications [Submit]
Comorbidities: Diagnosed in hospital: CKD, Non-hospital acquired: Fluid & electrolyte disorders [End]

3. Results

3.1. Univariate Analysis

The participants had an equal gender distribution (9 male, 9 female). Their mean age was 28.2 years (std. dev. = 1.7 years). Half of the participants answered that they are very familiar with medical simulation systems. When asked about their perceived expertise with computer use, seven participants (38.9%) said that they had average expertise, nine (50%) above average, and two participants (11.1%) thought that they have a far above average expertise. Finally, seven participants (38.9%) were somewhat familiar, and only two participants (11.1%) not as familiar with medical simulation systems. Of the four evaluation dimensions, the one with the highest score was the 'system features' (4.15); the dimension with the lower score was the 'information validity' (3.77). The composite variable about the participants' opinion on data-driven education was found to be 4.27.

Table 2. Individual item responses, Internal Validity and Composite Scores

	Mean (s.d)	Cronbach Alpha	Composite Mean (s.d)
Dimension 1: System Navigation			
The software that I used today was easy to navigate	3.89 (.83)		
I could navigate the software without any problems	3.89 (.96)		
I could understand the available choices that I was provided	4.17 (.51)	.70	3.96 (.47)
The navigation buttons were placed where they should be	4.17 (.51)		
It was easy to select options from drop-down lists	3.72 (.57)		
Dimension 2: System Usefulness			
Provided relevant information about comorbidities	3.94 (.63)		
Provided useful insights of the comorbidity effect on outcomes	3.89 (.83)		
The information of the system was interesting	4.11 (.47)	.87	3.98 (.47)
The system can help learn about the impact of comorbidities	4.06 (.53)		
Provides feedback & information relevant in actual clinical cases	3.94 (.41)		
Dimension 3: Validity of information			
The information that the system provided was correct	3.83 (.51)		
The information that the system provided was accurate	3.78 (.64)	.82	3.77 (.54)
The information that the system provided was unambiguous	3.72 (.75)		
Dimension 4: System Features			
Separating chronic vs hospital acquired conditions was important	4.17 (.51)		
The step-by-step system approach to develop my scenario was helpful	4.17 (.51)	.90	4.15 (.46)
The summary of the scenarios after completion is a useful feature	4.00 (.48)		
The updated risk estimations output after each step is a useful feature	4.28 (.57)		
Opinion about data-driven medical education			
Data-driven simulations systems are needed in medical curricula	4.22 (.54)		
Big data provide opportunities to examine clinical case combinations	4.39 (.50)	.84	4.27 (.40)
Comorb. with varying effect on outcomes should be easy to navigate	4.28 (.46)		
Familiarizing with data-driven estimations help proactive decisions	4.22 (.42)		

3.2. External Factors Associated with Perceptions about TrainComorb

Bivariate analysis was conducted to examine the association between the participants' age, their self-reported computer experience, and the simulation system familiarity, with each of the four composite evaluation dimensions. A negative and statistically significant correlation was observed between the participants' age and (i) their responses on the 'information validity' dimension ($r=-0.44$, $p<0.10$) and (ii) their opinion regarding data driven education ($r=-0.52$, $p<0.05$). The older the residents were, the more skeptical they

appeared to be regarding computer-generated clinical information, and they had a less positive opinion about the potential in data driven education.

A positive statistical association was observed between the familiarity with simulation systems and the 'information validity' dimension (r=0.49, p<0.05): Those exposed more in medical simulation systems appeared to be more confident about the information that the system was generating. Similarly, a positive association was observed between the residents' opinion about data-driven education and the 'system usefulness' (r=0.44, p<0.1) and the 'system features' (r=0.62, p<0.01) dimensions. No correlation was observed between the reported computer experience and any of the examined dimensions (Table 3).

Table 3. Association of External Factors with Perceptions about TrainComorb

	System Navigation	System Usefulness	Information Validity	System Features	Opinion Data-Driven educ.
Age	0.03 (p=.99)	-0.34 (p=.17)	-0.44 (p=.07)	-0.36 (p=.15)	-0.52 (p=.03)
Computer Experience	-0.21 (p=.39)	-0.19 (p=.44)	0.14 (p=.57)	-0.09 (p=.71)	-0.02 (p=.92)
Familiar with sim systems	-0.10 (p=.69)	-0.05 (p=.82)	0.49 (p=.03)	-0.01 (p=.96)	-0.09 (p=.71)
Opinion Data-Driven educ.	0.34 (p=.16)	0.44 (p=.06)	0.16 (p=.51)	0.62 (p=.01)	

4. Conclusions

The medical residents evaluated the four dimensions with average scores between 3.77 and 4.15 (5-scale) and thought highly of data-driven medical education. The finding supports a recently acknowledged need for data-driven physicians [6]. Although the residents' evaluation was not associated with their computer experience, those more familiar with simulation systems, and more positive about data-driven education, evaluated the dimensions 'usefulness', 'validity', and 'features' with higher scores: Apparently, the role of experience in user perception has been discussed in the literature, as in [7]. The new generation of medical students are gradually becoming familiar with alternative modes of medical training, and they appear to value evidence based and data driven modalities as useful supplementary learning approaches. This is supported by the external factor associations that were observed in the present study.

TrainComorb has the potential to become a useful supplementary tool for the education of future medical professionals. The results of this user-based evaluation study and the system prototype itself, are being communicated with the upper administration of a College of Medicine and its Simulation Center in the region of central Michigan, to identify effective venues of integration with the formal medical curricula.

References

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