JOURNAL OF CME
2024, VOL. 13, 2420373
https://doi.org/10.1080/28338073.2024.2420373

RESEARCH ARTICLE

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A Systematic Investigation of Assessment Scores, Self-Efficacy, and Clinical Practice: Are They Related?

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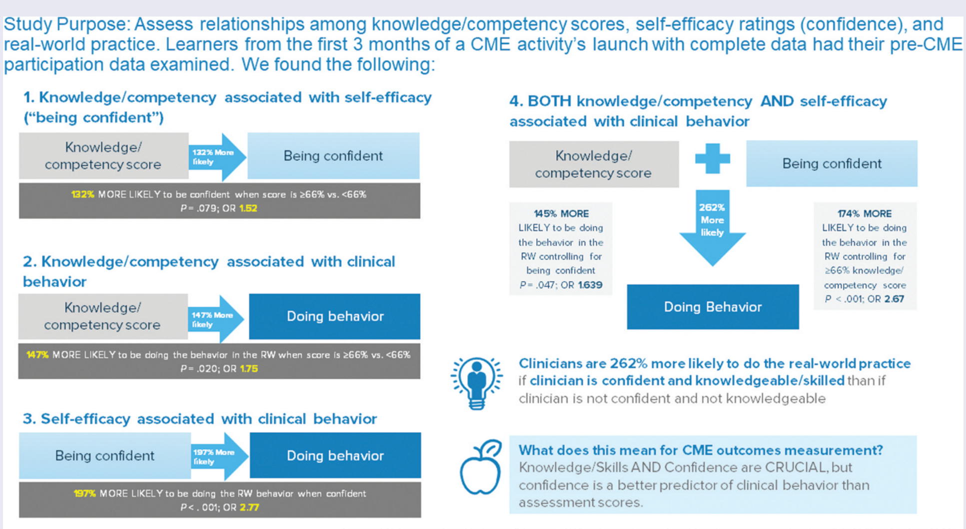
ABSTRACT

A considerable amount of continuing professional development (CPD) for health professionals is online and voluntary. There is evidence that some CPD activities impact clinical practice outcomes from self-reported and objective, administrative data. Some studies have shown that there is a potential mediating effect of knowledge/competency and/or self-efficacy between participation in CPD activities and the outcomes of that participation, specifically clinical practice. However, because clinical practice in those studies has been self-report, little is known about how this relationship impacts real world clinical practice. The purpose of the current study is to examine the relationship between knowledge/competency, self-efficacy, and real-world clinical practice so that we can begin to understand whether our focus on knowledge/competency and self-efficacy to change real-world clinical practice is empirically supported. We employed secondary data analysis from pre-participation questionnaire and medical and pharmacy claims data originally collected in three evaluations of online CPD interventions to examine if the relationship between knowledge/competency and self-efficacy contributed to physicians' real-world clinical practice. Results show an association between knowledge/competency scores and ratings of self-efficacy and suggest unique contributions of knowledge/competency and self-efficacy to clinical practice. Study results support the value of knowledge/competency scores and self-efficacy ratings as predictors of clinical practice. The effect size was larger for self-efficacy suggesting it may be a more practical indicator of clinical practice for CPD evaluators because its process of question development is simpler than the process for knowledge and case-based decision-making questions. However, it is important to conduct thorough need assessments which may include knowledge/competency assessments to identify topics to cover in CPD activities that are more likely to increase self-efficacy and ultimately, clinical practice.



ARTICLE HISTORY
Received 22 July 2024
Revised 11 October 2024
Accepted 18 October 2024

KEYWORDS
Outcomes; continuing medical education; assessment; real world evidence; clinical practice; behaviour change; CPD research

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Background

Persistent questions in continuing education research, evaluation, and practice have centred around the value of clinician learning in continuing professional development (CPD) activities, that is, do clinicians change their clinical practice behaviour after participating in continuing education activities, and are the level 3 (knowledge) and 4 (competence) outcomes measured from the Outcomes Framework [1] indicative of practice change (level 5). Cervero and Gaines [2] have shown that physicians are more likely to change their behaviour if they participate in CME activities that are planned to develop their knowledge and competence by focusing on improving health outcomes for conditions that their patients experience, providing multiple exposures to how these conditions present in the clinical encounter, and incorporating a range of learning that give physician learners opportunities to interact with instructors and other physicians about the content. One group of studies used a commitment to change (CTC) approach to evaluate CME activities to determine if a CTC statement was associated with practice behaviour change. While analysis of these efforts has shown that while there has been some empirical evidence that practice behaviour change is associated with CTC statements, [3–5] most of the studies focus on self-report or focus on the characteristics of CTC statement. Nonetheless, these studies showed that there were a variety of variables and relationships among variables that mediate the effect of CTC statements on changing practice behaviours. In one study, physician self-efficacy was shown to have a mediating effect on physicians' motivation which strengthened their intent to change practice behaviour. [6] Self-efficacy is a person's belief in their ability to achieve a goal or complete a task, like changing practice behaviour. [7] In an associated study an increase in knowledge from participating in a CME activity was associated with higher levels of self-efficacy [8]. In other words, physicians whose confidence was increased as a result of what they learned in the CME activity were more motivated to follow through on their intent to change practice behaviour. Lucero and Chen found similar associations, using a confidence construct to represent self-efficacy [9]. These findings are supported by similar work in social psychology and the behavioural sciences [10,11].

While these 2 groups of studies have advanced our understanding of how clinicians learn and change their clinical practice, what we know is not complete because real world clinical data measuring clinicians' performance is rare in studies of clinical practice change. Commonly, self-report is utilised, or the sample size is not large enough to have a well-powered study. The purpose of the current study is to expand what we know about how the knowledge/competency that physicians developed in CME activities contributed to their changing practice behaviour. The current study re-examined data from three of our previously conducted program evaluations that have continuing medical education (CME) assessment scores, self-efficacy ratings, and real-world practice data available to answer the following research questions:

(1) Is knowledge/competency score associated with self-efficacy?
(2) Is knowledge/competency score associated with clinical practice?
(3) Is self-efficacy rating associated with clinical practice?
(4) Is there any evidence of self-efficacy having a mediating or moderating role in the relationship between knowledge/competency and clinical practice?

We leveraged de-identified data available from our previous CME evaluations to conduct an observational, cross-sectional study to understand the associations among the following variables: (1) current knowledge; (2) competency; (3) self-efficacy, and (4) real-world clinical practice data *prior to participating in a CME activity*.

Background

Methods

Data were collected originally as part of real-world evidence program evaluations in CME. In those evaluations, we collected pre- and post-participation data. Data for this study focus on the data collected pre-participation and are used for purely observational purposes. All data were aggregated to examine the research questions. Each desired endpoint from each physician was aggregated into three variables representing (1) knowledge/competency, (2) self-efficacy, and (3) clinical practice pre-CME for each physician.

Human Subjects Protection

This study received exemption from an institutional review board (IRB ID: 12242-Klucero) because it utilises secondary, de-identified data that does not require consent pursuant to the terms of the U.S. Department of Health and Human Service's Policy for Protection of Human Research Subjects at 45 C.R.F. §46.104(d)(4)(ii).

Sample

This secondary data study included data from 346 physicians who treat patients in three different therapeutic areas: peripheral arterial disease, migraine, and atrial fibrillation. Each physician met the inclusion requirements of the original evaluation study: (1) coding for the condition of interest indicating seeing patients with the condition, (2) having treatment and medical claims data available in the full timeframe of interest, (3) participating in the CME activities of interest during the first 3 months it was posted for credit, and (4) completing outcomes assessments. Participation occurred between February 2021 and October 2022. No learners overlapped across the three original program evaluations. A total of 1170 of the physicians in the original studies were learners, and this secondary analysis leveraged the 346 who completed the full questionnaires in the original evaluation studies.

Measures

All questions were developed by a therapeutic area expert medical writer with review from an expert physician in the therapeutic area, CME compliance expert, and outcomes expert to establish content validity. Questions were asked pre-point of learning about the specific area the question addressed. Depending on the learning objectives of each of the CME activities, there was a combination of three knowledge and/or competency questions and one self-efficacy question. Claims data were pulled for each learner for a 3- or 6-month period before exposure to CME (depending on original evaluation design).

Knowledge/Competency Scores

Each assessment contained three multiple choice questions that were aligned to one or more learning objectives related to the desired evidence-based practice. Questions are developed by content experts with reviews from outcomes, compliance, content, and clinical perspectives. Questions were indicative of knowledge, or recall of fact, or were indicative of competency, or ability to make the best decision given a case scenario. There were 3 to 5 response options per question. Scores were calculated at the individual learner level by calculating the percentage of correct responses and dividing it by the total number of questions. Questions were combined into knowledge/competency scores.

Self-Efficacy

Physicians answered 1 Likert-type self-efficacy question that asked the respondent to rate their self-efficacy in an area relevant to the learning objectives of the education on a scale of 1 (not confident) to 5 (very confident). An example self-efficacy question is "How confident are you right now selecting a personalised preventive therapy for your patients with migraine?" The term "confident" was chosen because asking "how self-efficacious are you … " is not as intuitive to the learner.

Clinical Practice

Each physician had a primary endpoint examined that indicated clinical practice according to guidelines and/or evidence base for the specific practice area being assessed. The endpoint was examined via administrative claims data. In the United States, administrative claims data are available through companies that aggregate data for research and evaluation purposes. A protocol was developed for each study to identify the specific medical and treatment claims to be used to indicate the primary endpoint in real-world practice as aligned to the learning objectives of the CME activities. Endpoints included one of the following: (1) selecting preventative migraine therapy for patients with migraine with and without aura; (2) antiarrhythmic treatments for patients with atrial fibrillation; and (3) anti-thrombotic therapy for patients with peripheral arterial disease. Each learner had a calculated variable indicating the number of patients with the condition of interest who were receiving the appropriate evidence-based treatment. These practices occurred in time periods of 3 to 6 months prior to answering the questions creating a pre-participation practice variable.

Data Analysis

Data were aggregated so each learner had a knowledge/competency score, self-efficacy rating, and real-world practice indicator. Knowledge/competency scores were calculated by summing the number of correct responses and dividing that sum by the number of questions answered which was 3 for each learner. The score was then dummy-coded to indicate those with a low (<66%) and those with a moderate-to-high score (≥66%). This was an independent variable (herein "knowledge/competency"). Recoding was done because there were only three questions, so the data are more interpretable using this dichotomy. Self-efficacy rating was collapsed into two categories: confident (ratings 4 and 5) and not-to-moderately confident (ratings 1 to 3). This dichotomy was created because previous research has shown that this dichotomy is related to commitment to practice change [12]. This was an independent or dependent variable depending on which model we tested (herein "self-efficacy"). The clinical practice data was dummy-coded such that if the number of patients eligible who received evidence-based treatment was greater than 0, then a "1" indicated a clinician who use evidence-based treatment selection at least some of the time, whereas a "0" indicated a clinician who is not selecting the evidence-based treatment for eligible patients. This was the dependent variable (herein "clinical practice"). This dichotomy was used because claims data does have limitations in that we cannot consider the full gamut of individual variation that may inform treatment decisions, so we cannot assume that all patients eligible according to claims data should be on a treatment because evidence or guidelines suggest it. For example, a patient may have a personal or medical circumstance not measured by claims that may make other treatments best for that particular patient.

Logistic regression in SAS (version 9.4; SAS Institute) was conducted to address each of the research questions. Logistic regression was chosen because the primary outcome of interest is real world clinical practice (doing desired practice or not), and models could be compared using the odds (OR) and confidence intervals (CI) reported with each model.

Power Analysis

A post-hoc power analysis was conducted using G*Power (version 3.1.9.2; Faul). With a sample size of 346, we were powered at 91% to detect an OR of 1.5 at $p < .05$.

Results

Descriptive statistics for each variable are shown in Table 1.

Question 1: Is knowledge/competency score associated with self-efficacy?

Results showed that knowledge/competency has a nearly statistically significant association with self-efficacy ($p = .0789$; OR 1.515; CI: 0.953, 2.410). Learners who scored 66% or higher were 132% more likely to be confident.

Question 2: Is knowledge/competency score associated with clinical practice?

Results showed that knowledge/competency has a statistically significant association with clinical practice ($p = .0202$; OR 1.746; CI: 1.091, 2.793). Learners who scored 66% or higher were 147% more likely to be doing the associated clinical practice in the real world.

Question 3: Is self-efficacy rating associated with clinical practice?

Results showed that self-efficacy has a statistically significant association with clinical practice ($p < .001$; OR 2.768; CI: 1.705, 4.492). Learners who were confident were 197% more likely to be doing the associated clinical practice in the real world.

Question 4: Is there any evidence of self-efficacy having a mediating or moderating role in the relationship between knowledge/competency and clinical practice?

Two models were tested under this question.

Model 1: Results for a model where knowledge/competency and self-efficacy predicted clinical practice showed that both were significantly associated with clinical practice (knowledge/competency: $p = .0474$; OR 1.629, CI: 1.006, 2.640; self-efficacy: $p < .001$; OR 2.669; CI: 1.638, 4.348). This suggests partial mediation since both still have a statistically significant relationship with clinical practice when inserted into the model together [13].

Model 2: The interaction of knowledge/competency and confidence was not significant ($p = .3619$; OR .633).

Discussion

Results indicate that knowledge/competency and self-efficacy are correlated. Clinicians with a moderate-to-

Table 1. Descriptive statistics prior to continuing medical education participation.

	N	% >66% score[a]	% confident[b]	% doing real-world practice[c]
Atrial fibrillation	83	45.78	40.96	38.55
Migraine	125	23.91	26.09	26.09
Peripheral arterial disease	138	46.40	31.20	28.00
Total (n)	346	37.28 (129/346)	31.50 (109/346)	29.77 (103/346)

a. Measured on scale of 0 to 100% based on assessment questions.
b. Measured on scale of 1 to 5 with 4 and 5 indicating being confident.
c. Measured via medical and pharmacy claims data.

high knowledge/competency score are more likely to be confident. Results also indicate that knowledge/competency and self-efficacy predict clinical practice and that self-efficacy is a stronger predictor of practice than knowledge/competency scores. Based on motivation theory, conceptually, results suggest a partial mediating role of self-efficacy in the relationship between knowledge/competency and clinical practice [14]. Self-efficacy also has an additive effect.

This study was designed to begin to address persistent questions in continuing education research and evaluation regarding knowledge and competency scores and self-efficacy ratings and their association with real-world practice. If 48% and 29% of ACCME accredited activities assess knowledge and competencies, respectively, and 80% do not assess performance objectively, [15] then we should understand whether those outcomes are indicators of real-world practice in instances where the goal of an activity is to impact practice. Analysis of the data from 3 studies involving 346 physicians with complete in-activity and real-world outcomes data shows that physician performance is more evidence-based when physicians have confidence (self-efficacy) in their capabilities and meet a threshold of at least 66% pre-score in their first attempt at the questions.

Implications for CPD Evaluation

From a program evaluation perspective, results suggest correlational validity for the way we have measured self-efficacy and knowledge/competency. There was variability in their scores such that only 38% had a 66% score or greater at pre-point of learning. In outcome assessment, it is important that when post-scores are considered as indicators of clinical practice, evaluators use first responses to questions as using a final response (after one is told the response is incorrect) is plagued with response bias and not truly indicative of the learning that occurred in the activity. Given the challenges with writing valid and reliable knowledge and case-based multiple-choice questions, CPD evaluators may consider leveraging self-efficacy questions as they are not as complex to construct when measuring outcomes from CPD [16,17]. Bandura [18] authored a useful guide for constructing self-efficacy scales. It is, however, important to understand knowledge and skills needs of HCPs to develop effective CPD, so thorough needs assessments should be conducted. Evaluators should examine the relationship between knowledge/competency scores and self-efficacy ratings as a marker for correlational validity for each set of question(s) utilised. Ultimately, a modest number of assessment questions (1 for self-efficacy and 3 for knowledge/competence) can be used to get some indicating of clinical practice, but we should continue to understand other measurable factors that do not require claims data that may be associated with clinical practice.

Implications for CPD Development

Because this study suggests that self-efficacy has a partial mediating role in the relationship between knowledge/competency and clinical practice, individuals who plan and organise CPD learning activities should provide opportunities for physician learners to develop their confidence (self-efficacy) in providing evidence-based patient care. Because implementing a new approach in practice requires change management, CME providers should also consider incorporating elements of change management into CPD learning activities that introduce new evidence-based approaches to practice [19].

A four-phase instructional design model should be considered in formal CPD learning activities to develop the capability (knowledge/competence) to deliver evidence-based patient care: presentation of evidence-based approach; worked examples of evidence-based approaches in authentic settings; deliberate practice and, expert feedback and coaching [12,20–22]. Deliberate practice and expert feedback and coaching will build confidence in evidence-based patient care [23,24].

The characteristics of effective CPD activities described by Cervero and Gaines should be considered when planning formal CPD learning activities to develop and reinforce learner confidence. Their findings show that physicians are more likely to change their practice behaviour if they participate in planned CME activities that provide opportunities for learning that focus on improving health outcomes for conditions that their patients experience. Their findings also show that effective CME activities expose physician learners to the multiple ways that these conditions present in the clinical encounter. Effective CME activities also incorporate multiple learning strategies that give physicians opportunities to interact about the content with instructors and other physicians to develop actionable approaches to managing their patients' conditions [2]. These characteristics mesh well with the four-phase instructional design model described above.

Limitations and Future Directions

About 30% of the learners were included in this study. Therefore, the results may not be generalisable to those who did not respond to the pre- and post-questions. We should understand more about who answers both sets of questions in comparison to those who do not to better identify biases in sampling. The knowledge/competency scores are only as accurate as the underlying questions' validity and reliability. In this study, they were associated with self-efficacy and practice as theoretically expected, therefore, indicating correlational validity. Three questions do not capture the full gamut of what one knows about a topic; therefore, knowledge and skills were present that was not measured, creating measurement bias. Future research could examine the nature of relationships among these variables in a context unrelated to CPD and ask more questions about a relevant topic to assess knowledge and competencies more thoroughly. Self-efficacy could be examined with a series of questions about different elements of the desired real-world practice. It will also be important to test whether change in knowledge/competency scores and change in self-efficacy are associated with change in clinical practice to provide more compelling evidence for the theory of change we as CPD practitioners and evaluators have.

Despite limitations, we tested assumed relationships that have not yet been tested with statistical models in the published literature which furthers our understanding of how CPD may change behaviour.

Disclosure Statement

No potential conflict of interest was reported by the author(s).

Funding

This work was supported internally by Medscape, LLC.

Data Availability Statement

Data are proprietary to Medscape, LLC. Any requests for data should be made to the author Katie Lucero at klucero@webmd.net

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